Towards Sustainable Development

INDICATORS TO MEASURE PROGRESS

ROME CONFERENCE

SUSTAINABLE DEVELOPMENT

OECD

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Proceedings of the OECD Rome Conference

OECD

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

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FOREWORD

This report examines progress towards the *effective measurement of sustainable development*.

The achievement of sustainable development is a key priority for OECD countries. In 1998 Ministers asked the OECD to undertake a three-year project on sustainable development. Until recently, governments have measured economic progress through economic statistics as GDP, inflation and balance of payments. Today governments agree that economic growth should be socially and environmentally sustainable.

As part of its *initiative on sustainable development*, the OECD held a conference: "Towards Sustainable Development: Indicators to Measure Progress," on 15-17 December 1999 in Rome. The conference brought together about 150 participants from OECD countries and other international organisations and institutes. Participants discussed indicators able to measure various components of sustainable development, building on existing uses of indicators in OECD Member countries. Business, Trade Unions and environmental NGOs were consulted during the preparation of the Conference.

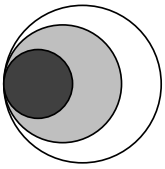
The *Rome Conference* demonstrated that sustainable development indicators are already being widely used for policy and communication purposes. The Conference also highlighted areas for further development. These included frameworks for measuring progress, the need for indicators of social dimensions of sustainable development and indicators for communicating with stakeholders and the public.

This report is divided into three volumes. Volume I contains the conference conclusions, opening and closing statements, a summary of consultations with non-government organisations, a list of conference participants and the conference programme. Volume II includes papers from conference sessions on frameworks for developing indicators, the interface between the environment, economy and society, and sustainability indicators for agriculture, transport and energy. The OECD provided an overview paper for each of these topics. Australia, Finland, France, Germany, Hungary, Italy, Japan, Mexico, the Netherlands, Norway and the United States contributed papers drawing on their country experiences. Volume III includes papers from the conference session on the assessment of sustainable development in Italy.

The conference was chaired by Domenico Siniscalco, Executive Director of the Fondazione ENI Enrico Mattei. The conference was an important milestone in the OECD's work on sustainable development and I would like to thank all those who contributed to the outcomes that are recorded in this book.

Joke Waller Hunter
Director
OECD Environment Directorate

Towards sustainable development
Indicators to measure progress



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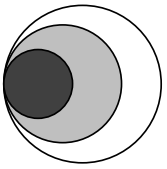
Indicators to measure progress



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VOLUME I
OVERVIEW

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Overview

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PART A.
CONCLUSIONS

CHAIR'S CONCLUSIONS

BY MR. DOMENICO SINISCALCO, ITALY

OECD member countries face the challenge of sustainable development. In this context, the Rome Conference has reviewed the experience accumulated over the last ten years in OECD countries concerning the measurement of progress towards sustainable development. The Conference has provided substantial guidance on the further development and use of sustainable development indicators at international, national and local levels.

Use of indicators and frameworks

There has been much progress in the 1990s in the use of indicators and measurement techniques, based on a solid analytic and knowledge base. Over the past ten years, indicators have gained in importance and have been used for a wide range of purposes. In a number of OECD countries, indicators are increasingly used in planning, clarifying policy objectives and priorities, budgeting, assessing performance, and communicating with the public. Some examples presented and discussed at the Conference include:

- reporting on sustainable development conditions and trends in the United States, Asia and Europe;
- monitoring and assessing sectoral sustainable development policies in Australia, Norway and Finland;
- tracking the implementation of plans in Japan and the Netherlands;
- monitoring performance in France;
- catalysing policy action in Hungary;
- supporting the budget process in Parliament in Sweden; and
- communicating with and involving the public in Germany, Sweden and the UK.

The Conference noted the importance of developing frameworks as well as indicators in order to examine the interactions of economic, environmental and social issues. One approach is to extend the national accounts system to incorporate both environmental and social accounting. This complements and builds on physical accounts by adding a valuation dimension. Many measurement problems remain to be solved and new developments are needed. Nevertheless, work at a practical and operational level should proceed without delay and some powerful indicators have already been derived from national accounting frameworks; example indicators derived from such frameworks include genuine savings by the World Bank, and intensity of water and forest use by the OECD.

Need for operational core sets of indicators

The discussions showed considerable interest in indicators that better reflect the linkages between the three dimensions of sustainable development and their interactions (positive and negative). There was also interest in reduced and balanced sets of indicators that provide signals on key dimensions of sustainable development to policy-makers and the general public.

There was general agreement that sets of indicators reflecting key trends and policy variables are useful to respond to common policy goals, and to demands for simplified indicator lists. Core sets

provide a base of comparable information to which countries can add to suit their circumstances. Core sets can also be adapted for different purposes, ranging from tracking performance against plans to budgetary information.

The Conference noted that some core sets already exist such as OECD environment indicators, or are within reach for transport - environment and energy - environment. There is also some convergence towards a core set of agri-environment indicators. Further details are in the attached conclusions of the individual sessions.

Increasing attention to the social dimensions of sustainable development

The Conference noted that many of the national and international initiatives on sustainable development indicators have been driven by demands from decision makers and stakeholders focusing on environment – economy interactions. But it was recognised that, in the context of sustainable development, there has also been considerable work done on social indicators (e.g. by UNCSD, some countries and many local Agenda 21 groups). As a result, sustainable development indicators primarily cover economic and environmental interface. But the presentations and the discussions at the Conference showed that the social interface is receiving increasing attention.

The Conference discussed a number of issues where there are important links between environmental policies, social, environmental and economic issues. It concluded that further work could be done on the relationship between environmental policies, sustainable development and employment (building on previous OECD work on employment - environment links), as well as equity issues (e.g. income distribution, education and public access to information and involvement in decision making). Population - environment and health - environment links were also recognised as being increasingly important.

Assessing sustainable development in Italy

The Conference reviewed progress towards the implementation of sustainable development in Italy, drawing on the analysis and recommendations of the OECD environmental performance review in 1994.

The Conference noted that positive developments include, inter alia, incorporation of goals from the Kyoto agreements on climate change into the latest government's Economic-Financial Planning Document (2000-2003), expected introduction of an environmental accounting framework for each level of public administration, and use of integrated indicators, including at local level.

The Conference also noted that progress is still needed in the integration of sustainable development concerns into sectoral policies (e.g. transport, agriculture, industry) and general economic policies).

Future directions

Governments in OECD countries are facing a growing number of large cross-sectoral and international issues, such as globalisation, climate change and biotechnology. These issues require solutions to be implemented in a co-ordinated and co-operative fashion by many governments, stakeholders and organisations. In this context a wide range of indicators will be required to track progress towards sustainable development.

The Conference demonstrated that the experience of OECD and its member countries in developing and using indicators in the economic, social and environmental dimensions, together with more recent national and international initiatives on sustainable development indicators, provides a

good basis for further developing and using indicators to measure progress towards sustainable development at OECD level.

Accounting and other frameworks are essential for structuring the development of indicators to measure progress towards sustainable development. Situating indicators within such frameworks allows interactions of different issues to be better understood and trade-offs to be examined.

The conference also highlighted, but did not reach conclusions on four key areas.

- First, the importance of a pragmatic approach to developing indicators (i.e. insuring that they are useful to decision-makers and to stakeholders) was stressed.
- Second, it was emphasised that work on communicative indicators needs to be linked more closely to an understanding of citizens' interests and information needs.
- Third, it was suggested that there is a need to demonstrate the "value-added" that indicators have for advancing sustainable development, especially in order to secure resources for further work in both capitals and international organisations.
- Finally, work is required to strengthen links between institutions; links to institutions with expertise on social issues was considered particularly important, in light of the need to better reflect the social dimensions of sustainable development in indicator sets.

In summary, there is a significant body of experience in the development and use of sustainable development indicators and a demand to give high priority to building a capacity for systematic monitoring of progress towards sustainable development. Governments should seek to build on existing expertise in further developing and using indicators to track and chart their progress towards sustainable development.

CONCLUSIONS FROM SESSION IIA

ACCOUNTING FRAMEWORKS

Chair: Mr. Steve Landefeld, United States
Rapporteur: Ms. Anne Harrison, OECD

Frameworks are essential for identifying and linking sustainable development indicators

A framework for sustainable development linking economic, environmental and social issues is essential to permit the identification of key indicators and to illuminate their interaction.

Frameworks and indicators are inter-dependent and both are necessary. The framework should also include links to policy goals and be easily comprehensible to policy makers.

National accounts are a good starting point for a framework

The existing national accounts form a good starting point for a comprehensive framework but need extending to include environmental and social accounting and complementing with other data sets.

Monetary and physical accounts are both necessary. Physical data provides vital information on quantities; valuation to monetary terms provides a means of aggregation particularly relevant for evaluating the costs and benefits of policies for sustainable development. The paper presented by France demonstrated the wealth of information coming from a set of physical accounts. The paper from Mexico illustrated the possibilities of monetary accounts extended to cover environmental issues.

Several issues have to be considered in further developing frameworks

Care needs to be given to the choice of units, regions and time-periods since different messages may emerge from different choices. Frameworks and indicators are needed which are relevant at regional levels and also address international/global concerns.

This subject is still evolving. New conceptual developments will emerge, must be encouraged and supported, but operational work should proceed in parallel with the goal of having immediate practical results.

The possible impact of omitted variables should be considered when presenting composite but partial systems. This reinforces the need for the conceptual system to be complete and comprehensive.

It is important to communicate frameworks to the public

Frameworks and associated indicators need to be simply, clearly and widely communicated to promote awareness among policy-makers, analysts and the general public.

CONCLUSIONS FROM SESSION IIB

ENVIRONMENTAL PERFORMANCE INDICATORS

Chair: Mr. John Custance, United Kingdom
Rapporteur: Mr. James Morant, United States

Tracking environmental performance is essential to the credibility of government action

Domestic and international environmental commitments range far and wide. The question of environmental performance - in other words, how far these commitments are actually met - is central to the environmental accountability of OECD countries' governments towards its stakeholders.

Since 1992, the OECD has conducted country environmental performance reviews to help member countries improve their individual and collective performance in environmental management and in making progress towards sustainable development. The OECD reviews establish the facts and develop recommendations to help the countries consolidate achievements and make further progress. OECD environmental indicators are used as a specific tool for evaluating environmental performance.

OECD countries are leaders in developing and using environmental indicators

Important lessons can be drawn from the collective experience of OECD countries in addressing environmental issues and their links with economic issues over the past 10 years. The presentations and discussions showed that, in most OECD countries, environmental indicators have stimulated the thinking of government policy makers in planning (e.g. Japan), in clarifying policy objectives and priorities (e.g. Hungary), budgeting, and assessing policy performance.

Presentations also showed that in a number of OECD countries there is now increasing interest in a reduced number of indicators selected from existing larger sets to capture key trends and draw attention to key issues of common concern (e.g. the German Environment Barometer, the Swedish and UK's headline indicators). Other countries (e.g. Korea, Greece) spoke of their use of indicators as a tool for better performance. Further, OECD staff reported on indicator outreach to Central and Eastern Europe, Russia, China, etc.

A core list of environmental performance indicators used by OECD countries can be identified

The discussion led to the conclusion that collective experiences are sufficient to consider a short list of core indicators for use by OECD countries. These represent the top or priority areas of the full core set of OECD indicators.

The discussion also focused on substantive and process concerns. In addition, environmental-related issue areas such as urban environmental quality, marine resources, soil quality (e.g. diffuse source pollution, toxics in biota) might be considered for inclusion in the priority list of indicators. It was suggested that the suite should also include response indicators, and that it should be flexible in order to include in the future "surprises" or emerging issues.

CORE LIST OF OECD ENVIRONMENTAL PERFORMANCE INDICATORS	
POLLUTION ISSUES	
Climate Change	◆ CO2 emission intensities
Ozone Layer Depletion	◆ Ozone depleting substances
Air Quality	◆ Air emission intensities
Waste	◆ Waste generation intensities
Water Quality	◆ Waste water treatment connection rate
RESOURCE ISSUES	
Water Resources	◆ Intensity of use of water resources
Forest Resources	◆ Intensity of use of forest resources
Land Resources	◆ Changes in land use and in key ecosystems
Energy Resources	◆ Intensity of use of energy resources
Mineral Resources	◆ Intensity of use of mineral resources
Biodiversity	◆ Protected areas

An expansion to social-environmental aspects

Finally, the discussion considered next steps to expand the set of OECD environmental performance indicators to cover social-environmental aspects in addition to economic-environment aspects by means of a brainstorming exercise.

There was general recognition that the three dimensions of sustainable development - economic, environmental, and social – should be reflected in the set of OECD indicators, and that in general, further attention has to be dedicated to the social aspect of sustainable development. Several issues such as tourism, urban environmental quality, transport, sewage treatment, and energy efficiency in buildings, were identified by delegates as possible candidate areas for further study.

A need for consolidating the experience acquired

The discussions also showed that there is need to further consolidate the experience acquired by OECD countries and the OECD, in particular through using these indicators even more systematically, and pursuing the development of a more elegant set of indicators tied closely to country planning targets and key objectives.

The second round of OECD country environmental performance reviews will provide an excellent opportunity for that purpose.

Also, it was recognised that there is a strong interdependence between progress at national level and progress at international level, and that the OECD has a role to play in this respect.

CONCLUSIONS FROM SESSION IIC

SUSTAINABLE DEVELOPMENT AND ITS ECONOMIC, SOCIAL AND ENVIRONMENTAL INDICATORS

Chair: Mr. Brian Emmett, Canada
Rapporteur: Ms. Anne Teller, Belgium

Progressing towards sustainable development raises important challenges for policy making

Progressing towards a more sustainable development and hence ensuring the well-being of present and future generations raises important challenges for policy making. It implies that the objectives of increasing economic efficiency and material wealth must take into account social and environmental objectives and must be placed in an inter-temporal framework.

Synergetic "win-win-win" options can only be identified if all three dimensions of sustainable development are taken into account. These three dimensions, economic, environmental and social, involve complex synergies and trade-offs. The discussions showed that the emphasis should be on the interactions among these three dimensions in order to minimise possible conflicts.

Sustainable development indicators are needed to inform decisions and raise awareness

To be successful in addressing these challenges, policies and decisions need to be supported by meaningful indicators. The presentations and discussions showed that indicators are not only needed to measure progress but also to raise awareness about the inter-linkages and trade-offs among the various dimensions of sustainable development, as well as about the longer term implications of current decisions and behaviours.

Indicators are seen as essential tools for communicating sustainable development issues to policy makers and to civil society, and for promoting institutional dialogue. There was a general feeling that the development and use of sustainable development indicators could also help to raise the profile of sustainable development issues in the public debate.

There is a need for an operational core set of sustainable development indicators

The presentations showed that most national initiatives are still driven by environmental actors, with the result that environmental indicators, complemented with selected economic indicators, still form a major part of sustainable development indicators.

Some countries have developed sets of indicators addressing all dimensions (e.g. Hungary, United Kingdom, USA). Social aspects are receiving increasing attention (e.g. Sweden). There is also considerable interest in indicators that better reflect the linkages between the three dimensions of sustainable development.

Participants stressed the need for indicators that i) are transparent, ii) can be easily communicated, iii) can be used as operational tools in policy making and iv) whose quality is defensible on both conceptual and practical grounds.

The discussion came to the conclusion that, in the short term, practical progress can best be achieved through selecting a limited number of core indicators. Such a list is expected to cover key issues that are of common relevance to sustainable development progress in OECD countries. It is further expected to be developed through a participatory process involving all players as stakeholders.

OECD countries can play a lead role in developing and using sustainable development indicators

It was recognised that the experience of OECD and its Member countries in developing and using indicators in the economic, social and environmental fields, together with more recent national and international initiatives on sustainable development indicators, provide a good basis for developing a core set of indicators to measure progress towards sustainable development at OECD level.

Participants recognised that the illustrative list of core indicators included in the OCD overview paper is a good first step in that direction. It was also recognised that the OECD can play a catalytic role with respect to national efforts.

Next steps

The discussions highlighted the need to further refine and link the indicators and to fill remaining gaps. In particular, more work needs to be done on incorporating indicators related to issues of social sustainability.

It was identified that core indicators should be organised in a way useful to decision-makers and the public, while ensuring that the integrated nature of sustainable development and the cause-effect relationships among its different components are apparent.

The discussions also reflected that there is still a lag between the demand for sustainable development indicators and the actual use of such indicators. Whereas economic, social and environmental indicators have individually proven their value in policy formulation, the use of combined sets of sustainable development indicators in the overall policy debate needs to be further strengthened. It was recognised that this is a long process, but participants felt that it is definitely worth it.

CONCLUSIONS FROM SESSION IID

TRANSPORT/ENVIRONMENT INDICATORS

Chair: Ms. Dominique Dron, France
Rapporteur: Mr. Klaas Jan Moning, Netherlands

Transport is essential to sustainable development

Transport is essential to the economies and social welfare of OECD countries. For the purposes of our discussion in Session D, the "transport sector" was taken to mean the management of freight and passenger traffic, as well as the construction, operation and maintenance of infrastructure and vehicles.

Transport has effects (positive and negative) on the social, economic and environmental dimensions of sustainable development. In the past decade, many countries have implemented policies to reduce transport's negative environmental impacts.

Although these policies have been effective to a certain extent, they have not been sufficient to mitigate some very important effects (e.g, CO_2, NOx, landscape fragmentation, noise). In addition to addressing these concerns, future policies should seek to achieve a better balance between all three dimensions of sustainable development, using integrated approaches.

Transport-environment indicators are useful, evolving tools

OECD member countries' experience using transport - environment indicators has demonstrated their practical value as tools for: 1) monitoring the environmental impacts of transport policies; 2) providing internationally comparable data on transport-related environmental issues, and 3) facilitating communication.

Based on the presentations made by Finland and Italy, as well as the general discussion, it became apparent that indicator sets require regular updating and refinement to reflect evolving policy and public interests and scientific developments. In practice, transport-environment indicators were not seen as sufficient to reflect all important dynamics, and required supplementation with qualitative information (e.g., from interviews and public consultation processes).

A core list of transport-environment indicators is in use by OECD countries

The presentations and following discussion demonstrated that it is now possible to identify a "core list" of transport - environment indicators in use by OECD countries. This "core list" comprises eight transport-environment indicators.

CORE LIST OF OECD TRANSPORT-ENVIRONMENT INDICATORS		
SECTORAL TRENDS OF ENVIRONMENTAL SIGNIFICANCE	Transport Intensity	◆ Passenger and freight transport per cent of GDP
	Vehicles	◆ Road vehicles per capita
	Fuels	◆ Fuel consumption intensities
	Infrastructure	◆ Road and rail network length and density
INTERACTIONS WITH THE ENVIRONMENT	Air Pollution	◆ Transport-related air emissions and intensities
	Noise	◆ Percent of population exposed to unacceptable noise levels
ECONOMIC AND POLICY ASPECTS	Pricing And Taxation	◆ Road fuel price and taxes
	Subsidies	◆ Level of subsidy by mode

Conclusions and next steps

The discussion led to several conclusions regarding next steps for the development of indicators of sustainable development for the transport sector. It can be concluded that:

OECD has taken a leading role in developing and using transport-environment indicators for the past ten years. For its future work on sustainable development, the OECD should build on this work to develop sets of sustainable development indicators for transport that are balanced, and include indicators reflecting the:

- social, economic, and environmental dimensions of transport;
- positive and negative effects of transport on these dimensions;
- interactive effects among these dimensions, as they relate to policy formation and implementation.

Within this framework, the OECD should give extra attention to the development and use of social indicators in relation to economy and environment.

- Future development and use of sets of sustainable development indicators should more explicitly take into account the intended functions and target groups, and the type of indicator that is most suitable. Indicators have various functions (e.g., goal-oriented, descriptive, communicative, comparative) and target groups (policy-makers at national and international level, politicians, private individuals and organisations).
- Special attention was given in the discussion to the need to further develop sets of indicators that are effective for communicating with the public and public interest groups. In order to do this, stronger interaction with stakeholders, and improved understanding of their interests, is necessary.
- OECD and other parties should continue to work to harmonise and standardise indicator sets and terminology. Such efforts are particularly important, since many parties are involved in the gathering and processing of data.

CONCLUSIONS FROM SESSION IIE

AGRICULTURE/ENVIRONMENT INDICATORS

Chair: Mr. J.C. Belausteguigoitia, Mexico
Rapporteur: Mr. Terence McRae, Canada

Agriculture is closely linked with the sustainable development

Although it represents only a small % of GDP in OECD countries, agriculture is very closely linked to the sustainable development. The sector uses environmental inputs such as land and water, and generates many outputs of environmental significance. As production intensity and output have increased, environmental policy issues have risen in importance across OECD countries.

Policy challenges facing OECD countries include reducing environmental impacts and risks from agriculture, responding to international environmental agreements which often touch on aspects of agriculture, and optimising agriculture's overall contribution to welfare.

Agri-environmental indicators have been developed and are widely in use in OECD countries

There is broad agreement that indicators are needed to both guide and assess agricultural and environmental policy in agriculture. The session demonstrated that much work is already underway to identify and develop indicators, and there is already a considerable base to build on. Case studies from Australia, the Netherlands, Switzerland and Italy illustrated ways in which agri-environmental indicators are being used to inform public debate and to guide and assess agricultural and environmental policy.

The OECD is developing a set of agri-environmental indicators

At the OECD level, an active indicator work programme is already underway through the Joint Working Party on Agriculture and Environment (JWP).

An initial series of policy questions have been identified, and indicators are beginning to be developed and used. Key uses include assessing the state and trends of environmental conditions in agriculture, and policy analysis and monitoring.

Three broad groups of OECD indicators are being developed.

- Several contextual indicators describe broader economic and social aspects of agriculture that have sustainability implications, such as land use trends, and education levels of producers.
- Another group considers management and use of natural resources, such as indicators of nutrient, pesticide and water use.
- A third group considers agricultural impacts on soil and water quality, land conservation, biodiversity, habitats, landscape and climate change.

Issues relevant to the further development of agri-environmental indicators

The following issues were highlighted:

- Indicators are required at different levels and for different uses. This has important implications for identifying and developing indicators. For example, at local or site specific levels, more detailed indicators may be required than at more aggregate levels.
- There is value in pursuing work to develop and use a core set of agri-environmental indicators, which are broadly comparable at the international level. The OECD provides a mechanism to progress such work.
- Scale issues are especially important when developing indicators at the national and international levels. Indicators must be sensitive to regional variability in both environmental conditions and farming systems, across and even within countries, because national aggregates by themselves can mask variability and thus be misleading. Ways of expressing regionality must be employed
- Indicators must be capable of reflecting both negative externalities (e.g. water pollution from nutrients and pesticides) and positive externalities of agriculture (e.g. provision of habitat and carbon sinks).
- A sound analytical framework which clarifies on linkages and policy objectives is required.
- Indicator sets must also be and remain flexible and adaptive to respond to emerging issues, such as GMOs
- The level of research and understanding varies across different groups of issues. For example, soil quality has been well researched, but more work is needed to deepen understanding in such areas as biodiversity, habitat and landscape
- The social aspects of agriculture are presently less developed. This area requires more attention. Such work should start by determining key social issues, policy questions and objectives for these, and understanding the linkages between social and environment issues (e.g the influence of education levels on farm management). Analysis and understanding of possible tradeoffs and synergies between economic, environmental and social aspects of agriculture is also needed.

Further OECD work on agri-environmental indicators

In summary, work on an OECD core set of indicators should proceed, taking into account the points made above. Care is also required to ensure that a core set does not exclude important policy issues, that a smaller core set complements, rather than replaces the more detailed indicators, and that data are always available to underpin analysis.

CONCLUSIONS FROM SESSION IIF

ENERGY/ENVIRONMENT INDICATORS

Chair: Mr Corrado Clini, Italy
Rapporteur: Mr Yuichi Moriguchi, Japan

Energy is essential for the economies of OECD countries

Energy is essential to the economies of OECD countries both as an industrial sector in itself and also as a valuable input to other economic activities. It is also essential to the every day lives of their citizens. A country's energy supply structure and its energy intensity, along with changes over time have major impacts on environmental performance. In particular, participants raised the issue of policy choices with respect to the use of different energy sources in the context of sustainable development.

It was also recognised that, although the integration of environmental concerns in energy policies has progressed since the 1980s, a more integrated approach including the greater use of economic and societal instruments is required in order to reach some key objectives towards sustainable development, such as those of the Kyoto Protocol under the Framework Convention on Climate Change.

Energy indicators are used to help integrate environment concerns into energy policies

The country presentations made during the energy session emphasised the Member countries active role in the development and use of energy-environment indicators both at the aggregated and disaggregated level. The main uses of these indicators were seen to be the identification of areas where policy interventions could improve environmental performance and the measurement of policy effectiveness.

For example, Norway has recently adopted a result-monitoring and reporting system of environmental performance that allows social and economic policy goals to be considered. France has developed approximately 300 indicators to guide and monitor energy efficiency policies at a more detailed level.

OECD's role in the development and use of energy-environment indicators

The OECD has taken an active role in developing energy-environment indicators, in co-operation with the International Energy Agency (IEA). A first set of energy-environment indicators was published in 1993 and is currently being updated. In 1995, the IEA launched further developed energy indicators at a more detailed level to help analyse energy end-use efficiencies and related CO_2 emissions.

Core list of energy-environment indicators for OECD Member countries

The discussion led to the conclusion that there is a policy need to identify a "core list" of energy-environment indicators to be used by OECD countries. It was generally thought that the list of nine indicators reflecting key sectoral trends, environmental impacts and policy variables proposed in the OECD paper would be useful to respond to common policy goals and demands for simplified indicator lists.

Although participant's thought that this list was a useful starting point, it was agreed that it should be flexible in nature and evolve according to wider discussions within countries. This "core list" consists of:

CORE LIST OF OECD ENERGY-ENVIRONMENT INDICATORS

SECTORAL TRENDS OF ENVIRONMENTAL SIGNIFICANCE	Energy Intensities	◆ Total primary energy supply and intensities
	Energy Mix	◆ Total primary energy supply by source
	Energy Use	◆ Total final energy consumption by sector
INTERACTIONS WITH THE ENVIRONMENT	Air Pollution	◆ Energy related air emissions and intensities
	Water Pollution	◆ Oil released through accidents
	Waste	◆ Radioactive waste (spent fuel) from power generation
ECONOMIC AND POLICY ASPECTS	Expenditure	◆ Public and private PAC expenditure by energy sector
	Pricing And Taxation	◆ Energy prices and taxes
	Subsidies	◆ Subsidies to energy sector and energy users

Further work

Further work should focus on indicators highlighting interactions between social and environmental aspects

During the discussions, participants agreed that there is a need to develop indicators that highlight the interactions between the environment and social dimensions. To achieve this further work is required to identify the key linkages and issues of this interface. Additional work on presentational aspects was also considered, in particular, the complementary use of qualitative and quantitative indicators. In connection with the use of the core list, participants stressed the continued need to improve data quality. In addition, it was thought that the "core list" should be used alongside more disaggregated indicators for policy purposes, as demonstrated by the presentations of France, Norway and the IEA.

CONCLUSIONS FROM SESSION III

ASSESSMENT OF SUSTAINABLE DEVELOPMENT IN ITALY

Chair: Mr. Øyvind Lone, Norway

In the Italian session of this conference, the Italian Government had the opportunity to present an overall evaluation of the implementation of the National Plan on Sustainable Development (1993-1998), approved by Italian authorities. The conference noted progress to date and possibilities for further progress.

The conference also received a detailed examination of progress achieved with respect to the OECD recommendations in the Environmental Performance Review of Italy in 1994. By updating major indicators, this examination has highlighted the evolution of environmental policies and the positive outcomes achieved in some sectors. However, the examination also showed the lack of attention given to the integration of environmental concerns in sectoral policies.

Positive examples of progress include:

- the intention to integrate sectoral goals from the Kyoto agreement on climate change into the Economic-Financial Planning Document (2000-2003) of the Government;
- the discussion in Parliament of a draft law on the introduction of an environmental accounting framework for each level of the public administration, starting in 2004.

The integration of environmental issues into policies needs to be improved in the transport sector, even though the Environment Ministry has been engaged in the development of sectoral strategic plans. Industry too still lacks effective organisation in pursuit of sustainable development objectives.

The papers of the Italian session also gave a broad picture of instruments used to evaluate plans and programs (Strategic Environmental Assessment), and projects (Environmental Impact Assessment). An example of integrated planning is the process recently used to define the Community Support Framework (CSF) in relation to the European Structural Funds objective 1 (2000-2006). In this case the Environment Ministry has developed guidelines for Regional Development Plans (RDP). Another example is the use of sustainable development indicators for local policy making. In particular, it is important that the development of urban sustainability indicators include information on environmental, economic and social factors.

PART B.
STATEMENTS

OPENING STATEMENT BY

UMBERTO VATTANI, SECRETARY-GENERAL, MINISTRY OF FOREIGN AFFAIRS, ITALY

Mr. Chairman, Mr. Minister, Mr. Deputy Secretary-General, Ladies and Gentlemen of the Delegations,

It is my pleasure to welcome you to the Farnesina's International Conference Room.

The Ministry of Foreign Affairs attaches great importance to enhancing the value of the OECD's activities in what have become some the most important sectors of today's international scene. A key priority among those sectors is undoubtedly the pursuit of sustainable development in all three of its components, as sanctioned by the Earth Summit in Rio de Janeiro in 1992, namely, economic development, social development and environmental protection.

Today, we place more and more emphasis on ensuring a strategically sustainable management of natural resources and collective and global assets, rather than on the more restrictive policy of past years, characterised by isolated and episodic responses to individual pollution-related problems. Today, we are witnessing an increasing inter-dependence between the environment and the economy, as a result of the growing globalisation of production and consumption processes. Consequently, the need for environmental protection on a world-wide scale is felt more sharply. And today, we realise that we must constantly broaden our range of instruments and decisions regarding the sustainable management of the environment. We must also collaborate with an increasing number of operators with whom to select and carry out operations aimed at endowing our life with a model of sustainable development.

This is the framework in which since 1998 the Environment Ministers of OECD countries have stressed that the priority in their commonly agreed-upon objectives is to ensure the integration of environmental concerns into economic policies, a goal that was later taken up by the OECD Ministerial Council.

As time goes by, it is becoming increasingly clear that we have an obligation to meet this objective. The acceleration of globalisation has introduced a new dynamic into the way we live. There is far greater international mobility of capital, goods, people and information. This has led to a more marked inter-dependence between industrialised countries and developing countries and has thus given rise to the quest for common models of co-operation.

Our studies and debates on globalisation and the environment within the OECD and other fora have highlighted the fact that the environmental consequences of such phenomena are far from certain and thus need not only to be continuously and carefully monitored, but also to undergo constant analysis. In this context, the problem of governance, including that of the institutions called upon to ensure environmental sustainability, will become more and more significant and will require our utmost attention.

As chairman of the OECD Executive Committee in Special Session, I feel this responsibility deeply. It also underpins the action of the Italian government aimed at providing our full support to the Organisation in its task of continually renewing its activities in such a way that they are adapted to the needs of an industrial society that is constantly growing and which must at the same time keep within the limits of sustainable development.

The OECD is called upon to lead the way in the search and refinement of the instruments required by the new industrial society at international level to achieve sustainable development. Through its study and research activities, the Organisation must continue to indicate the right

approach, by means of a constant exchange of information and through effective and open-minded co-operation with other national and international fora and institutions.

A significant example of that activity is this International Conference, co-organised by the OECD and the Ministry of the Environment and which we at the Farnesina have the privilege to host. It is dedicated to taking stock of the study and development of what is a vital instrument in the field of environmental protection.

To dispose of an adequate set of indicators to keep track of the progress of sustainable development means in fact to stop talking about the objectives to be met and to start reasoning, instead, in terms of results obtained. Indicators must enable us to measure the degree of integration of sustainable development in the widest possible range of policies, both national and supranational. This objective was in fact given particular emphasis at the European Council in Helsinki last week.

I know that this Conference constitutes an important step forward in the development of indicators. Focusing on three fundamental sectors - transport, agriculture and energy - it will compare national and international experiences and discuss the validity, efficiency and the radius of application of sustainability indicators.

I am sure that the results obtained by such a qualified group of representatives of OECD countries and international institutions will make it possible for a quality leap forward to be made that will provide a precious aid to the ongoing process of development of indicators in other fora and other areas too.

Italy will continue to support the OECD's key priority activities for sustainable development. We are all committed to protecting the environment in which we live, and to the efforts being made so that we can hand it on, unchanged and perhaps improved, to future generations. In nature, wrote Leonardo Da Vinci, nothing is missing and nothing is superfluous. It is up to us to show that we are worthy of this priceless gift that has been given to us.

OPENING STATEMENT BY

EDO RONCHI, MINISTER OF THE ENVIRONMENT, ITALY

Towards sustainable development: indicators for measuring progress

Mr. Chairman, Deputy-Secretary General of the OECD, Secretary-General of the Ministry for Foreign Affairs and Members of Delegations, I would like to open this important conference by extending a warm welcome to you all on behalf of the Italian government and myself to the magnificent city of Rome. The new century that is about to begin will be more than just an historic occasion. For the fact of the matter is that the production and consumption model of the twentieth century will no longer be able to continue to expand and spread throughout our planet in the coming century, for it is simply not sustainable. Unless we choose the course of sustainable development, there is very real risk that we will face serious global environmental crises that will also have major social and economic consequences. Never before in human history have we faced a transition on such a global scale and so fraught with risks. It took human beings tens of thousands of years to spread from Asia and Africa throughout the earth and grow to some 4 million only 10 thousand years ago. A thousand years ago, world population had risen to approximately 350 million, and it took the next nine hundred years for it to reach the figure of 1.6 billion.

In the twentieth century, it has taken only a hundred years for world population to quadruple, which now stands at over six billion. And it will continue to grow rapidly in the future, for in the next thirty years it will increase by a further two billion, rising to some 8 billion. This exponential growth of the world's population has also been accompanied by vigorous economic growth, for annual world production, which was estimated at 2.3 trillion current dollars at the beginning of the twentieth century, has now risen to some 39 trillion dollars per year. In only a century, production has grown by a factor of 17, i.e. 4 times faster than the population.

The twentieth century's dizzying economic growth has been based on the exploitation of fossil fuels. Consumption of fossil fuels rose from 628 million tonnes of oil equivalent (501 million tonnes of coal, 18 of oil and 9 of natural gas) to 7.13 billion tonnes (2.12 billion tonnes of coal, 2.94 of oil and 2.17 of natural gas). Burning fossil fuels produces carbon dioxide, which when released into the atmosphere causes a greenhouse effect.

World carbon dioxide emissions (CO_2) soared from 1.9 billion tonnes in 1950 to 6.38 billion tonnes in 1998. This increase in CO_2 emissions is already causing the climate to change and is one of the factors behind certain extreme weather conditions, such as prolonged drought, violent storms and floods and heat waves, causing glaciers to recede and leading to more frequent fires. The climate change caused by the greenhouse effect is the most serious environmental problem on earth.

Some 75 per cent of these polluting emissions are produced by the industrialised countries, which, although they account for approximately one-fifth of the earth's population, consume nearly two-thirds of fossil fuels. The economic growth of developing countries has led to greater consumption of fossil fuels and increased CO_2 emissions, which rose by 39 per cent in only 8 years, between 1990 and 1998. Unless the energy system is changed, we are in store for disastrous changes in climate.

Consequently, we will have to reduce our consumption of petroleum and coal in electric energy production, industry and transport (just think of how much gasoline we burn with our cars). We will have to use energy more efficiently so as not to squander it, and in the interim use methane, which produces less CO_2 than coal and petroleum, develop renewable sources (solar, wind-generated and hydroelectric energy) and start to phase in hydrogen, which is the clean fuel of the future. These and

other changes will be necessary to move away from an unsustainable energy model, for the conquest of sustainable energy will require nothing less than a veritable industrial revolution.

The economic growth of the twentieth century has led us to consume enormous quantities of minerals, metals, wood and synthetic materials, amounting to some 10 billion tonnes per year by the end of the 1990s and still growing. The industrial countries' model of economic growth based on high consumption and wasteful use of materials cannot be extended to the world's population. For example, if half the world's population consumed the same quantity of materials as the United States, world consumption would increase three-fold (3.5 times as many minerals, twice as much metal, 2.5 times as much wood and 5.5 times as many synthetic materials). This kind of growth would not be sustainable, for it would lead to a sharp rise in pollution, destruction of land and natural habitats and a tremendous increase in the amount of waste.

The new situation will require producing more, but doing so better and with less, i.e. reducing consumption of materials, reducing waste production and making more durable products that are easily recycled and reusable. The ability to reuse and recycle products and materials, whether through separate collection of urban waste or through industrial technologies that make production cycles more efficient, will become a key factor not only to the sustainability of economic systems, but also to their competitiveness. For, although financial capital and labour will continue to be abundant and technological innovation will be increasingly widespread, materials will be less available, not in the absolute sense, but in the relative sense that it will be less possible to use them indiscriminately due to the earth's limited capacity to withstand environmental pressures, absorb pollutants and adjust to the consumption of natural resources and the destruction of natural habitats. Wasteful economies will not only be anti-environmental, but less competitive as well.

In the twentieth century, the rate of extinction of animal and vegetable species is far higher than was the case in previous centuries, for the number of species naturally becoming extinct has risen from an average of ten to some one hundred per year. There are many causes of this mass extinction, such as pollution, destruction of natural habitats, exploiting species faster than they can reproduce and climate change.

Introducing genetically modified organisms into the environment, which have been produced or altered through biotechnology, might make the situation worse in the future, for natural species might succumb to stronger, genetically modified competitors, while others might be directly attacked by them or no longer have an available habitat in which to grow.

An environment rich in biodiversity, with many different species of fauna and flora, is ecologically more stable, lasting and productive, as well as being more pleasant and beautiful. Little thought has been given to the fact that the most advanced civilisations of the past grew in areas rich in biodiversity and that when this natural richness had been depleted, these civilisations came to an end.

Our industrial civilisation is no exception to this rule. It has relentlessly exploited the earth's natural heritage for its development, and not only in industrial countries. If it does not change course, if it does not learn to conserve and save natural resources, if it does not realise that everything in nature is linked, interwoven and interdependent, it may well saw off the very limb on which it based its development.

The European Union, with its Vth action programme and now its VIth programme in the preparation phase, has committed itself, albeit not without difficulty and with still unsatisfactory results, to the path of sustainable development. The European Council of Cardiff, in June 1998, decided to launch the development of indicators that will make it possible to measure the progress made in integrating environmental policies into other sectors. The subsequent European Council of Vienna specifically asked the European Commission to present a report on environmental indicators and integration indicators.

This report was prepared by the European Commission last October for the Helsinki Summit. According to this report, environmental indicators and integration indicators should make it possible to answer two questions:

a) Has the environment improved?

b) Do sectoral policies take environmental concerns into account?

The first set of indicators developed concern four basic sectors: transport, energy, agriculture and industry. In the transport sector, on the basis of a methodological framework defined by the European Environmental Agency and a statistical programme prepared by Eurostat, an initial framework of environmental and sustainability indicators was defined and annexed to Commission's report. A report on indicators in the energy sector will be published at the end of 1999. In the agricultural sector, a list of agro-environmental indicators has been prepared, which reflect the multi-functional role of agriculture, and a report to the Council and Parliament in this regard will be made by the end of 1999. For the indicators on the integration of environmental policies into industry, the Commission has initiated a study that will be completed by the year 2000 aimed at defining an initial series of eco-efficiency indicators for the main industrial sectors. Also for the year 2000, the Commission has proposed a programme for preparing environmental and sectoral indicators that should make it possible to make major progress towards lasting and sustainable development.

The wide range of activities initiated by the European Union on this crucial issue only makes it more important for us Europeans to establish closer co-ordination with OECD initiatives. On the basis of the opinions of the High-Level Advisory Group on Sustainable Development in November 1997 and of the Ministers for the Environment in 1998, the OECD Secretariat adopted the objective of sustainability as a strategic priority. It launched five activity programmes with a view to defining an acceptable framework that would allow the OECD to take a leadership role in the process of integrating environmental policies into economic policies.

It was in this context that it was decided to hold the Rome Conference on Sustainable Development Indicators, as part of the 1999-2000 activity programme of the Environment Directorate of the OECD. With this Conference, we underscore the need to develop and complete these studies, while strengthening co-ordination and standardisation of results.

Indicators, which are necessary to make information available in a concise and easy-to-use form both for decision-making and to raise public awareness, require uniform and standardised systems for collecting and processing basic data. The choice and definition of these indicators also has considerable political importance, since they are used by governments in setting objectives and policies. The environmental indicators currently being used have now been sufficiently tested and consolidated to make it possible to assess the state of the environment and the pressure of human activity on it. However, it is a more complex task, and one that has yet to be consolidated, to prepare sustainability indicators that can show meaningful correlations between economic, social and environmental data and information and that are concise and highly integrated. The availability of reliable, measurable and widely accepted sustainability indicators would be of great importance to international and national decision-making centres and also help raise public awareness, which might create strong bottom-up support for sustainability policies and measures and cause the market to shift more decisively towards sustainable development.

In the sessions of this Conference dedicated to assessing the progress Italy has made towards sustainable development, special emphasis will be placed on the preparation and use of sustainability indicators at the local level, where in their daily life citizens more directly face problems of traffic and pollution, food quality, economic activities and the management and use of land. The growing adoption of the Local Agenda 21 sustainable development programmes by cities is an aspect that I believe to be fundamental to sustainable development policies, and consequently these important local experiences should also be taken into account in preparing sustainability indicators.

I am confident that this Rome Conference will make major progress in preparing environmental and sustainability indicators and that this will enable the OECD countries, which account for a substantial share of the wealth produced on the planet, to embark more courageously and decisively on the path of sustainable development.

OPENING STATEMENT BY

THORVALD MOE, DEPUTY SECRETARY GENERAL OF THE OECD

"Sustainable development as an integrated framework for policies"

Ladies and Gentlemen,

It is for me a great honour to be here for the opening of this OECD Conference. Let me thank you all for joining us on what I hope will be a fruitful discussion. And in particular, let me express my gratitude to the Italian authorities for generously hosting this event.

The subject of the Conference is an important one, and one that goes well beyond the interest of environmental experts and statisticians. It is an integral element of our broader programme of work on sustainable development, and it is on this broader framework that I intend to focus.

The OECD is probably better known for its "economic" work and expertise than as an advocate of Sustainable Development but I believe that the two cannot be easily separated. After all, the Article 1 of the Convention of the OECD signed in Paris on December 1960 says that: "The OECD shall promote policies designed… to achieve the highest sustainable economic growth… in member countries...". We are often confronted to fears and concerns on the possible negative consequences of globalisation for the social and environmental conditions in our countries. And although we remain convinced that the economic rewards from further market openings are important and that the opposition between globalisation, on one side, and social and environmental conditions, on the other, is exaggerated, we also think that these fears and concerns should be taken seriously. Increased economic efficiency and material well being cannot be sustained if they do not translate in improvements of social and environmental conditions; if their benefits are not shared equitably between and within countries; and if today's progress comes at the expense of the opportunities of future generations. This is the meaning that we attach to the concept of sustainable development as a key economic issue. And it is to make this concept operational for policies that we have launched a major OECD initiative in 1998.

This initiative has started on the basis of a strong mandate to the Organisation from OECD Ministers and, more generally, on the background of the report of a High Level Advisory Group to the OECD Secretary General. This Advisory Group, in particular, had proposed that: "the OECD should be(come) the key intergovernmental organisation that will help governments move towards sustainable development". It is in response to these calls that the OECD Council of Ministers in 1998 initiated a major three-year project involving a majority of OECD Directorates and associated agencies.

Let me say that while this initiative is fairly recent, work on sustainable development issues has a long tradition in the OECD. Over the years the OECD has progressively extended its range of competence to sectoral, social and environmental issues. The Organisation created in 1971 its Environmental Directorate, which has since established itself as a fundamental part of our own programme of work. However, most of our past work dealing with sustainable development issues has been mainly carried out in a decentralised fashion, often in response to specific sectoral concerns. A fundamental objective of the current initiative is to provide coherence and visibility to this work, imposing Sustainable Development as the key principle for policy making in key areas. Progress towards Sustainable Development will not happen unless we succeed in focusing attention at the

highest political level, i.e. Prime Ministers, Ministers of Finance and Economy, of the Environment and of Social Affairs.

As an "Economic" organisation, we have approached Sustainable Development from an economic perspective. By this we mean recognising that economic decisions are driving phenomena like human-induced interference with the climate system and unsustainable exploitation of some natural resources, as well as contributing in some countries to poverty and high unemployment. The response to these global and long-term problems requires, at the level of markets, that we modify economic incentives to take the full costs of environmental and social degradation into account; in other words, that we try to correct as far as possible for market failures. At the policy level, it requires integration of economic, social and environmental objectives in all areas of policies, exploiting long-term synergies and balancing of trade-offs; in other words, that we correct as far as possible policy failures.

We have now entered the second year of our work. This will be devoted to the preparation of analysis and policy recommendations that will provide the basis for a discussion among Ministers from economics, environmental and possibly other fields in the context of our Ministerial Council Meeting in 2001. We hope that this discussion will lead to the endorsement by Ministers of a set of policy principles and of concrete strategies for their implementation that should underpin policies to progress towards sustainable development in Member countries.

Measurement of progress towards Sustainable Development, the subject of this Conference, is a central element of this broader initiative, and one where the OECD enjoys an important comparative advantage. The OECD developed in the 1990s, on the basis of a mandate from G7 countries, a specific programme on environmental indicators, major elements of which will be further discussed in this meeting. We also initiated in the early 1980s pilot work on social indicators which, in 1998, ministers of Social and Health Policy asked us to resume in order to produce a listing of internationally comparable social indicators. A process of consultation with countries is well under way, and we are confident that such a listing of social indicators will be published during 2000. So, it is probably fair to say that the major difficulty in developing indicators to track progress towards Sustainable Development is not the lack of individual data but of frameworks allowing to organise and summarise existing information. Extending the boundaries of economic measurement is the main challenge we are confronted with, and one that corresponds closely to the original spirit of the fathers of the national accounting system. Let me quote in this respect Richard Stone, who in his Nobel lecture of 1984, argued that: "by organising our data in the form of accounts we can obtain a coherent picture of the stocks and flows, incoming and outgoing of whatever variable we are interested in, whether these be goods and services, human beings or natural resources, and thence proceed to analyse the system of which they form part".

Let me conclude by saying that this measurement agenda is important because 'what cannot be measured will not be done'. We need indicators that allow more informed public debates, that catch the attention of the media and of the general public, and allow to track the consequences of policies for the economy, the environment and society. But more fundamentally, we need to engage policy makers in establishing explicit targets for their policies, in agreeing on the best indicators to monitor progress towards these targets and in being accountable for the results achieved. In order words, we need to move towards policies that are 'result-oriented' in the economic, social and environmental areas. We hope to move this agenda forward as part of our overall project on Sustainable Development. I am looking forward to your discussion and to the experience of Member Countries to learn more how we can jointly progress towards these results.

CLOSING STATEMENTY BY

FEDERICO DI ROBERTO, DIRECTOR GENERAL OF ECONOMIC AFFAIRS, MINISTRY OF FOREIGN AFFAIRS, ITALY

I have noted the invaluable and specific results of this Conference organised to take stock of the current situation regarding Indicators for Measuring Progress towards Sustainable Development. I have also noted the progress that has been made towards constructing a comprehensive system of indicators. As Senator Ronchi, the Italian Environment Minister had stated at the EPOC meeting organised at Ministerial level in the spring of 1998, this system will be capable of integrating the data needed to evaluate the effectiveness of strategies and national and international policies towards sustainable development into the decision-making process.

For my part, and on the basis of my experience as Director-General of Economic Affairs at the Foreign Ministry, I would like to conclude by considering three points.

Firstly, the choice of indicators to use in decision-making processes relating to sustainable development must always be a means and not an end. We must give ourselves clearly-defined objectives established by a political decision and based on concrete numerical data. A good example of this is provided by the Kyoto Protocol, which was the outcome of a political decision taken at the very highest level and which sets out precise and detailed obligations for the countries that have ratified it. The indicators will give use an idea of how much progress we have made towards the political decisions taken at the national, regional or international level.

We will clearly need to have indicators available for all, or at least initially most of, the key sectors in which we are pursuing the goals of sustainable development. We shall then be in a position to answer the basic question “can we achieve a general improvement in the use of the resources available and thus in the state of the environment?” The work of this Conference offers us hope that we will. But we must not lose sight of the fact that the road ahead of us remains long. There is as yet no single set of indicators that has been accepted by all operators in each of the key sectors and an ultimate effort will have to be made to define and test such indicators.

This leads me on the second point I wished to make in my concluding comments. The final task ahead of us is both difficult and compelling, and is such that it may engulf all the resources that we are able to devote to it. But it will be necessary to make optimal use of these resources by avoiding waste and duplication. It will also be necessary to pool all the available resources not only within the framework of the OECD but also, wherever possible, within that of other organisations mandated at the highest level to study and devise indicators of environmental sustainability. We will need to have, for example, an appropriate body of coherent data at our disposal within the framework of the OECD and the European Union, both of which have been mandated to pursue the integration of environmental protection into common policies. My hope is that it will be possible for us to work together, as we have done at this Conference, in order to meet as quickly and as fully as possible the common objectives we have all set for ourselves.

One example of fruitful collaboration which already exists in the sectors of interest to us here may be seen in the agreement between the OECD and EUROSTAT which allows these two bodies to use a system of environmental data, based on data collected jointly, for their own activities in the environmental field, as in, for example, the OECD “performance reviews” of individual countries.

We know that there are a large number of qualified organisations and institutions that are currently actively working on environmental indicators, namely the OECD, the European Commission, the European Environment Agency, and various bodies in the UN system (UNEP, World Bank, and others). What better opportunity to commit ourselves, wherever we can, to studying a working plan

that guarantees that the best use possible will be made of resources and that, at the same time, provides a basis on which to develop standardised indicators?

My third point is that, as I stressed earlier, our countries have all committed themselves in various bodies to finalising a effective system of environmental indicators in sectors of primary importance for sustainable development. These include climate change, air quality, the quality of freshwater and marine resources, water quantity, nature and biodiversity, territorial management, waste, chemical substances, urban areas, the most fragile ecosystems and many other areas besides.

This task is destined to finalise a considerable number of indicators that we must use in order to ascertain not only whether there has indeed been a general improvement in the state of the environment but also whether the sectoral policies of our governments have given sufficient consideration to environmental interests and, in the final analysis, whether sustainable development is achievable not only in terms of sectoral policy but also within society as a whole.

It is absolutely essential for this system of indicators, devised in different fora, and, as I hoped, in collaboration between these different bodies, to be standardised, and this for two very good reasons. On the one hand, it makes sense to impose the smallest and most reasonable burden of work on those who will be called upon to employ the indicators, given that our workforce and abilities are not unlimited and must be used in the most rational way possible; and on the other hand, we need to have a uniform framework within which to devise answers to the essential questions evoked above, which will tell us whether we are on the right track to achieving sustainable development.

The OECD, by virtue of its substantial scientific expertise in this regard, is called upon to play a fundamental role in achieving these objectives, serving as both a bridge and a counterweight in this crucial and delicate exercise. In this respect I consider that the work of the Conference has constituted a highly significant component of the three-year programme on sustainable development that the Organisation has undertaken. This programme will end in 2001 when Environment Ministers approve the OECD's strategy towards sustainable development and when this strategy will become one of the bases for action by the subsequent Council of Ministers. I am confident of this outcome, and encouraged by the results of this Conference in my firm conviction that we are well on the way to meetings the objectives we have set ourselves.

I would like to express to all of you present the most grateful thanks of the Ministry of Foreign Affairs and the Ministry of the Environment and their best wishes for the forthcoming festive season.

PART C.
CONSULTATION WITH STAKEHOLDERS

CONSULTATION WITH STAKEHOLDERS, 29 NOVEMBER 1999

Before the Rome Conference, the OECD Secretariat invited the input of comments and suggestions from stakeholders on the topics being addressed at the Conference. A multi-stakeholder consultation meeting was held at the OECD in Paris on Monday 29th November 1999. The main views expressed were as follows.

Business

Indicators should show how value created by industrial activity links with the environment and society, and provides benefits to them. Linkages need to be clearly identified. Indicators should be placed in a framework where businesses, governments and consumers can see the results of their actions.

Indicators should measure progress at the industry sector and also plant level and include efficiency indicators.

The identification of core indicators is a positive development because key comparable indicators are identified and this promotes transparency and accountability. The use of indicators can allow industry and other stakeholders to plan future actions on the basis of measured results.

Trade Unions

The understanding of sustainable development should evolve to encompass more than just environment. The PSR framework needs to be developed to include a wider range of issues and more state and response indicators. The Rome Conference should concentrate efforts in these areas to avoid perpetuating existing gaps. Trade Unions have developed response indicators and social indicators for sustainability (with the International Labour Organisation). Field tests have been carried out.

Indicators of sustainable development can be summarised under seven broad indicators that reflect the criteria or conditions of environmentally sound development that should take place in all countries. Employment and workplace issues require special attention. Process indicators are the most important from a health perspective. Further details are given below.

Concrete measurable targets are needed in the workplace. Indicators that meet agreement at the individual workplace level are required, as there are differences between companies. These indicators need to be developed and used.

Environmental Groups

Further work on state and response indicators is required. Response indicators need to be given higher profile and linked to political messages, for example through linking them with targets.

Indicators should relate to performance benchmarks and timetables for achievement.

A list of ten headline indicators proposed for environmental policy integration is given below.

All Stakeholders

All stakeholders wish greater participation in the Rome conference and follow up, and more generally in OECD work. They consider that they could have a concrete contribution to a pragmatic and operational approach. They would like an opportunity to comment on the indicators that are adopted by the Conference.

Issues and indicators proposed by Trade Unions and Environment Groups

Trade Unions

The following issues need a special focus:

- employment issues
- workplace, workers and work processes;
- workplace and health and safety strategy;
- workplace and participation indicators.

Environment Groups

Environment Groups proposed 10 headline indicators for environmental policy integration:

- air quality;
- water quality;
- climate change;
- hazardous substances;
- land use;
- biodiversity;
- water use;
- material use;
- transport;
- agriculture.

PART D.
ANNEXES

ANNEX A: LIST OF PARTICIPANTS

OECD CONFERENCE : TOWARDS SUSTAINABLE DEVELOPMENT INDICATORS TO MEASURE PROGRESS, ROME, 15-17 DECEMBER 1999

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ANNEX B: CONFERENCE PROGRAMME

OECD CONFERENCE :TOWARDS SUSTAINABLE DEVELOPMENT INDICATORS TO MEASURE PROGRESS, ROME, 15-17 DECEMBER 1999

Chair: Mr. D. Siniscalco

FIRST DAY

REGISTRATION

I. INTRODUCTORY SESSION

OPENING STATEMENTS

a. Mr. U. Vattani (Secretary General, Ministry of Foreign Affairs, Italy)

b. Mr. E. Ronchi (Minister of Environment, Italy)

c. Mr. T. Moe (Deputy Secretary General, OECD)

PROGRESS AT INTERNATIONAL LEVEL

a. OECD: Mr. L. Kincannon

b. Regional:
- Asian Development Bank: Mr. K. Jalal
- European Commission: Mr. G. Aubrée

c. World-wide:
- World Bank: Mr. K. Hamilton
- United Nations: Ms. J. DiSano

II. FRAMEWORKS AND INDICATORS (parallel sessions)

A

ACCOUNTING FRAMEWORKS

Chair: Mr. S. Landefeld (USA)
Rapporteur: Ms. A. Harrison
Discussant: Mr. P. Garonna (UN-ECE)

a. Overview: OECD

b. National initiatives and experiences:
- France
- Mexico

c. Discussion

D

TRANSPORT/ENVIRONMENT INDICATORS

Chair: Ms. D. Dron (France)
Rapporteur: Mr. K.J. Moning (Netherlands)
Discussant: Mr. M. Barreto (ECMT)

a. Overview: OECD

b. National initiatives and experiences:
- Italy
- Finland

c. Discussion

SECOND DAY

II. FRAMEWORKS AND INDICATORS (parallel sessions)

B. **ENVIRONMENTAL PERFORMANCE INDICATORS**

Chair: Mr. J. Custance (UK)
Rapporteur: Mr. J. Morant (USA)
Discussant: Mr. D. Brash (New Zealand)

a. Overview: OECD
b. National initiatives and experiences:
   - Japan
   - Germany
c. Discussion

E. **AGRICULTURE/ENVIRONMENT INDICATORS**

Chair: Mr. J.C. Belausteguigoitia (Mexico)
Rapporteur: Mr. T. McRae (Canada)
Discussant: Mr. M. Rayment (RSPB)

a. Overview: OECD
b. National initiatives and experiences:
   - Australia
   - Netherlands
c. Discussion

Lunchtime Panel discussion: sustainable development and globalisation
Chair: Ms. J. Waller Hunter
Panel: Mr. K. Jalal, Mr. B. Emmet, Mr. H. Schreiber, Mr. B. Moldan

C. **SUSTAINABLE DEVELOPMENT AND ITS ECONOMIC, SOCIAL, ENVIRONMENTAL INDICATORS**

Chair: Mr. B. Emmett (Canada)
Rapporteur: Ms. A. Teller (Belgium)
Discussant: Mr. J. Spangenberg (Wuppertal Institute)

a. Overview: OECD
b. National initiatives and experiences:
   - Hungary
   - Sweden
   - United States
c. Discussion

F. **ENERGY/ENVIRONMENT INDICATORS**

Chair: Mr. C. Clini (Italy)
Rapporteur: Mr. Y. Moriguchi (Japan)
Discussant: Mr. E. Lazo (NEA)

a. Overview: OECD
b. National initiatives and experiences:
   - Norway
   - France
c. Discussion

THIRD DAY

III. ASSESSMENT OF SUSTAINABLE DEVELOPMENT IN ITALY

Chair: Mr. O. Lone
Discussant: Mr. B. Moldan

1. **MAIN PROGRESS WITH SUSTAINABLE DEVELOPMENT (1995-1998)**

2. **MEASUREMENT OF SUSTAINABLE DEVELOPMENT PROGRESS**

3. **DISCUSSION**

IV. CONCLUDING SESSION

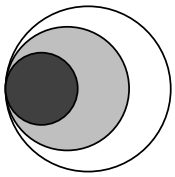
1. **SUMMARY AND CONCLUSIONS**

a. Statements by rapporteurs
b. Chair's conclusions

2. **CLOSING STATEMENTS**

a. Mr. C. Avérous (OECD)
b. Mr. G. Silvestrini (Ministry of Environment, Italy)
c. Mr. F. Di Roberto (Ministry of Foreign Affairs, Italy)

Towards sustainable development
Indicators to measure progress



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VOLUME II
FRAMEWORKS AND INDICATORS

OECD Rome Conference Proceedings – Volume II
Frameworks and indicators

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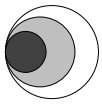

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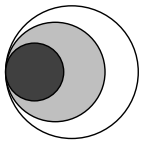
PART A.
ACCOUNTING FRAMEWORKS

ACCOUNTING FRAMEWORKS

OECD OVERVIEW



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EXECUTIVE SUMMARY

Frameworks have a key role in organising and relating information on economic, environmental and social development. Whereas statistics have been organised internationally around economic, environmental and social demographic themes, for the present purpose, accounting frameworks including the national accounting framework can broadly be divided into those that extend the economic accounting frameworks, and physical environmental accounting frameworks (including natural resource accounting).

Accounting frameworks provide a strong analytical base for the design of reliable sustainable development indicators, i.e. analytically sound, policy relevant and measurable.

Concerning extension of national accounts and satellite accounts, the United Nations (in co-operation with other international organisations such as OECD) and a number of countries have been pilot testing an integrated system of economic and environmental accounts (SEEA). Further, the World Bank has made estimates of various types of assets and genuine savings for a wide range of countries. However, progress on integrating human and social capital remains largely at the conceptual stage.

The greatest value of national accounting frameworks is their potential ability to integrate economic, environmental and social dimensions of sustainable development, and to relate monetary and physical data. The major limitations of the framework are theoretical and practical difficulties in accounting for and valuing some natural assets and human and social capital, and in handling uncertainties inherent to a number of environmental issues.

Natural resource accounts (e.g. water, forest, land, energy resources) describe, primarily in physical terms, stocks and flows, including quantitative and qualitative aspects of resources. Natural resource accounts can be used as tools for the development of sustainability indicators, (intensity of water use, intensity of forest use) policy analysis and resource management. National resource accounts as well as sub-national accounts (e.g. river basin level) have been constructed and used. The largest difficulty with this approach is combining physical measures made in different units.

Further work is needed concerning:

- measurement and economic valuation of some environmental, and social assets;
- assessment of links between the social dimension and the economic and environmental dimensions;
- linking physical and monetary accounts.

INTRODUCTION

The OECD is a major producer of economic indicators (for economic analysis and international comparisons), environmental indicators (to measure environmental performance, and to integrate environmental concerns in sectoral policies) and social indicators.

This paper briefly examines the purpose and desired characteristics of accounting frameworks for sustainable development indicators. The main part of the paper examines frameworks based on national accounting and related approaches, and physical natural resource accounting.

The paper draws on the outcomes of an OECD workshop, "Frameworks to Measure Sustainable Development", on 2-3 September 1999, in Paris, and OECD work on economic and environmental accounting and indicators over many years.

I. PURPOSE AND FEATURES OF FRAMEWORKS

Frameworks have a key role in organising and relating information on economic, environmental and social development. They need to embrace the interaction of current flows, the impact of different forms of capital stock and their development over time.

Indicators often focus on specific issues, outcomes, or sectors. This enables them to be relevant for policy monitoring but more difficult to situate in an overall context. Frameworks help to make indicators useful and relevant for policy, establish priorities and identify gaps in data and policies.

Desired characteristics of frameworks for sustainable development indicators are that they:

- integrate the economic, environmental and social dimensions of sustainable development;
- capture key information needed to measure sustainable development;
- provide a basis for selecting indicators that are analytically sound, policy relevant and measurable;
- clarify links between different indicators, and between indicators and policies[1];
- be transparent and simple to understand;
- cover information over time (trends) and data to interpret results (benchmarks).

In this paper frameworks are divided into two classes:

- frameworks based on national accounting and related approaches;
- natural resource accounting.

All of these approaches have useful features, but none is sufficient in itself to provide the framework for measuring all aspects of sustainable development.

1. Frameworks for sustainable development indicators also need to be transparent and simple to understand and cover information over time (trends) and data to interpret results (benchmarks).

II. NATIONAL ACCOUNTING AND RELATED APPROACHES

Efforts to extend the national accounting framework fall into several categories: satellite accounts, integration of human capital, wealth measures and genuine savings.

1. A satellite account including the environment

The system of national accounts (SNA) is the standard framework that is used by all OECD countries to portray the interaction of production, income generation, consumption and capital accumulation. For some years a number of countries have been pilot testing an extension to the system, described as a satellite account and referred to by its acronym, the SEEA (an integrated system of economic and environmental accounts).

The main direction of the extensions included in the SEEA can be summarised as follows:

- While the SNA includes all man-made assets and those natural assets drawn into the production process (natural forests harvested for timber, oil reserves and deep sea fish stocks, for example), the SEEA aims to have a wider coverage of environmental assets including all land, water resources and air.
- The SNA is expressed solely in monetary terms. The SEEA includes information on physical flows of natural resources;
  - where possible alongside corresponding monetary flows (for example, natural resources used as inputs to the production process); or
  - in physical terms only (for example, where water and air are used as environmental sinks and satisfactory market valuation is difficult or even impossible).
- Defensive expenditure is included in the SNA but is not separately distinguished and so not easily analysed. The SEEA gives this type of expenditure a more prominent role so that the extent to which defensive expenditure is (or is not) being taken is conspicuous.
- Just as the SNA relates to traditional commercial accounting, the SEEA is more in keeping with new forms of environmental accounting being implemented at the level of the individual firm.

Experience with implementing the SEEA so far has concentrated on three key areas: environmental protection expenditure, asset accounting and emissions accounting. The exact extent of the last two elements varies from country to country in response to the immediate policy needs and environmental concerns.

- Environmental protection expenditure can be linked with state of the environment indicators and trends to examine the effectiveness and efficiency of environmental protection policies over time. Care must be taken, though, not to assume high environmental expenditure implies major environmental problems; often it is the most environmentally conscious countries which have the highest protection expenditure.
- Physical asset accounts provide important information for assessing the rate of depletion of natural resources, and link the supply and use of natural resources to resource management policies including pricing and taxation. It is often important to examine physical changes in natural assets as well as monetary values where short term price fluctuations mask trends in resource depletion and scarcity. Further analysis investigating how far natural capital is being substituted by man made capital is also possible.
- Emissions accounting values emissions at maintenance costs (the costs of avoiding the impacts of emissions). This allows estimates of the financial cost of full environmental protection to be made and contrasted with the amount actually being undertaken. Almost all environmental extensions to the national accounts are made first in physical terms. The

extent to which monetary valuations are added varies from case to case but there is interest in extending these links between physical and monetary accounts in future. This is especially fruitful at the sectoral level, for example in water accounts, which combine information on water quantity and quality with information about expenditure on water pollution abatement and mobilisation of resources.

2. Integrating human and social assets in national accounting

It is difficult to determine robust measurement tools to integrate measures of human capital, social and institutional capital within the standard national accounting framework. Such estimates as have been made (for example by the World Bank) suggest that the value of these alternative forms of capital account for a greater share of wealth, widely understood, than manmade and natural capital in most OECD countries.

Traditional measures of human capital have been based on completed years of schooling or on formal educational qualifications. Market values of each level of educational attainment are based on earnings. This does not take account of the quality of formal education, depreciation of human capital over time, or the education or training received in the workplace[2]. Human capital formation is also influenced by human health, and that raises a further set of questions.

A recent major report on human capital by the OECD identifies the limits of existing measures of human capital, and the Organisation is working towards the development of a set of indicators. One possibility for a sustainable development framework is to include non-monetary measure of human capital in the system in a way similar to the inclusion of physical measure for environmental concerns.

Social capital focuses on relationships between people, and the norms that govern these relationships. It also includes questions of governance. Social capital does not lend itself to representation in terms of stocks, investment and depletion, and rates of return. Relationships cannot be clearly owned like an economic asset. Also many investments in social organisations are voluntary and can only be measured in terms of time spent on the activity. The direction of the causal links between social capital and economic activity is not clear although it is likely that there are links in both directions.

A number of social indicators may be used to highlight strains or fragmentation in the social fabric, so as to provide warning signals of a possible decline of social capital. These include participatory indicators such as numbers of people involved in and the size of contributions to voluntary organisations. Expenditure on improved communication and co-ordination may indicate an increase in social capital, although it does not measure the quality or impact of investment.

Efforts by the World Bank/OECD/UN to extend their working set of core set of indicators on measuring development progress to include social indicators are helping to increase recognition of the issues involved.

3. Wealth accounting

Stocks of both produced assets (man-made capital) and natural resources are important components of national wealth. Stocks of wealth determine the production opportunities people face, and since the preservation of wealth implies the preservation of production possibilities for future generations, the issue of sustaining development can also be seen as an issue of creating, maintaining, and managing wealth.

2. OECD studies of adult competencies, through survey-based skill assessments, show that significant proportions of individuals over- or under-perform relative to formal qualifications. They also show that literacy skills, like other capital assets, can depreciate as a result of technological change if not maintained through regular practice at home and at work.

The same level of wealth can be represented by quite different groupings of assets. If a monetary valuation can be ascribed to all forms of assets, this permits the trade-offs between different dimensions of sustainable development to be considered.

The World Bank has estimated values for a broader range of assets and this work has produced some interesting insights. This assesses the structure of a country's asset base and to consider what types of policy are relevant to either developing the asset base or using it more constructively.

Key findings are:

- some evidence that the most resource-intensive economies have grown more slowly than their peers since the 1970s. The transformation of resource wealth in all regions into income growth depends on sound policy, in particular the effectiveness of public investment of resource rents;
- human resources, including the returns to raw labour, are the dominant component of wealth, representing between 40 to nearly 80% of the total;
- portfolio balance is important—that is, while investments in produced assets are a necessary part of the development process, investments in human capital are also required.

While the World Bank work helps to focus attention on a broader definition of wealth there are the following issues:

- there are difficulties in applying a common approach to around 100 countries;
- so far it has not been possible to estimate human, social and institutional capital separately; they are estimates jointly as a residual; a more direct method of estimating each is required;
- distributional issues are not considered.

Overall, a wealth-based approach to sustainable development issues is useful. Further work is warranted to develop a common methodology and set of assumptions for cross-country comparisons, and refine estimates of environmental assets, human and social capital.

4. Genuine saving

Saving is closely linked with notions of future investment and sustainability. However, saving (as usually measured) does not exclude the costs of environmental depletion and degradation or include investment in human capital. Genuine saving is calculated by deducting consumption from Gross National Product (gross saving*),* deducting depreciation on produced assets (net saving*)*, the net depletion of living resources, depletion of mineral resources and pollution costs and adding expenditure on education (a measure of investment in human capital).

Positive genuine saving is a necessary, but not a sufficient condition for sustainable development. If genuine saving is negative for a reasonable period of time development is not sustainable. If genuine saving is positive it cannot be concluded that development is sustainable, because the measure does not include some natural assets (for example, biodiversity) or social capital. Decomposition of the measure, in the same way in which an economic analyst would decompose GDP, is required to identify key areas and possible solutions.

The World Bank has estimated and analysed genuine saving over time for many countries, with some interesting results:

- positive genuine savings were calculated for all OECD countries for 1997, but the pattern over time has been variable with very low genuine saving rates in some countries in some periods;

- resource-dependent economies are potentially sustainable if resource rents are invested in other productive assets (including human capital), but many of these economies have not chosen this path;
- robust genuine savings do not necessarily lead to a smooth development path. As the example of Southeast Asia in 1997/98 shows it is important to ensure that savings are invested productively;
- the allocation of resources rents and pollution costs, the quality of public investments of resource revenues and resource tenure policies have a significant impact on the returns to investment.

The practical benefits of the genuine saving approach include:

- it strengthens the case for increasing savings;
- it highlights a need to consider a range of assets, including natural resources and the relative significance of these assets (portfolio management);
- it draws attention to the significance of distribution of resource rents, with implications for budgetary processes, in terms of taxes and subsidies.

However, there are difficulties in the measurement of genuine saving:

- problems in estimating the value of environmental assets, and human and social capital;
- the method contains asymmetries in the treatment of education, minerals discoveries and CO_2 emissions[3];
- it does not make explicit whether the source of the saving, is from domestic saving or from the rest of the world[4];
- the effects of technological change are not accounted for[5].

Despite these difficulties, genuine savings allow analysis of linkages between sustainable development issues and summarises concisely a broad range of relevant information.

5. Assessment of the national accounts framework

A national accounting framework for sustainability indicators has several advantages:

- a long established theoretical structure which has direct links to sustainable development issues;
- valuation in monetary terms which allows comparison of different dimensions of sustainable development and an assessment of their relative importance;
- links between monetary and physical indicators (for example, numbers of unemployed) to assess policy issues under consideration;
- decomposition to a micro and sub-national level. Indicators derived from national accounting frameworks can feed into other, more detailed, sectoral frameworks;

3. Investment in education is included but depreciation of this capital is not. For education, while an asymmetry exists, to the extent that education can be considered as disembodied, i.e. not linked to individuals, the continual turnover in population need not be seen as pure depreciation in human capital since some information will be retained within society as a whole. The treatment of mineral discoveries (increases in natural resources) and CO2 emissions requires further development.
4. If a significant proportion of domestic investment is funded from external sources, questions of sustainability may arise (for example, in relation to the permanency of the external investment or regarding interest payments required to maintain the investment).
5. It has been estimated (Weitzman) that the size of the benefit premium to future generations stemming from technological progress may be very significant (possibly around 40% of GDP), and likely to dwarf any compensation for the decline in environmental assets. The size of this premium is diluted to the extent that increased efficiency owing to technological change does not contribute to sustainable development, and to the extent that technological change is endogenous.

- credibility and acceptance which makes it easier to relate sustainable development issues to finance and economics departments in national governments.

The major limitations of the framework are:

- theoretical and practical difficulties in determining the accounting links pertaining to some natural assets and human and social capital;
- practical difficulties in valuing (unpriced) assets and flows which have few relevant markets. More generally, the data needed to estimate environmental and social issues may not (yet) exist or be in a useable form;
- uncertainties inherent in a number of environmental issues.

6. Current OECD work

The OECD Statistics Directorate, in collaboration with other directorates, is working to develop an extended national accounts framework linking economic, environmental and social factors which will incorporate most of not all of the possibilities discussed above. This framework uses as its base the traditional framework used for economic measurement, the national accounts. In its application to sustainable development:

- the concept of production is extended to include the use of environmental resources and the deployment of all labour whether paid or not;
- the definition of asset is enlarged to include environmental assets and human and social capital;
- the measurement of consumption is contrasted with a measure of income modified to ensure that while remaining consistent with the new concept of production, provision is made for the maintenance of an adequate level of capital for future generations.

III. PHYSICAL NATURAL RESOURCE ACCOUNTING

1. Natural resource accounts (NRA)

Natural resource accounts describe, primarily in physical terms, stocks of resources, the flow of resources between the environment and the economy and the flow of resources within the economy. There are two types of NRA:

- Environmental resource accounts cover natural resources with multiple-uses: economic inputs, ecosystem services and non-market utility (for example, recreation). Generally stocks and flows of these resources are recorded in physical terms (volume, weight, area, population or diversity). Examples are the forest, water and land resource accounts that have been developed in some OECD countries[6]. In principle, environmental accounts can be extended to incorporate the quality aspects of natural resources. These extensions aim at measuring pollution flows from economic activities to natural resources or serve to draw

6. Examples from OECD countries are forest accounts (e.g. Finland, France, Norway, Portugal, United Kingdom), water resource accounts (e.g. France, Netherlands, United Kingdom), wild life resource accounts (e.g. France, Spain) and land accounts (e.g. Finland, France, Norway, Spain). Eurostat has also been active in this area.

a picture of the quality of a particular natural resource. Few such quality-based accounts exist[7].

- Material resources accounts which refer to natural resources whose value is typically defined through their single-use as an input to economic activities. Mineral or fossil fuel resources are examples of material resources, and energy accounts have been developed in a number of OECD countries.

NRA can be used as a tool for the development of environmental indicators, policy analysis, or resource management. For example, forest and water resources accounts provide the conceptual foundations to define indicators of sustainability such as the intensity of forest use or the intensity of water use. Intensity of forest use measures the volume of the forest harvest, in relation to growth in the forest volume minus losses owing to natural events. Intensity of water use measures gross or net withdrawal of water resources, in relation to renewal of water resources. The estimation of these indicators also relies on detailed data on forest and water stocks and flows. NRA also provide an analytical tool to assess the impact of sectoral economic activities on the different types of resources, and in turn are an important instrument of policy evaluation. For instance, they were useful in assessing sustainable levels of commercial exploitation of forest resources and the sustainable levels of water use in regions prone to water shortages and droughts.

In building a satellite national accounting framework, the process of incorporating environmental and material resources starts from these NRA. Both are incorporated in physical terms. For material resources it is usually possible to go on to convert these to monetary terms also. The aspects of NRA which are difficult to conceptualise in monetary terms yet are such aspects as the recreational value of forests and biodiversity. For these only indicative, non-monetary measures are practicable.

2. Material flows analysis

One response to the problems of valuing some environmental resources is the aggregation of NRA without considering monetary valuation at all. The rationale is that emphasis on the valuation of which is required within the national accounts approach and its related frameworks has one significant practical problem, it is very difficult to value assets and flows for which there are no markets. As well, a focus on valuation may hide a significant body of information, which exists in terms of physical units.

In the material flows approach the range of physical inputs and outputs are measured in tons and aggregated to derive measures of the total physical throughput in the economy.

One key benefit of the material flows presentation lies in the detail provided and the ability to examine the direction, speed and quality of the flows of individual materials, such as lead or nitrogen based fertilisers. Based on this detailed information, links to environmental pressures can be made and one of the key findings from the materials flows work is that unless economic growth is “delinked” from material throughput then environmental pressures will increase. This analysis also raises awareness of sustainable development issues.

The largest difficulty in the approach is the interpretation of aggregated physical measures. For example, it is not clear that adding tons of lead and tons of coal produces a meaningful overall measure. Also, links to environmental damage are more difficult to make since this requires additional information on thresholds and regional impacts.

7. For example, Norway has drawn up air-pollution accounts, and water quality accounts exist in Spain and France alongside quantity accounts.

Physical and monetary accounts provide complementary and important information for policy makers. NRA are linked into the overall structure of the national accounts within a satellite account to give a broader picture of sustainable development issues. Material flow accounts, at least at a disaggregated level, give useful insights where the links to monetary values do not add extra policy information.

IV. CONCLUSIONS

Accounting frameworks for sustainable development indicators provide a sound analytical foundation to integrate the economic, environmental and social dimensions of sustainable development.

There are a number of accounting frameworks, each serving different and useful purposes:

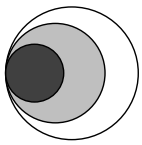
- A National accounting framework for sustainability indicators has the potential ability to integrate and aggregate economic, environmental and social dimensions of sustainable development, and monetary and physical data. The major limitations of the framework are theoretical and practical difficulties in accounting for and valuing some natural assets and human and social capital, and handling uncertainties inherent in a number of environmental issues.
- Physical natural resource accounts can be used as a tool for the development of sustainability indicators, policy analysis, and resource management. The largest difficulty with this approach is combining physical measures made in different units.

Key areas that need to be developed include:

- measurement and valuation of some environmental, and social assets;
- assessment of links between the social dimension and the economic and environmental dimensions;
- linking physical and monetary indicators.

ACCOUNTING FRAMEWORKS

THE EXPERIENCE OF FRANCE*



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* By Mr. Philippe Crouzet, Institut Francais de l'Environnement (IFEN), France.

EXECUTIVE SUMMARY

The accounting approach to measuring the quality and quantity of water resources aims to rationalise the exploitation of physical data and to place them within a consistent framework. Its other advantage is that it provides a general framework for relating aggregates derived from physical data to the economic and policy considerations that underpin decision-making. Resource accounting is thus a valuable method that can contribute to sustainable development. Although the conceptual basis of the approach was worked out at the beginning of the 1980s, it is only recently that full-scale applications have been conducted, i.e. at the level of an entire country and its main catchment areas.

The Institut Francais de l'Environnement (IFEN) has devised a methodology for compiling water accounts at three levels of complexity. This methodology is applicable to both quality and quantity accounts. Alongside these accounts, the IFEN compiles environmental expenditures and protection accounts (IFEN 1999), for water in particular. The three levels of the methodology are said to be "simplified", "semi-simplified" and "complete".

For the moment, only findings obtained with the simplified method concerning the quality of water in rivers are available. They relate to 55 major basins (average area: 10 000 km^2) of metropolitan France, four size classes of river and three major types of pollution, namely that caused by organic and oxidizable matter (i.e. "classical" pollution responsible for deoxygenation), that caused by nitrates, and eutrophication.

Although the method is said to be "simplified", it can also be used to construct a composite water quality index. This index makes it possible to monitor changes in the quality of water at every level of aggregation: by group of river size classes, group of catchment areas. It also makes it possible to evaluate the scale of one type of pollution in relation to another, for example, the scale of nitrate pollution in relation to organic matter pollution in a given basin.

Resource accounts are being developed using the same method for the same 55 catchment areas, but the results are not yet available.

Developments under way utilise the semi-simplified method, which is based on a detailed hydrological base common to both quality and resource accounts. As a result, it will be possible to aggregate not only hydrological data but also administrative data (N.U.T.S level). To evaluate quality, the complete method will use the representative networks defined in conjunction with the European Environment Agency Topic Centres The data sources and methods of compiling data used by the Commission, the EEA and other information users, could thus be unified, thereby optimising data collection and processing.

I. OBJECTIVES AND METHODOLOGY

1. The context for physical accounts

The compilation of physical accounts for water was one of the main objectives of the IFEN when it was set up in 1992. Given the practical impossibility, for want of adequate data, of compiling accounts in accordance with the complete methodology recommended by the *Commission Interministerielle des Comptes du Patrimoine Naturel* (CICPN 1986), it was decided to compile them using the data that were available, with the following aims:

- To produce water quality accounts and water resource accounts for each catchment area in the National Water Data Network (RNDE)[1], which could be aggregated at national level. Quality would be measured by weighting qualities by the number of kmcn (kilometre of standard river) so that the pilot project would remain compatible with subsequent developments using the basic method;.
- To use only data that were rapidly available, so as to produce the accounts at as low a cost as possible as part of a pilot project;
- To determine whether it would be timely to constitute data sets for a more orthodox method than the simplified method, the results of which could be aggregated by different geographical units, and administrative units in particular.
- To compile indicators, so as to exploit fully the rigour and comparability of the accounting framework.

The context was particularly conducive to compiling water accounts in so far as a new environmental accounting and economics commission was set up in the second half of 1998.

However, the IFEN did not develop accounting methodologies solely because it had to produce physical data for environmental accounts. European agencies, the European Environment Agency (EEA) and Eurostat in particular, increasingly require the most composite and most representative indicators possible. This trend is illustrated by the development of EUROWATERNET, in which the IFEN is participating as the national focal point for water matters; the Office international de l'eau (OIE) is also participating as the national centre of reference for water and partner in the European Topic Centre for Inland Waters (ETC/IW).

Admittedly, the accounting approach is not a panacea but it ensures internal and external consistency between the magnitudes involved, and exhaustiveness.

2. Simplified method of water quality accounting

It was in this favourable context that the three levels of the methodology and the application of the simplified method of water quality accounting were defined. The table in Annex I shows the connections between the quality, resource, satellite and central accounts and the various methodological stages.

1. The IFEN developed under the RNDE a breakdown of metropolitan France into 55 major catchment areas based on a hydrographical coding system. These "RNDE catchment areas" are the basis on which national surface water statistics are compiled. The European Environment Agency (EEA) has also suggested applying this concept at European level. Each RNDE catchment area is characterised by a four-digit code, the first two digits denoting the Water Agency (of which there are six) to which it belongs. Each area ranges between 6 000 and 13 000 km2.

The simplified methodology developed by the IFEN consists in weighting each stretch of river by a derived magnitude, "kmcn"[2], corresponding to the length of the stretch multiplied by the reference discharge for the stretch. These values were applied to the linear quality maps for each reach which are published by the RNDE with the twofold aim of improving existing data and informing the public and decision-makers. The calculations were done for the 55 RNDE catchment areas and the four size classes, namely, "main rivers", "large tributaries", "rivers" and "streams". The overall length of rivers ranges from 70 000 to 80 000 kilometres, of which 55 000 to 33 000 kilometres have a quality grade.

The discharges for each stretch were calculated using a simplified method based on the assumption of constant hydrological productivity for a class of river in a given catchment area. The data used to make this approximation of flows come from nearly 200 sites which were regularly monitored up to 1993, and are published by the RNDE. The details, representativeness and limitations of the method are discussed in depth in the basic document (IFEN 1999).

The work on resource accounts, which is also based on approximations of primary resources, flows, abstraction, consumption and exchanges between agents, will be described in detail in a forthcoming report (Crouzet, 1990) but has not made enough progress to be described here. In contrast, work on the common hydrological base is well under way (see Annex Table 1).

II. RESULTS

1. Relative size of the various river systems

The presence of certain types of rivers and their size as expressed by the number of kmcn vary widely from one French region to another. These disparities are illustrated by the figure in Annex 1, which shows that certain types of rivers are not found in all RNDE catchment areas, and especially that their size varies widely from one region to another. In particular, it may be noted that the Rhone accounts for a large share of the total kmcn of the "main river" class.

2. Summary table of accounts (organic matter quality)

By definition, the summary table of accounts defines only states -- before and after. For the moment, all we have for these two states is the pollution caused by organic matter as measured by the *SEQ-eau* [3](water quality monitoring system), which takes into account dissolved oxygen, the BOD5 (biochemical oxygen demand at 5 days), the COD (chemical oxygen demand) and ammonium (NH_4^+ ion). Quality is expressed in five classes, ranked 1A, 1B, 2, 3 and unclassified), ranging from best to worst and colour coded from blue to red.

2. The Kmcn (standardised kilometre) is a conversion unit which represents a river 1 km long with a flow of 1 m3/s, or 0.5 km with a flow of 2 m3/s.
3. SEQ-eau (système d'évaluation de la qualité des eaux) is the water quality monitoring system developed by the Ministry for Land Use Planning and the Evironment, and the Water Agencies (Oudin and Maupas 1999). The map of the 1992 state was not drawn up in strict accordance with the *SEQ-eau* rules. Actually, however, the methods used to evaluate the general quality of water were very close to those subsequently used to measure pollution by organic and oxidisable matter. It was thus considered possible to compare the 1992 map with the 1994 map.

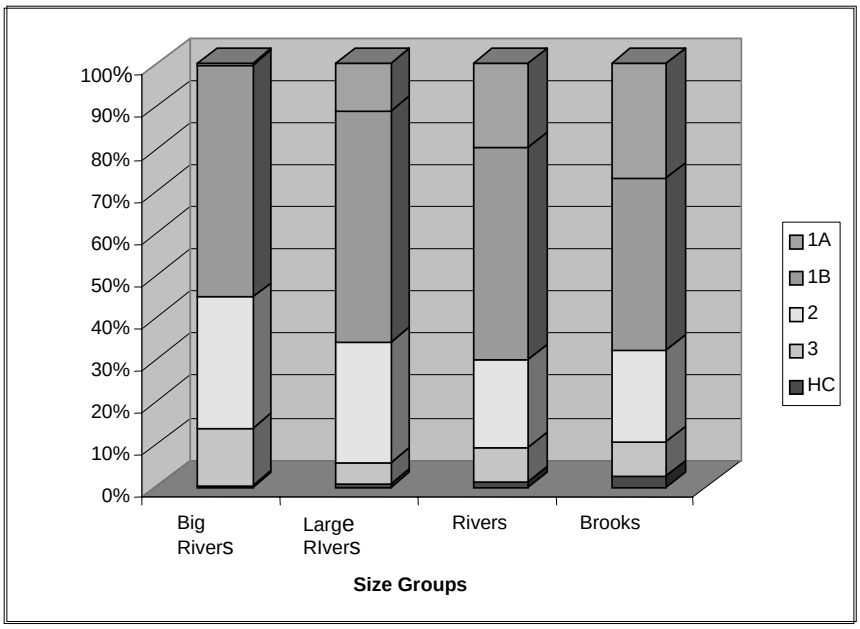
The findings can be presented in the form of an account. The aggregated results are presented in Table 1 below, which was compiled by comparing the two maps with a common hydrographical base calculated for the 1994 state[4].

Table 1. **River water quality in France,** 1992 and 1994

Group of water	kmcn 1992 water quality class					Differences					kmcn 1994 water quality class				
	1A	1B	2	3	HC	D1A	D1B	D2	D3	DHC	1A	1B	2	3	HC
Big rivers	5	1253	891	510	177	3	*336*	*9*	*- 183*	*- 165*	8	1583	893	358	12
Large rivers	309	1228	1194	336	50	*16*	464	- 275	- 182	- 22	325	1691	919	154	28
Rivers	260	615	451	128	47	*44*	*130*	- 129	- 17	- 28	306	749	322	110	18
Brooks	860	1464	690	243	95	*- 44*	*- 176*	*228*	*15*	- 23	810	1295	917	258	72
Total	1434	4560	3226	1217	369	19	754	- 167	- 367	- 238	1448	5318	3051	881	131

Notes: Water quality is measured by organic matter content. The figures in italics in the difference column denote a difference which was calculated slightly differently from the difference between the 1994 and 1992 states. This is because it impossible to compare certain groups of rivers in a few RNDE catchment areas. The Kmcn (standardised kilometre) is a conversion unit which represents a river 1 km long with a flow of 1 m3/s, or 0.5 km with a flow of 2 m3/s.

Figure 1. **River water quality in France,** 1994



Source: Data water agencies, RNB via BNDE, Ifen calculations

Figure 1 shows the breakdown of the various quality classes weighted by the size of the river (kmcn values) and broken down by size class. Comparison of the 1992 and 1994 states suggests there was a marked improvement in water quality, especially in the "main river" class.[5]

4. The states and differences were calculated separately, which highlighted some inconsistencies in the data. The general methodology provides for a common hydrographical base but tests are being done to determine whether the use of annual flows whose quality had been measured would not be more representative of water resources.

A further simple and clear way of representing water quality from one year to another is proposed in Annex Figure 2. The geographical breakdown of the 1994 state was summarised by aggregating the quantity of kmcn in the good (classes 1A and 1B) or bad (classes 3 and unclassified) quality classes in each basin, and by calculating the proportion. The graduation of proportions is obviously different, good quality being the rule while bad quality should be the exception.

3. Other water quality indicators

The simplified method was applied to nitrate and eutrophication indicators. Quality classes were assigned according to the nitrate indicator of the *SEQ-eau*, which measures only the NO_3 ion concentration in the water[6].

Despite the limits of the nitrate indicator, nitrate pollution can clearly be seen to a problem west of a north-east/south-west line which divides France in two, and is confirmed by other studies and data given in the last report on the state of the environment (Crouzet et al. 1998).

Eutrophication is a specific problem which mainly takes the form of plant growth that exceeds the ability of the environment to consume and degrade it. It thus acts like secondary organic pollution, which uses up oxygen, asphyxiates the water and causes leaching out of toxic substances (methane, ammonia, hydrogen sulphide)) when critical. It is measured by a specific indicator.

Analysis of the findings shows that eutrophication follows a marked regional pattern. It is principally caused by discharges of bio-available phosphorous by towns, industries and possibly agriculture.

4. Composite index of water quality

The aforementioned tables, diagrams and maps are the basic components of water quality accounts. It is also possible however to compute a composite index of the quality of water in a basin or a cluster of basins.

In compiling the index, it is necessary to take account of the real weight of each quality that enters into it. The use of the *SEQ-eau* now makes possible a more rigorous approach. The water quality classes of the *SEQ-eau* were based on the prior definition of a continuous indicator ranging from 1 to 100. The five classes were obtained by dividing the indicator into equal intervals of 20. The class intervals are thus constant because of the evaluation method itself. An overall “average class” type index was compiled for the quality accounts on the basis of the definition of classes in the SEQ. Each class expresses an equal degree of pollution, irrespective of the type, so that class N3 relating to nitrates is considered as serious as class E3 relating to eutrophication.[7]

Aggregating the data at national level, a single value can be obtained. The average quality values obtained are shown in the following table.

5. It is tempting to conclude that “main rivers” gained 0.3 quality class throughout the country between 1992 and 1994. However, this approach requires a prior theoretical discussion, presented in a later section.
6. Quality is measured on a scale which goes from N1 to N5. This indicator refers very explicitly to the conformity values for supply water. The limits are consequently 5, 25, 50 and 80 mg NO_3^{-1}. These values are very excessive for rivers, which have a natural concentration of about one mg NO_3^{-1}. Hence, apparently satisfactory water quality may be reported.
7. For practical reasons, the designations of the quality grades (1A, etc. for oxidizable matter, N1, N2 etc. for nitrates, E1, E2, etc. for eutrophication,) were replaced by an index of 1 to 5, denoting the range of qualities from best to worse. Obviously, it is possible to calculate the quality index for each level of aggregation (for example, the “main rivers” in X basin), or to aggregate it at national level.

Table 2. **Results of aggregating water quality classes by the simplified method**

Indicator	Size class of water-courses				
	Main rivers	Large tributaries	Rivers	Brooks	Whole
Organic matter (1992)	3.32	3.05	2.88	2.68	2.98
Organic matter (1994)	3.06	2.82	2.69	2.75	2.83
Nitrate	2.49	2.30	2.35	2.44	2.39
Plant blooms	2.75	2.53	2.43	2.39	2.53

Note: The "total" column is not the average of the other columns but is weighted according to the kmcn of each size class of river.

A composite quality index broken down by group of river and type of pollution makes it possible to compare one indicator with another, and the difference in quality. It is thus an extremely useful evaluation tool. We see, for example, that in 1992 the quality of large tributaries with respect to nitrate content was *on average one class better* than the quality with respect to organic matter of main rivers.

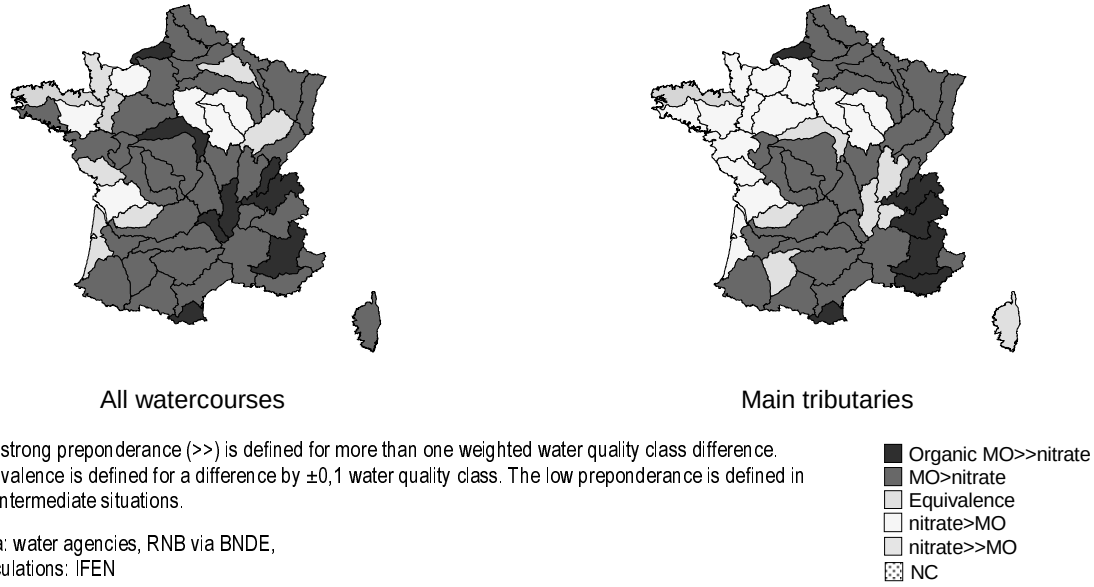
Figure 2. **Geographical distribution of eutrophication and organic matter,** 1994

Note: The strong preponderance (>>) is defined for more than one weighted water quality class difference. Equivalence is defined for a difference by ±0,1 water quality class. The low preponderance is defined in the intermediate situations.

Source : Data: water agencies, RNB via BNDE, Calculations: IFEN

The figure shows clearly that a variety of policies are needed for controlling organic matter pollution and eutrophication, but less so for nitrate pollution, which is more localised geographically.

Figure 3. **Geographical distribution of nitrate and organic matter,** 1994



III. COMPARISON OF POLLUTION LEVELS

Comparison of the differences in the values of average quality classes makes it possible to compare rapidly the basins in which the deterioration in quality is most marked, for a given river. The following two maps compare organic matter pollution, taken as the benchmark, and eutrophication and nitrate pollution, in different regions. In order to bring out the diversity of situations, one map shows the aggregated incidence of pollution for all size classes of river, and the other the class of river in which the deterioration is preponderant in the largest number of basins.

IV. CONCLUSIONS

1. Validity of the findings

The results of the pilot study carried out with the simplified method are very promising, mainly due to the use of a conversion unit, the kmcn, derived from theoretical and practical considerations regarding the comparability of rivers.

When the simplified method was applied to other kinds of data for which it was not intended, the results tallied with the findings obtained by other means. It can thus be considered a means of adding value, by making it possible to compare successive states of quality with the same parameters, and to rank the causes of water pollution.

2. Informing the public and decision-makers

Indices aggregated at different levels, with a unit of measurement that remains the same throughout methodological improvements, are very useful to the public and decision-makers.

The mass of chemical, biological, hydrological and other data**,** even when translated into qualities classes for specific points or stretches of river, is not readily intelligible and usable by the public and decision-makers, as summed up by the aphorism “data rich, information poor”. To make a simple comparison, price indices (consumer, construction, etc.) aggregated at national level or broken by down by region provide relevant information that enables everybody to know whether prices are rising or not.

The same goes for water resources. The aggregated indicator described here provides a similar kind of information about water quality as a price index provide about the economy. For example, it make is possible immediately two maps of water quality at specific points or on linear stretches of river and to visualise whether the pollution is caused by nitrate or organic matter and whether it affects primarily main rivers or streams.

Resources accounts are similar: they highlight pressures on resources, availability, etc.

3. Proposed improvements

Given the value of the findings that were obtained, the simplified method should be improved so that its possibilities can be exploited to the full. Being very simple, it can be used whenever the data available are limited. The most important improvement would be to choose the most relevant hydrological base to calculate the value of the kmcn. In the example given, the inter-annual module) was used. The current approach first considers the module of the quality reference year, which could significantly affect the results, and then takes the flow references which are closest to those observed during the most critical periods for the quality of water.

Similar issues are being evaluated with regard to the development of resource accounts with the simplified method, since the pressures on resources in a country fairly well endowed with water like France occur only during periods of high demand and low resources. It is thus necessary to take into account both seasonal factors (that that are main determinants of demand), and the combination of seasonal and annual factors that determine resource availability.

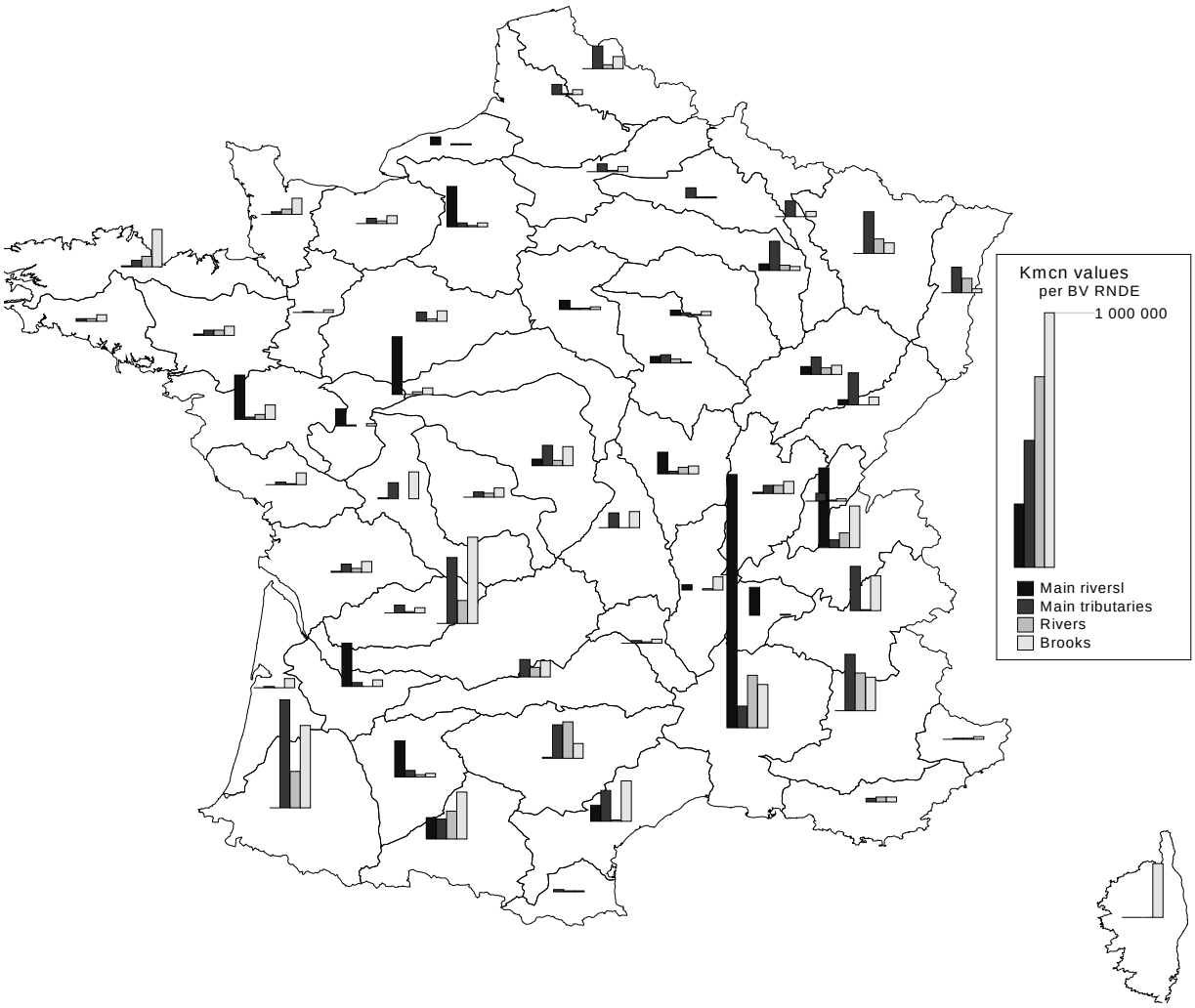
ANNEX. TABLES AND FIGURES

Table 1. **Connections between the accounts and the methodological stages**

Methodology	Summary table		Central account	External
Simplified	Quality : Non-localised linear maps Flow : by size class of river, statistics for a class		National level: feasible. Level of RNDE catchment area : impossible.	Emissions, LB pilot project
Semi-simplified	Quality : Linear maps, with localisation. Flow : database of resource accounts, modelled.		*Level of RNDE catchment area : feasible, depending on quality data / causes of changes.* *Simplified pilot project feasible*	
Complete	*Quality : representative networks (EUROWATERNET) with partial localisation.* *Flow :modelled, data base of resource accounts,.*	**Quality**	*Level of RNDE catchment area : ditto* *National prototype feasible*	*Emissions national prototype* *Representative quality network*
Simplified	Flow reference values(Cf. quality simplified method), but at point of outlet. Ground water : calculated pluriannually Uses : statistics per type of use, average over a period.		*National level : feasible..* *Level of RNDE catchment area : impossible.* *Simplified national pilot project feasible*	
Semi-simplified	*Flow : modelled on main hydrographical network* *Ground water : calculated pluri-annually* *Uses : per year, changes taken into acount.*	**Resource**	*Level of RNDE catchment area : possible, depending on data on water use* *National prototype possible*	*RNDE, withdrawals and water uses*
Complete	*Flows :modelled on main hydrographical network.* *Ground water : patrimonial monitoring networks taken into account.* *Uses :per year, changes taken into account.*		*Ditto*	*RNDE ground water*

Note : In grey, completed or in the course of completion. In normal letters, actions feasible in the next stage. In italics, actions feasible only in the medium term because they depend on data sources available in the short term.
The grey arrows indicate contributions between levels or from outside.
The black arrows indicate connections which can be made immediately, in grey those which are possible only later.

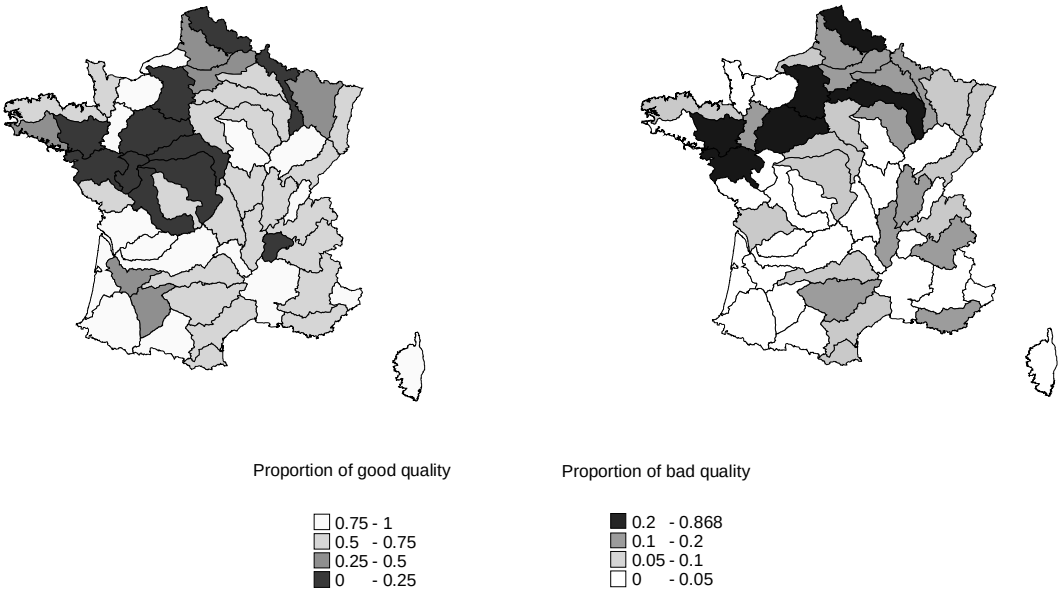
Figure 1. **Distribution of kmcn[8] values in 55 major catchment areas of Metropolitan France**



Source : National Water Data Network (RNDE)[9] data, average interannual flows calculate using the simplified method, IFEN calculations.

8. The Kmcn (standardised kilometre) is a conversion unit which represents a river 1 km long with a flow of 1 m3/s, or 0.5 km with a flow of 2 m3/s.
9. The IFEN developed under the RNDE a breakdown of metropolitan France into 55 major catchment areas based on a hydrographical coding system. These "RNDE catchment areas" are the basis on which national surface water statistics are compiled. The European Environment Agency (EEA) has also suggested applying this concept at European level. Each RNDE catchment area is characterised by a four-digit code, the first two digits denoting the Water Agency (of which there are six) to which it belongs. Each area ranges between 6 000 and 13 000 km2.

Figure 2. **Proportion of good and bad quality river water in each RNDE catchment area,** 1994



Note: Water quality is measure by oxidisable matter content. It can be seen that some basins have only a few kmcn of good quality water and a lot of bad quality, the sign of general bad quality (downstream Seine, Loire and Sarthe, Nord, etc.), while others on the contrary (Charente, upstream Seine, Mediterranean coastal rivers, etc.) are characterised by limited areas of bad quality water, shown in the dark colour on the right-hand map, and in light colour on the left-hand map.

Source : RNB data via BNDE, IFEN calculations

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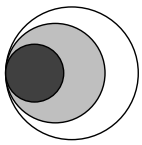
ACCOUNTING FRAMEWORKS

THE EXPERIENCE OF MEXICO*



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IV. THE ECOLOGICAL NET DOMESTIC PRODUCT (ENDP) 97

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I. INTRODUCTION

The System of National Accounts (SNA) presents an accountable integrated structure that brings together a wide network of concepts in a coherent manner. It constitutes an analytic scheme with multiple uses that provides a description of the economic process and of the productive structure, as well as of its evolution through time.

The systematic and periodical integration of the national accounts has allowed countries to know the behaviour of major macroeconomic aggregates such as production, consumption, investment, and income, among others.

The development achieved by the System of National Accounts of Mexico (SNAM) has been a basic factor in bringing our country up to date within the environmental accounting field. It has given continuity to the research to generate annual results for the Net Domestic Product (NDP).

In this section the conceptual and methodological framework used in the development of the System of the Economic and Ecological Accounts of Mexico (SEEAM) is described. The exhibit follows a sequential order and is illustrated by equations; additionally, it incorporates the mentioned identities within a table (Basis Structure), allowing a major economic-environmental scheme to be understood in an integrated manner.

From the basic identities of the traditional macroeconomic accounting, the items corresponding to the broader coverage of the assets are introduced successively, including the natural resources and the environment. Different types of assets are also defined and classified, regarding their corresponding balances and flows. This new coverage is expressed by means of balances that include the produced assets and the non-produced assets. On the other hand, on the expenditure side, a new concept of net accumulation is shown, based on net values of economic and environmental assets.

The valuation methods applied to estimate the natural resources depletion and the environmental degradation costs are explained in a general manner. The derivation of the Environmental Net Domestic Product (ENDP) by means of two methods is shown: that of the production method and the expense method. This constitutes the integrated economic-environmental framework of the System of Economic and Environmental Accounts of Mexico (SEEAM).

II. MACROECONOMIC VARIABLES

In traditional economic accounting, production, the consumption and accumulation can be presented in a synthesised way by means of the basic identities described as follows: the first one of them connects the total supply with the total use of goods and services from the economy:

$$P + M = CI + C + I + X \qquad (1)$$

This means: Total supply = Total use

Where:

P	= Total Gross Production
M	= Imports
CI	= Intermediate Consumption
C	= Final Consumption
I	= Gross Capital Formation or Investment
X	= Exports

Identity (1) links the total value of domestic production to imports; this is equivalent to the goods and services supply, with its destiny at the intermediate consumption, final consumption, investment and exports.

A second identity expresses that the Gross Domestic Product (GDP) is equal to the difference between the production and the goods and services consumption used to their transformation, this means:

$$GDP = P - CI \qquad (2)$$

Substituting equation (1) for (2) a third identity is obtained that links GDP to final consumption expenses of households and the government, investment, foreign sales and imports, which expression is:

$$GDP = C + I + (X - M) \qquad (3)$$

On the other hand, the economic process is supported by a set of assets called capital goods (machinery, equipment, installations, etc.), which, as a consequence of their use, depreciate, but their availability can also increase or diminish.

Thus, the modification of assets reflects both the addition of the new capital goods, known as gross capital formation (GCF), and the consumption of fixed capital (CFC) that corresponds to the depreciation of the capital goods used, and that is closely related to the concept of depreciation in management accounting.

The above named elements enable the explanation of the balance of the economic assets that are expressed in the next equation:

$$K_{ep_{t+1}} = K_{ep_t} + I_t - \delta K_{ep_t} + R_{kep_t} \qquad (4)$$

Where[1] :

$K_{ep_{t+1}}$	= Total Capital at the end of the t period
K_{ep_t}	= Total Capital at the beginning of the t period
I_t	= Gross Capital Formation from the t period
δ	= Depreciation Rate
R_{kep_t}	*= Revaluation of Produced Economic Assets*

From equation (4) two concepts are identified about Gross Capital Formation or Investment:

Gross investment (I_t) is the total of capital goods that are added to the economy within a determined period.

Net investment (In) corresponds to the change at in total capital and it is similar to gross investment minus depreciation:

$$In_t = I_t - \delta K_{ep_t} \qquad (5)$$

1. R_{kep} component represents the revaluation of the Produced Economic Assets, and it was added with the purpose of complementing the equation of the Economic Assets closing.

In a corresponding way, there are two concepts of production:

- GDP is the sum of the monetary values of produced goods and services during a period that generally is one year.
- Net Domestic Product (NDP) is GDP minus depreciation:

If net investment is incorporated in equation (3), the NDP expression is obtained from the expenditure side:

$$NDP = C + In + (X - M) \quad (7)$$

Using equation (7), it is also possible to set the next ratio:

$$NDP = GDP - \delta K_{ep_t} = C + In + (X - M) \quad (8)$$

Besides constituting an important macroeconomic indicator of the effort carried out in the economy, taking into account the depreciation from fixed assets, the NDP is the variable which is adjusted for changes in the natural resources and the environment, in order to obtain the Ecological Net Domestic Product (ENDP).

III. ASSETS: ENLARGEMENT OF THE CONCEPT

1. Assets

One very relevant aspect of analysis and policy making is the incorporation of natural resources and environment into the System of National Accounts.

This innovation in the treatment of the natural resources and the environment requires enlarging the border of the assets in the traditional system of economic accounting, as follows:

Table 1. **Assets clarification**

Assets	Economic	Produced	Installations, machinery and equipments
		Non-produced	Oil, natural resources in general
	Environmental	Non-produced	Air, water and soil

The Produced Economic Assets (K_{ep}) are assets arising from the processes included within the border of SNA production. They are relevant to construction, machinery and equipment, as well as cattle breeding, improvements of land, etc. These assets are elaborated under control and responsibility of an institutional unity, and they are capital goods used to obtain a product, under the form of other goods and services.

The Non-Produced Economic Assets (K_{enp}), for their part, are used in the production, but they are not from any productive process; they include natural origin assets like soil, forests and mineral deposits, among others.

Finally, the Environmental Assets (K_{anp}) are those of natural origin affected by economic activity. They possess such characteristics that it is not possible to establish some of their properties; for example, the air and the oceans.

Under this denomination, not only those assets whose existence is unknown are included (for example, mineral deposits that are not yet discovered), but also those (for example, forests) that are not exploited, which people know exist, but which are remote and inaccessible –according to the current technology. In practice, these are not under the effective control of an institutional unit[2].

In order to link the economic aggregates to the natural resources and the environment, it is necessary to assign to the latter the non-produced asset class. With this fact, the traditional concept of asset is redefined in recognition that natural resources and the environment interact with economic activity, increasing or decreasing their present and future capacity or growth and changing their quality. In this way, they are no longer considered as free goods of unlimited supply, but instead as scarce goods.

In this context, the enlargement of the coverage of assets (K_t), can be expressed as follows:

$$K_t = K_{ep_t} + K_{enp_t} + K_{anp_t} \qquad (9)$$

Where:

K_t = Total of Assets

K_{ep_t} = Produced Economic Assets

K_{enp_t} = Non-Produced Economic Assets

K_{anp_t} = Non-Produced Environmental Assets

To assign the asset class to natural resources and the environment, their treatment within the economic-environmental accounting is similar to that of the produced economic assets. Natural resources and the environment are assigned asset classes within the economic environment accounting framework in a similar way to that of the produced economic assets. There is a necessity to assign a monetary value to resources in order to calculate the depletetion and degradation costs, with the purpose of integrating them into the rest of the monetary flows from the economy, and generating the ENDP.

2. The Non-Produced Assets Balances

The method to obtain the balance of the non-produced economic assets is similar to that used for the balance of the produced economic assets. This means, estimating the changes produced –positives and/or negatives- between the initial asset (Opening Balance) and the availability at the end of the period (Closing Balance).

The integration of the balances into the non-produced assets depends on the quantification of the resources. This means, that their total availability must be known, as well as their recorded changes, both as a result of human activity and/or through the natural phenomena action (earthquakes, floods, fires, among others).

However, there are some resources for which it is not possible to identify total availability; for example, in the case of air and surface water, we can know only the damage or deterioration that they suffer, i.e. changes in quality.

2. See, SCN 1993, Chapters. X: “La Cuenta de Capital” and XII: “Cuentas de Otras Variaciones de Activos”

According to the above, the algebraic expression from the total balance that includes the produced and the non-produced assets is:

$$K_{t+1} = K_t + (I_t - \delta K_{ep_t}) - (AG_{Kenp_t} + AG_{Kanp_t} + DG_{Kanp_t}) + \ldots$$
$$\ldots + (\Delta I_{Kenp_t} + \Delta I_{Kanp_t}) + R_{Kep_t} + R_{Kenp_t} + R_{Kanp_t}) \quad (10)$$

Where:

K_{t+1} = Total Assets at the end of the period t

K_t = Total Assets at the beginning of the period t

AG_{Kenp_t} = Depletion of the Non-Produced Economic Assets

AG_{Kanp_t} = Depletion of the Non-Produced Environmental Assets

DG_{Kanp_t} = Degradation of the Non-Produced Environmental Assets

ΔI_{Kenp_t} = Changes in the Non-Produced Economic Assets

ΔI_{Kanp_t} = Changes in the Non-Produced Environmental Assets

R_{Kep_t} = Revaluation of the Produced Economic Assets

R_{Kenp_t} = Revaluation of the Non-Produced Economic Assets

R_{Kanp_t} = Revaluation of the Non-Produced Environmental Assets

In this identity the changes recorded by the non-produced assets as a consequence of the depletion of the natural resources and the degradation of the environment are explicit. The changes of the non-produced economic assets are also explicit because of the increase or decrease of the environmental assets, which are considered an element next to the Gross Capital Formation. It is shown that natural resources become non-produced economic assets and vice versa.

3. Economic and Environmental Assets Accumulation

The variables related to the natural resources and the environment, presented at equation (10), allow us to identify both assets changes, and the enlargement of the accumulation concept. Traditionally, this concept refers to the change within produced economic assets due to the incorporation of new capital goods (Gross Capital Formation), which, at the moment of are related to the wear and tear arising from the productive process, (depreciation). This leads to the net accumulation of the produced economic assets.

Net accumulation now includes two additional elements corresponding to the balance of the non-produced economic assets. The first element is referred to as an element that represents investments in the non-produced economic assets (ΔI_{kenp}), which results from the transference from the environmental assets to economic activities. An example is in the transfer of soil and mineral reserves to economic use. The second element represents the exhaustion of the non-produced economic assets (AG_{kenp}). An example is the use of natural resources such as oil reserves that cannot be replaced.

That is why changes within produced assets, and also modifications recorded by the non-produced economic assets are grouped within the net accumulation of economic assets concept (A_{ke}).

This is expressed as follows:

$$A_{Ke_t} = In_t - (\Delta I_{Kenp_t} + AG_{Kenp_t}) \quad (11)$$

Another enlargement of the net accumulation concept is that which refers to the environmental assets. This corresponds to natural resources that are affected by the productive process, even though they are not part of it. The enlargement refers to an additional concept called the net accumulation of environmental assets (A_{Kanp}), which represents the changes or affects on the quality and quantity of the environmental assets resulting from economic activity. This can be represented at the next equation:

$$A_{Kanp_t} = \Delta I_{Kanp_t} - (AG_{Kanp_t} + DG_{Kanp_t}) \quad (12)$$

4. Non-Produced Assets Valuation

The methods most often used to assign a value to the non-produced assets are: “Net Rent”, “Use Cost” also known as “Allowance for Depletion” and “Maintenance Cost”. The first two were applied alternatively to the depletion concerns and the third, to degradation. Each of them are described below:

4.1 Net Rent Method

This values the units extracted on the basis of the difference between production or incomes (market values) and total expenses –including labour force costs and a normal margin of profit- made to exploit the natural resource throughout its useful life. That is to say, the current value of expected net incomes is calculated. The result is interpreted as the cost required to keep the natural resource in such a condition that it continues generating incomes.

This method, by Roberto Repetto, has been applied in a lot of surveys carried out by the World Resource Institute (WRI), mainly to estimate the value of those resources that could be exhausted, such as forest areas and mineral deposits, among others.

4.2 Use Cost Method

This values the resource on the basis of the depletion cost of it, calculated as a part of the current value of the expected net income in the useful life of the resource, on condition that this part must be re-invested in order to obtain a permanent income in the future.

This method has been developed by Salah El Serafy, from the Hicksian notion of the income and it has had a wide application in surveys of different countries supported by the World Bank (WB).

4.3 Maintenance Cost

This procedure takes into account the possible costs of avoiding the deterioration or restoring the quality of the resource, according to the quality standards considered as acceptable. This method assumes many alternatives to their choice.

In abstract, the new assets coverage and their balances, the net accumulation concept, as well as the incorporation of the environmental costs (by depletion and degradation), are the elements that allow the enlargement of the scheme of the traditional macroeconomic accounting towards an Integrated System of Economic and Ecological Accounts.

5. Basic Structure of the System of Environmental and Economic Accounts of Mexico

The conceptual framework on which environmental adjustments to the traditional concepts from the SNAM: NDP and GCF, for the determination of the ENDP and of the enlarged concept of accumulation, respectively, are presented in the next "Basic Structure" table. Equations 1 to 10 are included in this table.

Table 2. **System of environmental and economic accounts**

Concept		Economic activities					Environment
		Economic Assets					
		Production	Rest of the World	Final Consumption	Produced Assets	Non Produced Assets	Non Produced Environmental Assets
OPENING ASSETS					Kept	Kenpt	Kanpt
		(1)	(2)	(3)	(4)	(5)	(6)
Economic supply	(1)	P	M				
Economic uses	(2)	Ci	X	C	I		
Gross deomestic product	(3)	GDP	(X-M)	C	I		
Depreciation	(4)	D			D		
Net domestic product	(5)	NDP	(X-M)	C	In		
Environmental uses							
Depletion and use of the land	(6)	Cag				Δ^{I}Kenp (AGkenp)	Δ^{I}Kanp (AGkanp)
Net dom. Prod., Aj. Environmental: ENDP	(7)	ENDP1	(X-M)	C	Ake1		Akanp1
Environmental degradation	(8)	Cdg	(X-M)				(Dgkanp)
Net dom. Prod., Aj. Environmental: ENDP	(9)	ENDP2		C	Ake2=Ake1		(Akanp2)
Revaluation	(10)				Rkep		RkanRkenpp
CLOSING ASSETS	**(11)**				Kept+1	Kenpt+1	Kanpt+1

Two columns (5 and 6) are included in the table to incorporate the non-produced assets balances.

Column (5) includes the non-produced assets used directly in economic activities (such as: agriculture, livestock, forestry, extraction of crude oil and natural gas, construction, electricity, gas and water, transport and services, among others). This group, together with produced assets from equation (4) column, are economic assets and they are used as production factors.

The environmental assets, presented within column (6), refer to natural resources and the environment. These assets are only affected by economic activities and are not part of the productive process.

In the case of Mexico, the oil proven reserves and the use of soil, by farming and livestock activities, as well as by the city growth, were treated as non-produced economic assets. Air, soil (erosion) and all forests are considered as environmental assets.

Column (1) shows, from Production, the variables for the determination of NDP, together with the items of environmental uses adjustment (depletion costs and degradation costs) that enable to determine the ENDP. Within line (9), ENDP components by the expense side are presented.

IV. THE ECOLOGICAL NET DOMESTIC PRODUCT (ENDP)

The System of National Accounts of Mexico (SNAM) is a conceptual framework that has a set of definitions, technical norms and methods to quantify the economic factors. Aggregates can be determined within the SNAM. The SNAM also includes internal connections throughout the accounts, standardised tables and algebraical expressions. This enables estimates of one variable to be made using more than one procedure. This allows consistency checks to be made.

The System of Economic and Ecological Accounting of Mexico (SEEAM), at the time of incorporating the natural resources and the environment into the economic field follows the same logic as the SNAM.

In this way, as we can obtain GDP by the production method (equation 2) and by the expense method (equation 3), it is also possible to determine the ENDP from both methods.

Using the first method, from the NDP, and taking into account the natural resources depletion and the environmental deterioration, the ENDP is determined as follows:

$$ENDP = NDP - (Cag + Cdg) \qquad (13)$$

Where:

Cag = Costs for exhaustion of the natural resources

Exhaustion costs, are the monetary estimates that show the natural resources wear and tear or loss (equivalents to depreciation), as a consequence of their use within the productive process.

Degradation costs are the monetary estimates required to restore the environmental deterioration caused by the economic activities. For instance, the environmental cost of the water is related to the monetary amount required to avoid and/or diminish its pollution.

In equation (13), it is considered that in the productive process there are exhaustion (Cag) and degradation (Cdg) costs that reduce the NDP level (taking again the logic and similarity that depreciation has at the moment to diminish the GDP).

In the second method, the ENDP is obtained with expense variables, taking into account the net accumulation from the produced and non-produced economic assets (equations 11 and 12). The corresponding identity is:

$$ENDP = C + (A_{Ke_t} + A_{Kanp_t}) + (X - M) \qquad (14)$$

As a special case, we have to mention the expenses carried out by the economical agents in natural resources and environment profit. These expenses were called within the SEEAM “environmental protection services”. As these expenses are still included within the SNAM, in the SEEAM they were identified and assigned by economic activity, for the purpose of comparative analysis.

On the basis of the conceptual frame, described above, an investigation into Mexico’s case was carried out, by means of quantification of the balances and/or flows in physical units and, later on, in monetary units. The survey was limited, in the depletion case, to: oil, forest resources (timber-yielding), and soil use changes, as well as hydric resources (subsoil water): concerning degradation, the survey touched upon: soil erosion and the pollution of water, air and soil. The impact that the productive activity has on them was considered here.

The development of the investigation required the gathering and processing of a great deal of information, from the point of view of the production, estimating the costs for depletion and degradation; and also the expense, determining the non-produced assets and the investments.

In a similar manner, it is important to mention that for many of the studied themes more than one of the valuation methods were applied, with the purpose of confronting and analysing the results arising from each of them. This permitted us to choose the one that expressed in the best way the environmental costs and the components of the balances.

In the oil survey, the depletion of deposit costs were estimated on the basis of the "Net Rent" method; on the assets side, the impact of the production and the new findings of oil were considered, with the logical reduction of the environmental assets.

For forest resources and use of soil the survey included the sale of timber-yielding forests, as a part of forest activity; the reduction in forest areas, due to their destination, to other economical uses, and the loss of trees resulting from soil change. In this context, soil is considered as a part of the environment, and as a non-produced economic asset. In this case, by means of the "Rent Net" method, the resources were evaluated and the depletion costs were estimated, as well as the elements of the balances.

Soil erosion and water and air pollution are environmental items, whose value reflects changes in their environmental quality (i.e. degradation). They are not easily quantified. Their estimation is based on analysis of the expenses done to avoid and/or re-establish their deterioration: the maintenance cost method.

Soil erosion, valuation was based on the costs of fertilisation required to maintain the soil productivity. Regarding the exhaustion of the subsoil water, it was assumed that the environmental cost is equivalent to the cost of restoring the water level to the phreatic mantles.

In its turn, the costs generated because of water, air and soil pollution were estimated, taking into account the possible future expenditures to reduce or eliminate such pollution, according to certain known quality standards.

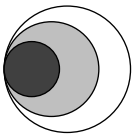
In this way, the ENDP, adjusted throughout the production method, includes the corresponding effects of oil depletion, subsoil water and deforestation, that are the quantitative impacts on resources, and reflect the air, water and soil deterioration.

Through the expense method, the adjustments to the NDP for environmental reasons, come from the net accumulation of economic assets that includes the changes of non-produced economic assets (additions and diminutions that present oil and forest resources as an effect from the modification of soil uses); in a similar manner, the net accumulation of the environmental assets is included that reflects both the timber-yielding forests depletion and the air, water and soil degradation.

PART B.
ENVIRONMENTAL PERFORMANCE INDICATORS

ENVIRONMENTAL PERFORMANCE INDICATORS

OECD OVERVIEW



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EXECUTIVE SUMMARY

Domestic and international environmental commitments range widely. The question of environmental performance - in other words, how far these commitments are actually met - is central to the environmental credibility of governments in the eyes of public opinion, other governments, and the international community. The review of trends, policies and country performances, as well as the use of peer pressure to improve them, is a basic OECD function.

Each OECD environmental performance review establishes the facts, uses environmental indicators and addresses recommendations to the reviewed country. Reviewing environmental performance helps governments evaluate and improve their individual and collective performance in environmental management and sustainable development. It promotes policy dialogue among member countries and accountability by governments towards public opinion and other countries.

Important lessons can be drawn from the collective experience of OECD countries in addressing environmental issues over the past 10 years, in particular in using OECD environmental indicators and performance reviews. From this experience it has been possible to designate a short list of core indicators that have proven their usefulness and that are available for most OECD countries. This responds to the increasing interest by Member countries in a reduced number of indicators selected from existing larger sets to capture key trends and draw attention to key issues of common concern. It is recognised that this list of core indicators needs to be adapted to specific country contexts and policy uses, and that the interpretation of the indicators in context is essential.

CORE LIST OF OECD ENVIRONMENTAL PERFORMANCE INDICATORS

POLLUTION ISSUES	
Climate Change	◆ CO2 emission intensities
Ozone Layer Depletion	◆ Ozone depleting substances
Air Quality	◆ Air emission intensities
Waste	◆ Waste generation intensities
Water Quality	◆ Waste water treatment connection rate
RESOURCE ISSUES	
Water Resources	◆ Intensity of use of water resources
Forest Resources	◆ Intensity of use of forest resources
Land Resources	◆ Changes in land use and in key ecosystems
Energy Resources	◆ Intensity of use of energy resources
Mineral Resources	◆ Intensity of use of mineral resources
Biodiversity	◆ Protected areas

The OECD is now developing social-environment indicators to complement its sets of economic-environment indicators. This work has been undertaken in recognition that sustainable development has three dimensions - economic, environmental, and social - and that, to date, insufficient attention has been dedicated to the social aspect of sustainable development. The last section of this paper briefly explores some social aspects of sustainable development.

I. INTRODUCTION

This paper reviews the development and use of indicators for measuring environmental progress. It builds on work carried out by the Organisation for Economic Co-operation and Development (OECD) since the 1980s on economy-environment relationships and related indicators, and draws on OECD's accumulated experience in using indicators in country reviews of environmental performance. It describes the policy context and demand for environmental performance assessment; presents the indicator framework and their use in OECD's policy work, and identifies a "core list" of environmental performance indicators. The final section seeks to spark a discussion among conference participants regarding indicators to describe the "social environment" interface of sustainable development.

II. POLICY CONTEXT

Domestic and international environmental issues have come, in the late 1980s and early 1990s, to the forefront of the political agenda, receiving high priority in the attention of the public, governments and enterprises in OECD countries and beyond. This has led to an unprecedented range of domestic and international environmental commitments. The environmental performance question, i.e. the question of the actual fulfilment of these commitments, was and is central to the environmental credibility of governments vis-à-vis their own public opinion, other governments, and the international community. This question is even more pressing now because environmental policies have to be implemented under domestic and international conditions often characterised by short term time horizons, underpricing of natural resources, concerns over budgets and cumulated public deficits, and structural economic changes, as well as increased globalisation and international economic interdependencies.

There is also increasing interest in greater accountability and in evaluating how well governments are doing in their efforts to implement their domestic environmental policies and international commitments. In this context, environmental indicators are seen as necessary tools for helping to chart and track the course towards a sustainable future.

Environmental performance analysis has been organised around three strategic orientations:

- the cost-effectiveness of environmental policies for reducing the overall pollution burden and ensuring sustainable use and management of natural resources; here environmental management is related to a country's absolute environmental quality; environmental performance is measured with respect to a country's objectives in air, water and waste management, nature conservation and natural resource management;
- the integration of environmental considerations into all other policies; here environmental management is related to a country's overall decision-making process; environmental performance is measured with respect to a country's capacity to take account of environmental considerations in economic, social and sectoral decision making, to avoid unsustainable patterns of development and to achieve efficiently related objectives;
- the effectiveness of co-operation with the international community; here environmental management is related to a country's relations with its neighbours and the international community; environmental performance is measured with respect to bilateral, regional and multilateral commitments.

OECD's experience shows that improved assessment and policy planning will require better databases, broader use of environmental impact assessment to deal with programmes and policies, and evaluation of cost-effectiveness and cost-benefit comparison.

Tracking progress through development of environmental data and indicators has already proven its value. The availability of meaningful environmental indicators and well-synthesised information contributes to a better democratic debate, and to better accountability of public authorities and the various actors. In the future, indicators will even be more necessary to gauge the results obtained by implementing environmental policies, to identify shortcomings that may arise at all government levels, and to provide the basis for sound economic and environmental decision making at national and international levels.

III. OECD WORK ON ENVIRONMENTAL PERFORMANCE INDICATORS

1. Background and mandate

The environmental policies adopted by OECD countries over the past 30 years have shown a steady evolution. This evolution has shaped related reporting activities at national and OECD level. Indicators have been part of OECD's work on environmental information and reporting since the late 1970s, and some were already published in the 1985 State of the environment report. A specific programme on environmental indicators using a harmonised approach was initiated in 1989 following requests from Member countries' governments; several G-7 summits and from the international community. It was then further refined to respond to the needs of the OECD programme on environmental performance (EPR)[1] In 1998, the OECD Council Recommendation on Environmental Information reinforced this request and asked OECD countries to further develop and use indicators to measure environmental performance, and to establish indicators of progress concerning the implementation of national and sub-national policies on the environment, eco-efficiency and sustainable development.

The OECD environmental indicators programme recognises that there is no universal set of indicators; rather, several sets exist, corresponding to specific purposes. Indicators can be used at international and national levels in state of the environment reporting, measurement of environmental performance and reporting on progress towards sustainable development. They can further be used at national level in planning, clarifying policy objectives and setting priorities. The OECD work focuses principally on indicators to be used in national, international and global decision making, yet the approach may also be used to develop indicators at sub-national level.

2. Results to date

Work on international environmental indicators has been carried out in close co-operation with OECD member countries and has led to:

- agreement on a common conceptual framework, based on a common understanding of concepts and definitions and on the pressure-state-response (PSR) model;
- identification of criteria to help in selecting indicators and validating their choice (Inset 1);

1. In 1991, the OECD Council Recommendation on Environmental Indicators and Information called for further development of reliable, readable, measurable and policy-relevant environmental indicators to better measure environmental performance and better integrate environmental concerns into sectoral policies.

- identification, definition, measurement, publication and use of the indicators;
- provision of guidance on how to use the indicators (stressing that indicators are only one tool and have to be interpreted in context).

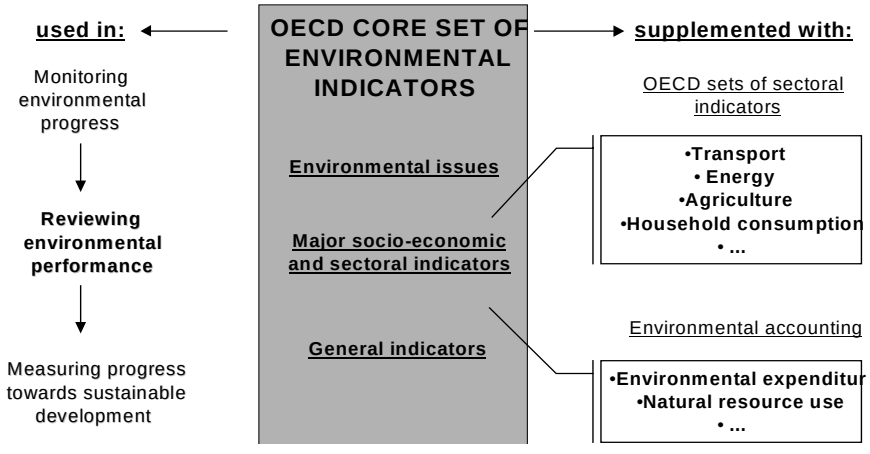
The results of this work, and in particular its conceptual framework, have in turn influenced similar activities by a number of countries and other international organisations.

Inset 1. **Criteria For Selecting Environmental Indicators**

POLICY RELEVANCE AND USEFULNESS FOR THE USER	An environmental indicator should: ♦ provide a representative picture of environmental conditions, pressures or society's responses; ♦ be simple, easy to interpret and able to show trends over time; ♦ be responsive to changes in the environment and related human activities; ♦ provide a basis for international comparisons; ♦ be either national in scope or applicable to regional issues of national significance; ♦ have a threshold or reference value against which to compare it, so that users are able to assess the significance of the values associated with it.
ANALYTICAL SOUNDNESS	An environmental indicator should: ♦ be theoretically well founded in technical and scientific terms; ♦ be based on international standards and international consensus about its validity; ♦ lend itself to being linked to economic models, forecasting and information systems.
MEASURABILITY	The data required to support the indicator should be: ♦ readily available or made available at a reasonable cost/benefit ratio; ♦ adequately documented and of known quality; ♦ updated at regular intervals in accordance with reliable procedures.

Extract from "Environmental indicators for environmental performance reviews", OECD, 1993.
N.B.: These criteria describe the "ideal" indicator and not all of them will be met in practice.

Three categories of indicators have been developed, each corresponding to a specific purpose and framework. These are the OECD Core Set of environmental indicators, to keep track of environmental progress and several sets of sectoral indicators, to promote integration of environmental concerns into sectoral policy making. Indicators derived from environmental accounting promote both integration of environmental concerns into economic policies and sustainable use and management of natural resources.



All these indicator sets are closely related to each other, the OECD Core Set being a synthesis and representing a minimum set of indicators common to OECD countries and to different uses and purposes. They are regularly used in OECD country environmental performance reviews and provide important building blocks for sustainable development indicators.

3. The OECD Core Set of environmental indicators

A major source for environmental performance indicators is the OECD Core Set of environmental indicators which is essentially linked to the monitoring of environmental conditions and trends, and the factors having a bearing on them. It includes about 50 indicators, which cover a broad range of environmental issues and economic data to track pressures on the environment and responses by governments, industry and households. It is based on environmental data collected regularly by the OECD Secretariat from national authorities and harmonised among countries.

3.1 Framework and structure

The conceptual framework adopted for the Core set of environmental indicators comprises two dimensions: First, it uses the Pressure-State-Response model which provides a first classification of indicators into indicators of environmental pressures, indicators of environmental conditions and indicators of societal responses. Second, it distinguishes a number of environmental issues which reflect major environmental preoccupations and challenges in OECD countries. Thus, for each issue, indicators of environmental pressure, conditions and societal responses were defined.

The issues identified relate: i) to the environment's "sink capacity" dealing with aspects of environmental quality (e.g. climate change, acidification, toxic contamination, biodiversity, urban environmental quality, waste); and ii) to the environment's "resource" function, focusing on the quantity aspect of natural resources. Most of these issues are of a horizontal, cross-media nature. They are complemented with a category that reflects general background variables and driving forces, such as population growth, demographic patterns, and economic growth; selected sectoral trends and patterns of environmental significance, as well as economy-wide environmental expenditure and public opinion. This provides an opportunity to include core indicators from sectoral sets in the OECD Core Set.

The list of issues covered is not seen as final nor exhaustive. It may change as scientific knowledge and policy concerns evolve. Furthermore, the issues are of varying relevance for different countries and different contexts. A certain balance is however kept between the need for flexibility and the need for longer term monitoring and analysis.

3.2 Sectoral breakdown

Environmental indicators can further be disaggregated at sectoral level. Data availability permitting, this is one tool for analysing environmental pressures exerted by different economic sectors and for distinguishing government responses from those of the business sector or private households. Indicators at the sectoral level are useful tools to review the integration of environmental and sectoral policies, to monitor resource use and emission intensities in the various economic sectors, and to more effectively assess the efficiency and sustainability of selected policy actions. They also facilitate the link with economic information systems and models.

3.3 Link with other international initiatives

The OECD's work on environmental indicators work has been closely co-ordinated with other international indicator initiatives Continued co-operation has been established in particular with the UNCSD and its work on sustainable development indicators to which the OECD has actively contributed, with UN regional offices, UNEP, the World Bank, The European Union (Commission of the European Communities, Eurostat, EEA) and with a number of international institutes. International co-operation is

essential to achieve synergies, to help identifying commonalities and to clarify the specific purposes of the various initiatives.

4. Use of indicators in country environmental performance reviews

Over the years, the OECD has accumulated practical experience not only in the developing, but also in using environmental indicators in its policy work. Indicators from the OECD Core Set are used as a specific tool for evaluating environmental performance. They support and illustrate the analysis made in OECD Environmental Performance Reviews (conducted since 1992) and provide all reviews with a common denominator. To date, the environmental performances of most OECD countries have been reviewed, and environmental information and indicators have been assembled for all OECD Member countries.

These reviews address the concept of environmental performance by comparing achievements or progress with national objectives, international commitments and taking into account each country's absolute levels of environmental quality and the physical, human and economic context (Inset 2).

The use of indicators in a performance evaluation context implies linking them to objectives or results achieved. To this purpose, three broad groupings of indicators can be distinguished:

- performance indicators linked to explicit quantitative objectives (goals, targets, commitments) (e.g. air emission trends compared with national or international targets, urban air quality compared with national standards);
- performance indicators linked to broad qualitative objectives, generally addressing the concept of performance in two ways: i) with respect to the efficiency of human activities, linked to the notions of decoupling, elasticities, integration (e.g. emissions per unit of GDP, relative trends of waste generation and GDP growth, change in fossil fuel supply); and ii) with respect to the sustainability of natural resource use (e.g. intensity of the use of forest and water resources);

Inset 2. **Appraising environmental performance**

Whether policy objectives and commitments are being met is the essence of appraising environmental performance. Environmental objectives may be more or less explicit and precise; they include: aims at general level (e.g. preserving and improving environmental quality, achieving sustainable development); qualitative goals at the intermediate level (e.g. preserving the ozone layer, reducing acidity); and quantitative and dated targets at a more specific level.

More precisely, performance refers to three main questions relating to the achievement of domestic objectives or the compliance with international commitments:

- To what extent are the objectives achieved? A clear distinction needs to be made between intentions, actions and results, an emphasis on results being central to assessing performance.
- Are the objectives ambitious or modest? In other words, how do these objectives relate to the country-specific context, i.e. to the past and current state of the environment, natural resource endowment, economic structure and development levels, and demographic trends?
- Are the objectives achieved in a durable and cost-effective way?

HIERARCHY OF PERFORMANCE

- intentions
- actions
- results

Building on the answers to these questions, recommendations on how to improve performance in the future can be formulated.

- descriptive indicators not linked to explicit national objectives and close to the concept of State of the Environment (SOE) reporting (e.g. population connected to waste water treatment plants, river quality).

However, it is important to recognise that indicators cannot provide a mechanical measure of environmental performance.

First, indicators provide only one tool for evaluations and need to be supplemented by other qualitative and scientific information in order to avoid misinterpretation. Such information is particularly needed to explain driving forces behind indicator changes which form the basis for an assessment.

Second, indicators must be reported and interpreted in context, taking into account the ecological, geographical, social, economic and structural features of countries. In the OECD environmental performance reviews, international indicators derived from the Core Set are generally used in combination with specific national indicators and data. These national indicators provide a more detailed picture of the country's situation through a greater sectoral and/or geographical breakdown and often point at particular issues of concern.

5. Core indicators

The regular use of performance indicators in OECD's analytical work and environmental performance reviews has not only provided useful feedback on the indicators' policy relevance, but also on the measurability and quality of underlying data sets. Based on this experience, a few core indicators have been identified and are presented here. The list represents a selection of indicators regularly measured and used, and deemed to be most important for monitoring the environmental aspects of sustainability.[2]

Table 1. **Core list of OECD environmental performance indicators**

POLLUTION ISSUES	
Climate Change	◆ CO2 emission intensities
Ozone Layer Depletion	◆ Ozone depleting substances
Air Quality	◆ Air emission intensities
Waste	◆ Waste generation intensities
Water Quality	◆ Waste water treatment connection rate
RESOURCE ISSUES	
Water Resources	◆ Intensity of use of water resources
Forest Resources	◆ Intensity of use of forest resources
Land Resources	◆ Changes in land use and in key ecosystems
Energy Resources	◆ Intensity of use of energy resources
Mineral Resources	◆ Intensity of use of mineral resources
Biodiversity	◆ Protected areas

Most of these indicators stem from the OECD Core Set[3] and are based on data currently available for a majority of OECD countries. They cover both the "outcomes" of environmental progress and the "inputs" (or assets) that support it, and address performance with respect to the efficiency of human activities and to the sustainability of natural resource use.

This list is by no means exhaustive, and although these indicators alone cannot give a complete picture of environmental issues, they are deemed essential for identifying key trends, which deserve further analysis. In this respect, the change in a particular indicator's value over a longer time

2. See Annex for some examples of their use.
3. See Annex for a full list of the OECD Core Set of environmental indicators.

period is often of greater interest than its measured value in a particular year. It is expected that each country will supplement this core list with additional indicators of particular interest, and that over time the list will be expanded with indicators of progress at the social-environment interface.

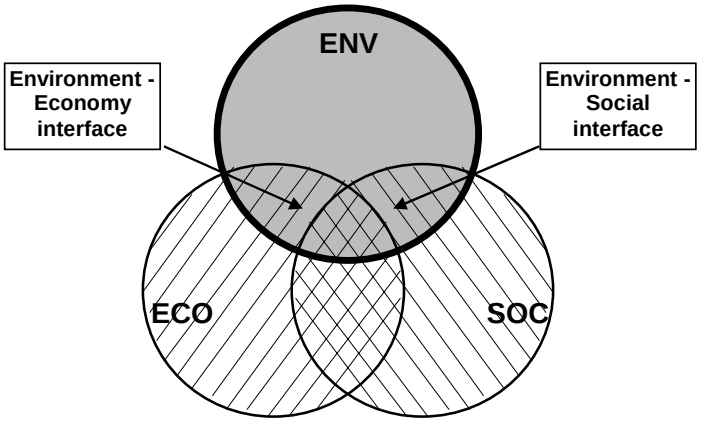
IV. SOCIAL ASPECTS OF ENVIRONMENTALLY SUSTAINABLE DEVELOPMENT

Over the past 10 years, the OECD has played a lead role in the field of environmental indicators mainly due to the very active support of its Member countries. Tracking environmental progress through development of environmental indicators has proven its value. Environmental indicators have gained in importance in most OECD countries, and they are increasingly used in planning, clarifying policy objectives and priorities, budgeting, and assessing policy performance. More recently an expanding array of international indicator activities have been launched.

Achieving sustainable development will involve addressing the three aspects of sustainability -- economic, environmental, and social. Until very recently, OECD work has largely focused on two aspects -- economic and environmental. Significant progress has been made on these fronts, as represented by the various OECD sets of environmental indicators and the core list of indicators presented in this paper. However, it must be noted that additional work is needed to expand and complement the OECD Core Set and to develop social-environment indicators for environmental performance reviews.

Whereas work to develop indicators for the economic/environmental interface can draw upon long standing OECD experience and expertise, this is not the case for the social/environmental indicators, which require more conceptual and analytical work. So far social considerations are partially covered in environmental indicator sets; for example, demographic trends are used as contextual indicators and some human health aspects are covered in relation to air pollution and urban environmental quality.

Figure 1**. The three dimensions of sustainable development and the relevant interfaces for environmental indicators**



Future developments should focus on the effects, positive and negative, of social concerns on environmental protection as well as on the effects of environmental protection measures on social concerns. Six categories of social-environment issues are considered by the OECD for indicator development (Table 2).

OECD experience has demonstrated that indicators are dynamic, changing over time in response to changes in knowledge and data availability. The core list presented in Section 2.3 can therefore continue to evolve in response to the needs of the OECD programme on sustainable development, as well as the programme on environmental performance reviews. For example, economic and policy aspects may be better covered with additional indicators reflecting costs of social and environmental externalities, expenditure for environmental protection, environmental taxation and subsidies. Moreover, as explored briefly in this paper, numerous social issues have important influences on the environmental performance of an economy, and some environmental variables have considerable social implications. Further discussion and work is need to identify and prioritise these issues, and to develop appropriate indicators.

Over the past ten years, environmental indicators have gained in importance and have helped to raise the profile of environmental aspects in economic and sectoral decisions. In a number of OECD countries, these indicators are increasingly used in planning, clarifying policy objectives and priorities, budgeting, and assessing policy performance. Experience however shows that there are still lags between the demand for environmental indicators, the related conceptual work and the actual capacity for mobilising and validating underlying data.

Further work is needed to continuously refine and discuss current indicators and their measurement. Major efforts, at both the national and international levels, will have to be devoted to: i) establishing a closer link between the indicators and results achieved; ii) improving the quality of underlying data, including the further international harmonisation of these data; and iii) establishing closer links with economic and social information systems. Also, the pressure-state-response model that has proven robust and useful in structuring the indicators, may need to be further adapted and expanded to take into account the work that is needed to develop indicators relating the environment both to social and to economic issues.

Table 2. **Preliminary list of social-environment issues for indicator development**

Health	◆ Exposure to air emissions, to noise ◆ Morbidity/mortality rates and life expectancies
Employment	◆ Employment, Unemployment ◆ Employment in environmental services and industries ◆ Working conditions; enforcement of labour regulations (effect on competitiveness)
Demographic aspects	◆ Population growth and structure ◆ Household size and numbers ◆ Rural/urban population and migrations (within and across countries)
Poverty and socio-economic inequity (distributional aspects)	◆ (Affordable) access to utilities (e.g. safe drinking water, electricity, sewage treatment) ◆ Income distribution and poverty levels (low incomes, minimum wage) ◆ Land rights and social groups (e.g. ownership or non ownership, land claims) ◆ Average burden of environmentally related taxes by income group ◆ Proximity to contaminated areas, toxic waste, etc.
Environmental information and participation (environmental democracy)	◆ Investment/expenditure on environmental information ◆ Access to environmental information ◆ Membership of environmental NGOs ◆ Municipalities with LA21 plans ◆ Participation in environmental decision making ◆ Access to justice
Environmental awareness and education	◆ Investment/expenditure on environmental education & training: public & private ◆ No. of people being trained or educated in environmental matters: public & private ◆ Public opinion

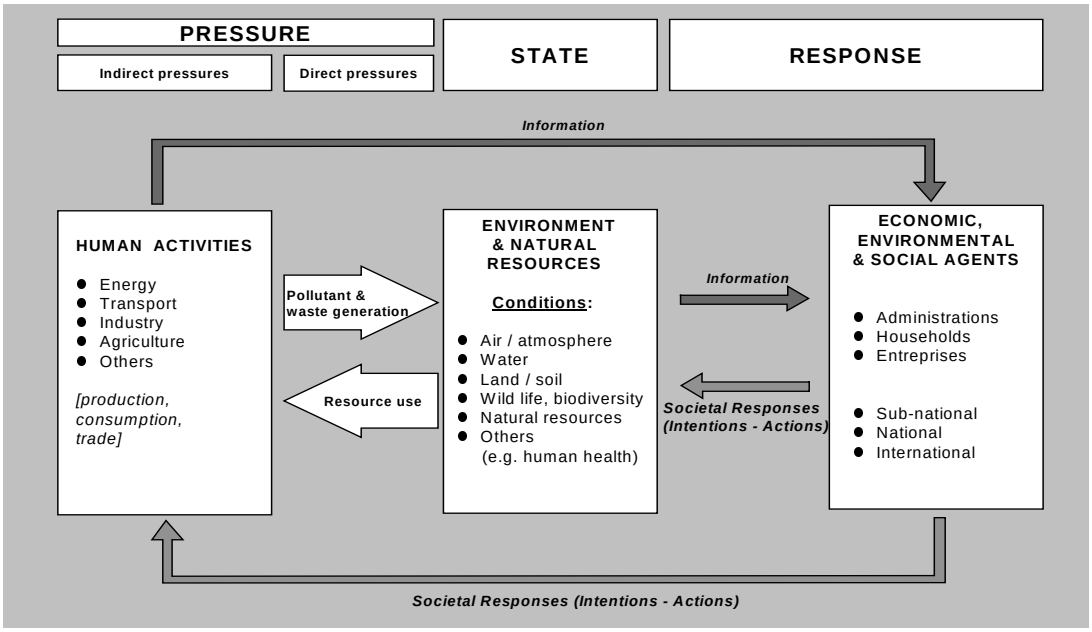
ANNEXES

A. THE PRESSURE - STATE - RESPONSE (PSR) MODEL

The PSR model was initially developed by the OECD to structure its work on environmental policies and reporting. The PSR model considers that: human activities exert pressures on the environment and affect its quality and the quantity of natural resources ("state"); society responds to these changes through environmental, general economic and sectoral policies and through changes in awareness and behaviour ("societal response").

It highlights the cause-effect relationships between economic activities, environmental and selected social conditions, and helps decision makers and the public see environmental and economic issues as interconnected. It thus provides a means of selecting and organising indicators in a way useful for decision-makers and the public.

The PSR model has the advantage of being one of the easiest frameworks to understand and use; and of being neutral in the sense that it shows which linkages exist, and not whether these have negative or positive impacts. This should however not obscure the view of more complex relationships in environment-economy and environment-social interactions.



- Indicators of environmental pressures describe pressures from human activities exerted on the environment. "Pressures" here cover underlying or indirect pressures (i.e. the activity itself and trends of environmental significance) as well as proximate or direct pressures (i.e. the use of resources and the discharge of pollutants and waste materials). Such indicators are closely related to production and consumption patterns; they often reflect emission or resource use intensities, along with related trends and changes over a given period. They can be used to show progress in de-coupling economic activities from related environmental pressures and in meeting national objectives and international commitments (e.g. emission reduction targets).

- Indicators of environmental conditions relate to the quality of the environment and the quality and quantity of natural resources. Hence they reflect the ultimate objective of environmental policies. Such indicators are designed to give an overview of the situation (the state) concerning the environment and its development over time. Examples are: concentration of pollutants in environmental media, exceedance of critical loads, population exposure to certain levels of pollution or degraded environmental quality and related effects on health, the status of wildlife and of natural resource stocks.
- Indicators of societal responses reflect the extent to which society responds to environmental concerns. They refer to individual and collective actions and reactions, intended to mitigate, adapt to or prevent human-induced negative effects on the environment; to halt or reverse environmental damage already inflicted; or to preserve and conserve nature and natural resources. Examples are: environmental expenditure, environment-related taxes and subsidies, price structures, market shares of environmentally friendly goods and services, pollution abatement rates, waste recycling rates, public opinion.

Depending on the purpose for which the PSR model is used, it can easily be adjusted to account for greater details or for specific features. Examples of adjusted versions are the Driving force - State - Response (DSR) model used by the UNCSD in its work on sustainable development indicators, the framework used for OECD sectoral indicators and the Driving force - Pressure - State - Impact - Response (DPSIR) model used by the European Environment Agency.

B. INDICATORS IN ENVIRONMENTAL PERFORMANCE REVIEWS - AIR POLLUTION

Context and supplementary information

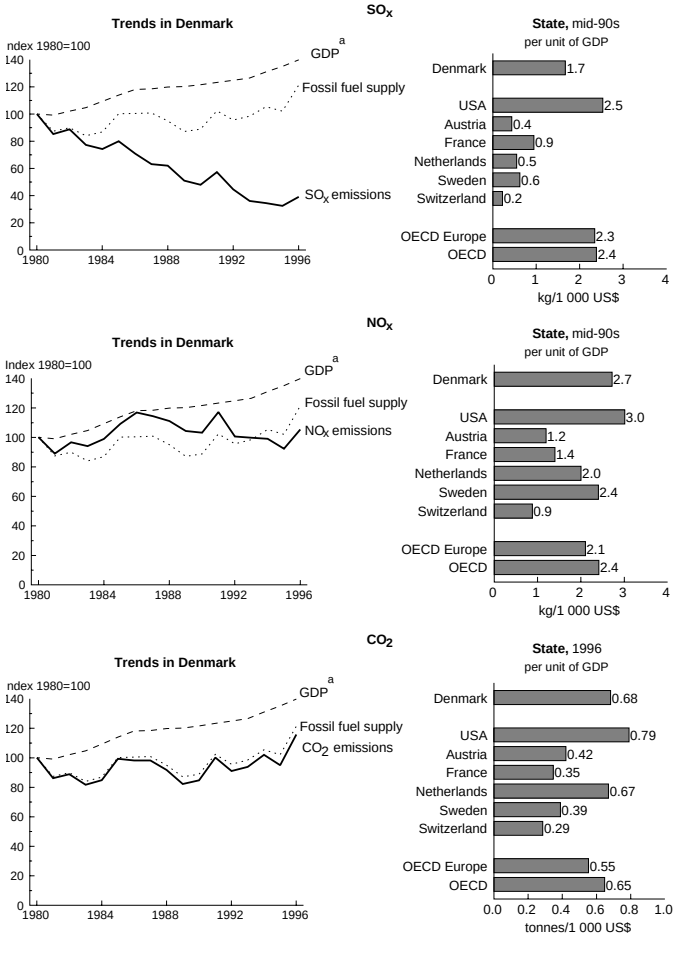
SO2 emissions totalled 176,930 tonnes in 1996, a 62 per cent decrease from 1980. Power generation accounted for 82 per cent of emissions and other stationary combustion sources for 13.2 per cent. Mobile sources accounted for 4.8 per cent. Emissions per unit of GDP are higher than in most other Nordic and EU countries.

CO2 emissions from fuel combustion were estimated at 72.3 million tonnes in 1996, up from 52.9 million in 1990, a 37 per cent increase. Emissions per unit of GDP and per capita are amongst the highest in Europe. Coal combustion, essentially for power generation accounts for a larger share of CO2 emissions than in most OECD countries

Country specific indicators and data

International Core Set Indicators

Figure 3.1 **Atmospheric emissions**



a) GDP at 1991 prices and purchasing power parities.

Source: OECD.

Assessment

Denmark has made significant progress over the last two decades in reducing or containing emissions of conventional atmospheric pollutants. Between 1980 and 1995, while GDP increased by 36 per cent, SOx emissions dropped by 67 per cent and those of NOx fell by 11 per cent. Such emissions reductions have made it possible for Denmark to meet its national and international commitments, and have had a positive impact on local air quality.

Nevertheless, Danish emissions of SOx and NOx per unit of GDP are relatively high in Europe and further reductions in emissions of atmospheric pollutants are necessary to reduce ozone levels and acid deposition. Transport emissions play an increasingly central role in air pollution management and CO2 emission reduction policies. Many of the measures will have to be directed at controlling the increase in road traffic and related emissions.

C. INDICATORS IN ENVIRONMENTAL PERFORMANCE REVIEWS - PROTECTED AREAS

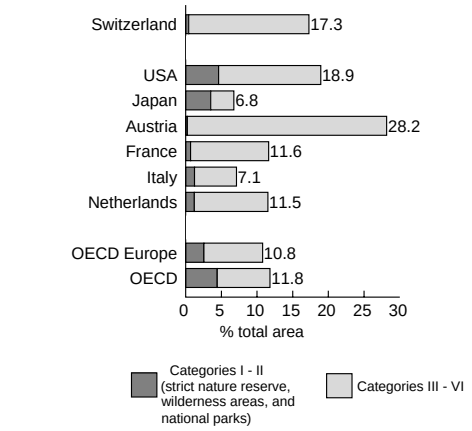
Context and supplementary information

The Swiss National Park was created in 1909 in the Canton of Grisons and given legal status in 1980. As the country's only national park, it is the only place in Switzerland where such strict protection exists over such a large area (169 km^2).

Nature protection was given a full legal basis by the 1966 Act on Nature and Landscape Conservation. Subsequently several inventories made it possible to designate particular areas and specify how they would be protected. The level of protection remained generally low due to development pressure, with more attention being given to landscapes than to biotopes. In 1987 the Rothenthurm initiative having been taken into account in the Federal Constitution, federal authorities were given broader and clearer responsibility for the protection of marsh and wetland biotopes.

International Core Set Indicators

Figure 5.3 **Major protected areas,** [a] 1996



a) IUCN management categories, includes only areas above 10 km^2. National classification may differ.

Source: IUCN; OECD.

Country specific indicators and data

Protected nature and landscape areas [a], 1997

Type	Number	Surface area ha	Surface area % of Swiss territory[b]
Biotope protection			
Swiss National Park (1980) (IUCN categories I-II)	1	16887	0.40
Waterfowl and migrating bird reserves (1991)	11	12230	0.30
Highland wetland biotopes (1991)	514	1470	0.04
Alluvial area biotopes (1992)	169	11021	0.27
Lowland wetland biotopes (1994)	1163	19214	0.47
Wetland areas (1996)	88	87365	2.10
Forest reserves	42	7000	0.17
Protection of landscapes, sites and natural monuments (1977); built sites (1981)	161	780573	18.90

a) Under preparation: inventory of historic paths and roads; inventory of amphibian reproduction sites; inventory of dryland pastures and meadows.
b) As a percentage of the territory; different protected areas may overlap.
Source: OFEFP.

Assessment

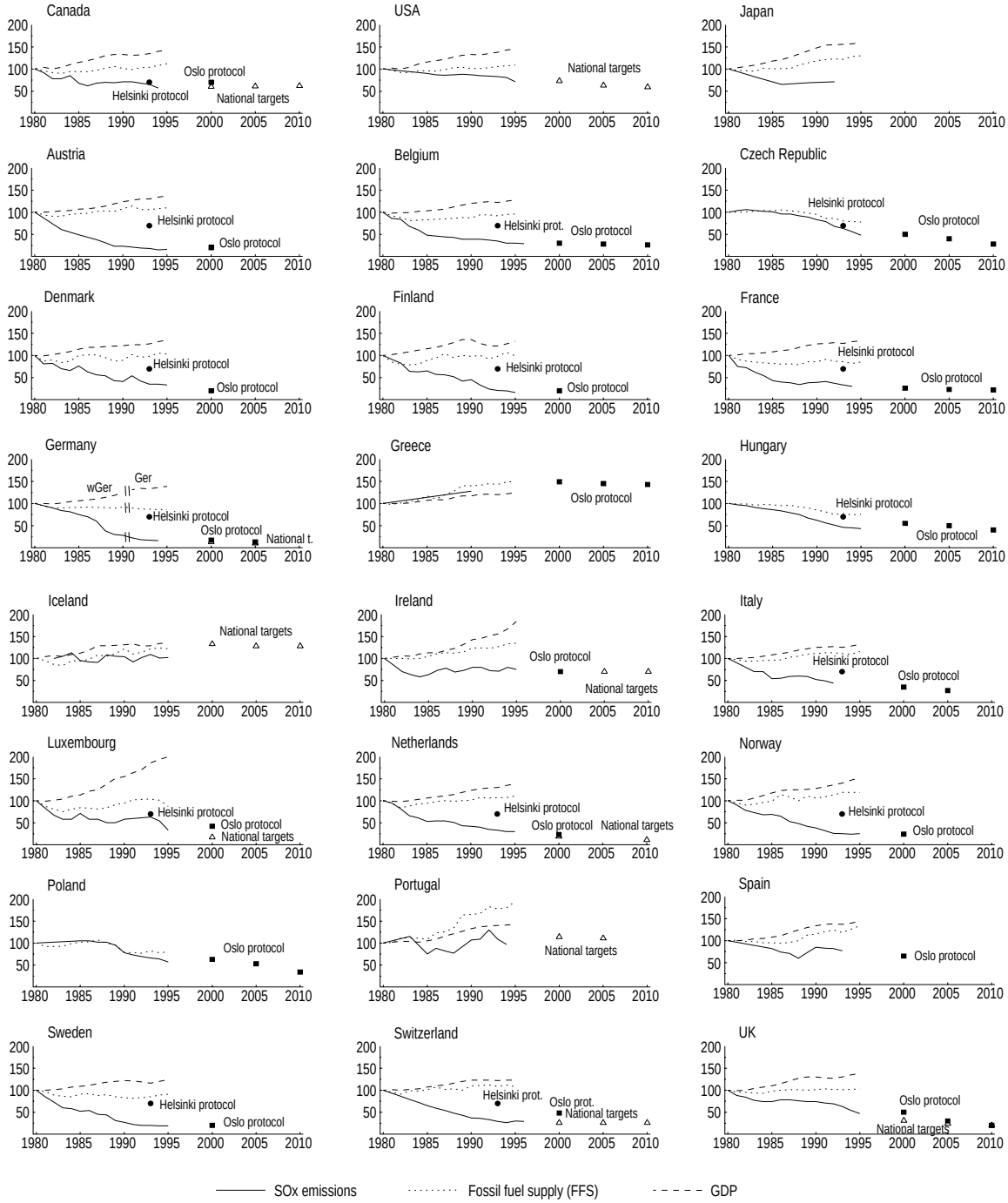
The Swiss public and NGOs have been and continue to be a moving force behind policies for protected areas. The success of the 1987 Rothenthurm initiative and the amendments to the law on nature and landscape protection have given the Confederation an important role in this area. Federal inventories have recently been completed or undertaken to identify biotopes and landscapes in need of protection. In order to influence economic activities outside protected areas, instruments such as environmental impact assessments (EIAs) and regional planning are being used. Switzerland has ratified the main international agreements on biodiversity and nature conservation and takes and active part in international debates, notably on wetland protection.

D. "TOWARDS SUSTAINABLE DEVELOPMENT - ENVIRONMENTAL INDICATORS", OECD 1998 SELECTED EXTRACTS

Air quality

5 AIR EMISSION INTENSITIES

Trends in SO_x emissions, Index 1980 = 100

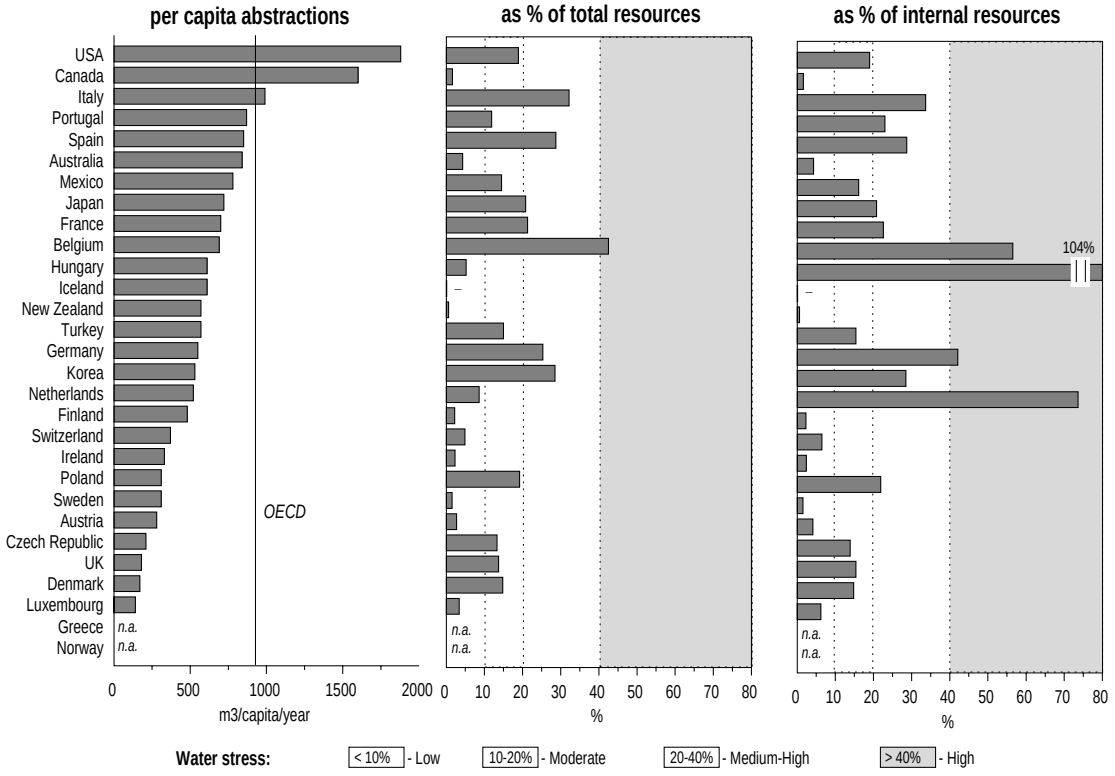


D. (cont'd)

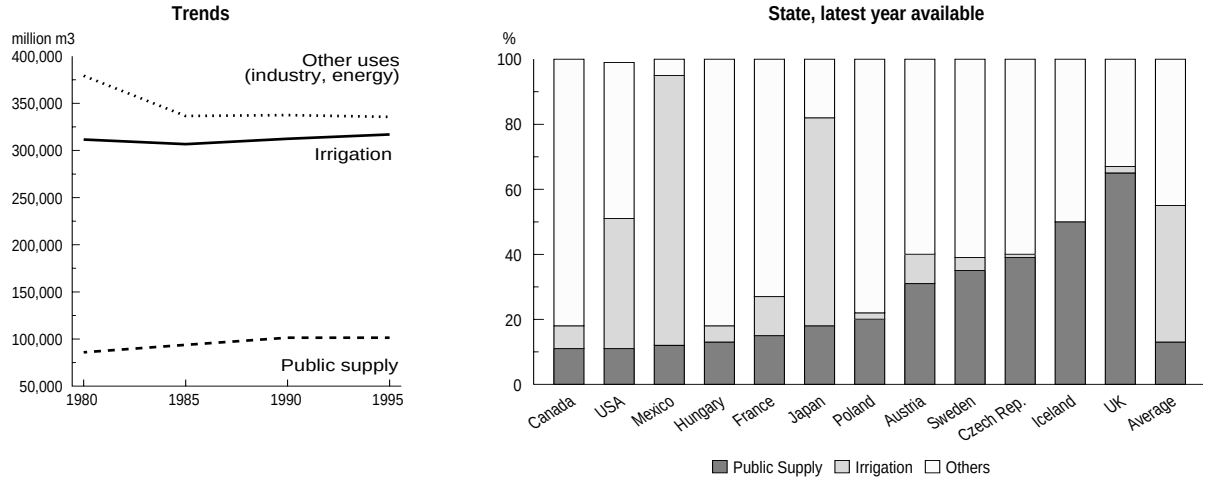
Water resources

INTENSITY OF USE OF WATER RESOURCES 11

Gross freshwater abstractions, mid-1990s



Freshwater abstractions by major uses



E. SUMMARY OF OECD CORE SET INDICATORS[4] BY ENVIRONMENTAL ISSUE

Environmental issue		Core indicators	[4]
Climate change	Pressures	♦ Index of greenhouse gas emissions	M
	Conditions	♦ Atmospheric concentrations of greenhouse gases; Global mean temperature	S
	Responses	♦ Energy efficiency	M/L
Ozone layer depletion	Pressures	♦ Index of apparent consumption of ozone depleting substances (ODP)	M
	Conditions	♦ Atmospheric concentrations of ODP; Ground level UV-B radiation	S/M
	Responses	♦ CFC recovery rate	M
Eutrophication	Pressures	♦ Emissions of N and P in water and soil (--> nutrient balance)	L
	Conditions	♦ BOD/DO, concentration of N & P in inland waters and in marine waters	S/M
	Responses	♦ Population connected to biological and/or chemical sewage treatment plants	M/L
Acidification	Pressures	♦ Index of acidifying substances	M/L
	Conditions	♦ Exceedance of critical loads of pH in water & soil	M/L
	Responses	♦ % of car fleet equipped with catalytic converters	S/M
		♦ Capacity of SOx and NOx abatement equipment of stationary sources	M/L
Toxic contamination	Pressures	♦ Emissions of heavy metals; Emissions of organic compounds	M/L
	Conditions	♦ Concentration of heavy metals & organic comp. in env. media & in living species	L
	Responses	♦ Changes of toxic contents in products and production processes	L
Urban environmental quality	Pressures	♦ Urban air emissions	M/L
	Conditions	♦ Population exposure to air pollution, to noise	L/M
		♦ Ambient water conditions in urban areas	M/L
	Responses	♦ Green space (Areas protected from urban development)	M/L
		♦ Economic, fiscal and regulatory instruments	M
Biodiversity	Pressures	♦ Habitat alteration and land conversion from natural state	L
	Conditions	♦ Threatened or extinct species as a share of total species known	S
	Responses	♦ Protected areas as % of national territory, and by type of ecosystem	S/L
Waste	Pressures	♦ Generation of waste (municipal, industrial, hazardous, nuclear)	S
	Responses	♦ Waste minimisation (to be further developed)	L
Water resources	Pressures	♦ Intensity of use of water resources	S
	Conditions	♦ Frequency, duration and extent of water shortages	M/L
	Responses	♦ Water prices and user charges for sewage treatment	M
Forest resources	Pressures	♦ Intensity of forest resource use (actual harvest/productive capacity)	M
	Conditions	♦ Area, volume and structure of forests	S/M
	Responses	♦ Forest area management and protection	M/L
Fish resources	Pressures	♦ Fish catches	S
	Conditions	♦ Size of spawning stocks	M
	Responses	♦ Fishing quotas	S/M
Soil degradation (desertification & erosion)	Pressures	♦ Erosion risks: potential and actual use of land for agriculture	L
	Conditions	♦ Degree of top soil losses	M/L
	Responses	♦ Rehabilitated areas	M/L
Socio-economic, sectoral and general indicators *(not attributable to specific issues)*	Pressures	♦ Population growth & density	S
		♦ Growth and structure of GDP; Private & government final consumption expenditure	S
		♦ Industrial production	S
		♦ Structure of energy supply	S
		♦ Road traffic volumes; Stock of road vehicles	S
		♦ Agricultural production	S
	Responses	♦ Environmental expenditure	M/L
		♦ Public opinion	S

4. Measurability: S = short term, basic data currently available for a majority of OECD countries; M = medium term, basic data partially available; L = long term, basic data not available for a majority OECD of countries.

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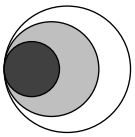
Japan	(1994)	*English, French, Japanese*
United Kingdom	(1994)	*English, French*
Italy	(1994)	*English, French, Italian*
Netherlands	(1995)	*English, French*
Poland	(1995)	*English, French, Polish*
Canada	(1995)	*English, French*
Austria	(1995)	*English, French, German*
United States	(1996)	*English, French, Spanish*
Bulgaria	(1996)	*English, French, Bulgarian, Russian*
Sweden	(1996)	*English, French*
New Zealand	(1996)	*English, French*
France	(1997)	*English, French*
Spain	(1997)	*English, French, Spanish*
Korea	(1997)	*English, French, Korean*
Finland	(1997)	*English, French*
Belarus	(1997)	*English, French, Russian*
Switzerland	(1998)	*English, French, German*
Mexico	(1998)	*English, French, Spanish*
Australia	(1998)	*English, French*
Belgium	(1998)	*English, French*
Czech Republic	(1999)	*English, French, Czech*
Denmark	(1999)	*English, French*
Turkey	(1999)	*English, French, Turkish*
Russian Federation	(1999)	*English, French, Russian*
Greece	(2000)	*English, French, Greek*
Hungary	(2000)	*English, French, Hungarian*

ENVIRONMENTAL PERFORMANCE INDICATORS

THE EXPERIENCE OF JAPAN*



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ANNEX. TENTATIVE PLAN OF COMPREHENSIVE ENVIRONMENTAL INDICATORS 126

* By Mr. Choei Konda, Special Advisor, Strategic Environmental Planning Division, Planning and Co-ordination Bureau, Japan.

EXECUTIVE SUMMARY

In Japan, the development of comprehensive environmental indicators has been attempted according to the requirement of the Basic Environment Plan. These comprehensive environmental indicators show the progress of four long-term objectives in the Plan. Many are expected to be utilized as environmental performance indicators in the new Basic Environment Plan that is scheduled to be decided by the Cabinet late next year.

The development of comprehensive environmental indicators has been very difficult within limited time. A new approach has been taken in order to make best use of the results obtained so far in the new Basic Environment Plan. This is the use of indicators for analysis of the state of the environment, which leads to a tentative core set of environmental sustainability indicators.

This paper includes background and a brief history of the development of environmental indicators in Japan, the initial outcome of the efforts made to develop comprehensive environmental indicators, and the policy context of environmental sustainability indicators.

I. BACKGROUND

The Basic Environment Law enacted in Nov. 1993 called for the establishment of a basic plan on environmental conservation in order for the government to promote various environmental measures comprehensively and systematically. Responding to it, the Cabinet decided on the Basic Environment Plan in Dec. 1994. Looking ahead to the middle of the 21st century, the plan shows four long-term objectives of environmental policy (sound material cycle, harmonious coexistence, participation and inter-national activities) specifies and the measures to be taken by the government up to the early 21st century.

The development of environmental indicators was started by the Environment Agency's initiative, based on the requirement of this Plan which says:

> "*It is desirable to specify comprehensive indicators which show the progress of these long-term objectives and the relation between objectives and measures, in order to ensure effective implementation of the measures. Whereas studies and research have been carried out extensively both domestically and abroad at this point, there are not enough results to incorporate the indicators in this Plan. Therefore, the Government will immediately begin working on the development of comprehensive indicators. The results of this work will be used in implementing and reviewing the Plan."*

Generally speaking, an indicator helps us to recognise or understand a complex phenomenon. If we can evaluate how a policy obtains good results by using environmental indicators appropriately, people and decision-makers will know the present situation and are able to judge whether the policy is sufficient or not. In Japan, the pollution concentration level of an item for which an environmental quality standard is set, or the achievement ratio of an environmental quality standard are used as indicators of the state of the environment.

It is, however, apparent that these pollution-related indicators are insufficient to meet the requirement of the Basic Environment Plan aiming at building a sustainable society through achieving four long-term objectives. Pollution-related indicators coming from environmental quality standards worked well for traditional environmental policies, mainly aimed at pollution control and prevention, By contrast, comprehensive environmental indicators (CEIs) are required to measure the progress of "new environmental policies" under the Basic Environment Law and the Basic Environment Plan.

II. DEVELOPMENT OF COMPREHENSIVE ENVIRONMENTAL INDICATORS

Responding to the requirement of the Basic Environment Plan, the Environment Agency set up an expert committee on comprehensive environmental indicators (CEIs) in Nov. 1995. Since then, the Expert Committee promoted the development of CEIs in order to apply the DSR (Driving force-State-Response) model to each of four long-term objectives, particularly to sound material cycle and harmonious coexistence. After 7 discussion sessions in the Expert Committee over two years, an interim report which included a tentative plan of CEIs under discussion was published in July 1997. Public comments on the interim report were sought.

The tentative plan of CEIs shown in the interim report is summarized in Annex to this paper. Several indicators were still in the development stage, particularly those on participation and international activities. The DSR framework was more difficult to apply to indicators of participation and

international activities than sound material cycle and harmonious coexistence. Moreover, all R indicators were not developed as it was difficult to choose response indicators from a great variety of measures. Much work was still needed to finalize the development of CEIs and utilize its results in the next Basic Environment Plan.

The main points of the tentative plan of CEIs are as follows:

- As for indicators on sound material cycle and harmonious coexistence, the DSR framework was applied as far as possible to clarify environmental loads, their effects are the state of the environment and responses to such changes.
- Particular emphasis was put on the development of D indicators in the field of sound material cycle to clarify which field gets a good score in the reduction of environmental loads. Besides, "hidden flow"[1] was taken into consideration in the development of indicators that pay attention to material flow amount.
- Lots of efforts were made to develop indicators on harmonious coexistence as it was more difficult to quantify nature than environmental pollution. Besides, it was difficult to obtain data on nature conservation and the progress of development on such indicators was also delayed internationally.

The Expert Committee reviewed its interim report in Oct. 1997 based on the public comments received. The following suggestions were made there:

- It is not appropriate to develop CEIs strictly along with each of four long-term objectives because there are some phenomena that relate to both sound material cycle and harmonious coexistence.
- It is not reasonable to incorporate DSR framework into each long-term objective. The DSR framework was only applied, with partial success, to the fields of sound material cycle and harmonious coexistence.
- It is not clear what aspect of environmental problems most CEI's measure. Environmental indicators measure the state of the environment or the progress of environmental counter measures.

Taking the above suggestions into consideration, a new working idea for developing environmental indicators was proposed in the Expert Committee. First, the environmental problem is classified as a cycle of "human activities", "environmental loads", "state of the environment", "responses or countermeasures", ("human activities"). Then, the DSR framework is applied to this cycle; human activities are indirect D, environmental loads direct D, state of the environment S and response or countermeasures R. The development of environmental indicators under the new working idea will be done by the Expert Committee after the new Basic Environment Plan is established, possibly late next year.

III. APPLICATION OF INDICATORS TO ANALYSIS OF THE STATE OF THE ENVIRONMENT

The current Basic Environment Plan specifies that: "The Plan shall be reviewed, responding flexibly and appropriately to the changes of economy and society in Japan and abroad. The review will be made around five years after the Cabinet decision on the Plan." The review of the current Basic Environment Plan and the work for preparing the new Basic Environment Plan started from June this year. The tentative plan of CEIs needs to be put into use urgently. However, it is difficult to utilise CEIs

1. "Hidden flow" means soil dug with construction works, stone and ore discarded with extraction of useful ore, erosion from cultivated lands, wood cut indirectly, etc.

as initially intended since they have not been fully developed. Therefore, the Expert Committee has decided to use in the new Basic Environment Plan CEIs that have been developed to describe the state of the environment.

When it comes to analysis of the state of the environment, traditional practice is always the compilation of the data on pollution and nature as typically shown in the annual white paper on the environment. Considering the ultimate objective of the Plan to build a sustainable society, it is necessary to answer whether our society is moving towards a sustainable course or not. In other words, another compilation of the data in relation to sustainability of our society is needed. Generally speaking, the environment has some capacity to regeneration. Even if human beings exploit natural resources from the environment and release pollutants into the environment, human beings can do social and economic activities in a sustainable way as long as their resource use and pollutant loads stay within the limit of the environment's capacity to regeneration. If follows that necessary conditions for being a sustainable society in terms of environment are:

- environmental loads from human activities shall stay within self-purifying capacity of the environment;
- utilisation of environmental resources shall stay within regenerative capacity of the environment;
- human activities shall be done with minimum environmental impact considering the coexistence of human beings and nature (flora and fauna).

It is desirable to develop indicators to measure the achievement of the above three conditions, but the knowledge on self-purifying and regenerative capacity of the environment and how to realise the coexistence of human beings and nature is scarce. Even the state of environmental loads and environmental resource use, and information on natural environment are not sufficiently available. Consequently, it is relevant to use the following three groups of data to reflect the above three conditions to some extent in order to judge sustainability of a society from the viewpoint of environment:

- data on the state of environmental loads having significant impacts on the environment;
- data on the state of environmental resource use;
- data on the state of natural environment.

IV. DEVELOPMENT OF A TENTATIVE CORE SET OF ENVIRONMENTAL SUSTAINABILITY INDICATORS

We can describe whether our society is moving towards a sustainable course or not if we could grasp the overall trend of the above three groups of data. Based on this idea, several environmental indicators are selected from CEIs developed so as to meet the above data requirement.

1. Indicators of environmental impact

On the basis that it is relevant to select typical environmental loads having significant impact on each environmental medium, the following indicators should be abstracted since they are available and show annual changes. They have severe impacts on global, air, water and nature environments and they are available and show annual changes. These indicators are:

- greenhouse gas emissions (sum of converted amounts of 6 gases designated in the Kyoto Protocol with the global warming potentials);

- NOx emissions in large cities (designated areas under the Automobile NOx Law)[2];
- COD, N (nitrogen) and P (phosphorus) generation in semi-closed water areas;
- waste generation (including generation amount of wastes by sector, per capita and per real GDP)[3].

2. Indicators of environmental resource use

Materials, water and energy should be selected as basic environmental resources. The state of their use can be measured by the amount of resource used and reused/recycled. Indicators for the amount of resource used consist of total amount of material input, water resource use and domestic primary energy supply and final energy consumption. As regards indicators for the amount of resource reused/recycled: for materials, it is necessary to see the proportion reused/recycled in total amount of material input, as well as in wastes generated. However, since it is difficult to collect the data for all kinds of materials, five kinds of materials should be selected to see the rate of the amount reused/recycled. Energy reused/recycled can be measured by energy available in recycled material plus energy potentially available, but it is difficult to collect this data. Therefore, the rate of renewable energy supply should be adopted as alternative indicator.

- Materials:
  - total amount of materials input (including total amount of materials input by sector, per capita and per real GDP);
  - domestic and overseas hidden flow amounts;
  - proportion of wastes reused/recycled;
  - proportion of five materials (iron, aluminium, paper, glass and plastics) that are reused/recycled.
- Water:
  - state of water resource use (amount of water resource use, proportion of reused water and rainwater and amount of groundwater pumped).
- Energy:
  - state of energy use (domestic primary energy supply and final energy consumption, including by sector and per unit GDP, and energy efficiency by sector) and rate of renewable energy supply.

3. Indicators of the state of natural environment

Flora and fauna are most important elements of natural environment. Among other things, forest connectivity is essential for animal habitat and bio-diversity, and endangered species are important indicators for the richness of natural environment. Human activities affecting natural environment should be also considered. Destruction of nature is accelerated by conversion of land use, and slowed down by designation of area for nature protection. The selected indicators are:

- forest connectivity indicator (average size of forest clusters);
- flora indicator (area by nature vegetation);
- fauna indicator (typical animal species appearing);
- indicator for bio-diversity and endangered species (total number of species and endangered species);
- conversion of land use (conversion from forest to agricultural use and from agricultural use to city-type use);

2. It is desirable to consider both NOx and SPM (suspended particle matters), but generation and formation amount of SPM are not available at present.
3. Using the data from the PRTR system, indicators for amount of chemicals released and transferred will be added in the near future.

- areas designated for nature conservation (natural parks, highly natural areas, anti-hunting areas, green areas in cities, protected forests, etc.).

We could call the above data groups a tentative core set of environmental sustainability indicators (ESIs). As a next step it is important to establish methods to evaluate the ESI values obtained. Firstly, the method for assessing the overall trend of the core set of ESIs should be explored, to answer whether our society is moving towards a sustainable course or not. Secondly, it is desirable to develop the method for applying ESIs to target setting and progress management, clarifying self-purifying and regenerative capacity of the environment. The development of such methods is, however, seen to be difficult for the time being. The following ideas to judge environmental sustainability should be considered:

- comparison of indicator values with population and GDP;
- comparison of indicator values with those in foreign countries.

V. FUTURE TASKS

Work on the new Basic Environment Plan is continuing, leading towards a Cabinet Decision late next year. Currently, the use of the above environmental sustainability indicators is only examined in the description of the state of the environment in the new Plan. After establishing the new Basic Environment Plan, the development of environmental indicators under the new working idea will be actively promoted by the Expert Committee taking into consideration the following remarks:

- Further development of environmental indicators: review of the basic framework. The development of CEIs was promoted along with four long-term objectives. However, the system of environmental indicators is not clear as the relationship among four long-term objectives and the relation between ultimate target (building a sustainable society) and four long-term objectives are not clear. The basic framework for developing environmental indicators more effectively should be examined to clarify the system of environmental indicators.
- Importance of D and R indicators: S indicators in relation to environmental quality standards are more available than other types of indicators. In terms of implementing effective environmental measures, D and R indicators are more important, as D indicators show the origin of a problem and R indicators tell cost-effectiveness of the measure to be undertaken.
- Establishment of model: Future studies could enable us to build a model that takes in various phases from the causes to the measures of an environmental problem. It is important to develop such a model and apply it in policy planning, target setting, etc.
- Consolidation of environmental data and statistics: Environmental data and statistics is the base of environmental indicators. Most of the data available now are pollution-related data for which environmental quality standards are set and nature-protection-related data for which the National Survey is done. In the near future, it will be necessary to consolidate environmental data and statistics to support the development and application of environmental indicators.
- Co-ordination of environmental indicators developed with international ones and local ones: Environmental indicators are developed or used by international organisations such as OECD and UNCSD and local governments as well as central governments. One of the practical uses of indicators is the comparison among countries or among local areas. In order to enable such comparison, appropriate co-ordination is needed.

ANNEX. TENTATIVE PLAN OF COMPREHENSIVE ENVIRONMENTAL INDICATORS
Summary

1. Indicators of a Sound Material Cycle

1.1 Indicators of material and energy flow

1.1.1 Indicators of material flow:

- total amount of materials input;
- total amount of wastes generated;
- ratio of materials reused and recycled;
- ratios of iron, aluminium, paper, glass and plastics that are reused and recycled.

1.1.2 Indicators of energy flow:

- primary energy supplied domestically;
- final energy consumption;
- primary energy supplied domestically per unit GDP;
- final energy consumption per unit GDP;
- ratio of renewable energy in primary energy supplied.

1.2 Indicators of water circulation (under development)

- natural circulation indicator;
- artificial circulation indicator.

1.3 Indicators of environmental load, quality of the environment, and material flow and energy flow responses

Applying DSR framework, D and S indicators were developed for the following 15 policy subjects [4].

- global warming;
- ozone layer protection;
- acid rain;
- photochemical oxidants;
- air pollution in large cities;
- harmful air pollutants;
- noise/vibration/offensive odor;
- organic water pollution;
- safe water environment;
- marine environment;
- safe soil environment;
- ground subsidence;
- waste;
- hazardous waste;
- environmental risks of chemicals.

2. Indicators of Harmonious Coexistence

2.1 Indicators showing features of natural environment

- D: indicator on the conversion of land use;
- S: indicators on forest connectivity, flora, fauna, bio-diversity and endangered species;
- R: indicator on areas designated for nature conservation.

2.2 Indicators of contact between people and nature (under development)

- actual indicators of contact;
- potential indicators of contact.

3. Indicators of Participation (under development)

Indicators that pay attention to the response of each stakeholder; the State, local governments, corporations, people and private organisations

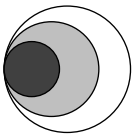
4. Indicators on International Activities (under development)

- indicators of international co-operation on global environmental policies;
- indicators of the support for developing regions (financial and human contributions).

4. Several D and S indicators are still under development. No R indicators are developed.

ENVIRONMENTAL PERFORMANCE INDICATORS

THE EXPERIENCE OF GERMANY*



I. MAKING SUSTAINABILITY MEASURABLE: THE ENVIRONMENT BAROMETER 128

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* By Mr. Uwe Taeger, Ministry for Environment, Nature Conservation and Nuclear Safety, Germany.

I. MAKING SUSTAINABILITY MEASURABLE: THE ENVIRONMENT BAROMETER

Environmental policy has as yet no well-known and generally accepted indicator of success or failure. Whereas, for example, gross national product, the unemployment rate and the rate of inflation are widely accepted as measures of economic and social development, there is no comparable yardstick for measuring environmental development.

If environmental policy wants to get its proper place in the political debate on sustainable development, which embraces ecological, economic and social goals, it should also be possible to describe environmental development with a few key indicators. The "Environment-Barometer for Germany" that is being introduced, contains such indicators.

The Barometer will be published on a year-by-year-basis in order to monitor progress in environmental protection and should indicate in which environmental policy areas further action is required. The Barometer was first brought into public as part of the “Draft programme for priority areas in Environmental Policy” that was published in the middle of 1998.

The Barometer is still a draft version and will have to be improved. The experiences with the Barometer as well as the ongoing debate on indicators and targets in Germany and in the international community have shown, that indicators as well as targets may have to be adjusted. As a first major change the decision was made to exclude the current indicator for nature and to develop a new one (respectively new ones) to include biodiversity aspects. Although the Barometer is not yet perfect, it is in use and has got a wide acceptance in the public as well as in the policy arena.

II. LIST OF INDICATORS AND TARGETS

The Barometer covers six major environmental policy fields and related indicators, each associated to quantitative targets or environmental goals (Table 1).

Table 1. **List of indicators and targets**

Environmental field	Key indicator	Environmental goal
Climate	**Indicator for greenhouse gas emissions** ⇒ Annual CO_2 emissions	Reduction of 25 % in CO_2 emissions by 2005 on 1990 basis
Air	**Indicator for air pollution** ⇒ Emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x), ammonia (NH_3), volatile organic compounds (VOC)	Reduction of 70 % by 2010 compared to 1990

.../...

Environmental field	Key indicator	Environmental goal
…/…		
Soil	**Indicator for land use** ⇒ Daily increase in area covered by human settlements and infrastructure	Reduction to 30 ha per day by 2020
Nature*	**Indicator for nature conservation** ⇒ "Ecological priority areas"	Safeguarding of 10 - 15 % of non-settled land in 1998 as "ecological priority areas" to create a biotope network by 2020
Water	**Indicator for water quality** ⇒ Percentage of flowing water bodies in Chemical Quality Class II for ∗ Important pollutants (AOX) ∗ Nutrient pollutants (total nitrogen)	Achieve mandated goals of Chemical Quality Class II for all flowing water bodies (100% of measuring stations) by 2010 ∗ < 25 µg/l for AOX < 3 mg/l for total N
Resources	**Indicator for energy use** ⇒ Energy productivity (GDP in relation to energy consumption) **Indicator for raw materials use** ⇒ Raw materials productivity (GDP in relation to consumption of non-renewable raw materials)	Doubling of energy productivity by 2020 compared to 1990 Increasing raw materials productivity 2.5-fold by 2020 compared to 1993

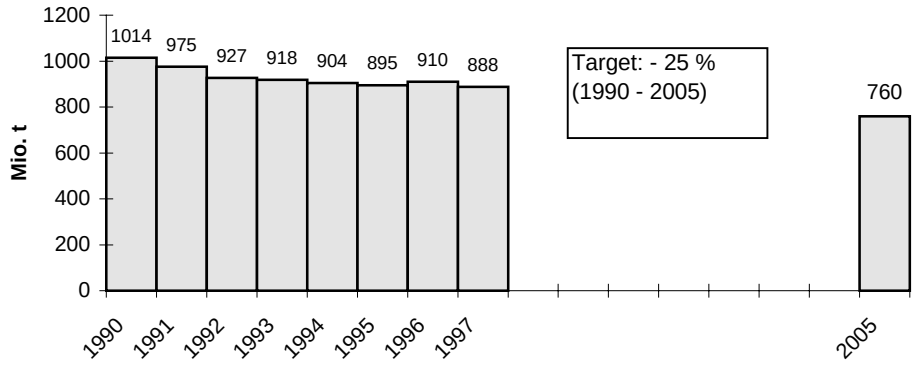
* *Indicator not in use, research and discussions underway.*

The recent status of the indicators in the Environmental Barometer, in comparison with the targets, is as follows:

1. Climate

CO_2 emissions are considered to be the main cause of the threat of global warming. In 1990, the German Government set itself the target of reducing CO_2 emissions by 25% (1990-2005).

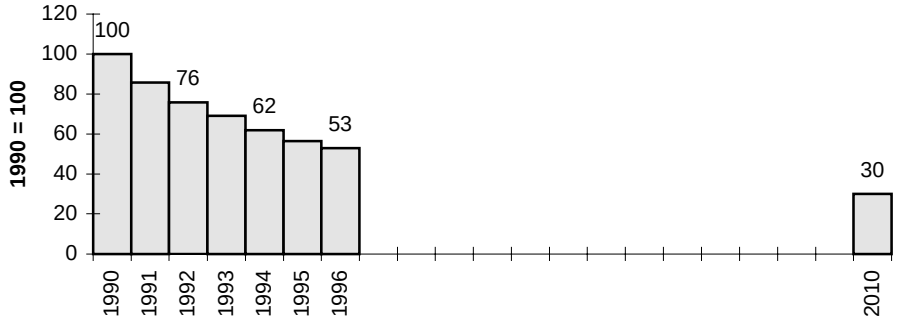
Figure 1. **CO_2 Emissions**



2. Air

SO_2, NO_x and NH_3 emissions are responsible for the acidification of soils. NO_x and VOC emissions are the main precursor substances for the formation of ozone (“summer smog”).

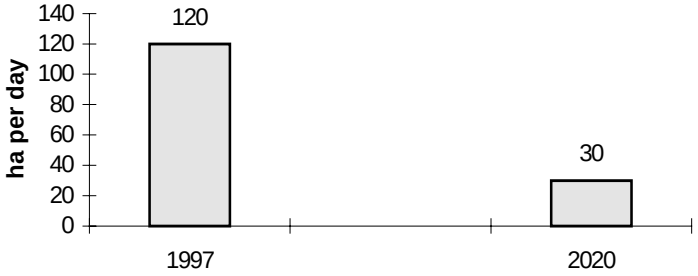
Figure 2. **Emissions of SO_2, NO_x, NH_3 and VOC**



3. Soil

The steady increase in area covered by human settlements or traffic routes mainly affects the urban climate, water balance, pollutant filtering (soil as buffer for substance inputs) and the diversity of species and biotopes. Moreover, land is a scarce natural resource.

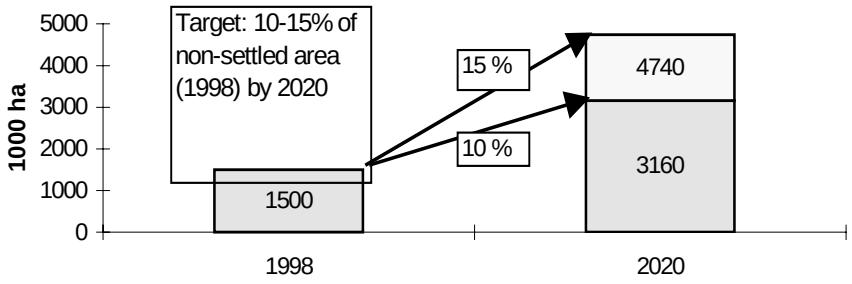
Figure 3. **Increase per day in area covered by human settlements and traffic routes**



4. Nature

In order to permanently safeguard biological diversity, protected areas of sufficient size are necessary in which nature can develop free from adverse human intervention. These "ecological priority areas" are to be linked to counteract the deleterious effects of splitting and fragmentation.

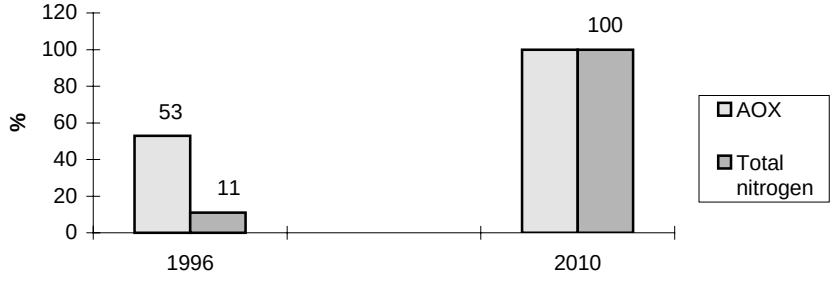
Figure 4. **Ecological priority areas**



5. Water

The concept of the Chemical Quality Class for water comprises mandated goals for a number of substances or substance groups. The two selected indicators mainly record industrial sources (AOX – adsorbent organohalogen compounds) and diffuse sources from agriculture and traffic (total nitrogen). AOX are currently recorded at 31, and total nitrogen at 66 measuring stations on flowing water bodies in Germany. Figure 5 shows the percentage of measuring sites at which water quality goods relating to chemicals (AOX) and nitrogen are achieved.

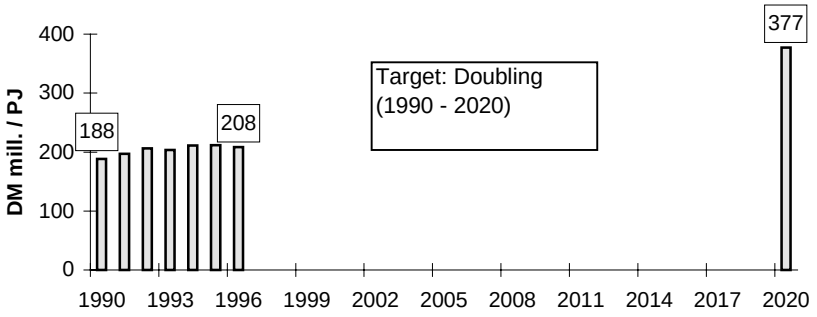
Figure 5. **Achievement of water quality targets**



6. Resources (energy)

Energy productivity (GDP at 1991 prices in relation to primary energy consumption) shows the extent to which energy is being used efficiently. Since the production and use of energy are associated with a multitude of environmental stresses and may adversely affect the outlook for future generations, boosting energy productivity is an important goal of environmentally sound sustainable development.

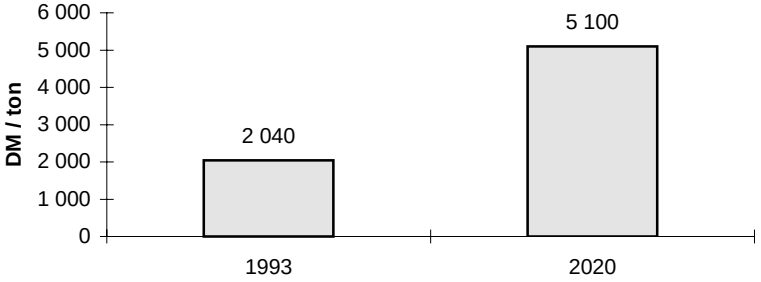
Figure 6. **Energy productivity**



7. Resources (raw materials)

Resource consumption involves domestic extraction or importation of non-renewable raw materials (e.g. energy sources, non-metallic minerals, other minerals). The “resource productivity” indicator (GDP at 1991 prices in relation to resource consumption) records how efficiently raw materials are used. It is cross-sectoral since a wide variety of environmental pressures are associated with the production and consumption of resources, e.g. destruction of habitats, pollution of soil and water, emissions of CO_2 and other harmful substances.

Figure 7. **Resource productivity**



III. CHARACTERISTICS AND USES

The Environment Barometer covers a few (less than ten) key environmental *issues.*

One key indicator is established per issue. Each indicator:

- is connected to a long-term environmental goal;

- is representative;
- is easy to understand;
- can be updated on a yearly basis.

The Environment Barometer has a number of uses. It provides:

- eye-catching "environmental indicators";
- information that makes environment problems easier to comprehend and easier to ex-plain to the public;
- a counterpart to key socio-economic indicators (e.g. GNP, unemployment ratio, rate of inflation);
- information on the general environment trend (Are we moving in the right direction?).

IV. INFORMATION PYRAMID – BUILDING BLOCKS

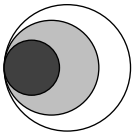
Indicators fall within an information pyramid that includes basic data, environmental accounting, indicators systems, and key highly aggregated indicators. These building blocks are set out in the following table.

Building block:	**Function/Task:**
Basic data	– full description of the state of the environment, detailed presentation of developments – planning – ecological research
Environmental Accounting (physical and monetary indicators)	– presentation of long-term environmental and economic developments, their correlations and interactions – assigning environmental stresses to economic sectors (according to economic statistics) – better assessment of the economic impact of environmental policy measures (in relation to economic sectors) – evaluation of natural assets
Indicator systems: **> Environment** **> Sustainability** **(c. 100)**	– highlighting trends in priority environment and/or sustainability areas using representative indicators – monitoring for priority issues / implementation of Agenda 21(are targets being achieved?) – highlighting need for action – keeping the (educated) public better informed about the state of the environment
Key indicators / Highly aggregated indicators (c. 5-10)	– eye-catching "environmental indicators" (only one indicator per environmental theme!) – making environment problems easier to comprehend and easier to explain to the public – counterpart to the key socio-economic indicators (e.g. GNP, unemployment ratio, rate of inflation) – is the general environment trend moving in the right direction?

PART C.
SUSTAINABLE DEVELOPMENT AND ITS ECONOMIC/SOCIAL/ENVIRONMENTAL INDICATORS

SUSTAINABLE DEVELOPMENT AND ITS ECONOMIC, SOCIAL AND ENVIRONMENTAL INDICATORS

OECD OVERVIEW



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EXECUTIVE SUMMARY

In recent years, the debate about the twin challenges of sustainable development and globalisation has moved up on the international agenda. This reflects an increasing awareness that economic growth can no longer be credibly pursued without a much stronger concern for its environmental and social implications. The three dimensions of sustainable development, economic, environmental and social, involve complex synergies and trade-offs. The emphasis is on the interactions and complementarities among these three dimensions. Progressing towards sustainable development, a goal to which all OECD countries are committed, raises important challenges for policy making, notably the search for synergetic "win-win-win" options that can only be identified if all three dimensions of sustainable development are taken into account. In this context, it is essential that meaningful indicators are made available to inform decision making and to raise awareness about the inter-linkages and trade-offs among the various dimensions of sustainable development, as well as about the longer term implications of current decisions and behaviours.

Since Ministers asked the OECD, at the Ministerial Council Meeting of April 1998, to undertake a three-year programme to help Member countries address fundamental sustainable development issues, the OECD has embarked on the development of appropriate indicators to measure progress. Sustainable development indicators can be seen as a juxtaposition of indicators or sets of indicators that are relevant to monitor particular policy concerns and targeted at particular audiences. A more ambitious task is to further combine these indicator sets in a way that is useful for practical policies. Work within the OECD concerns both levels and aims to develop indicators whose quality is defensible on both conceptual and practical grounds and whose information content, and thus potential use in policy making, justifies the development. The experience of OECD and its Member countries in developing and using indicators in the economic, social and environmental fields, together with more recent national and international initiatives on sustainable development indicators, provide a good basis for developing indicators to measure progress towards sustainable development at OECD level.

The OECD experience suggests that, in the short term, practical progress can best be achieved through a process focusing on a set of core indicators. This also responds to the increasing interest by Member countries in a reduced number of indicators selected from existing larger sets. Selecting core indicators requires the identification of key issues for which indicators are needed, i.e. those that are of common relevance to sustainable development progress in OECD countries and to the three dimensions of sustainable development (economic, social, environmental). It further requires the use of a framework that reflects the integrated nature of sustainable development, while organising the core indicators in a way useful to decision-makers and the public. Frameworks that have proven useful are frameworks based on the OECD "pressure-state-response" (PSR) model, and frameworks based on the national accounts approach.

A first illustration of possible core indicators was included in the Interim report on the OECD three year project on sustainable development. This list can serve as a basis for a discussion at the conference. It is however recognised that the indicators shown in the list are derived from sets developed independently from each other and whose original purpose has not been the measurement of sustainable development progress. More work is required to further refine and link the indicators and to fill remaining gaps. In particular, indicators are needed to describe the social-environment interface, and to address issues of social sustainability.

It is also recognised that there is still a lag between the demand for sustainable development indicators, the measurability of underlying data sets and the actual use of such indicators. Whereas economic, social and environmental indicators have individually proven their value in policy formulation, the use of combined sets of sustainable development indicators in the overall policy debate needs to be further strengthened.

I. INTRODUCTION

This paper describes indicators to measure progress towards sustainable development in the economic, social and environmental domains with a particular focus on economic-environment and social-environment relationships. It exploits the accumulated OECD experience in developing and using indicators, and builds on recent work done as part of the OECD's initiative on sustainable development. The paper: i) describes key interactions between the three dimensions of sustainable development, and major challenges for public policies, including the demand for appropriate information tools; ii) describes existing OECD work on economic, social and environmental indicators, and explores the possibility to further combine these indicators into a core set that is useful for practical policies and for the OECD's work; and iii) identifies major areas for progress.

II. POLICY CONTEXT

In recent years, the debate about the twin challenges of sustainable development and globalisation, has moved up on the international agenda. This reflects an increasing awareness among decision-makers that economic growth can no longer be credibly pursued without a much stronger concern for its environmental and social implications.

The concept of sustainable development[1] is embodied in Agenda 21, endorsed by the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992 and to which all OECD countries are committed. First, it refers to "needs" in a broad sense, not only economic needs but also needs for a clean environment, for a secure and cohesive society and for ample employment opportunities. Second, explicit in the concept is a focus on "inter-generational" equity, implying that the next generation should be secured opportunities similar to those available to the current one. Third, it puts an emphasis on equity that applies both across and within countries, suggesting for example that preservation of the environment should be a joint responsibility of developed and developing countries, and that all individuals should benefit from the opportunities created by globalisation and technology, and have a stake in the progress of society.

1. Key dimensions of sustainable development

Sustainable development is concerned both with the quality and the quantity of economic growth. In this perspective, it encompasses three dimensions of welfare — economic, environmental and social —that involve complex synergies and trade-offs. The social dimension emphasises the importance of well functioning labour markets and high employment, of adaptation to major demographic changes like population ageing, of equity considerations, and of participation in more effective decision making. The environmental dimension focuses on the stability of biological and physical systems, and on preserving access to a healthy environment. These requirements are recognised to be as important as economic growth and efficiency. Progress towards sustainable development depends on understanding the interactions among these three dimensions and their complementarities. Examples of key interactions are given below.

1. In 1987, the World Commission on Environment and Development called for sustainable development, defining it as. "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". See World Commission on Environment and Development, Our common future, New York, Oxford University Press, 1987.

1.1 Environment-economy interactions

The interactions between the economic and environmental dimensions have long been analysed, and therefore accumulated policy experience in this field is considerable.

❶ Economic activities and related policies have effects, both positive and negative, on environmental issues and performance. Economic growth implies use of energy and other natural resources, as well as pollutant discharges and waste production. Its environmental effects depend on production and consumption patterns, and are influenced by the behaviour of firms' and the public, and by government interventions. Other factors such as technology also play an important role. Economic growth also provides opportunities to finance environmental protection expenditure with potential benefits in the form of cleaner and less resource-intensive technologies and the production of environmentally friendly goods.

❷ Conversely, the environment provides a number of productive and other services, including amenities and natural resources, while environmental policies and related instruments may have economic implications. Changes in environmental conditions affect the economy through changes in the quality and quantity of available natural resources. This is particularly relevant for environmentally-sensitive sectors such as agriculture, forestry and tourism, but also for sectors relying on the use of natural resources (e.g. mining).

1.2 Environment-social interactions

The interactions between the environmental and social dimensions are equally complex. Many of the links are obvious and have long been recognised, while others are more difficult to observe directly and need to be further explored.

❸ Environmental degradation causes a number of negative social effects, including effects on health that impose large costs on society. These social effects and related external costs are often unevenly distributed among population groups and insufficiently addressed by policies. In countries facing problems of rural or urban poverty, the provision of equitable access to natural resources and to environmental goods and services is an issue. Environmental policies and related economic instruments (e.g. taxes, subsidies, prices) may have side effects that are unevenly distributed among population and income groups, including direct or indirect effects on employment.

❹ Conversely, social conditions and behaviours shape environmental conditions and policies. Population growth and changing demographic patterns (ageing, migration between and within countries, number and size of households) may have major environmental consequences. Education and training, awareness and consumer habits are important elements, as are features of social organisations, institutional arrangements and legal frameworks. The availability and access to environmental information, opportunities for participation and partnerships of individuals, firms and NGOs, and the capacity to have access to courts are important preconditions for triggering integrated, pro-active approaches to environmental management and sustainable development.

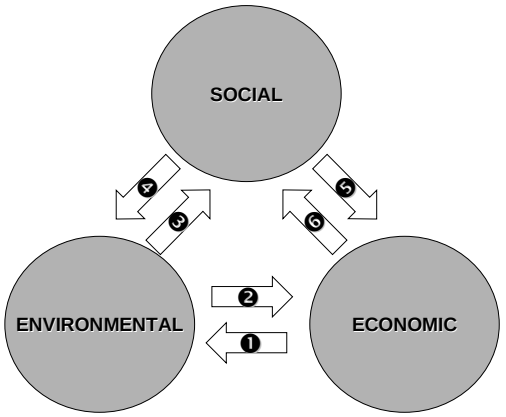
1.3 Economic-social interactions

The interactions between the economic and social dimensions have long been recognised. Many of the links are however not directly observable, hence the difficulty of mapping threats to social sustainability to specific economic forces.

❺ Many social factors act as driving forces behind economic growth and related sectoral trends and patterns (e.g. consumer behaviour and household consumption patterns, time for leisure pursuits, disposable income levels, patterns of urban sprawl, number of households). The provision of human inputs to economic activities is an essential element of a country's economy. Social norms, attitudes and institutions also affect the functioning of markets, for example, by reducing transaction costs. Social policies and related instruments are closely interwoven with economic processes and markets.

❻ Conversely, most economic processes affect society at large, providing the foundation for greater prosperity but also affecting the distribution of economic benefits between individuals, and hence social conditions (cohesion, equity, well-being, etc.).

Inset 1.**The three dimensions of sustainable development – Summary of key interactions**



❶ Effects of economic activity on environmental issues (resource use, pollutant discharges, waste generation); environmental protection and management activities by economic agents; implications of economic policies and market forces (production levels and patterns) for the environment.

❷ Productive functions and services of the environment, (resource and sink functions); implications of environmental policies for economic efficiency.

❸ Provision of environmental services (access to resources, amenities); effects of environmental conditions on health, on living and working conditions; implications of environmental policies and related instruments for society (distributional aspects).

❹ Effects of demographic changes and consumption patters on environmental resources; implications of social conditions and policies for the environment; environmental awareness and education; environmental information and participation; institutional arrangements; legal frameworks.

❺ Quantity and quality of the labour force, population and household structure, education and training; information and participation; consumption levels and patterns; implications of social conditions and policies for economic growth, institutional arrangements; legal frameworks.

❻ Income levels and distribution; employment; implications of economic policies and market forces for society.

2. Key policy challenges

Progressing towards a more sustainable development and hence ensuring the well-being of present and future generations raises important challenges for policy making. It implies that the objectives of increasing economic efficiency and material wealth must take into account social and environmental objectives and must be placed in an inter-temporal framework. It also implies that the capital or asset base of our economies and societies is preserved. There are many options for making use of synergies that should be explored in greater detail. Typically, such synergetic "win-win-win" options can only be identified if all three dimensions of sustainable development are taken into account. Lessons drawn from the OECD's environmental performance reviews[2] highlight the need to step up the integration of government policies, to make greater use of market instruments and to strengthen international co-operation. Further, it underscores the role of indicators in providing appropriate information to policy makers and in informing the public about the results of these policies.

2.1 Preserving the asset base

A key determinant of the potential to satisfy the needs of the present and the next generation is the availability of assets. This includes natural assets, i.e. natural resources and environmental assets; produced assets and financial assets; and human and social assets, i.e. health, education, social institutions, networks and norms. In the absence of technical progress, a condition commonly considered for sustainability is that the total stock of assets is non-declining.

A key question is to what extent the different assets can be substituted for each other. While increasing levels of produced assets and declining levels of natural assets have been among the main features of economic growth to date, respecting minimum levels for natural and environmental assets

2. - *Environmental performance in OECD countries - Progress in the 1990s*, OECD, 1996
- Interim report on the OECD three year project on sustainable development, SG/SD(99)1

may be critical for sustainable development. This issue is most relevant when the asset decline is irreversible, as in the case of some non-renewable resources and of renewable resources that are exploited beyond their capacity of reconstitution. In the case of social assets, the need to renew and maintain the stocks of human and social capital in the face of various demographic and social pressures is increasingly recognised as an important issue that deserves further investigation.

2.2 Fostering the integration of government policies

Progress towards sustainable development will necessitate much stronger integration of government policies than has been achieved so far by Member countries, and wider adoption of result-oriented policies, i.e. policies explicitly aimed at achieving specified objectives. This can be promoted by: i) broad strategies that incorporate economic, social and environmental dimensions from the outset; ii) a close dialogue between relevant ministries; iii) stronger co-operation among the various levels of government; and iv) a full engagement of industry, the general public and other stakeholders. Progress towards sustainable development will require significant changes in production and consumption patterns to avoid that current patterns continue to outpace improvements in technology and in environmental protection. This can be promoted by increasing consumer awareness and expanding use of integrative approaches such as life cycle analysis and extended producer responsibility. In this perspective, it is important that governments provide the conditions that promote individual and corporate responsibility.

2.3 A greater role for market forces

Ensuring sustainable development also requires greater use of market forces through removal of distortions caused by subsidies that affect environmental and social conditions adversely and through provision of price signals that promote internalisation of externalities. The importance of externalities has long been recognised for environmental and natural resource issues; but they are also pervasive in other policy areas such as technology, training and education policies, where the divergence between private and public returns may lead to under-investment and depreciation of skills.

2.4 International co-operation

Even though action is required at the domestic level, progress is also required to address transfrontier, regional and global problems. Globalisation means that linkages among the activities and interests of nations are tightening. OECD countries could do much more to strengthen the coherence between their trade, investment, environment and development policies and to involve major non-members in efforts to address global environmental concerns, such as climate change and biodiversity, and to ensure compliance with social and environmental safeguards.

3. The role of sustainable development indicators

To successfully meeting the challenge of sustainable development, both nationally and internationally, a participatory approach is essential. Decisions need to be supported by broad-based consultative and awareness-raising activities, by openness in decision making and by high quality assessment processes. In this context, it is essential that all players have access to appropriate information, and that meaningful indicators are made available.

Sustainable development indicators are needed to raise the profile of sustainable development issues in the public debate, to inform decision making in identifying major conditions for sustainability and in monitoring progress by establishing baseline conditions and trends. In particular, indicators can play an important role in raising awareness about the inter-linkages and trade-offs among the various dimensions of sustainable development, and the longer term implications of current decisions and behaviours.

III. OECD WORK ON SUSTAINABLE DEVELOPMENT INDICATORS

1. Background and mandate

In November 1997, the High-Level Advisory Group on the Environment to the OECD Secretary General, recommended[3] that the OECD should become the leading international organisation analysing how best to harmonise economic, environmental and social policies and that it should embark on the development of a set of sustainable development indicators supported by reliable and comparable data sets.

In response to this request, Ministers asked the OECD at the Ministerial Council Meeting of April 1998, to undertake a three-year programme to help Member countries address fundamental sustainable development issues. This involves making the concept of sustainable development operational for public policies and moving beyond a sectoral approach to a more integrated approach. It also involves the development of appropriate tools to monitor progress towards sustainable development.

Following the Rio Conference in 1992, the number of international and national initiatives on sustainable development indicators has been expanding, stimulated by the work of the United Nations Commission for Sustainable Development[4] (UNCSD). Most of these initiatives were driven by demands from environmental decision makers and stakeholders, with the result that sustainable development has often been considered as an environmental issue.

Environmental indicators, complemented with selected economic indicators, have generally provided the first basis for sustainable development indicators but social aspects have received increasing attention. There is also considerable interest in indicators that better reflect the linkages between the three dimensions of sustainable development and in a reduced number of indicators that provide key signals to policy-makers and the general public.

2. Link to other international initiatives

To guide the overall OECD programme, an OECD Round Table on Sustainable Development has been established in 1998. It gathers, in a personal capacity, high-level officials from other international organisations (e.g. World Bank, World Trade Organisation, UNEP, UNCTAD, UNDP), Ministers of Environment and Finance, and officials from business and NGOs.

The OECD's work on sustainable development indicators has been closely co-ordinated with other international indicator initiatives, in particular with the work of the UNCSD to which the OECD has actively contributed, and with the work of the World Bank.

This co-operation is essential to achieve synergies and advance knowledge about measurement of sustainable development. It is also essential to help identifying commonalities in international work and to clarify the specific purposes of the various initiatives.

3. *Guiding the Transition to Sustainable Development: A Critical Role for the OECD.*
4. The UNCSD adopted in 1995 a Work Programme on Indicators of Sustainable Development with the objective to develop, by 2001, a set of indicators for use in national decision making. An initial set of 134 indicators organised in the Driving Force-State- Response framework has been tested by volunteering countries, including Austria, Belgium, United Kingdom, Germany, Finland, France and the Czech Republic and Mexico. Current work focuses on further prioritising and linking the indicators.

3. Current OECD work and approach

Sustainable development indicators can be seen as a juxtaposition of indicators or sets of indicators that are relevant to monitor particular policy concerns and targeted at particular audiences. A more ambitious task is to further combine these indicator sets in a way that is useful for practical policies. Work within the OECD concerns both levels with the requirement that it should lead to indicators whose quality is defensible on both conceptual and practical grounds and whose information content, and thus potential use in policy making, justifies the development.

The OECD work encompasses the several types of indicators, each responding to specific policy questions:

- Resource indicators, which may be used to describe the accumulation and depletion of capital (produced, natural, and social assets). These indicators provide information on how current patterns and activities are impacting on future opportunities.
- Outcome indicators:
  - in the economic, environmental and social fields, which may be used to characterise the direction and quality of the development that are being achieved;
  - in specific sectors, which may be used to monitor the integration of economic, environmental and social concerns at the sectoral level. These sectoral indicators describe how development and policies at the sectoral level interact with environmental and social conditions and with economic efficiency.[5]
- Summary indicators, which combine and/or select information from a number of areas and which aim to provide a broad picture of the current path towards sustainable development.

OECD work benefits from work in Member countries and other international fora, and builds on OECD's experience with economic, environmental and social indicators. These indicators cover both the "outcomes" of the development process, and the "inputs" (or assets) that support it, with various degrees of sectoral and spatial detail.

Standard economic indicators like real GDP and inflation, and some socio-economic indicators like unemployment rates, represent a key base for economic policy formulation. Other measures, such as environmental and social indicators have a shorter history and their impact on policy making remains more limited.

Over the past ten years, however, environmental indicators have gained in importance. In a number of OECD countries, these indicators are increasingly used in planning, clarifying policy objectives and priorities, budgeting, and assessing policy performance. More recently, interest in broader sets of social indicators as a tool for policy evaluation has been increasing.

4. Core indicators

4.1 Towards an operational set of sustainable development indicators

Moving from a juxtaposition of individual indicator sets to an operational set of sustainable development indicators requires a good understanding of how different driving forces and policies interact, as well as a good knowledge of underlying concepts and definitions. It also requires a good understanding of member countries' political priorities, and of their economic, social and environmental contexts. It can be achieved:

5. Much of this work has focused on sectors or activities that play a key role in the sustainability of a country's development and where government intervention is important. Examples are: transport, agriculture, and energy. See pages 202, 250, 292 for further details.

- Through structuring the indicators and/or indicator sets in appropriate conceptual frameworks[6] covering all relevant dimensions of sustainable development, and within which the relationships of different policy goals, the links between indicators and goals, and the interactions between different indicators are made apparent.
- Through the careful selection of core indicators that provide key signals to high-level policy makers and to the general public, and whose combined use helps to raise the profile of sustainable development issues.
- Through the aggregation of selected indicators into sustainable development indices. Aggregated measures are in general considered with caution and lack international consensus about the choice of the component indicators and their relative importance within an overall index. Their development is thus a rather long term effort and is not discussed in this paper.

Inset 2. **OECD work on environmental indicators**[7]

Environmental indicators have been part of the OECD's work on environmental information and reporting since the late 1970's. A specific programme using a harmonised approach was initiated in the early 1990's responding to the request of G7 summits (Paris, Houston, and London) and the OECD Council. It includes several types of indicators:

- an OECD Core Set of environmental indicators, that represents a minimum set of indicators common to OECD countries and to different uses and purposes,
- several sets of sectoral indicators, to promote integration of environmental concerns into sectoral policy making.
- indicators derived from environmental accounting, to promote both integration of environmental concerns into economic policies and sustainable use and management of natural resources.

Work on international environmental indicators has led to i) the use the pressure-state-response (PSR) model as a common harmonised framework; ii) the identification and definition of indicators based on their policy relevance, analytical soundness and measurability; iii) the regular use of the indicators in the OECD's environmental performance reviews and iv) the provision of guidance on how to use them. The results of this work, and in particular its conceptual framework, have influenced similar activities by countries and other international organisations.

Inset 3. **OECD work on social indicators**[8]

The case for social indicators has long been recognised. A first list of social indicators was developed by OECD in the early 1980s[9]. Many of these indicators have since been published in a number OECD publications, but regular reporting was never implemented. In June 1998, Social and Health Policy Ministers mandated the OECD to develop a comparable set of social indicators with the aim of summarising the social status of OECD Member countries, and providing a tool for assessing the cost-effectiveness of measures taken to pursue social objectives.

In response to this mandate, the OECD has developed a provisional listing of social indicators, which reflects current social policy concerns and the following underlying objectives:

- promoting autonomy;
- equity;
- healthy living; and
- social cohesion.

The list distinguishes i) social context indicators, ii) social status indicators, and iii) societal action indicators. It has been limited to key indicators covering education, labour markets, the family, ageing, health, expenditure on social policy and income distribution. It is expected to further evolve as discussions within relevant OECD bodies progress.

6. See page 65 for further details.
7. See page 101 for further details.
8. See page 151 for further details.
9. *Living Conditions in OECD Countries*, OECD, 1984.

The OECD experience suggests that, in the short term, practical progress can best be achieved through a process focusing on a set of core indicators. Such a list could provide a useful tool for current OECD work on country reviews and policy analysis. It would also respond to the increasing interest by Member countries in a reduced number of indicators selected from existing larger sets.

4.2 The core set approach

Selecting a set of core indicators has both benefits and limits. On the one hand, by presenting indicators from various disciplines together, it allows key aspects of sustainable development to be communicated in a simple way and thus to raise the profile of sustainable development issues in the public debate. On the other hand, it is recognised that core indicators are not designed to provide a full picture of economic-social-environmental relationship, but rather to capture key trends and draw attention to selected issues that require further analyses. These limits need to be taken into account when using such indicators.

At international level, the core set approach has the benefit of using indicators that are common to different countries, that respond to different uses, and that can be meaningfully compared across countries. The OECD Core Set of environmental indicators and the OECD list of social indicators are examples of this approach. The list of indicators of development progress set up jointly by the UN, the World Bank and the OECD is another example for developing countries. The core set approach is also used by the UNCSD to further prioritise its working list of sustainable development indicators.

At national level, the benefits are similar; it allows the use of indicators that are common to different sub-national units, that respond to different uses, and that can be meaningfully compared across the country. The core set approach has been adopted by a number of OECD countries when developing environmental and sustainable development indicators. A similar approach, pursued in several OECD countries, is that of further reducing the number of core indicators to so-called "headline" indicators.[10]

4.3 Scope and criteria

Applying the core set approach to sustainable development indicators requires:

- A balanced coverage of the three dimensions of sustainable development (economic, social, environmental). Monitoring progress towards sustainable development requires indicators that point to how well policies in the economic, environmental and social fields are performing in relation to this overall goal. Particular attention should be given to indicators that are of significance for at least two of the three dimensions.
- The identification of key issues for which indicators are needed, i.e. those that are of common relevance to sustainable development progress in OECD countries. This should draw upon the OECD's accumulated experience in policy analysis and evaluation. Particular attention should be given to a medium- and long-term view of developments in the various fields. Such a view is important for assessing the scale of a number of threats to the environment, such as climate change, but also in the social area, where long-term demographic developments may pose threats to the financial sustainability of, for example, pension and health systems.
- The use or development of a framework that reflects the integrated nature of sustainable development while organising core indicators in a way useful to decision-makers and the public. Frameworks based on the OECD "pressure-state-response" (PSR) model, for example, have proven very useful to structure OECD work on environmental and sectoral indicators, and UNCSD work on sustainable development indicators. Accounting

10. Several OECD countries have pursued this approach; see Sustainability Counts: Consultation Paper on a set of 'headline' indicators of sustainable development, United Kingdom, 1999; see also page 184.

frameworks have proven useful to structure economic statistics; they have further the potential to link monetary and physical data, to trace basic stock-flow relationships of natural resources and to serve as a basis for constructing indicators of sustainability such as the intensity of natural resource use and genuine savings.

- The careful selection of indicators that best reflect major trends related to these issues. These indicators can be selected from existing sets and complemented with new indicators to fill remaining gaps. As indicators can serve different purposes and uses, the number of potentially useful indicators is fairly large. It is therefore necessary to agree upon the criteria that should guide and validate their choice. In the environmental field the OECD applies the following criteria: policy relevance, analytical soundness, and measurability. These criteria can equally be applied to sustainable development indicators with a few minor adjustments.

4.4 A possible core set of sustainable development indicators for OECD work

While it may be premature to identify a small set of core sustainable development indicators, a preliminary selection can be made on the basis of existing sets and of the OECD's accumulated experience in the economic, environmental and social fields. Such a pilot set could serve as a basis for further discussions and as a short term tool for ongoing OECD work.

The list shown here is designed to spark a discussion at the conference. Most of the indicators given as examples are based on inputs from existing indicator work and on data currently available for a majority of OECD countries. A few indicators require further conceptual and data work. The list covers the three dimensions of sustainable development with a focus on those indicators that are relevant to at least two of the dimensions, for example those describing the economic-environment interface. It is expected to be supplemented with country specific indicators and with other more detailed sectoral and thematic indicator sets whenever necessary.

Table 1. **Illustrative list of possible core indicators**

Main issues	Examples of possible core indicators or topics	Related OECD work and publications
Economic aspects		
1. Economic development and growth	♦ Gross Domestic Product per capita; Net National Income per capita	Main economic indicators
2. Asset replacement	♦ Net saving rate	Annual national accounts
3. Productivity	♦ Total Factor Productivity	Economic outlook
4. Financial status	♦ Net foreign debt/GDP; Net and gross government debt/GDP	Economic surveys
Social aspects		
1. Employment	♦ Unemployment rate	Employment outlook
2. Education	♦ Attainment; Participation	Education at glance
3. Health	♦ Life expectancy	OECD Health Data Base
4. Income	♦ Incidence of poverty	OECD social indicators
Environmental aspects		
1. Climate change	♦ CO2 emission intensities	OECD Core set of environmental indicators Environmental indicators, biennial publication Environmental performance reviews, 4 countries per year, since 1992
2. Air	♦ SOx and NOx emission intensities	
3. Waste	♦ Waste generation intensities	
4. Water	♦ Population connected to waste water treatment plants	
5. Natural resources	♦ Intensity of use of renewable resources (e.g. water, forest)	
	♦ Intensity of use of non-renewable resources (e.g. minerals, energy)	
6. Biodiversity	♦ Share of threatened species	
	♦ Protected areas	

Note: Based on the Interim report on the OECD three year project on sustainable development [SG/SD(99)1]

5. Major areas for progress

The experience of OECD and its Member countries in developing and using indicators in the economic, social and environmental fields, together with more recent national and international initiatives on sustainable development indicators, provide a good basis for developing indicators to measure progress towards sustainable development at OECD level.

It is however important to recognise that the proposed indicators are derived from sets developed independently from each other and whose original purpose has not been the measurement of sustainable development progress. More work is required to further refine and link the indicators and to fill remaining gaps. The indicators are thus expected to evolve as work on underlying indicator sets carried out by the relevant OECD bodies progresses and as policy work on sustainable development moves forward.

It is also recognised that there is still a lag between the demand for sustainable development indicators, the measurability of underlying data sets and the actual use of such indicators. Whereas economic, social and environmental indicators have individually proven their value in policy formulation, the use of a combined set of sustainable development indicators in the overall policy debate needs to be further strengthened. To gauge how well policies are performing with respect to sustainable development and to identify shortcomings that may arise, it is necessary to increase the perceived value of such indicators.

Progress is needed in:

- identifying a core set of sustainable development indicators common to OECD countries and to different uses in the economic, social and environmental fields;
- examining approaches to further linking and combining environmental, social and economic indicator sets. Ultimately, full integration of selected indicators will require a greater understanding of the interrelationships among the various aspects of sustainable development, and an agreement on a conceptual framework that organises and communicates core indicators in a simple and understandable way;
- identifying and filling remaining gaps in the indicator coverage, and in particular raising the profile of social aspects and of their inter-relationships with environmental conditions and policies;
- placing further emphasis on developing indicators measuring externalities, and describing societal responses including economic and fiscal instruments;

Progress is also needed in:

- further improving the availability and comparability of underlying data sets;
- exploring how much aggregation would be useful without loosing transparency.

Experience shows a strong interdependence between progress at national level and progress at international level. The OECD can play a catalytic role with respect to national efforts by stimulating further national initiatives through: sharing experience among Member countries; systematic use of the indicators in OECD analysis of national policies; and regular publication of the indicators.

Inset 4. **Criteria for selecting environmental indicators**

POLICY RELEVANCE AND USEFULNESS FOR THE USER	An environmental indicator should: ♦ provide a representative picture of environmental conditions, pressures or society's responses; ♦ be simple, easy to interpret and able to show trends over time; ♦ be responsive to changes in the environment and related human activities; ♦ provide a basis for international comparisons; ♦ be either national in scope or applicable to regional issues of national significance; ♦ have a threshold or reference value against which to compare it, so that users are able to assess the significance of the values associated with it.
ANALYTICAL SOUNDNESS	An environmental indicator should: ♦ be theoretically well founded in technical and scientific terms; ♦ be based on international standards and international consensus about its validity; ♦ lend itself to being linked to economic models, forecasting and information systems.
MEASURABILITY	The data required to support the indicator should be: ♦ readily available or made available at a reasonable cost/benefit ratio; ♦ adequately documented and of known quality; ♦ updated at regular intervals in accordance with reliable procedures.

*Extract from "Environmental indicators for environmental performance reviews", OECD, 1993.
**These criteria describe the "ideal" indicator and not all of them will be met in practice.

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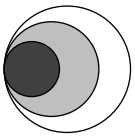
OECD SOCIAL INDICATORS

PROPOSED FRAMEWORK AND STRUCTURE*



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* This is a revised version of a paper discussed by the OECD Employment, Labour and Social Affairs Committee in October 1999. It builds on a paper presented at the *Siena Group Meeting*, 22-24 May 2000, Maastricht.

I. INTRODUCTION

Although the demand for social indicators has recently become more pressing, the case for such indicators has long been recognised. The OECD developed a list of such indicators already in the early 1980s. Most of these indicators are published on an annual or irregular basis in OECD publications or elsewhere, even though regular reporting was never implemented.

In 1998, OECD Social and Health Ministers agreed that the availability of suitable social and health indicators would provide a valuable tool to assist in any comparison of the results of social programmes across countries. An improved base of information about the population, available on a comparative cross-country basis, would support this effort. Ministers gave a high priority to developing a comparable set of such indicators and supported OECD work in this area, emphasising in particular continued OECD development of health outcome indicators.[1]

This paper describes the structure for the new OECD collection and an initial listing of social indicators. This listing is explicitly *ad hoc,* designed to enable a publication in the near future. It does not pre-empt any decision which may or may not be made on the development of a more formal analytic framework for social indicators.

II. THE NATURE OF THE NEW OECD COLLECTION

Any listing of social indicators should reflect the purposes for which they are intended. Various possibilities exist. One common reason for compiling social indicators is that the most commonly used indicator of the well-being of society -- GDP per capita -- does not capture a whole range of other variables which affect the quality of life. One key objective of social indicators is that they should *describe the social conditions* in different OECD countries and over time.

Another, more ambitious, objective has often been proposed for social indicators: they should *describe the effectiveness of public policy* in ameliorating the social situation in countries. This requires that (at a minimum) two types of indicators be identified: those which reflect the objectives of policy, and those which summarise the policy input. Data limitations make such an objective as much aspirational as realisable. At the very least, such an approach draws attention to the paucity of existing data on societal interventions in the social sphere. An attempt is made in the OECD list to address this objective.

III. OTHER APPROACHES

Many people and institutions have developed indices which weight a range of measures, such as life expectancy, pollution, job insecurity, access to public goods, etc. in order to come up with an underlying measure of the social development of a country. The difficulty with such weighted indices in an international context is that there is no reason to believe that agreement can easily be achieved on

1. Communiqué of the June 1998 meeting of OECD Social and Health Ministers.

the weights to be given to the various variables. A society which puts great weight on social solidarity may well prefer to stress variables other than GDP per capita as being of great importance, but this is not necessarily true of countries which put material gain at the centre of their approach. For that reason, no index of social development is proposed.

It is possible to envisage two other approaches. One is to adopt a *unifying framework* for collecting statistics of use in social policy analysis, using this to identify gaps in data collection and drawing from the framework those indicators of most use in describing and explaining differences in social policy and social status. One such unifying framework could be time spent in different activities or states over the life course. Such an approach would imply that data should move beyond looking at the number of unemployed, or poverty 'headcounts", towards a greater focus on how much time is spent in unemployment, or in poverty. Insights derived from greater use of panel data can be presented with some ease in such a framework.

A second alternative approach would be to build on the fact that many published national statistics are disaggregated in similar ways (by income level, family type, etc). Systematic collection of such information could lead to insights on similarities and differences across countries, without necessitating a common data collection framework. Such an approach would permit a linkage with only widely-used international data framework in the area of economic and social policy -- the system on national accounts.

The OECD has concluded that while both of the alternative approaches were potentially of interest, they should be seen as options for the future evolution of social indicators, rather than short-term alternatives to an ad hoc approach.

IV. PROPOSED FRAMEWORK AND STRUCTURE

1. The 'PSR' approach

A *structured grouping* of indicators has been adopted. This structure falls well short of being a full-scale framework for the collection of social statistics, but nevertheless is more than a straightforward, one- (or possibly two) dimensional listing of indicators as in existing lists of social indicators. The reason for having a structured grouping is that the 1982 OECD listing (Annex C), and those of other international organisations, are not oriented to the assessment of policy effectiveness. If this is to be the goal, policy response indicators need to be assessed against policy outcome indicators.

Colleagues using indicators in other parts of the OECD have encountered the same problem, and their experience has provided some guidance as to how we can achieve this. For example, the highly-successful set of education indicators published in *Education at a glance* is implicitly structured into a three part grouping: context; inputs (including expenditures); and outputs.

The OECD Environment Directorate uses a different approach in its set of Environmental Indicators (*Towards Sustainable Development: Environmental Indicators).* It has a model based on what is known as a 'PSR' framework[2]. In the environmental area:

> *Human activities exert pressures on the environment and affect its quality and the quantity of natural resources (state); society responds to these changes through environmental,*

2. The PSR framework has also given rise to the *Driving force -- State -- Response* (DSR) model used by the UN Commission for Sustainable Development; and the *Driving force -- Pressure -- State -- Impact -- Response* (DPSIR) model used by the European Environment Agency. See p.111 for further details.

general economic and sectoral policies and through changes in awareness and behaviour (societal response). The PSR model has the advantage of highlighting these links, and helping decision-makers and the public see environmental and other issues as interconnected.

Examples of '*pressures'* include indirect pressures (indicators of sectoral activities such as energy, transport, industry, agriculture, etc.) and direct pressures (pollutant and waste generation, resource use). Examples of the '*state'* of the environment are measures of air, water, land quality, ecosystem health, etc. Examples of '*responses'* include various measures of the extent of policy interventions for environmental purposes (such as expenditures, environmental taxes, etc.). The attraction of the approach is that it focuses on broad indicators of what government and society do (response indicators) with broad indicators of what they are trying to influence (state and pressure indicators).

The OECD initially tried a similar approach: it divided proposed social indicators into three categories. However, the three groupings differed somewhat from the pure PSR model[3]:

1) Social context. These are those social variables, which are not usually directly the target of policy, or which may be policy objectives, but only in the longer term. Nevertheless they are crucial for understanding the context within which social policy is developed. For example, except in the very long run, the dependency ratio is not the target of policy. However, developments in the dependency ratio are of importance in understanding more immediate developments (the living standards of the elderly, for example).

2) Social status. These are, to the greatest possible extent, descriptions of those social situations that are of highest current priority for policy action. These indicators should be chosen so that the variables are easily and unambiguously interpreted -- all countries would rather have low poverty rates than high ones, for example.

3) Societal actions. These indicators illustrate what society is doing which may affect social status indicators. Most such actions will be government policies, but wider definitions of societal actions might sometimes be useful; for example, indicators of the activities of non-governmental organisations in the social sphere; the development of private pension saving insofar as this is an important pillar of retirement income policy; actions taken by individuals and families which address some key social issues (i.e. elderly living with their children). However, as data on government policy is generally of better quality than data on societal responses more generally, the initial listing below focuses almost exclusively on the role of the public sector.

However, the distinction between 'social context' and 'social status' cannot always be made in a clear-cut manner. Fertility is an objective of pro-natalist policies in some countries, but is in the social policy background in others. Family breakdown can be seen as a failure of family-support policies or as leading to growth in families at risk of economic insecurity, or both. Inevitably any dividing line is arbitrary. Nevertheless, there is clearly some difference in the degree to which governments might affect unemployment on the one hand and age dependency ratios on the other. Hence the distinction between them may be dropped when the data are published.

3. In the environmental indicators, pressure indicators are 'flow' data (emissions, waste generation, resource use) which affect 'stocks' of environmental goods (water or air quality, bio-diversity). Public responses may target both the flows and the stocks. There is no corresponding analogy in social policy. Whilst it is no doubt possible to separate flow and stock data ('flows onto benefit', 'number of people on benefit at any one point in time'), this will not always be true for all possible policy areas, and the issues upon which such data would shed light can often be addressed more directly using longitudinal data (see below).

2. The use of the indicators

One objective given for social indicators is to describe the social condition of the population. The *social status* measures in themselves do this.

The other objective given for the social indicators is to measure policy effectiveness. The *social status* indicators can also be interpreted as the *outcome* of policy, measuring one particular dimension of what social policy is aiming to do. Response measures give one (or more) dimension of the scale and nature of social policy interventions. Confronting *action* indicators with *status* indicators provides a first-order indication of policy effectiveness. This is not to say that something so crude as dividing one by the other to determine cost effectiveness is justified; simply, that if the indicators have been chosen well and the measures of *societal actions* are high compared to average and the indicators of *social status* low, then there is justification for questioning why there is an apparent anomaly.

Social context indicators are included to help in interpretation of policy effectiveness. Such indicators are intended to enumerate those quasi-exogenous variables which 'explain' some part of the *social status* indicators, regardless of the response indicators. Hence the age dependency ratio is an important variable in interpreting the income status of the elderly, but is not directly influenced by public policy. Hence the intention of *social context* indicators is to give some impression of the differences across countries within which public policy operates. The policy effectiveness of response indicator X can be determined by social situation indicator Y, given exogenous social trend indicator Z.

It is not intended that there should be a 'one-for-one' relationship between *societal actions* and *social status* indicators. However, some sort of underlying grouping of indicators into very broad policy fields may well prove useful. Various possibilities exist. One option would be to define policy areas which have recognisable counterparts in public budgets (invalidity, old age, etc.); another would be to use a life course classification (children, youth, working age, etc.). However, some key indicators, such as income distribution, cut across such categories. It is proposed instead that four underlying *objectives* of social policy be used to classify indicators:

- *Self-sufficiency*
- *Equity*
- *Health*
- *Social cohesion*

Self-sufficiency has been increasingly stressed as an underlying objective of social policy. It is promoted by ensuring active participation in the economy and society.

Equity in this context refers mainly to equity of outcome (policies which seek to overcome social or labour market disadvantage, thereby promoting equality of opportunity, are here classified as having as a primary function the promotion of autonomy). Equitable outcomes can be measured mainly by the access of households to resources.

The underlying objective of health care systems is to promote *Health,* which leads to a broader focus than an emphasis on disease and its cure, towards broader social factors which can affect mortality and morbidity.

The criteria *Social cohesion* is often identified as an over-arching objective of the social policies of countries, but its definition is rarely attempted and there is unlikely to be cross-country agreement on what precisely it means. However, it is possible to identify various pathologies which have been mentioned as causes of the lack of social cohesion, which do have resonance as objectives of social policy, albeit not ones where cause-and-effect of social policies is straightforward. This is true, for example of crime rates (particular those relating to property); industrial strife; integration of different nationalities; and family stability.

As many societal actions have an impact on multiple areas of social policy, they could be recorded in more than one of these broad headings. This is most true for measures to promote labour market participation, which are undertaken in order to improve the living standards of those who benefit from them. Similarly, the ability to undertake activities of daily living without assistance is both a sign of autonomy, and of health; and drug abuse may signal lack of social cohesion as well as leading to poor health.

The problem of indicators which could be classified under many different headings is not a problem particular to social policy[4]. The response in this and other indicator listings is to indicate which indicators would be included in a *comprehensive* listing under each heading, but not to publish the indicator more than once in each publication.

3. Criteria for choosing indicators

The OECD has 29 countries which vary substantially in their collection of statistics. In choosing the indicators, a choice has to be made as to whether only indicators which are already available on an internationally comparable basis for all countries should be chosen or, if not, how significant a departure from this principle should be allowed.

The suggested list does not insist on absolute comparability in data across countries. Such a condition would, for example, rule out most income distribution and poverty statistics. Work in this area has indicated the nature and extent of bias in comparisons between countries, and it is suggested that suitable sourcing and description of data will alert users of the statistics to potential pitfalls. The alternative of insisting on complete comparability may well reduce the listing to a small and familiar set of widely-available numbers.

The approach has sought to maximise country and geographic coverage. As a general rule, the list includes only those indicators where there is a resonable probability of collecting data for at least half of OECD countries, including both EU and non-EU member states. However, this rule is relaxed in some circumstances. Where there are known limitations in widely-available data, supplementary indicators which illustrate the limitations of the main indicators should be included. Such reasoning explains, for example, the including of measures of the *net social spending* in countries, and the *workless households,* even though such indicators are available for only a minority of countries.

No new large-scale data collection exercise is proposed (though this should not preclude collection of national data with a view to determine whether data definitions are sufficiently similar to permit use as indicators). The ability or otherwise of the indicator list to meet the objectives of summarising societal conditions and to indicate policy effectiveness may indicate where further work in data collection may be warranted.

3.1 Gender, household status, region and age

All indicators should be broken down by age group, family type and gender wherever possible. Use of individual or household data varies according to indicator. No attempt will be made at this stage to collect data for sub-national regions or units of government, although the OECD Territorial Development Service is developing separately a procedure for collecting such data.

3.2 Measurement units and time periods

In the absence of any common statistical framework, no attempt is made to record data in common units. Hence, indicators will be in a mixture of head counts, currency units, percentages of

4. For example, emission of some airborne pollutants is a key indicator determining the quality of air, land *and* water resources.

GDP, etc. Given an interest in understanding longer term trends and patterns of change in social conditions, it will be necessary to have access to data which is comparable over time.

3.3 Subjective and objective data

Some data exists on the opinions of people -- whether they believe the lives of their children will be better than their own; whether they consider themselves healthy, or happy; whether they trust the main institutions of society; whether society is 'fair', etc. No such data is included in this collection, although data on subjective health status is included in the companion series *OECD Health Data*.

V. THE INDICATORS CHOSEN

The indicators suggested are listed in Annex A; Annex B provides more details on definitions and sources. Most indicators exist in one form or another already; many are already published in various OECD publications on a regular basis. Others have been collected on an *ad hoc* basis for particular projects. It is particularly in these cases that we will use this opportunity to expand country and time coverage.

The majority of the indicators are drawn from underlying databases where co-operation between the organisations is either taking place (OECD labour force statistics, social expenditure data bases, some health data etc.) or is under discussion (Benefits and Incentives, other health data). Contacts have been established with several United Nations and European Union agencies in order to obtain standard definitions for the social indicators and ensure their international comparability.

Taking a broad view on the objectives of social policy, rich international surveys such as the International Crime Victim Survey of the UNICRI (United Nations Interregional Crime and Justice Research Institute) or the World Values Survey of the Institute for Social Research of the University of Michigan have also been used.

It appears that there are far fewer good-quality response indicators than social situation indicators. This might be taken as suggesting a need for more effort in improving data collection describing public and private action, including private social spending and information on numbers of people and households receiving different benefits and services.

For these reasons, almost all the indicators in Annex B are already available to the OECD Secretariat. There are only three for which explicit requests will be necessary, namely benefit dependency, institutionalisation of the elderly and drug deaths.

VI. SOCIAL INDICATORS IN OTHER INTERNATIONAL ORGANISATIONS

Annex E gives a listing of the indicators produced by three organisations: the World Bank, the European Union, and three agencies of the United Nations. (No special mention is made of health indicators. Co-operation between the European Union, the World Health Organisation and the OECD on developing systems of health indicators is already taking place).

The indicators in these lists are valuable. Clearly, many indicators in any OECD list will be contained in the listings by these other organisations. However:

- many of the variables in the World Bank and UN listings are aimed primarily at less developed economies. These listings would be of limited use to OECD countries.
- in some areas, the listings of other international organisations are fairly conservative, with little use being made of more novel approaches, such as disability-free life expectancies, longitudinal data, etc.
- these listings are not suitable for assessing 'policy effectiveness'.

Clearly, given the likely overlap, there is a need to ensure that any OECD list uses existing data sources, be they collected by the OECD or other organisations.

ANNEXES

A. INITIAL LIST OF OECD SOCIAL INDICATORS

Context indicators

- Accidents
- Age dependency ratios
- Age of women at first childbirth
- Asylum-seekers*
- Divorce rate
- Fertility rates
- Foreign-born population
- Group membership
- Lone parents
- Voting

A. Self-sufficiency

Social status

- Unemployment
- Workless households
- Employment
- Jobless youth
- Retirement age

Societal response

- Activation policies
- Early childhood education
- Educational attainment.
- Educational expenditure
- Literacy
- Replacement rates
- Tax wedge

B. Equity

Social status

- Low income
- Income inequality
- Low paid employment
- Wage gender gap

Societal response

- Minimum wages
- Public social spending
- Private social spending
- Net social spending
- Benefit dependency

C. Health

Social status

- Disability
- Life expectancy
- Potential years of life lost
- Infant mortality
- Institutionalisation of the elderly

Societal response

- Health care spending
- Health infrastructure
- Health co-payment

D. Social Cohesion

Social status

- Suicides
- Working mothers
- Crime against property
- Drug abuse and deaths
- Strikes

Societal response

- Prisoners

B. INDICATOR DEFINITIONS, DATA SOURCES AND AVAILABILITY

Indicator	Definition	Sources	Variables	Number of countries
Context indicators				
Accidents	a) Work accidents: accidents per 100 000 people occurring at or in the course of work. b) Road accidents: accidents per 100 000 people	◆ a) ILO, Eurostat ◆ b) European Conference of Ministers of Transport	resulting in injury, death	a) nearly all
Age dependency ratios	a) Persons aged under 15 or over 65 / people between 15 and 64 b) Persons aged 65 and over / people between 15 and 64	◆ UN Populations Database		All
Age of women at first childbirth		◆ Eurostat and national sources		26
Asylum-seekers	Inflows of asylum-seekers as a percentage of resident population	◆ OECD International Migration Database ◆ United Nations High Commissioner on refugees ◆ Published in SOPEMI		23
Divorce rate	Divorces per 1000 married couples	◆ Eurostat and national sources		23
Fertility rates	a) Total fertility rates b) Completed fertility rates c) Age-specific birthrates	◆ Eurostat ◆ National surveys ◆ Published in *Family, Market and Community*		Nearly all
Foreign-born population	Share of foreigners or foreign-born in total population	◆ OECD International Migration Database ◆ Published in SOPEMI		21
Group membership	Average number of groups (such as social welfare services, religious organisations, trade union associations…) per respondent in each country.	◆ World Values Surveys		22
Lone parents	Incidence of lone parent families as a percentage of all households with children	◆ Eurostat and national sources		21
Voting	Percentage of those eligible who vote in the 'main' parliamentary and/or Presidential elections	◆ Institute for Democracy and Electoral Assistance (IDEA)		28

Indicator	Definition	Sources	Variables	Number of countries
A. Self-sufficiency				
Unemployment	a) Unemployment as a percentage of the labour force b) Long term unemployment as a percentage of total unemployment	◆ OECD LFS database ◆ Published annually in *Employment Outlook*	by age group and sex	All
Workless households	Risk of non-employment for working age households	◆ OECD LFS database ◆ Published in *Employment Outlook,* 1998 edition		17 (mid-1980s) 23 (mid-1990s)
Employment	a) Number of employed as a percentage of the working age population b) Labour force as a percentage of the working age population	◆ OECD LFS database ◆ Published annually in *Employment Outlook*	by age group and sex	All
Jobless youth	Proportion of young people not in school or employment in the corresponding total youth population.	◆ Eurostat and national surveys ◆ Published in *Family, Market and Community*	by sex, by age groups: 15-19, 20-24, 25-29	17
Retirement age	Variable is derived from labour forces status data showing falls in net cohort participation rates after a given age.	◆ Secretariat calculations, using LFS	by sex; by different maximum age of retirement.	25
Activation policies	Participant inflows as a percentage of the total labour force	◆ OECD ALMP database ◆ Published annually in *Employment Outlook*		22
Early childhood education	Share of children under 6 years enrolled in primary/childhood education in total children under 6	◆ OECD Education database ◆ Published annually in *Education at a Glance*	early childhood education or primary education	28 (in 1998)
Educational attainment	a) Percentage of the population who have achieved at least upper secondary education . b) Share of young people at school in the corresponding youth population.	◆ OECD Education database ◆ Published annually in *Education at a Glance*	a) by age and sex. b) by age group: 15-19 and 20-24	All
Spending on education	Public and private educational expenditure as a percentage of GDP	◆ OECD Education database ◆ Published annually in *Education at a Glance*	per student by school level: primary, secondary, tertiary	All
Literacy	a) Percentage of the population scoring at IALS literacy level 3 or higher. b) Percentage of the population aged 25-64 who participated in education or training in the previous year	◆ International Adult Literacy Survey ◆ Published in *Education at a Glance, 1998*	by age	a) 12 b) 10
Replacement rates	Initial (1 month - generally unemployment insurance) and long term (60 month - generally social assistance) out of work replacement rates for 40 year old person with 22 years continuous work experience.	◆ OECD Benefits and Incentives Database ◆ Published biannually in *Benefit systems and work incentives*	by family type and earnings level	Nearly all
Tax wedge	Total taxes wedge including employer's social security contributions	◆ OECD Tax Equations ◆ Published annually in *The tax/benefit position of employees* (*Taxing Wages*)	By type of households (single, married)	All

Indicator	Definition	Sources	Variables	Number of countries
B. Equity				
Low income	a) Households with income levels below 50% of the median equivalised household disposable income level. b) Average time spent with low income (50% mean) over a 6 year period. c) Probability of exiting low income over a 6 year period. d) Probability of re-entering low income over a 6 year period.	◆ a) Income distribution questionnaire. Will be published in an OECD monograph ◆ b) and c) and d) ◆ National panel survey, analysis commissioned by OECD. ◆ Various versions published in *Economic Outlook*, 1998 and Economic Studies.		a) 20 b) and c) and d) 6
Income inequality	Gini coefficients of household disposable income	◆ Income distribution questionnaire ◆ Will be published in an OECD monograph		20
Low paid employment	Incidence of low-paid employment (employees working full-time, earning less than 2/3 median earnings) as a percentage of all employees	◆ OECD earnings database ◆ Published in *Employment Outlook, 1997*		12
Wage gender gap	Ratio of average female to male wages	◆ OECD earnings database		21
Minimum wages	Minimum wage rates as a percentage of full time median earnings	◆ OECD earnings database		19
Public social spending	Total public social expenditure as a percentage of GDP	◆ OECD, Social expenditure database ◆ Included in various recent publications	by expenditure category	27
Private social spending	Private social expenditure as a percentage of GDP	◆ Published a recent OECD *Occasional Paper*	by expenditure category	6
Net social spending	Net social expenditure as a percentage of GDP	◆ Published a recent OECD *Occasional Paper*		13
Benefit Dependency	(Benefit Dependency Ratio) Proportion of non-working individuals of working age who receive cash benefits relative to the population in employment. (Benefit Recipients Ratio) Proportion of people receiving benefits in relation to the population in employment.	◆ Derived from national sources		10

Indicator	Definition	Sources	Variables	Number of countries
C. Health				
Disability	Disability-free life years and severe disability-free life years.	• Indicator derived from national sources.	At birth and at 65	14
Life expectancy	Life expectancy at birth and at age 65	• OECD Health database	by age and sex	All
Potential years of life lost	Potential years of life lost by disease, per 100 000 people	• OECD Health database	by sex and source of premature mortality	All
Infant mortality	Number of deaths of infants under one year of age per 1 000 live births	• OECD Health database		All
Institutionalisation of the elderly	Share of the population aged 65 and over living in institutions Share of the population aged 80 and over living in institutions	• Indicator derived from national sources. • Published in *Occasional paper no. 37.*		17
Health care spending	Total public and private health care spending as a percentage of GDP	• OECD Health database		All
Health infrastructure	Equipment indicators: a) hospital beds; b) number of doctors; c) bed utilisation ratios	• OECD Health database		28
Health co-payments	The part of total health care expenditure which is covered under public programs and which is actually paid from public sources of financing	• OECD Health database	by type of medical intervention: in-patient, out-patient, and pharmaceutical	22
D. Social Cohesion				
Suicides	Suicide rates per hundred thousand people	• International Academy for Suicide Research		27
Working mothers	Per cent of working mothers with children	• Eurostat and National surveys • Published in *The Caring World*	single parents/couples, by age of children.	12
Crimes against property	Crimes per hundred thousand people	• International Crime Victim Survey (UNICRI)	by type of crime (against property, person); minor or adult (depending on national definitions)	17
Drug abuse and deaths	Annual prevalence rates Death rates per hundred thousand people	• UNDCP • European Monitoring Centre for Drugs and Drug Addiction (EMCDDA)	Prevalence rates, by type of drug (opiates, cannabis, cocaine, amphetamines and ecstasy)	28 (UNDCP) 15 (EMCDDA
Strikes	Days lost due to work stoppages (1000s of days), different definitions applied to each shown country	• OECD *Main Economic Indicators*		10
Prisoners	Percentage of people in correctional facilities	• United Nations Crime and Justice Information Network	with a distinction between minor and adult (depending on national definitions)	Nearly all

C. Listing of 1982 OECD social indicators

(those included in the new collection are in **bold**)

1. HEALTH:

- Life duration:
  - **Life expectancy**
  - Perinatal mortality rate
- Healthy living:
  - Short-term/long-term disability

2. EDUCATION AND LEARNING

- Use of existing educational facilities:
  - **Educational atttainment**
  - Adult learning
- Learning:
  - **Literacy**

3. EMPLOYMENT AND JOB QUALITY

- Access to employment:
  - **Unemployment rate**
  - Part-time work
  - Discouraged workers
- Job quality:
  - Average working hours
  - Distance to work
  - Paid annual leaves
  - Atypical work schedule
  - Wage distribution
  - Fatal occupational injuries
  - Work environment nuisances

4. TIME UTILISATION

- Free time
- Free time activities

5. PURCHASING POWER

- Income:
  - **Income distribution**
  - **Low income**
  - Poverty rate
- Wealth:
  - Wealth distribution

6. PHYSICAL ENVIRONMENT

- Housing:
  - Dimension
  - Access to outdoor space
  - Access to housing amenities
- Access to outdoor space:
  - Proximity of selected services
- Nuisances:
  - Exposure to air pollutants
  - Exposure to noise

7. SOCIAL ENVIRONMENT

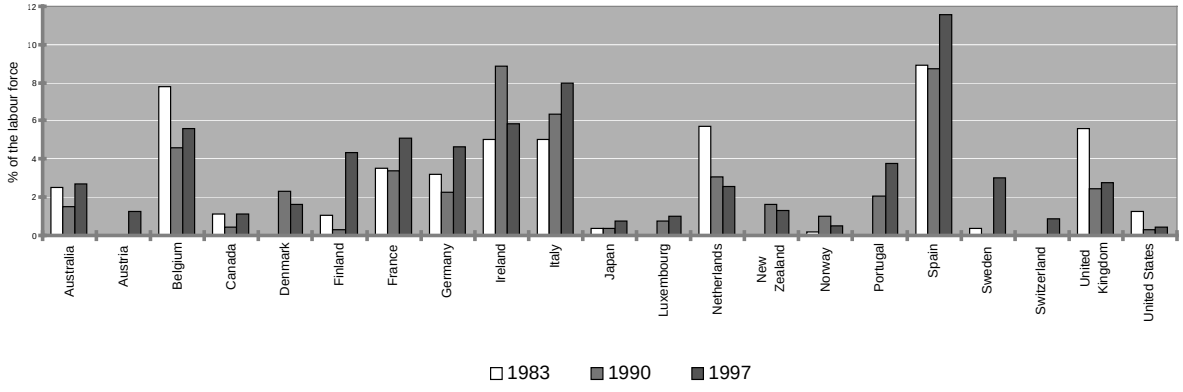
- Social Attachments:
  - **Suicide rate**

8. PERSONAL SAFETY

- Risk exposure:
  - Fatal accidents
  - Serious accidents
  - **Fear of crime**

D. EXAMPLES OF MEASURED INDICATORS[5]

Long-term unemployment as a percentage of the labour force



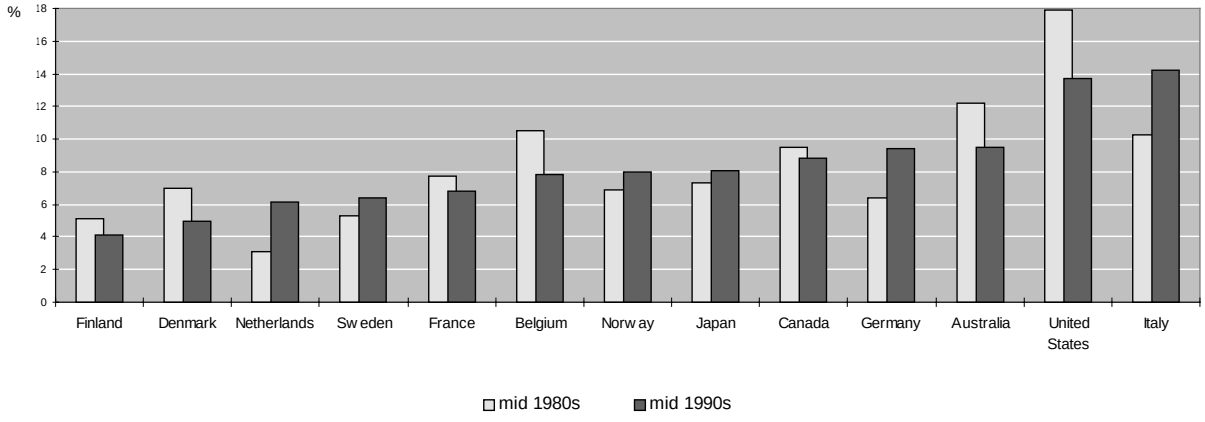
Reading the figures:

Those who have been unemployed for more than one year are defined as being 'long-term unemployed'. In some countries, there are few long-term unemployed -- only around 1 per cent of the labour force in Austria, Canada, Japan, Luxembourg, Norway, Switzerland and the United States fell into this category in 1997. At the other extreme are Italy, with a long-term unemployment rate of around 8 per cent of the labour force, and Spain, with a rate of nearly 12 per cent. Since 1990, the long-term unemployment rate has increased in most countries, but declines were recorded in Denmark, Ireland, the Netherlands, New Zealand and Norway.

Source: OECD Employment Outlook (1998)

Relative poverty rates

Proportion of the population living in households with income less than half of the current median equivalent income.



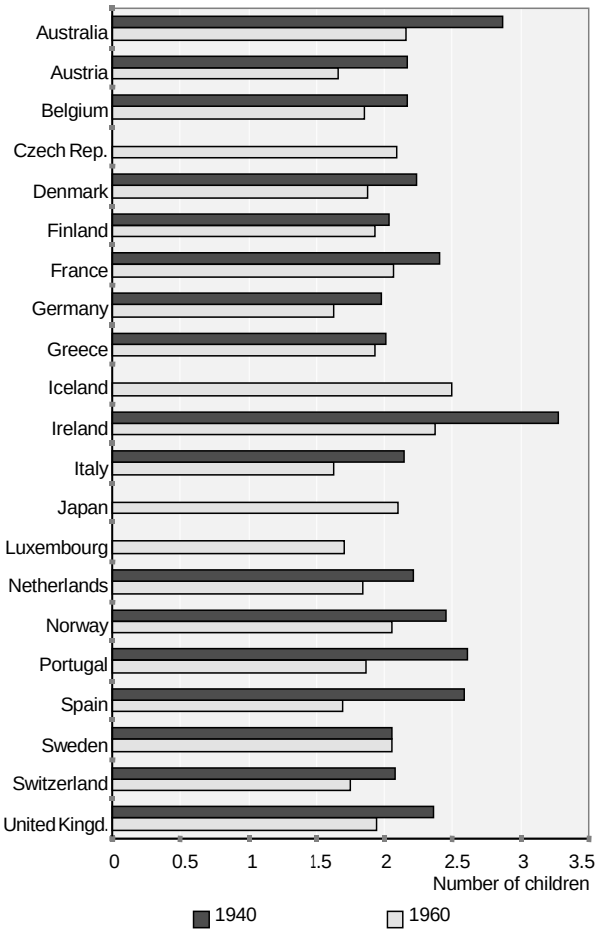
Reading the figures:

Relative poverty is said to exist when household income, adjusted for family size (i.e. so-called "equivalent income"), falls below half the median level of household income. On this basis, the lowest poverty rates are found in the Nordic countries and the Netherlands. Relative poverty has increased in around half of all countries, but there have been large falls in the United States, Australia and Belgium.

Source: National Statistical Agencies

5. Extract from an illustrative compilation of social indicators prepared for the Meeting of the OECD Employment, Labour and Social Affairs Committee at Ministerial Level 23-24 June 1998.

Completed fertility rates
(by year of birth of the mother)

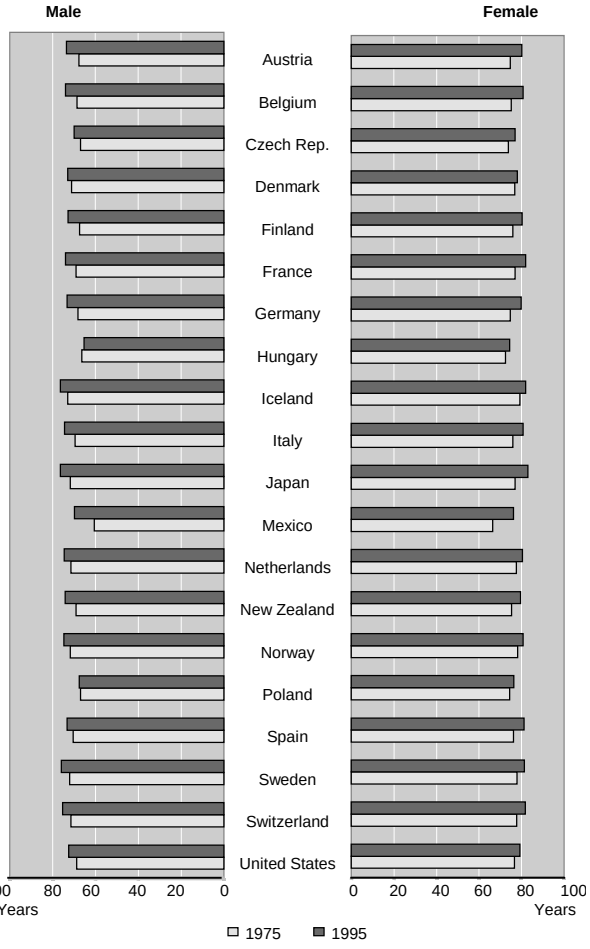


Reading the figures:

Not too much should be read into fertility rates based on annual birth data, as these often fluctuate substantially as pregnancies are deferred or brought forward. For example, women are having fewer children at younger ages, but many go on to have children at higher ages The completed fertility rate shows how many children women who have reached the end of their childbearing years have actually had.. Overall, however, the completed fertility rate is declining and in most countries is now below two children per woman, with particularly low rates found in southern Europe.

Source: EU Members: EUROSTAT (1996), Demographic statistics 1996. Australia: Australian Bureau of Statistics. Czech Republic: Ministry of Labour and Social Affairs. Switzerland: Office Fédéral des assurances sociales.

Life expectancy at birth



Reading the figures:

The lowest life expectancies at birth can be found in Turkey and the newest OECD Member countries. In these countries, life expectancy is 5 or more years less than in most other OECD countries. Elsewhere, a female life expectancy of over 80 and a male of over 75 is common. Each year, on average across the OECD, life expectancy at birth is growing by around 2 months for both males and females.

Source: OECD Health Data 98

E. SOCIAL INDICATORS COMPILED BY OTHER INTERNATIONAL ORGANISATIONS

The World Bank

The World Bank development indicators[1] go much further than covering the social sphere; economic and environmental data is also covered. Indicators are grouped in Tables, but each table may contain several indicators. Note that the World Bank has its own model household survey, from which several of the indicators are derived.

Table no.	Heading	Indicators
1.2 + 2.17[2]	Quality of life	Life expectancy at birth (by gender)
1.2		Adult illiteracy rate (by gender)
1.3	Development progress	Net primary enrolment ratio (by gender)
1.3 +2.17[2]		Infant mortality rate
1.3 +2.17[2]		Under 5 mortality rate
1.3 + 2.15[2]		Maternal mortality rate
1.3		Health care access rate
2.1	Population	Age dependency ratio
2.1		Population age 60 and above (by gender)
2.2	Population Dynamics	Crude death rate
2.2		Crude birth rate
2.2		Average annual growth rates
2.6	Unemployment	Rates (by gender)
2.7	Poverty	Population below the poverty line, national/international, rural/urban.
2.8	Distribution of income or consumption	Gini coefficient
2.8		Share of income, consumption by quintile
2.10	Access to education	Gross enrolment rates (pre-primary, primary, secondary, tertiary)
2.10		Net enrolment rates (primary, secondary)
2.14	Access to health services	Health care
2.14		Child immunisation: measles; DPT
2.15	Reproductive health	Total fertility rate
2.15		Adolescent fertility rate (births to women aged 15-19)
2.15		Unwanted fertility rate[3]
2.15		Births attended by trained health staff
2.17	Mortality	Child mortality rate (by gender)
2.17		Adult mortality rate (by gender)

Notes:
1. There are many more indicators of less relevance.
2. Indicator enters into multiple tables
3. Very few figures available for OECD countries

The United Nations

Three United Nations programmes are relevant for the development of social indicators.

Follow-up to the world summit for social development

Following a series of UN Conferences with a social theme (e.g. Population and Development, Cairo 1994; Social Development, Copenhagen, 1995; Women, Beijing, 1995), an expert group was set up to consider the implications for the statistical work of the organisation. The result was a two-tier listing of indicators: of their full list, a small number were identified as constituting 'a minimum national social data set'. Within the broader list, not all indicators have been defined; rather, the intention is to indicate a list to which countries (and international organisations) should aspire.

No.	**Title** (entries in bold signify part of the minimum national social data set)
	A. Population and Development
A1	**Life expectancy at birth, by sex**
A2	**Infant mortality, by sex**
A3	**Child mortality, by sex**
A4	**Maternal mortality**
A5	**Percentage of infants weighing less than 2.5kg at birth, by sex**
A6	**Ave. no. of years of schooling completed, by urban/rural, sex, and income class**
A7	Percentage of pregnant women who have an ante-natal visit
A8	Percentage of pregnant women who have a trained attendant at delivery
A9	Percentage of pregnant women immunised against tetanus
A10	Contraceptive prevalence rate
A11	Incidence and prevalence of sexually transmitted diseases
A12	Quality of family planning services
A13	Access to, and quality of, maternal health services
A14	Incidence of female genital mutilation
	B. Eradicating Poverty
B1	Physical and mental health
B2	Literacy
B3	Family conditions
B4	Unemployment
B5	Social exclusion and isolation
B6	Homelessness
B7	National and international causes underlying poverty
B8	**Number of people per room, excluding kitchen and bathroom**
B9	**Access to safe water**
B10	**Access to sanitation**
B11	**Monetary value of the basket of food needed for minimum nutritional requirement**
B12	Percentage of population in poverty (national/international definition)
B13	Access to services related to health, nutrition, and community infrastructure
B14	Income
B15	Education
B16	Possibility of entering the labour force
B17	Food
B18	Food prices
B19	Access to productive assets, especially land and water
B20	Geographic location
B21	Public transfers
B22	Families below a relative poverty line
B23	Poverty gap
B24	Families with less than 25 per cent and 40 per cent of mean income
B25	Gini coefficients
B26	Income share of lowest/highest income quintile

No.	**Title** (entries in bold signify part of the minimum national social data set)
	C. Expansion of productive employment and reduction of unemployment
C1	**GDP per capita**
C2	**Household income per capita**
C3	**Unemployment rate, by sex**
C4	**Employment-population ratio, by sex**
C5	Wage employment as a percentage of the working age population
C6	Formal sector employment
C7	Median and average length of job-tenure in years
C8	Index of real wages in manufacturing and in the economy as a whole
C9	Ratio of the average wage in formal sector to GDP per person employed in the economy
C10	Wage dispersion (coefficient of variation)
C11	Ratio of average female to average male wage
C12	Unpaid work outside of the market economy
C13	Non-wage compensation
C14	Time use
C15	Precariousness of employment
C16	Invisible underemployment
C17	Training data
	D. Social Integration
D1	Number of people in vulnerable groups
D2	- Age/gender structure
D3	- Occupational profile
D4	- Economic activity profile
D5	- Income levels
D6	- Position within overall income distribution
D7	- Housing standards
D8	- Health status
D9	- Educational standards
D10	- Crime victimisation rate
D11	- Proportion eligible to vote
	E. Status of women and men
	Data distributed by sex on:
E1	- population and households
E2	- health
E3	- diseases and cause of death
E4	- education
E5	- enrolment rates
E6	- drop-out rates
E7	- higher level education, by subject
E8	- time use
E9	- child care
E10	- gainful employment
E11	- wage, salary and income
E12	- individual and household income
E13	- informal sector
E14	- income control
E15	- access to land and credit
E16	- influence and power
E17	- decision making
E18	- violence and crime

The UN human development index

The UN Development Programme has developed the 'Human Development Index' (HDI). This combines indicators of life expectancy, educational attainment and income into a composite human development index. The HDI sets a minimum and a maximum for each dimension, and then shows where each country stands in relation to the scales, expressed between 0 and 1. The index is defined:

- Minimum literacy is 0 and maximum is 100 per cent; therefore a literacy rate of 75 per cent gives an indicator value of 0.75;
- Minimum life expectancy is defined as 25 years and the maximum as 85; a life expectancy of 55 would give an indicator value of 0.5
- Minimum income is taken to be $100 and maximum $40,000 (using PPPs). Income above the average world income is adjusted using a discounting factor.
- A simple average of the three indicators is the index.

The HDI can be used for subgroups to show relative differences in social status. Hence a recent study in Canada (which ranks highest on the HDI) shows that those living on tribal reservations have an HDI score equivalent to that of Brazil.

UN Economic Commission for Europe: family and fertility surveys

The UNECE publishes a standard country report based on a common framework. Most variables (indicated by FFS below) are collected using a specific survey. Others are collected from national sources.

Table 1 Selected economic, social and cultural indicators
Table 2 Selected demographic indicators
Table 3 Percentage population distribution by age and sex: 1 December 1950 and 1 January 1990
Table 4 Position in the household, female sample, FFS
Table 5 Position in the household, male sample, FFS
Table 6 The parental home, female sample, FFS
Table 7 The parental home, male sample, FFS
Table 8 Partnership formation, female sample, FFS
Table 9 Partnership formation, male sample, FFS
Table 10 Partnership dissolution, female sample, FFS
  a % of divorces of women married for the first time (irrespective of prior cohabitation) by age and period of marriage, FFS
  b % of separations of women cohabiting for the first time (irrespective of later marriage), by age and period of cohabitation, FFS
Table 11 Partnership dissolution, male sample, FFS
Table 12 Number of live births, female sample, FFS
Table 13 Number of live births, male sample, FFS
Table 14 The timing of fertility, female sample, FFS
Table 15 Partnership status at first birth, female sample, FFS
Table 16 Partnership status at first birth, male sample, FFS
Table 17 Age at first birth by educational level at interview, female sample, FFS
Table 18 Age at first birth by educational level at interview, male sample, FFS
Table 19 Contraceptive status of couples, female sample, FFS
Table 20 Contraceptive status of couples, male sample, FFS
Table 21 First sexual intercourse and first use of contraception, female sample, FFS
Table 22 First sexual intercourse and first use of contraception, male sample, FFS
Table 23 Induced abortion, female sample, FFS
Table 24 Expected ultimate family size, female sample, FFS
Table 25 Expected ultimate family size, male sample, FFS
Table 26 Average number of children ultimately expected, already born and expected in the future, by level of education at interview, female sample, FFS
Table 27 Average number of children ultimately expected, already born and expected in the future, by level of education at interview, male sample, FFS
Table 28 Values and beliefs, female sample, FFS
Table 29 Values and beliefs, male sample, FFS
Table 30 Studying and having children, female sample 15-34 years of age, FFS
Table 31 Working and having children, female sample, FFS
Table 32 Selected event histories combined, female sample, FFS
Table 33 Selected event histories combined, male sample, FFS
Table 34 Summary measures for selected life events, female sample, FFS
Table 35 Summary measures for selected life events, male sample, FFS
Table 36 The survey population and non-response, FFS

The European Union

The European Union has an irregular publication called 'Living Conditions in Europe -- Selected Social Indicators'. The latest update proposes the following indicators and their source:

Domain	Indicator	Source
1. Population		
	Population trends	Demographic Statistics
	Population structure and dependency	Demographic Statistics
	Population growth	Demographic Statistics
	Non-national population	Demographic Statistics
2. Households and families		
	Size and composition of households	Census, LFS, ECHP
	Cohabitation, Marriage and divorce	Demographic Statistics, ECHP
	Fertility	Demographic Statistics, ECHP
3. Education and training		
	Education outcomes	LFS
	Participation in education and learning	UOE, VET, LFS
	Foreign language learning	UOE
	Tertiary education	UOE
	Lifelong learning	UOE, LFS
	Expenditure on education	UOE
4. Labour market		
	Activity and employment	LFS
	Flexibility	LFS
	Working time	LFS
	Unemployment	LFS
	Long-term unemployment	LFS, ECP
	Unemployment and education	LFS
	Labour costs in industry	Statistics on cost of labour
5. Earnings		
	Average earnings of full-time workers	SES
	Earnings of men and women	SES
	Minimum wage	NSIs
6. Income		
	Net equivalised income	ECHP
	Income distribution	ECHP
	Low income	ECHP
	Non-monetary poverty	ECHP
7. Social Protection		
	Social protection expenditure	ESSPROS
	Social protection benefits and receipts	ESSPROS
8. Consumption and housing		
	Consumer expenditure	HBS
	Housing type, size and ownership	Census, ECHP
	Housing problems	ECHP
	Household goods	ECHP
9. Health		
	Infant mortality and life expectancy	Demographic Statistics
	Health problems	ECHP
	Major causes of death	WHO
	Accidents at work	ESAW
	Road traffic accidents	REGIO

Indicators from other international organisations not included in the new OECD listing.

World Bank Indicators not included

Definitions vary somewhat, reflecting LDC focus (e.g. health care access; births attended by trained staff, etc.). Ignoring these:

1. Population growth rate
2. Unwanted fertility rate (in practice, not available for most OECD countries)

United Nations Indicators not included

Definitions vary somewhat, reflecting LDC focus (e.g. health care access; births attended by trained staff, etc.). Otherwise (note those in bold are those included in the list of 15 'core' social indicators):

A3	**Child mortality, by sex**
A4	**Maternal mortality**
A5	**Percentage of infants weighing less than 2.5kg at birth, by sex**
A7	Percentage of pregnant women who have an ante-natal visit
B5	Social exclusion and isolation
B9	**Access to safe water**
B10	**Access to sanitation**
B11	**Monetary value of the basket of food needed for minimum nutritional requirement**
C10	Wage dispersion (coefficient of variation)

European Union Indicators not included

1.	Various educational measures	
2	Flexibility	LFS
3	Working time	LFS
4	Labour costs in industry	Statistics on cost of labour
5	Average earnings of full-time workers	SES
6	Non-monetary poverty	ECHP
7	Consumer expenditure	HBS
8	Housing problems	ECHP
9	Household goods	ECHP
10	Major causes of death	WHO

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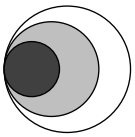
SUSTAINABLE DEVELOPMENT INDICATORS

THE EXPERIENCE OF HUNGARY*



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* By Mr. István Pomázi, Chief Advisor, Ministry of Environment, Hungary.

I. HISTORY OF USE OF INDICATORS IN HUNGARY'S ENVIRONMENTAL POLICY

The framework of Hungarian environmental policy-making from the mid-1970s until the end of the 1980s (or the free elections in spring 1990) have been determined by the one-party political system, a centrally planned economy, a paternalistic society and a lack of, or very low level of social self-organisation.

In this period the environmental policy context was also characterised by deficiencies of available information on the state of the environment and its economic and social interlinkages, and difficulty of access to information. Evidently, the decision-makers of this totalitarian regime hardly, or to a lesser degree, claimed to have sound scientific information on the environment and its economic and social interlinkages.

Environmental performance and its measurability have not been taken into account by this closed system in the formulation and assessment of the implementation of environmental policies. Although in the mid-1980s reports on the state of the environment had been prepared on an ad hoc basis for decision-makers, they did not have any influence on policy design and implementation. There was only a very weak demand for integrating environmental considerations at different levels of policy-making into sectoral and development policies, plans and programmes.

Within the one-party political system in the mid-1980s, some reform measures and Soviet "glasznoszty" have had impact on the early democratisation of environmental policy; the clear evidence of this has been the publication of two reports on the state of the environment, based upon scientific analyses, in the second half of this decade.

After the free and democratic elections in 1990, the whole political, economic and social context of environmental policy-making has been dramatically changed. Multiparty plural democracy and openness to the world market and liberal economic policy, to price and trade liberalisation, to successful privatisation, as well as the highest foreign direct investment in the Central and Eastern European region have put the environmental policy and its institutional system into a significantly different situation. Social sensitivity towards environmental problems and demand for easier access to environmental information have also grown.

Due to globalisation and the developments of international environmental diplomacy (e.g. the 1992 UN Conference on Environment and Development in Rio de Janeiro), the quick political and economic reorientation into the markets and institutions of developed countries have influenced domestic environmental policy.

In 1991 the OECD launched its "Partners in Transition" programme for Central European reform countries, including Hungary. This programme provided an opportunity for Hungarian experts to participate as observers in the work of the Environment Policy Committee and its subsidiary bodies (Groups on Environmental Performance and State of the Environment), when the conceptual and methodological frameworks and work programmes of these policy fields were clarified and consolidated.

As a visible result of this "learning process", the 1994 publication of the Ministry of Environment and Regional Policy on "Environmental Indicators of Hungary" should be mentioned. This document contained predominantly media-oriented environmental indicators, but the following links between the "pillars" of sustainable development have also been incorporated, in a preliminary stage: GDP growth in economic transition, share of environmental expenditure related to GDP, and environment and health interrelationship.

An important experimental step in the development of indicators was taken in 1994, with the publication by the Hungarian Academy of Sciences of a research document, “Environmental Future of Hungary”. Sponsored by the Government, the aim of this document was to establish long-term environmental goals up to 2010, using environmental indicators as a measure of progress, with 1990 as a reference year. Unfortunately, it has not been possible to draw up as deeply or as broadly as necessary the interfaces between environment, economic and social development scenarios and the progress towards sustainable development measured by integrated indicators.

In the beginning of the 1990s, an overall economic, social and environmental regulatory reform took place in Hungary, and one of its milestones could be considered a new act on the environment. This act is an attempt to adjust environmental rights and obligations to the newly established market and social conditions. As part of the new generation of Hungarian environmental legislation, it has laid down important guarantees for the enhancement of the implementation of result-oriented, measurable environmental policies. The act formulates the obligation of the Government to prepare annual state-of-the-environment reports and prescribes working out a six-year National Environmental Programme, including goals to be achieved, implementation instruments and required budgetary funds.

The law also compels the Government to report biannually to the Parliament on the implementation of the Programme. This provision unambiguously defines the overall demand for an environmental administration that has been accepted and put into practice in many OECD Member countries, namely, that environmental policies should be result-oriented, and that policy measures should be transparent and accountable, environmentally effective and economically efficient.

The fortunate coincidence of the preparation of the National Environmental Programme and Hungary's accession to the OECD in May 1996 has accelerated and strengthened this environmental policy orientation. Hopefully, the recently prepared OECD Environmental Performance Review of Hungary, discussed in November 1999 by the Working Party of the Environmental Policy Committee, will have further impetus in dynamising this process.

Until the mid-1990s the diffusion and use in Hungary of environmental indicators describing only one important pillar of sustainability have dynamically evolved and have proven to be the most traditional and relatively well-established. The economy/environment interface and related measurement indicators have had a strong impact on the indicators' development process in Hungary through OECD membership. This interface could enhance policy integration as it's more attractive and easily understood, and interpreted for and by decision-makers and economic and financial experts.

The analysis of social/environment interlinkages has been addressed in Hungary in the framework of the post-Rio process (UN Commission on Sustainable Development). The preliminary set of indicators measuring progress toward sustainable development was published in 1997 as an Annex to the National Report presented at the UN General Assembly Special Session.

It should be mentioned in this context that the UNDP published the "Human Development Report of Hungary" in 1998, which can be regarded as the most comprehensive presentation of the human and social-capital dimension of sustainable development. Parallel to this publication, Hungarian researchers have attempted to calculate the Genuine Progress Index (GPI). One of the shortcomings of these approaches has been the fact that they have not been able to present interlinkages between economy, environment and social aspects in a comprehensive and integrated manner.

The above-mentioned Report, to be adopted by the Parliament on the Biannual Implementation of the National Environmental Programme, was prepared on the basis of measuring progress philosophy. The main environmental indicators used in the assessment of policy measures are as follows (Table 1).

Table 1. **Environmental indicators for the assessment of policy measures**

Issues	Indicators
Air management	– trends in emissions of main air pollutants; – trends in ambient air quality, concentrations of main pollutants; – regional air pollution and ambient air quality (sub-national level).
Land resources	– changes and trends in land use by main categories; – trends in fertiliser use by types (Annex Figure 1); – trends in pesticide use by types (Annex Figure 2).
Water quantity and quality	– trends in water abstraction by sources; – trends in ground water withdrawal by types; – water quality of major rivers; – changes in ratio of water supply and sewerage network (Annex Figure 3); – share of dwellings connected to sewerage network by regions (sub-national level).
Natural values, biodiversity and forest resources	– threatened species of flora and fauna; – trends in protected areas; – trends in ownership changes in protected areas; – trends in protected caves; – changes of forest areas.
Waste management:	– trends in waste generation by economic sectors; – changes in hazardous waste production; – changes in composition of municipal solid waste; – changes in composition of municipal solid waste in Budapest (sub-national level); – regional distribution of municipal waste generation by regions (sub-national level).
Urban environment:	– housing stock and public utilities; – water consumption of households; – municipal wastewater generation and treatment; – trends in wastewater treatment by purification types; – trends in municipal waste collection; – changes in dwellings connected to water supply and sewerage network; – trends in green areas; – size of green areas by major cities (sub-national level); – concentrations of main air pollutants in cities (sub-national level); – population exposed to different noise levels by sources.
Environmental health and safety	– life expectancy at birth and at age 60 (male, female); – settlements affected by arsenic contamination of drinking water (sub-national level); – trends in environmental emergencies by affected media and pollutants; – trends in environmental emergencies by regional environmental inspectorates (sub-national level).

II. TOWARDS SUSTAINABLE DEVELOPMENT AND ITS MEASURABILITY

In the "Conclusions and Recommendations" of the Hungarian Environmental Performance Review (adopted by the Working Party on Environmental Performance), the OECD has proposed to "start discussion of a new sustainable development strategy, building on the National Environmental Programme and with the participation of local stakeholders".

In the early period of the transition to market economy in Hungary (between 1990 and 1993), GDP, industrial and agricultural production decreased markedly. This contributed to a significant reduction of air and water pollution and a sharp fall in the use of agricultural chemicals.

In the mid-1990s GDP recovered its 1990 level. There are clear indications that the renewed economic growth has not been accompanied by a similar increase in pollution. If this decoupling of economic growth from environmental degradation is maintained, it will encourage more changes for guiding transition to sustainable development. This would require better integration of environmental concerns into overall economic and social development and sectoral policies (energy, industry, agriculture, transport, tourism and other services).

There will be a need also to strengthen institutional integration and co-operation among government, business and civic organisations, and to ensure effective and efficient environmental expenditure and wider application of economic instruments and voluntary approaches.

The demand for the preparation of a sustainable development strategy necessitates establishing an appropriate set of indicators to measure progress in this direction, including interlinkages between the economic, environmental and social dimensions. To meet the requirements of both compatibility with OECD approaches and national specificities, a balanced "mix" of indicators will have to be established.

As far as the economy/environment interface is concerned, the use of the following indicators is recommended to measure the level of policy integration (Table 2).

The presentation of this interface can be very attractive and easily interpreted for decision-makers, to what extent at a given time economic development can be seen to be environmentally sustainable.

III. SOCIAL/ENVIRONMENT INTER-LINKAGES

Measuring social and human capital seems to be the most difficult task, although in most OECD countries this element creates the highest share of national wealth. Population growth, population density, age structure, urbanisation, etc., significantly affect, through general and territorial dimensions, production and consumption resource-use and the state of the environment.

In a social and environment interface the following aspects could be taken into consideration (Table 3).

Table 2. **Indicators for measuring economy / environment policy integration**

Issues	Indicators
Economic development and accompanied environmental pressures (Annex Table 1):	– GDP growth; – GDP/capita; – population trends; – trends of the main economic activities; – selected environmental pressures; – decoupling pollution from economic development (Annex Figure 4).
Resource efficiency and sustainable use of natural assets:	– intensity of use of water resources; – trends in intensity of use of natural resources per unit of GDP; – use of forest resources; – utilisation of renewable energy sources; – material flows (international and interregional).
Changing production and consumption patterns	– share of private consumption from GDP; – private consumption per capita; – changes in consumption structure; – impact of resource pricing on water and energy consumption; – generation of household waste; – consumer information; – share of eco-labelled products in relevant product groups; – share of governmental consumption in GDP; – resource consumption in government operations (energy, water, paper use etc.); – greening of public procurement; – share of environment-friendly products in public tendering.
Environment financing and expenditure:	– pollution abatement and control (PAC) expenditure; – environmental investments; – share of end-of-pipe investments; – operational costs; – share of PAC in GDP; – ratio of private-public investments; – pollution reduction and control investments by sectors; – change in environmental expenditure in state budget; – change in revenue and expenditure of the Central Environmental Fund.
Use of economic and fiscal instruments	– charges related to resource use and consumption (pollution and user charges); – deposit refund schemes; – taxation and environment issues (fuel taxes, excise taxes, tax differentiation, import duties, VAT preferences, tax rebates, income tax, corporate tax); – subsidies detrimental to the environment (PSE); – cross-subsidisation among different sectors.

Table 3. **Social and environmental interface**

Issues	Indicators and comments
General demographic processes	– population growth or decrease, ageing, family structure; – change in urban/rural population; – living and housing conditions; – life prospects, life expectancy at birth (male, female); – infant mortality; – change in unemployment rate (age and gender structure); – urban and rural poverty.
Environmental health and safety	– air and water-borne diseases; – exposure to air and water pollution, radiation, dangerous substances, natural hazards and industrial accidents; – food safety
Employment	– worker safety; – employment in environmental industry and services
Environmental democracy, public awareness and education	– access to environmental information by media (e.g. Internet use); – participation in civic organisations; – environmental sensitivity and perception of social groups, public opinion; – environmental issues in written and electronic media; – environmental education at different levels (primary, secondary, higher, non-scholar)
Distributional aspects, social disparities	– resource consumption (water, energy, food, waste generation, etc.), by income groups; – population exposure to environmental risks, by income groups; – impact of use of economic and fiscal instruments, by income groups; – ownership and use of consumption goods (private cars, household appliances, etc.), by income groups; – living and housing conditions (water supply, wastewater treatment, mobility patterns, urban amenities).
Institutional indicators	– Institutional indicators may cover different aspects of environmental policy structures and mechanisms (e.g. decision-making, legislation, enforcement). They can also include issues of international co-operation, fulfilment of environmental agreements, participation in international organisations, etc.
Territorial-sub-national dimension	– Careful analysis of the regional dimensions of economic, social and environmental capital and their interlinkages is a very important interpretation tool for measuring progress toward sustainability. The consideration of territorial inequalities in the quality of life should be seen as an essential factor in the integration of environmental policy and regional development.

ANNEX. TABLES AND FIGURES

Figure 1. **Apparent consumption of fertilisers**

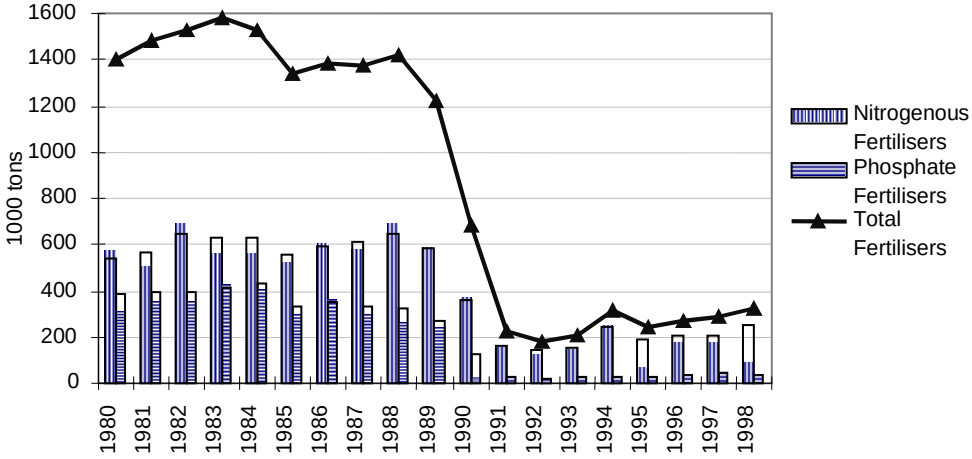


Figure 2. **Consumption of pesticides**

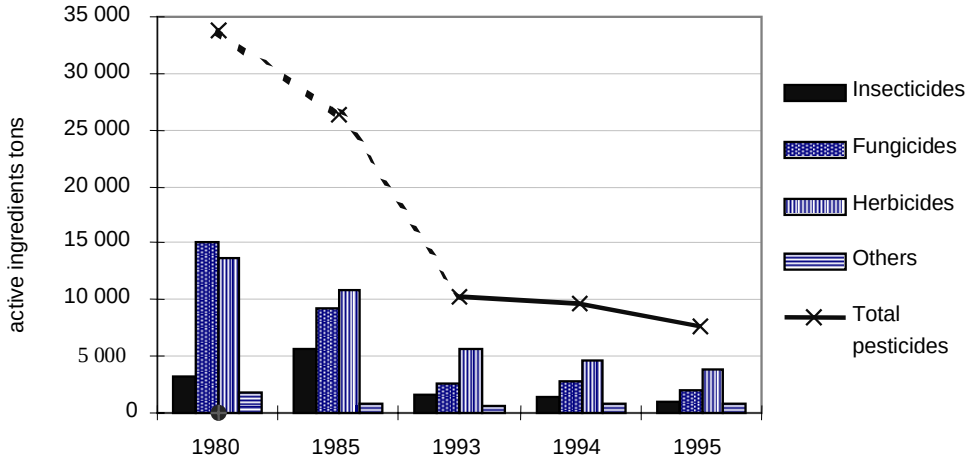
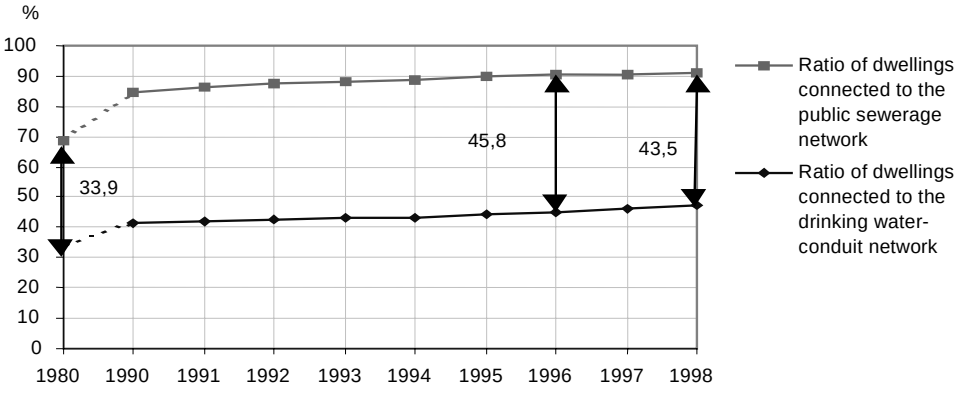
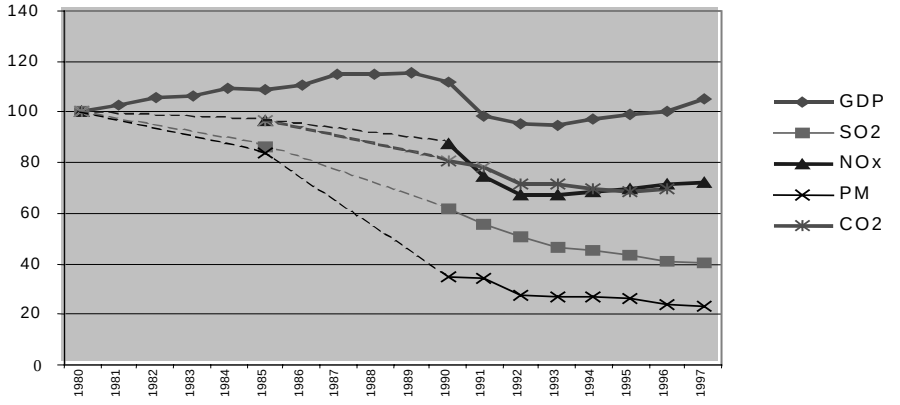


Figure 3. **Dwellings connected to the drinking water-conduit network, and to public sewerage**



Source: HCSO

Figure 4. **Decoupling of GDP from air emissions in Hungary,** 1980-1997



Source: HCSO, MfE

Table 1. **Changes in economic, social, sectoral trends and environmental pressures (%)**

	1990-93	1993-97	1990-97
Selected economic trends			
GDP[a]	-15.3	10.4	-6.5
Population	-0.7	-1.2	-1.8
GDP[a]/capita	14.7	-11.7	-4.7
Agricultural production	-26.4	9.4	-19.5
Industrial production (ISIC 2+3+4)	-23.4	31.7	0.9
Total primary energy supply	-11.7	0.7	-11.1
Energy intensity (per GDP)	4.3	-8.8	-4.9
Total final consumption of energy	-18.0	-0.4	-18.3
Road freight traffic[b]	-11.7	12.8	.-0.5
Road passenger traffic[c]	2.1	-10.0	-8.1
Selected environmental pressures			
CO_2 emissions from energy use	-10.4	-4.5	-14.5
Emissions of SO_x [d]	-25.0	-13.3	-35.0
Emissions of NO_x	-22.7	7.3	-17.0
Emissions of CO	3.8	-9.4	-6.0
Water abstraction[e]	5.5	-9.5	-4.5
Municipal waste[f]	-1.7	15.4	13.4
Nitrogenous fertiliser use	-57.5	88.7	-19.8
Phosphate fertiliser use	-81.1	211.8	-41.1

Notes:

a) GDP at 1991 prices and PPPs.
b) Based on values expressed in tonne-kilometres.
c) Based on values expressed in passenger-kilometres.
d) SO_2 only.
e) Data refer to 1996 and not 1997.
f) Municipal waste: refer to collected and transported amounts.

Source: OECD; HCSO.

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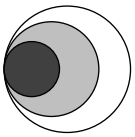
SUSTAINABLE DEVELOPMENT INDICATORS

THE EXPERIENCE OF SWEDEN*



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EXECUTIVE SUMMARY

In this paper three sets of indicators are presented together with their expected role and policy relevance:

- headline Indicators for an ecologically sustainable development;
- indicators for monitoring the Swedish Environmental Quality Objectives;
- indicators for Agenda 21 in the City of Stockholm.

To emphasise some factors that are particularly important for the development of society from an ecological perspective, a set of twelve Green Headline Indicators has been developed by the Swedish Environmental Advisory Council. Some of the indicators were presented to the Government in December 1998 followed by the complete set in November 1999. In spring 1999, the Green Headline Indicators were published in the Swedish Government Budget Bill. The target audience for the indicators is decision makers and the indicators are intended to form a basis for discussions about sustainable development and the need for further measures.

In 1998, the Swedish Parliament adopted 15 Environmental Quality Objectives. To monitor progress towards achieving the Objectives, a comprehensive system consisting of more than 200 indicators, has been developed by the Swedish EPA (SEPA). It was presented to the Government in October 1999. Target groups are politicians and other decision makers. The process of defining the objectives in greater detail as well as defining the indicators together with the sector authorities has been a good way to achieve sector integration.

The paper also gives a short description of the City of Stockholm's indicators for Agenda 21 as an example of an indicator system that is developed with a "bottom up" procedure.

Finally the paper addresses the question of how the next steps in the development of indicators should be taken.

I. INTRODUCTION

Society must work towards sustainable development. A great deal of work and commitment will be needed for this process of adjustment to succeed. Monitoring systems of various kinds are necessary in order to measure the progress made in these efforts.

This paper shortly presents three indicator systems in Sweden - two national sets of indicators for the ecological dimension and one local indicator system aimed to monitor all three dimensions of the sustainability concept. The paper also addresses the lessons learned while working with these indicators and the question of how the next steps in the development of indicators should be taken.

- headline Indicators for an ecologically sustainable development;
- indicators for monitoring the Swedish Environmental Quality Objectives;
- indicators for Agenda 21 in the City of Stockholm.

The mandate to develop a limited number of Green Headline Indicators to follow the transition towards an ecologically sustainable society was given to the Swedish Environmental Advisory Council in 1997. The Advisory Council presented a first proposal with a set of eleven Green Headline Indicators to the Government in 1998.

In 1999 those Green Headline Indicators were published in the Swedish Government Spring Budget Bill and commented on in the Budget Statement and Summary. They were also included in the Budget Bill this autumn. These indicators provide readily understandable information for the public and decision makers on whether the transition towards an ecologically sustainable society is moving in the right direction and at an appropriate speed. The intention is to present them annually in the Budget bill and to use them as a basis for political decisions and general discussions about an ecologically sustainable society.

In some important areas indicators could not be presented in 1998, either because statistical information was not available or further work to develop the indicators was required. These areas were biological diversity, use of chemicals and materials, environmentally sound purchasing and work practices in schools. On 1 November 1999 a revised and complete set of 12 headline indicators was presented to the Government[1]. This report includes the earlier proposed indicators now structured into three groups which resemble the PSR-model.

In 1998, the Swedish Parliament adopted fifteen Environmental Quality Objectives. To monitor progress towards achieving the Objectives, a comprehensive system consisting of more than 200 indicators, has been developed by the Swedish EPA (SEPA). It was presented to the Government in October 1999.

The aim of the system is to supply politicians and other decision-makers with clear, comprehensive and regularly updated information on ecological impact and the state of the environment. It will also provide them with information on driving forces, consequences for society and the measures that are being taken.

The City of Stockholm's indicators has developed an indicator system for Agenda 21 with 20 indicators aimed to monitor all three dimensions of the sustainability concept. The system has been developed by using a so-called "bottom up" procedure.

1. See report at: http:\\www.miljovardsberedningen.gov.se .

II. THE NATIONAL INDICATOR SYSTEMS

1. The Green Headline Indicators

1.1 What is the purpose of Green Headline Indicators?

The monitoring of progress towards ecological sustainability is based on large quantities of statistics, which makes it difficult for non-specialists to understand the information. A system consisting of a small number of Green Headline Indicators provides the public and decision-makers with a simple and comprehensive way of seeing whether progress is being made and, if so, if the rate of progress is satisfactory.

We hope that in time Green Headline Indicators will have the same status as the accepted measures of inflation, growth and other economic indicators and that they will form a basis for political decision-making and also contribute to a livelier, broader and more objective debate about the ecologically sustainable development.

The indicators that the Council proposes are intended to reflect domestic developments, but they should also make a useful contribution to the efforts being made to design internationally accepted indicators.

1.2 What do Green Headline Indicators tell us?

The Green Headline Indicators proposed by the Environmental Advisory Council relate to twelve strategically important areas (Table 1).

Three of the indicators illustrate underlying causes of specific problems. Pollutant emissions and environmental problems are largely caused by the massive requirement of materials, chemicals and energy. It is therefore important to reduce material and energy turnover and switch to materials, chemicals and energy sources that make less impact on health and the environment.

Five indicators are measures of emission levels or the state of the environment that relate to five serious environmental problems: the greenhouse effect, acidification, eutrophication, the quality of urban air and depletion of biological diversity.

To resolve environmental problems a large number of actors must begin to behave with greater environmental awareness. We must all take responsibility for reducing the impact on the environment. The remaining four indicators illustrate the pace at which various sectors, such as the public, consumers, enterprises, the public sector and schools, are moving towards an ecologically sustainable society. There are many possible measures in this area, and we could easily have chosen many more indicators, for example in the transport sector.

In the spring of 1999, the Government presented Green Headline Indicators in the budget statement annexed to the Spring Finance Bill:

- use of energy and energy efficiency;
- electricity for heating purposes;
- emissions of carbon dioxide;
- benzene level in urban air;
- emissions of acidifying substances (sulphur dioxides and nitrogen oxides);
- environmentally sound means of transport;
- enterprises with environmental management systems (EMAS and ISO 14001);
- waste to landfill sites;

- load of phosphorus and nitrogen into the sea;
- recovery of phosphorus to cultivated land;
- percentage of protected forests.

The selection criteria for the indicators were that they must:

- reflect conditions that are strategically relevant for the transition towards an ecologically sustainable society;
- be limited in number;
- be simple and readily comprehensible;
- be measurable and possible to follow in time series;
- be based on available data, wherever possible.

Table 1. **The Proposed Green Headline Indicators**

Driving forces (Facts behind environmental problems)	◆ **Energy consumption** measured as – total energy consumption – energy efficiency by relating to GDP – electricity used for heating ◆ **Material consumption** measured as: – materials required in tons per person – quantities of waste to landfill sites ◆ **Consumption of chemicals** measured as: – imported and produced amount of hazardous chemicals in tons per person
Pressure and state (Emissions and state of the environment)	◆ **Green-house effect** measured as: – emissions of carbon dioxide ◆ **Acidification** measured as: – emissions of sulphur dioxide and nitrogen oxide ◆ **Eutrophication** measured as: – load of nitrogen and phosphorus into the seas ◆ **Urban air pollution** measured as: – benzene levels in urban air ◆ **Biological diversity** measured as: – an index based on habitat variety in forests, cultivated land, lakes, sea – protected forests as a proportion of productive forest land
Response (Transition of e.g. companies, citizens and the public sector to an ecologically sustainable society)	◆ **Environmentally adapted means of transport** measured as: – intensity use of public transport etc., to work or school – use of cars for transportation ◆ **Environmentally sound purchases** measured as: – purchases of eco-labelled products per person – green public procurement ◆ **Recycling of nutrients** measured as: – recovery of phosphorus to cultivated land ◆ **Environmentally sound ways of working** measured as: – number of enterprises with environment management systems **(**EMAS or ISO 14001) – number of schools that have received the Green School Award

2. The Swedish Environmental Quality Objectives

The Swedish Government has declared that the Ecological dimension of Sustainable Development basically involves three horizontal and comprehensive objectives.

These are:

- protection of the environment (emissions of pollutants must not damage nature nor human health);
- sustainable supplies (the long-term capacity of the ecosystems must be assured);
- efficient resource utilisation (the use of energy and other natural resources must be used more efficiently).

These three objectives constitute the starting point for the formulation of 15 Swedish Environmental Quality Objectives, which were proposed by the Government in 1997[2] and adopted by the Parliament in spring 1998. The intention is to achieve these objectives within one generation, i.e. by 2020-2025 (Table 2).

Table 2. **The Swedish Environmental Quality Objectives**

1. Clean air
2. High-quality groundwater
3. Sustainable lakes and watercourses
4. Flourishing wetlands
5. A balanced marine environment, sustainable coastal areas and archipelagos
6. No eutrophication
7. Natural acidification only
8. Sustainable forests
9. A varied agricultural landscape
10. A magnificent mountain landscape
11. A good urban environment
12. A non-toxic environment
13. A safe radiation environment
14. A protective ozone layer
15. Limited influence on climate change

For the implementation of the objectives a parliamentary committee has been appointed. The committee shall make a comprehensive review of the targets, strategies and propose measures that are necessary. The committee shall report back to the Government by June 2000.

The sector authorities have proposed measures to develop and define these objectives in greater detail in their sectors, representing a significant step towards sector integration. The sector authorities are responsible for setting up targets, carrying through the measures and delivering the data necessary to create the indicators.

For the monitoring of the objectives, an annual indicator-based progress report and a more detailed report produced once during each government term shall be developed.

On the 1st of October this year, SEPA, who has been co-ordinating the work, and a number of sectoral authorities, delivered more than 25 reports to the Government and to the parliamentary committee. All these reports (with English summaries) can be obtained via SEPA's homepage: www.environ.se.

2. Swedish Environmental Quality Objectives. Environmental policy for a sustainable Sweden. The Swedish Government bill 1997/98:145.

2.1 Indicators for monitoring the Environmental Quality Objectives

One of the reports delivered on the 1st of October concerns the question of how progress towards the Environmental Quality Objectives should be monitored. In the report[3] SEPA declares that it intends to establish an indicator-based system for the follow-up of the environmental quality objectives.

The aim of the system is to supply politicians and other decision-makers with clear, comprehensive and regularly updated information on ecological impacts and the state of the environment. It will also provide them with information on driving forces, consequences for society and the measures that are being taken. An indicator report should be published annually along with presentations on the Internet.

The DPSIR model is used and about 200 indicators are identified in the system. About 40 of these appear under more than one of the objectives, which means that the gross number of indicators is approximately 250.

The proposed system is based on national environmental monitoring (run by SEPA), information from the responsible sector (the proposal is that the sector authorities should be responsible for delivering the data), the statistical authorities and some other organisations. SEPA proposes that the official statistics within the environmental field are to be adapted so that they can form a basis for the follow-up of the environmental quality objectives.

As an example Tables 3, 4 and 5 show the indicators concerning the Quality Objective Clean Air. The goals have been selected primarily to improve the air quality in cities to protect human health and to reduce the impact on cultural objects and other materials.

Table 3. **Quality Objective Clean Air – Driving Forces and Pressures**

Energy use (D) –Energy consumption per capita –Energy consumption per sector **Emissions (P)** –Of NO_x, NMVOC, Air-borne particles and of PAH's by sources	**Transports / Travels (D)** –The proportion of journeys to and from work: by walking, by bicycle, by public transportation –Passenger transport; by road, rail, air, sea –Freight transport; by road, rail, air, sea

Table 4. **Quality Objective Clean Air – State and Impact**

Ground level ozone (S)	◆ Urban concentrations of ozone in relation to threshold values
Air Quality in Cities (S)	◆ Air quality index ◆ Concentrations of inhalable particles ◆ Concentrations of benzene
Deposition of acidifying substances (S)	◆ Deposition of nitrogen & sulphur (national & international origin)
Health effects (I)	◆ Lung cancer cases per year
Crop losses (I)	◆ Area where ozone concentration exceeds threshold value for the protection of crops
Damage from corrosion (I)	◆ Corrosion losses on steel and zinc

3. System with indicators for measuring national progress of the Environmental Quality Objectives (SEPA Report No. 5006) In Swedish *with English summary.*

Table 5. **Quality Objective Clean Air – Response**

Emission reductions (R)	◆ Block heating, proportion of total energy consumption ◆ Proportion of private house furnaces equipped with accumulator tanks ◆ Proportion of mobile machinery satisfying the EU requirements
Promotion of better passenger transport (R)	◆ Investments in public transportation
Public air quality information (R)	◆ Number of cities covered by reports on pollen, spores and air pollutants

3. Indicators in the City of Stockholm

In the City of Stockholm[4] an indicator system is the successful result of a bottom-up process with several different stakeholders, such as local businesses, NGOs, the city administration and individual citizens within the framework of the Agenda 21. The indicators are targeted at the general public to promote them to take action. A lot of effort has been put into the work in order to provide the information in an easy and understandable way.

By December 1996, roughly 10 000 written suggestions from the citizens of Stockholm had been received about issues for the local Agenda 21 work. Five topics were identified (Table 6). Round table discussions were carried out during 1998 and more than 350 different indicators were identified. This number has now been reduced to 20 (Table 7).

It is interesting to note that in the process of identifying Agenda 21 indicators in Stockholm, targets for the indicators were never formulated. The national experience is that the target-setting has been a good basis for the discussion on indicators, the Stockholm experience is however that if the procedure also includes targets, it will be much harder to reach some form of consensus.

Table 6. **Topics for Agenda 21 in Stockholm**

– How can we achieve a secure city?
– How can we minimise the environmental impact of our travel?
– How can we consume less resources?
– How can we better protect nature in Stockholm?
– How can Stockholm residents have greater influence in their city?

4. Stockholm is the capital of Sweden and roughly 730 000 inhabitants live in the municipality. In the Greater Stockholm area there are nearly 1.8 million inhabitants which equals nearly 20% of the total number of inhabitants in Sweden.

Table 7. **Agenda 21 indicators in Stockholm**

- Household waste per citizen.
- Energy consumption per citizen.
- Emissions of CO_2 per citizen.
- Amount of heavy metals aggregated in the City.
- Share of eco-labelled groceries.
- Number of days with good air quality.
- Share of public transportation compared to the total commuting.
- Number of people suffering from asthma.
- Share of citizens feeling economically at ease.
- Time a child is spending with his parents during his growth.
- Share of young people, under the age of 25, that say they can influence the development of society.
- Number of citizens that feel they are participating in the community development.
- Number of people active in an NGO.
- Number of people afraid of violence in streets and squares.
- Number of young people casting their vote in the municipal election.
- Regional GDP per citizen.
- Educational background of the citizens.
- Number of working hours per year.

III. EXPANSION TO ECONOMIC AND SOCIAL ASPECTS

The Green Headline Indicators reflect changes in society in a broad ecological perspective, and our method is broadly consistent with the models that have been developed in other countries. It is important that Green Headline Indicators designed to monitor the ecological transition to sustainability are presented and established as a familiar concept. There are economic and social indicators already established such as gross domestic product and unemployment rates.

The presentation of the Green Headline Indicators in the Budget Bill is the first step in the vision to achieve the same publicity for environmental indicators as is given to economic indicators like GDP and unemployment rates. The intention is to report the Headline Indicators to the Swedish Parliament annually and to initiate a discussion of their development. The next step is to develop indicators for the whole concept of sustainable development, which includes both economic and social issues, besides environmental ones, and the interaction between them. Sweden has developed an environmental accounting system in order to provide comprehensive information on the environment and the economy. So far the physical accounts in Sweden contain information on energy use, emissions and waste linked to economic data on production and consumption in the different sectors of society and they constitute a source for indicators that combine data on economy and environment. Accordingly we have a good basis for the interaction between the environment and the economy, but we need to develop sustainability indicators for the social (and maybe also cultural) interaction with the environment.

The vision is that, in the future, we will be able to follow the transition to a sustainable society, in the full sense of the word, through a connected set of Headline Indicators.

IV. CONCLUSIONS

- Green Headline Indicators are presented in the Government's Budget Bill as an important first step towards an integration of environmental and economic issues.
- Behavioral patterns by a large number of actors need to be changed to achieve ecological sustainability. Environmentally strategic work done by important actors is therefore included in the set of twelve Green Headline indicators. The indicators must be as simple and understandable as possible.
- We have reasons to believe that the process with environmental objectives (definition and indicators) will prove to be a good way to achieve sectoral integration. The sectors have been active and they will provide the data for the indicators.
- The "bottom-up process" in Stockholm has been a success in terms of involving stakeholders initiating discussions etc.
- Indicators that more closely combine existing data on economy and environment should be further developed and used.
- Regarding the interactions between the environment and the social development, further work needs to be done.

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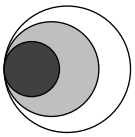
SUSTAINABLE DEVELOPMENT INDICATORS

THE EXPERIENCE OF THE UNITED STATES*



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* By Mr. David Berry, Executive Director of the United States Interagency Sustainable Development Indicator Group, United States.

I. BACKGROUND

In March 1996, the President's Council on Sustainable Development (PCSD) presented its initial recommendations to President Clinton in the document Sustainable America: a New Consensus. The Council recognised the need to identify sustainability goals for the country and to track progress in achieving those goals. It specifically recommended that the Federal Government continue to intensify its effort to develop national indicators of progress toward sustainable development in collaboration with non-governmental organisations and the private sector.

In response to that recommendation, the Administration established the US Interagency Working Group on Sustainable Development Indicators (SDI Group). This action formalised the activities of an informal group of agency representatives who, since 1994, had been examining possible approaches for developing a set of sustainable development indicators. The SDI Group formally reports to the Council on Environmental Quality in the Executive Office of the President and is supported through the resources of participating Federal agencies.

The SDI Group published a report in early 1999 that was distributed at the National Town Meeting in Detroit which concluded the activities of the PCSD. The report is viewable at the SDI Group's web site: www.sdi.gov.

The work of the SDI Group is advisory or consultative in nature rather than a formal policy of the United States Government. Indicators of sustainable development are not currently used to inform policy discussions in the United States in any generalised way. Some Agencies are more involved in this work and more supportive than others. To increase the visibility of the work, to improve the perceived value of indicators to decision-making and to find a permanent institutional home for this work is one of the objectives of the SDI Group.

The SDI Group developed a conceptual framework for organising indicators that encompasses the economic, environmental, and social aspects and the inter-generational nature of sustainable development. We may not know what future generations will want and need but we can monitor the economic, environmental and social capital, what the SDI Group calls endowments, we are passing on to them and which give them the capacity (either degraded or enhanced) to meet those needs.

The SDI Group also created an experimental set of 40 indicators: economic, environmental, and social and related to current conditions, endowments and the processes that change those endowments. Many of the individual indicators have appeared in Federal agency publications, but they have not previously been published in the same document. By presenting indicators from various disciplines together, we hoped to communicate the integrated nature of sustainability. The indicators presented in the SDI Report are not sufficient to provide a complete, integrated assessment of the Nation's progress toward sustainable development, but they do represent a cross-section of some of the most important issues.

II. A FRAMEWORK FOR INDICATORS

We think of sustainable development as a three-legged stool, with one leg representing the economy, another representing the environment, and the third representing society or equity. The legs of the stool are grounded in traditional academic disciplines, such as the social, economic, political, biological, and physical sciences.

Over the years, each academic discipline has developed its own concepts, statistical programs, and classification systems and is often treated separately by government agencies and the private sector. For example, efforts to further economic growth in a particular geographical region without adequate consideration of the region's environment, natural resources, and social character may lead to urban sprawl, the disintegration of inner city neighbourhoods, pollution, and/or the destruction of habitat. On the other hand, efforts to avoid any changes in natural habitat or the environment may hamper a region's ability to meet the economic and social needs of its residents.

Each economic, environmental, and social issue requires attention, but from the standpoint of sustainable development, we must examine the issues together, rather than in isolation. There will always be trade-offs among different interests, but this does not preclude us from making decisions that advance all interests over the long term. Trade-offs among the environment, the economy, and society will always occur, and there may be more progress in one area than another at any particular time. Nevertheless, by adopting multi disciplinary decision-making processes, we can develop approaches that do a better job of advancing progress in all three areas over the long term.

We frequently pay more attention to our wants and needs than we do to the potential long-term consequences of our actions. While we know that future development depends on having adequate assets and resources, concerns about the future often pale in comparison to immediate and pressing needs (e.g. for public safety or jobs). Consideration of the future becomes even more difficult when there are uncertainties about environmental trends, ecosystem carrying capacities, economic interactions, and future technological advances.

A set of indicators that reflects today's conditions as well as the assets and liabilities we pass on to future generations can be an important tool in fostering integrated decision-making processes. The indicators selected by the SDI Group are based on data that are currently available, primarily from the Federal agencies. The SDI Framework organises the indicators into three major categories representing i) long-term endowments and liabilities, ii) processes, and iii) current results. These categories are then divided into subcategories for the economy, the environment, and society.

Endowments are assets or capacities inherited from past generations, used to meet our own needs and handed on to the next generations. These include our natural heritage of resources and the environment; existing capital in the form of factories and infrastructure, and our social heritage including our educational system and legal and cultural traditions. As an analogy, one can think about the endowment of a university as the long-term capital base that the university needs to ensure adequate funding for current operations. This endowment must be maintained to provide the income the university needs for the future.

A principal purpose of sustainable development indicators is to consider the importance of long term endowments and to become more deliberate about what inheritance we pass on to our children and grandchildren. Children are a particularly important endowment provided by each generation to the future. We also inherit a variety of challenges such as hazardous wastes, income disparity, and ethnic or racial tensions that can carry over from generation to generation and we call these "Liabilities".

Processes are activities that act upon endowments to produce current output and results. A key subset of processes are Driving Forces which directly increase or decrease endowments. The impact can be positive such as investments which increase productive efficiency or a project for

environmental remediation. They can also be negative such as depleting renewable resources faster than the resources replenish themselves. The decision-making which uses the indicators is also a subset of processes.

Current Output and Results are the goods, services and experiences produced by using endowments. A majority of decisions are made with a view only to current results. The purpose of the framework is to encourage an increased awareness of the broader implications for the long term of the decisions we make.

III. LIST OF INDICATORS FROM THE NATIONAL SET

By examining a diverse set of indicators together, we can begin to understand the conditions and approaches that will support sustainable development. If we do a better job meeting today's needs, while also enhancing the assets and resources we ourselves inherited, we will be a step closer to designing a path of sustainable development.

The first set of experimental indicators published in the US was based on input from over a dozen Federal agencies and White House offices. It also drew on indicators suggested by the PCSD; on national indicator efforts in The Netherlands, Canada, and Europe; and on the work of the Organisation for Economic Co-operation and Development (OECD), the World Bank, the United Nations Commission on Sustainable Development (UNCSD), and other organisations. In several outreach meetings, comments were solicited from non-governmental organisations, industry, youth, and local community representatives.

Each type of indicator helps to assess sustainability in a somewhat different way. Indicators such as erosion, the utilisation of fisheries, and greenhouse gas emissions provide information on driving forces that ultimately affect our long-term well-being; these indicators can serve as early warning signals and alert us to the need for possible changes in human production processes, policies, management approaches, or individual behaviour patterns. In a number of cases, we must pay attention not only to the status of a resource, but to the forces of change. For example, if we wait until we see declines in agricultural production, the collapse of fish stocks, or higher global temperatures, it may be too late to reverse or mitigate the changes.

Some of the most widely used indicators are based on theories and methodologies that are not as commonly understood as the indicators themselves. For example, GDP is a well-recognised indicator of national economic output, but the economic concepts behind it are probably not foremost in people's minds when they read the latest GDP figure in the newspaper. The meaning of the indicator should be clear, but the complexity of the methodology does not necessarily detract from the utility of the indicator.

Over the past several years, the SDI Group has gained humility about our ability to understand and measure sustainable development. We have come a long way in thinking about the many aspects of sustainability, but we do not yet understand many of the interrelationships. We are still unsure how best to measure some important aspects of sustainable development, such as social resiliency and cohesion, and these areas will require further research. Sustainable development is not an end in itself, but rather an evolving process. All components of the Earth, including human knowledge and technological development, are constantly changing, and in our effort to realise sustainable development, we must recognise and respond to these changes.

We also want to explore the relationships among indicators at the national, regional, state, and local scales in co-operation with the Livable Communities Initiative Chartered by the White House. As the development of indicators continues, we hope to engage broader participation both within and

outside the Federal Government and provide opportunities for more workshops around the country. Ultimately, we would like to be able to provide regular (perhaps annual) indicator reports and have indicators inform policy making.

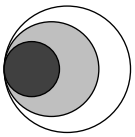
Table 1. **Sustainable development: an experimental set of indicators**

Endowments	Economic	Environmental	Social
	• Capital Assets • Labour Productivity • Federal Debt to GDP Ratio	• Surface Water Quality • Endangered Ecosystems • Contaminants in Biota • Contaminated Land Area • Storage of Spent Nuclear Fuel • Cropland Converted to Other Uses • Status of Stratospheric Ozone	• US Population • Children in Families with One Parent • Teacher Training Level
Driving Forces	**Economic**	**Environmental**	**Social**
	• Investment as a Percentage of GDP • Energy Use per Capita & GDP • Materials Use per Capita & GDP • Inflation • Investment in R&D per GDP	• Water Use to Renewal Ratio • Fisheries Utilisation • Invasive Exotic Species • Cropland Erosion Rates • Timber Growth/Removals Balance • Greenhouse Gas Emissions	• Contributing Time & Money to Charities • Births to Single Mothers • School Enrolment by Level • Participation in Arts & Recreation • People in Census Tracts with 40% or More Poverty
Current Outputs and Results	**Economic**	**Environmental**	**Social**
	• Domestic Product • Income Distribution • Consumption Expenditures per Capita • Unemployment • Home Ownership Rates • % Households in Problem Housing	• Metropolitan Air Quality Nonattainment • Outdoor Recreational Activities • Greenhouse Climate Response Index	• Crime Rate • Life Expectancy • Educational Achievement Rates

PART D.
TRANSPORT/ENVIRONMENT INDICATORS

TRANSPORT-ENVIRONMENT INDICATORS

OECD OVERVIEW



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EXECUTIVE SUMMARY

Transport is essential to the economies of OECD countries, and affects the daily lives of their citizens. The extensive scope of transport activities, as well as the externalities they generate, translates into a complex policy context for sustainable development of the sector. In most OECD countries, integration of environmental objectives into transport policies has been a formal goal since at least the late 1980s. Many countries have implemented policies aimed at reducing transport's negative environmental externalities, and these policies have been effective to a certain extent. However, it is now recognised that these policies have not been sufficient to reach some key objectives of sustainable development, and that a more integrated approach is needed, combining institutional integration (e.g. greater inter-modal co-ordination of transport policies) and market-based incentives (e.g. pricing and fiscal measures). In this evolving policy context, environmental and sustainability indicators for the transport sector are essential for shedding light on policy-relevant questions, and helping to monitor the effectiveness of policy intervention.

Since the Council of Ministers meeting of 1989 gave the OECD the mandate to better integrate environment and economic policies, the OECD has taken a leading role in developing transport-environment indicators, working in close co-operation with the European Conference of Ministers of Transport (ECMT). A first set of transport-environment indicators was published in 1993. Since then, the regular use of the indicators in OECD environmental performance reviews and in other analytical work has provided useful feedback on their policy relevance, which has contributed to their refinement and expansion.

From this experience it was possible to designate a small list of core indicators that have proven their usefulness and that are available for most OECD countries. This responds to the increasing interest by Member countries in a reduced number of indicators selected from existing larger sets to capture key trends and draw attention to key issues of common concern. It is recognised that this list will need to be supplemented when used in policy analysis, and that the interpretation of the indicators in context is essential.

CORE LIST OF OECD TRANSPORT-ENVIRONMENT INDICATORS*

SECTORAL TRENDS OF ENVIRONMENTAL SIGNIFICANCE	Transport Intensity	◆ Passenger and freight transport per cent of GDP
	Vehicles	◆ Road vehicles per capita
	Fuels	◆ Fuel consumption intensities
	Infrastructure	◆ Road and rail network length and density
INTERACTIONS WITH THE ENVIRONMENT	Air Pollution	◆ Transport-related air emissions and intensities
	Noise	◆ Percent of population exposed to unacceptable noise levels
ECONOMIC AND POLICY ASPECTS	Pricing And Taxation	◆ Road fuel price and taxes
	Subsidies	◆ Level of subsidy by mode

The OECD has recently engaged in the development of social-environment indicators, to complement its sets of economic-environment indicators. This effort has been undertaken in recognition that sustainable development has three pillars -- economic, environmental, and social -- and that, to date, insufficient attention has been dedicated to the social aspects of sustainable development. The last section of this paper briefly explores some social aspects of sustainable development in the transport sector. It is hoped that this section will spark a discussion at the conference aimed at identifying the key issues at the social-environment interface.

I. INTRODUCTION

The purpose of this paper is to review the development and use of indicators for measuring progress toward sustainable transport. It stems from work carried out by the Organisation for Economic Co-operation and Development (OECD) and the European Conference of Ministers of Transport (ECMT) in the 1990s on transport-environment relationships and related indicators, and draws on OECD's extensive experience in using indicators in country reviews of environmental performance. It describes the policy context of the sector, reviews progress towards developing relevant transport-environment indicators and identifies a "core list" of transport-environment indicators. The paper's final section seeks to spark a discussion among conference participants regarding the "social pillar" of sustainable transport.

II. THE TRANSPORT SECTOR AND ITS POLICY CONTEXT

1. Importance and scope of sector

Transport systems play a major role in the economic life of OECD countries, and in the daily lives of their citizens. In industrialised countries, the production, maintenance, and operation of transport vehicles, equipment, and infrastructure accounts for an estimated 5 to 8 % of GDP. Transport is essential for trade and employment, and comprises a significant part of public expenditure and household consumption. Most countries consider transport services and infrastructure as essential for regional development.

The transport sector refers to the construction, operation and maintenance of infrastructure and vehicles, and the management of freight and passenger traffic. Essential related activities include the refining and distribution of fuels, the management of waste, and the financing of projects.

The extensive scope of transport activities, as well as the externalities they generate, translates into a complex policy context for sustainable development of the sector. In OECD countries, responsibilities for different facets of the transport sector are usually divided among several ministries (e g. Public Works, Industry, Transport, Mercantile Marine, Energy, Finance and Environment). The "regulated universe" of the transport sector is also complex, as private sector actors are multiple and diverse (e.g. firms that manufacture vehicles, construct or maintain infrastructure, operate transport systems, refine vehicle fuels). The complexity of the sector renders the integration of environmental objectives into sectoral policies particularly challenging.

Transport is also a fundamental part of the globalisation process. The trend toward international trade and tourism has led to increased competition among transport suppliers at the international level. The sector is undergoing significant changes (e.g. deregulation, privatisation, mergers). The consequent lowering of prices has fed increasing demand for transport services.

The principal environmental pressures caused by transport are air pollution, noise, and consumption of energy, land and other natural resources. These pressures are generated by the production and maintenance of vehicles, the construction of infrastructure, the operation of transport equipment, the provision of energy and fuel, and the disposal and decommissioning of vehicles. In most OECD countries, road transport consumes more than 80 % of transport-related energy consumption and is the source of most of the sector's impact on the environment. Since 1970, air transport has grown quickly, resulting in a 50 % increase in air transport's energy consumption, and raising increasing concern about its environmental impacts.

2. Integration of environmental concerns into transport policies

2.1 Government policy measures

In most OECD countries, integration of environmental concerns into transport policies has been a formal goal for at least ten years. This was reflected in the 1989 ECMT Resolution on transport and the environment (ECMT Resolution No. 66), which recommended that member countries implement specific policy actions in three domains: vehicles and fuels, infrastructure, and traffic management. Due to the complexity of the transport sector, each of the three groups of actions typically involves a corresponding group of actors and decision-makers: 1) the vehicle manufacturing and fuel industries and related government administrations; 2) the public works industry and related government administrations; and 3) the national and local transport companies, private households, and related government administrations.

Many countries have implemented policies with the direct aim of reducing transport's negative environmental externalities (mainly air pollution, noise, congestion). For example, policies aiming to reduce air emissions from transport have mandated fuel quality improvements and have set emissions limits for vehicles. In most OECD countries, the implementation of such policies has resulted in drastic reductions in unitary vehicle emissions. Likewise, noise has been addressed by policies aimed at changing traffic patterns (e.g. restricted traffic zones, curfews for aeroplane landings), vehicle performance (e.g. noise standards for vehicles) or infrastructure performance (e.g. surface quality standards for roads, noise barriers along motorways). Infrastructure standards and Environmental Impact Assessment procedures have helped to improve the environmental performance of infrastructure.

While these preventive or remedial efforts have had a certain effect, it has become evident that greater integration of environmental concerns into transport policies is necessary to foster sustainable development of the sector. This implies institutional integration at strategic, planning, programming, budgeting and project levels, as well as providing appropriate economic signals through prices and taxes.

2.2 Transport prices and taxes

Pricing and fiscal measures are particularly important tools for the co-ordination of transport policies, having pervasive effects on infrastructure development, vehicle stocks, modal choice and traffic patterns. An ECMT resolution on internalising the external costs of transport (ECMT Resolution No. 98/1) recently urged countries to make greater use of economic instruments, differentiated taxation, and variable charges to internalise the external costs of transport activities.[1] The European Union also prioritises the integration of such sustainability concerns into transport policy, as reflected by the Treaty of Amsterdam (October 1997) and the Cardiff Summit (June 1998).

Energy prices play a major role in determining energy use in transport, and also influence technology choices. To the extent possible, energy prices should internalise externalities such as the environmental costs of energy production and use.

3. The role of sustainable development indicators

In this evolving context, development of environmental and sustainability indicators for the transport sector has been initiated by countries and international organisations alike, with the aim of shedding light on policy-relevant questions, monitoring sectoral performance, and helping to assess the effectiveness of policy intervention. A major role of indicators of transport sustainability is to reflect progress toward environmentally sound, socially equitable and economically viable transport.

1. See Annex B.

III. OECD WORK ON TRANSPORT-ENVIRONMENT INDICATORS

1. Background and mandate

The OECD and ECMT have been active in the field of transport and the environment since the 1970s, and have expanded the scope of their work in this domain since the late 1980s. The Council of Ministers meeting of 1989 gave the OECD the mandate to better integrate environmental and economic policies, and since then OECD's co-operative efforts with the ECMT have led to the publication of numerous monographs and compendia.

- In 1989, a resolution on transport and environment (ECMT Resolution No. 66) was adopted by the ECMT at a Ministerial meeting organised in co-operation with the OECD. This resolution gave recommendations to better integrate environmental concerns into transport policies, through measures aimed at vehicles, traffic management, and infrastructure.
- In 1994, the OECD initiated a project on Environmentally Sustainable Transport (EST) aimed at reconciling transport with environmental and sustainable development objectives. The project relies on the assumption that no activity can be sustainable if it surpasses the environment's long-term capacity to support it. It aims at characterising EST, developing sustainability criteria that can be quantified and have environmental significance, and establishing policy guidelines.
- OECD Environment ministers at their meeting in Paris (2-3 April 1998) agreed on a number of Shared Goals for Action as an expression of their commitment to sustainable development. These included the strengthening of international co-operation in meeting global and regional environmental commitments by, "... giving particular focus to key cross-sectoral issues and the strategic directions for environmentally sustainable transport developed at the 1996 OECD Vancouver Conference and the 1997 UN Economic Commission for Europe's Conference on Transport and the Environment in Vienna ..."

In recent years, concern over the contribution of transport to greenhouse gas emissions has further added to the demand for work on transport and the environment. Although road transport has been the traditional focus of OECD work due to its dominant role in environmental impacts of transport, air transport is receiving increasing attention due to its growing environmental impacts.

2. Results to date

2.1 OECD set of indicators for the integration of environmental concerns into transport policies

The OECD has been developing indicators to better integrate environmental concerns into transport policies since 1989.[2] In 1990, an initial set of transport-environment indicators was discussed and approved by the OECD State of the Environment Group, in consultation with the ECMT Secretariat. A first set of transport-environment indicators was published in 1993, and has subsequently been refined and expanded. A 1999 OECD monograph on environment-transport indicators presents a complete view of indicators currently used by the OECD, detailing their development, measurement, and applications.[3] The data used to calculate OECD indicators are drawn from regular OECD and ECMT publications (e.g. OECD Environmental Data Compendium 1999) and from other international sources.

2. This work is part of a broader work programme on sectoral indicators which covers the transport, energy, and agricultural sectors.
3. Indicators for the Integration of Environmental Concerns into Transport Policies, OECD, Paris, 1999.

2.2 Purpose

The main purpose of these indicators is to provide a basis for monitoring the integration of environmental concerns into transport policies and to identify how different driving forces and policy instruments interact and affect the environmental impacts of transport activities. Particular attention is given to the national level and to indicators to be used in an international context. The indicators are not designed to provide a full picture of transport-environment relationships, but rather to draw attention to selected issues that require further analysis. They need to be supplemented with additional information and interpreted in context to acquire their full meaning and to capture more specific linkages between transport and human activities.

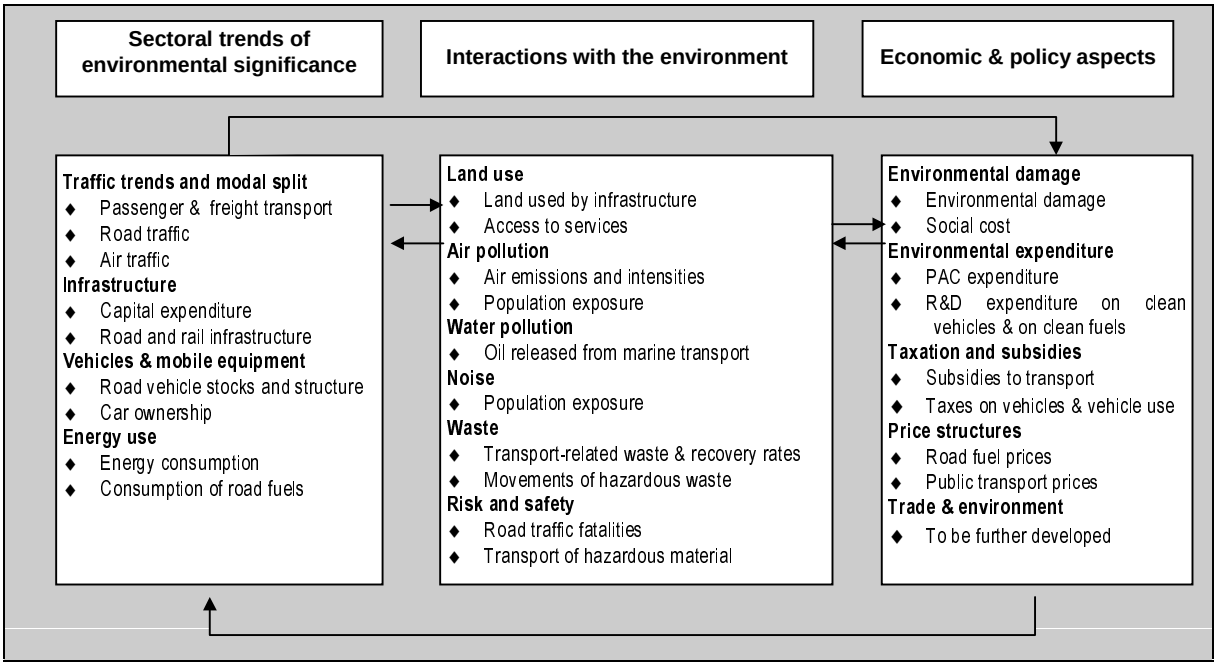
2.3 Use

These indicators are regularly used in OECD country reviews of environmental performance and in other analytical work. In practice, the indicators have proven to be essential for monitoring the transport-environment interface and the integration of economic and environmental decision-making overall. The continuous use of transport-environment indicators in OECD environmental performance reviews of member countries has also helped to further refine the indicators to improve their policy relevance and measurability.

2.4 Links with other international initiatives

The OECD's work on transport-environment indicators has been, and will continue to be, co-ordinated with international indicator initiatives. In 1998, based on the conclusions of the Cardiff and Vienna Summits, the European Commission (DG XI, DG VII and Eurostat), in collaboration with the European Environment Agency (EEA), initiated the development of an indicator-based Transport and Environment Reporting Mechanism (TERM). TERM aims to develop indicators useful for monitoring and assessing the effectiveness of integration measures taken in the 15 EU Member States.

Figure 1. **OECD Transport-environment indicators-overall framework**



Inset 1. **OECD work on environmental indicators**

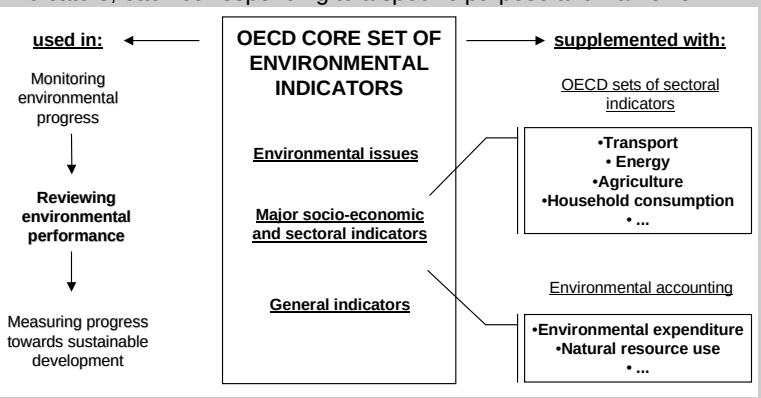
Environmental indicators have been part of the OECD's work on environmental information and reporting since the late 1970s. A specific programme on environmental indicators using a harmonised approach was initiated in the early 1990s, responding to the request of G7 summits (Paris, Houston, and London) and the OECD Council. In 1991, the OECD Council Recommendation on Environmental Indicators and Information called for further development of reliable, readable, measurable and policy-relevant environmental indicators to better measure environmental performance and better integrate environmental concerns into sectoral policies. In 1998, the OECD Council Recommendation on Environmental Information asked OECD countries to further develop and use indicators to measure environmental performance, and to establish indicators of progress concerning the implementation of national and sub-national policies on the environment, eco-efficiency and sustainable development.

The OECD environmental indicators programme recognises that there is no universal set of indicators; rather, several sets exist, corresponding to specific purposes. Indicators can be used at international and national levels in state of the environment reporting, measurement of environmental performance and reporting on progress towards sustainable development. They can further be used at national level in planning, clarifying policy objectives and setting priorities. The OECD work focuses principally on indicators to be used in national, international and global decision making, yet the approach may also be used to develop indicators at sub-national level.

SEVERAL TYPES OF INDICATORS

The OECD work includes several types of indicators, each corresponding to a specific purpose and framework:

- the OECD Core Set of environmental indicators, to keep track of environmental progress;
- several sets of sectoral indicators, to promote integration of environmental concerns into sectoral policy making;
- indicators derived from environmental accounting, to promote integration of environmental concerns into economic policies and sustainable use and management of natural resources.



All these indicator sets are closely related to each other, the OECD Core Set being a synthesis and representing a minimum set of indicators common to OECD countries and common to different uses and purposes.

APPROACH AND RESULTS

In developing harmonised international environmental indicators, OECD countries adopted a pragmatic approach, which led to:

- agreement on a common conceptual framework, based on a common understanding of concepts and definitions and on the pressure-state-response (PSR) model;
- identification of criteria to help in selecting indicators and validating their choice: all indicators are reviewed according to their policy relevance and utility for users, analytical soundness and measurability;
- identification, definition, measurement, publication and use of the indicators;
- provision of guidance on how to use the indicators (stressing that indicators are only one tool and have to be interpreted in context).

The results of this work, and in particular its conceptual framework, have in turn influenced similar activities by a number of countries and other international organisations.

USES

The OECD's environmental indicators are regularly used in environmental performance reviews and in other analytical and evaluative work. This creates a synergy in which feedback is provided on the indicators' policy relevance, analytical soundness and measurability. Beyond these applications, they also provide building blocks for sustainable development indicators.

The framework for indicator development used by the TERM project is based on the OECD Pressure-State-Response model, modified to distinguish two categories of pressures (Driving forces, and Pressures), and two categories of states (State, Impact). The framework is therefore called the DPSIR model, reflecting the addition of Driving forces and Impacts. To date, work carried out under the TERM project has closely paralleled OECD work, and OECD personnel have participated in consultative meetings.

2.5 Framework and structure

For the development of transport-environment indicators, the OECD pressure-state-response model was adapted to account for the specificities of the transport sector (Inset 1, Figure 1). Indicators to monitor the integration of environmental concerns into transport policies were developed to supplement the OECD core set of environmental indicators, in three categories:

- transport sector trends and patterns of environmental significance (i.e. indirect pressures and/or related driving forces);
- interactions between the transport sector and the environment (direct pressures, and resulting environmental or social conditions);
- economic and policy aspects of the transport-environment interface (e.g. cost of environmental damage, environmental expenditure, economic and fiscal instruments).

3. Core indicators

The regular use of transport-environment indicators in OECD's analytical work and environmental performance reviews has not only provided useful feedback on the indicators' policy relevance, but also on the measurability and quality of underlying data sets. Based on this experience, a "core list" of transport-environment indicators used in OECD work has been identified and is presented here.

Table 1. **Core list of OECD transport-environment indicators***

SECTORAL TRENDS OF ENVIRONMENTAL SIGNIFICANCE	Transport Intensity	◆ Passenger and freight transport per cent of GDP
	Vehicles	◆ Road vehicles per capita
	Fuels	◆ Fuel consumption intensities
	Infrastructure	◆ Road and rail network length and density
INTERACTIONS WITH THE ENVIRONMENT	Air Pollution	◆ Transport-related air emissions and intensities
	Noise**	◆ Percent of population exposed to unacceptable noise levels
ECONOMIC AND POLICY ASPECTS	Pricing And Taxation	◆ Road fuel price and taxes
	Subsidies**	◆ Level of subsidy by mode

* based on "Indicators for the integration of environmental concerns into transport policies", OECD, 1993 and 1999
** further work required on data availability for some OECD countries

The list represents a selection of regularly measured indicators, presently available for the majority of OECD countries and deemed to be most important for monitoring the environmental sustainability of the transport sector.[4] The list represents a selection from the complete set of indicators in use.[5] It is expected that, in practice, each country will supplement this core list with

4. See Annex A for some examples of their use.
5. See OECD 1999, Indicators for the Integration of Environmental Concerns into Transport Policies, for a full list of indicators in use.

additional indicators of particular interest, and that over time the list will be expanded with indicators of progress at the social-environment interface of the transport sector.

Eight indicators have been selected for the core list (Table 1), four reflecting sectoral trends, two reflecting environmental pressures, and two reflecting key economic and policy variables. This list is by no means exhaustive, and although these indicators alone cannot give a complete picture of the transport sector, they are deemed essential for identifying key trends, which deserve further analysis. In this respect, the change in a particular indicator's value over several years is often of greater interest than its measured value in a particular year. Although two of the indicators are not yet available for several OECD countries (noise and subsidies), they are included in the core list, in recognition of their importance.

3.1 Sectoral trends of environmental significance

Transport intensity: Passenger and freight transport per unit of GDP

The extent of passenger and freight transport per unit of GDP is an indicator of the transport dependency of a country's economy (passenger-km/unit GDP; tonne-km/unit GDP). In the 1990s, no OECD country has yet shown evidence of decoupling between economic growth and mobility. In fact, transport growth has been stronger than economic growth in most countries.

Vehicles: Road vehicles per capita

The number of road vehicles per capita (vehicles/capita) is of primary importance in determining the environmental pressures from the transport sector. The operation of road vehicles accounts for four-fifths of transport-related energy consumption, so the number of road vehicles is a good indicator of the importance of air emissions from transport. More detailed characterisation of road vehicle stocks can also be very informative; of specific interest are the number, average age, and fuel type (gasoline, diesel, others) of vehicle categories (e.g. motorcycles, passenger cars, utility vehicles, buses).

Fuels: Fuel consumption intensities

The intensity of transport fuel consumption (toe/tonne freight; toe/passenger km) reflects a number of characteristics of the transport sector (modal split, energy efficiency, fuel prices and taxes). World-wide, the transport sector consumes more than 60 % of oil products, and oil products account for about 98 % of transport energy use.

Infrastructure: Road and rail network length and density

The extent and density of transport infrastructure, (e.g. km road/km^2, km road/capita) is indicative of both the capacity and accessibility of transport services and the extent of land used for transport infrastructure, which in turn contributes to environmental pressures (impermeability of the ground, fragmentation of habitats). Transport infrastructure is estimated to consume up to 25-30 % of land in urban areas and less than 10 % in rural areas.

3.2 Interactions with the environment

Air pollution: Transport-related air emissions and intensities

Transport-related air emissions (kg emissions/VKT; kg emissions/capita) give an indication of the magnitude of the sector's environmental impacts and related health risks. At the local level, transport is a major contributor to urban air pollution (NO_x, VOCs, particulates and photochemical pollution), and related health concerns. VOCs (including toxic substances such as benzene) and fine particulate matter are of particular concern. At the regional level, air emissions from transport (notably NO_x and VOCs) are important contributors to regional (e.g. ozone) and transfrontier (acidification) air

pollution which contribute to crop and forest damage. At the global level, transport is responsible for about 25 % of CO_2 emissions, and thus is a major concern for climate change. The OECD's programme on Environmentally Sustainable Transport (EST) has identified emissions of CO_2, CO, NO_x, VOCs, and particulates as criteria for environmentally sustainable transport.

Noise: Percent of population exposed to unacceptable levels of traffic noise

The percent of the population exposed to unacceptable levels of traffic noise (greater than 65 dBA) is an important indicator of environmental disturbance caused by transport. Ground and air traffic are considered to be the major sources of noise that disturb individuals and ecosystems.

3.3 Economic and policy aspects

Pricing and taxation: Road fuel prices and taxes

Road fuel prices and taxes are key variables for the transport sector, influencing consumer choice of vehicles, fuels, and transport mode. Pollution, accidents and congestion cause negative environmental and social effects, which are often not sufficiently taken into account in transport prices. Internalisation of such external (environmental or social) effects through the use of economic or regulatory instruments is considered a key element of policies aimed at fostering sustainable development. Furthermore, governments exert a major influence on the level of energy prices through taxation. Although the levying of fuel taxes has historically been primarily used as a tool to raise revenue and reduce energy dependency, the use of fiscal instruments to internalise environmental costs is being increasingly pursued. The degree to which vehicle ownership versus operation is taxed has been shown to influence demand for personal mobility.

Subsidies: Level of subsidy by mode

The degree of subsidisation of transport investment and operational costs is a key policy variable, affecting traffic and the overall size and modal balance of the sector. In practice, data availability relating to the use of transport subsidies is poor, and advances are needed in this area.

IV. SOCIAL ASPECTS OF SUSTAINABLE DEVELOPMENT OF THE SECTOR

Achieving sustainable transport will involve comprehensively addressing the three aspects of sustainability -- economic, environmental, and social. Until very recently, OECD work has largely focused on two aspects -- economic and environmental. Significant progress has been made on this front, as represented by the core list of transport-environment indicators. However, it must be noted that additional work is needed, both for the development of indicators of the environmental pressures and key policy variables, and for the improvement of data availability. The OECD has recently engaged in the development of social-environment indicators for the transport sector, to complement its set of economic-environment indicators.

Section 2 of this paper presented the principal indicators that the OECD currently uses for analysis of the environmental performance of the transport sector. This section is intended to turn attention to the social-environment interface of the sector, identifying selected social issues that are related to transport's environmental performance. The social issues listed here (Table 2) are in no way exhaustive; for a fuller examination of the social implications of sustainable transport, see the proceeding of the 1998 OECD Ottawa workshop. The list here is limited to issues at the social-environment interface, with the goal of stimulating a group discussion at the Rome Conference,

and together working toward the identification of issues for which social-environment indicators should be developed.

Transport activities and related environmental effects interact in many ways with social aspects. Ultimately, a set of indicators of sustainable development should be useful for evaluating progress towards achieving both environmental and social objectives in the transport sector, and perhaps also provide insight into the interactions of environmental and social policies within the sector. On the one hand, a number of social factors act as driving forces behind transport trends and patterns (e.g. household consumption patterns, time for leisure pursuits, disposable income levels, patterns of urban sprawl, average size of households). And on the other hand:

- transport activities and mobility play an important role in the daily lives of citizens, influencing the accessibility of leisure, education and other services, and the level of development of public transport;
- pollution, accidents and congestion cause a number of negative social side effects, which impose large costs on society. These effects and related external costs are often unevenly distributed among population groups and insufficiently addressed by transport policies;
- transport and environmental policies and related economic instruments (e.g. taxes, subsidies, prices) may have social implications which are unevenly distributed among population and income groups.

Six categories of social-environment-transport indicators are under development at the OECD, as summarised here (Table 2). For certain categories, such as health, some accepted indicators already exist and are in use (e.g. exposure to air emissions). For other categories, development of indicators is in a preliminary stage, and requires further discussion (e.g. access to transport).

Table 2. **Preliminary list of social-environment-transport issues**

Health	◆ Exposure to emissions (air, noise) ◆ Respiratory morbidity and mortality, stress ◆ Accidents (fatalities and injuries)
Employment	◆ Retirement, pension costs (effect on competitiveness of the mode) ◆ Working conditions and hours ◆ Enforcement of labour regulations (effect on competitiveness of modes) ◆ Unions and transport system dysfunction
Demographic aspects	◆ Urban sprawl , household size and demand for transport ◆ Congestion
Poverty and socio-economic inequity	◆ Access to transport, urban sprawl ◆ Affordability of transport and housing
Environmental democracy	◆ Access to environmental information ◆ Public participation in transport sector decision-making (e.g. EIA, strategic planning)
Environmental awareness and education	◆ Influence on transport safety, driver performance ◆ Consumer choice of transport equipment and mode

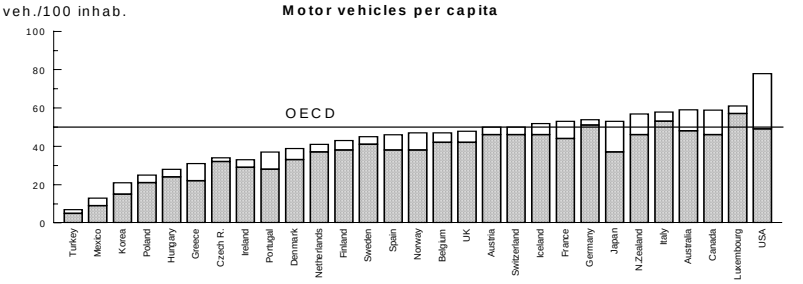
OECD experience has demonstrated that indicators are dynamic, changing over time in response to changes in knowledge, scale, and data availability. The core list presented in Section 3.3 can therefore be expected to continue to evolve in response to the needs of the OECD programme on sustainable development, as well as the programme on environmental performance assessment. For example, economic and policy aspects may be better covered in the future with additional indicators reflecting costs of social and environmental externalities, expenditure for environmental protection, degree and extent of environmental taxation and subsidies. Moreover, as explored briefly in this paper, numerous social issues have important influences on the environmental performance of the transport sector, and some environmental variables have considerable social implications. Further discussion and work is need to identify and prioritise these issues, and to develop appropriate indicators.

ANNEXES

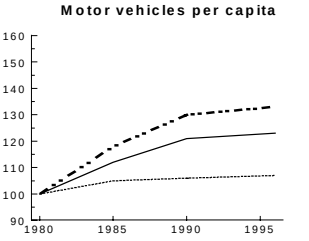
A. MEASURED INDICATORS - SELECTED EXAMPLES[6]

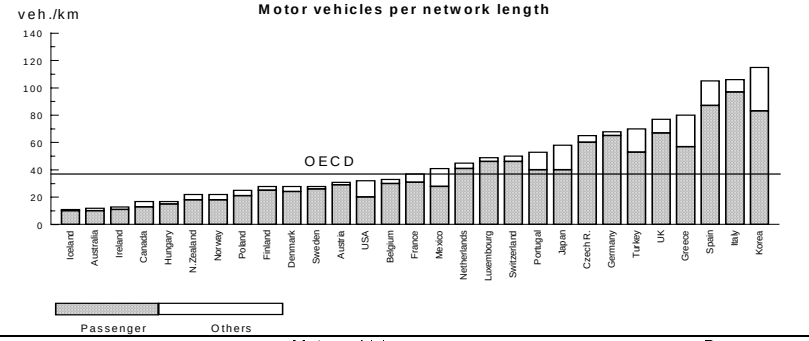
Road vehicle stocks and intensities

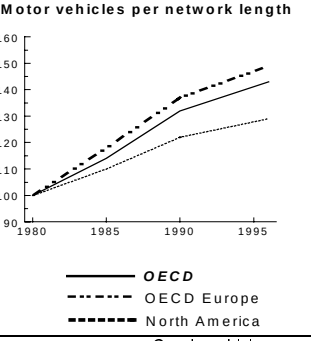
Road vehicle intensities
State, 1996



Road vehicle intensities
Trends, Index 1980 = 100





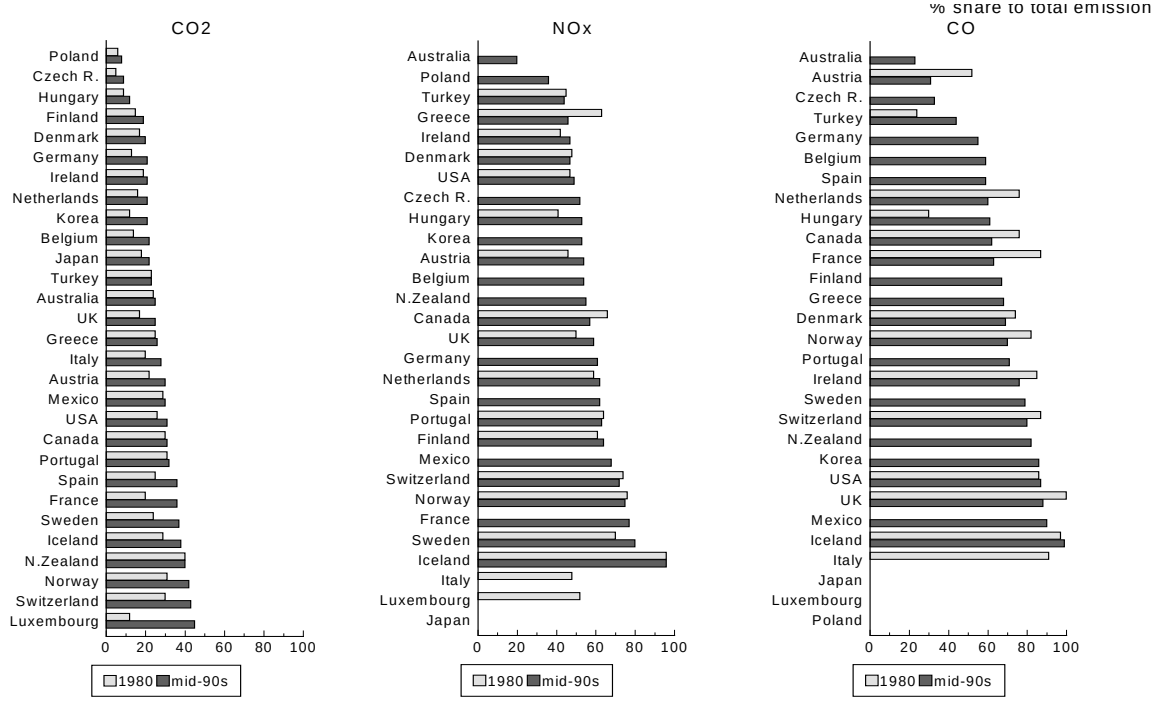


		Motor vehicles						Passenger cars			Goods vehicles		
		Total stocks (a)			Intensity per network length			Ownership			Intensity per unit of GDP		
		million	% change		veh./km	% change		veh./100inh.	% change		veh./10^6	% change	
		1996(b)	'70-'80	'80-'96	1996(b)	'70-'80	'80-'96	1996(b)	'70-'80	'80-'96	1996(b)	'70-'80	'80-'96
Canada		17.7	63	34	17	49	16	46	35	11	6.3	32	-11
Mexico		12.9	245	109	41	15	43	9	177	35	7.5	45	117
USA		206.4	44	32	32	38	29	49	23	-6	11.2	32	49
Japan	*	67.2	115	81	58	96	74	37	139	84	7.9	3	-8
Korea		9.6	308	1710	115	286	919	15	247	2216	3.7	115	131
Australia	*	10.8	52	48	12	66	31	48	32	21	6.0	11	-14
N. Zealand		2.1	50	32	22	47	33	46	35	11	6.8	28	1
Austria	*	4.0	85	64	31	64	35	46	86	54	2.1	10	15
Belgium	*	4.8	49	38	33	12	21	42	50	32	2.5	-18	25
Czech Rep.		3.6	146	87	65	146	88	32	146	88	2.1	..	..
Denmark	*	2.0	24	24	28	13	19	33	24	20	3.2	-18	-3
Finland		2.2	68	60	28	62	54	38	66	48	3.1	2	26
France	*	30.8	51	42	38	49	40	44	45	23	4.7	-3	52
Germany	*	43.6	..	..	69	..	..	51	..	..	1.7	..	..
w. Germany	*	35.2	63	44	..	47	..	51	64	35	1.3	-4	-7
Greece		3.3	267	159	79	247	133	22	245	151	8.6	129	84
Hungary		2.8	132	137	18	161	31	24	205	156	3.9	..	..
Iceland		0.1	104	48	11	85	49	46	89	23	3.2	-18	26
Ireland		1.2	80	52	13	69	52	29	62	35	2.5	-18	12
Italy		33.5	72	75	106	65	64	53	66	70	2.8	8	56
Luxembourg	*	0.3	44	78	49	40	76	57	36	56	1.4	-9	9
Netherlands	*	6.3	70	40	46	53	9	37	62	23	2.1	-17	46
Norway		2.1	67	47	22	48	31	38	69	26	3.7	-28	47
Poland	*	9.6	290	213	26	285	149	21	355	211	6.5	..	..
Portugal	*	3.7	117	205	53	75	130	28	87	189	8.2	49	135
Spain		17.9	173	100	105	152	77	38	171	86	5.7	31	55
Sweden		4.0	26	29	29	22	21	41	22	19	2.0	3	36
Switzerland	*	3.5	62	46	50	47	37	46	60	31	1.7	31	27
Turkey		4.3	293	270	70	290	259	5	332	213	2.3	81	12
UK	*	28.5	28	64	77	21	50	42	29	54	3.4	-10	34

6. Excerpt from OECD 1999, Indicators for the Integration of Environmental Concerns into Transport Policies

A. MEASURED INDICATORS-SELECTED EXAMPLES (cont'd)

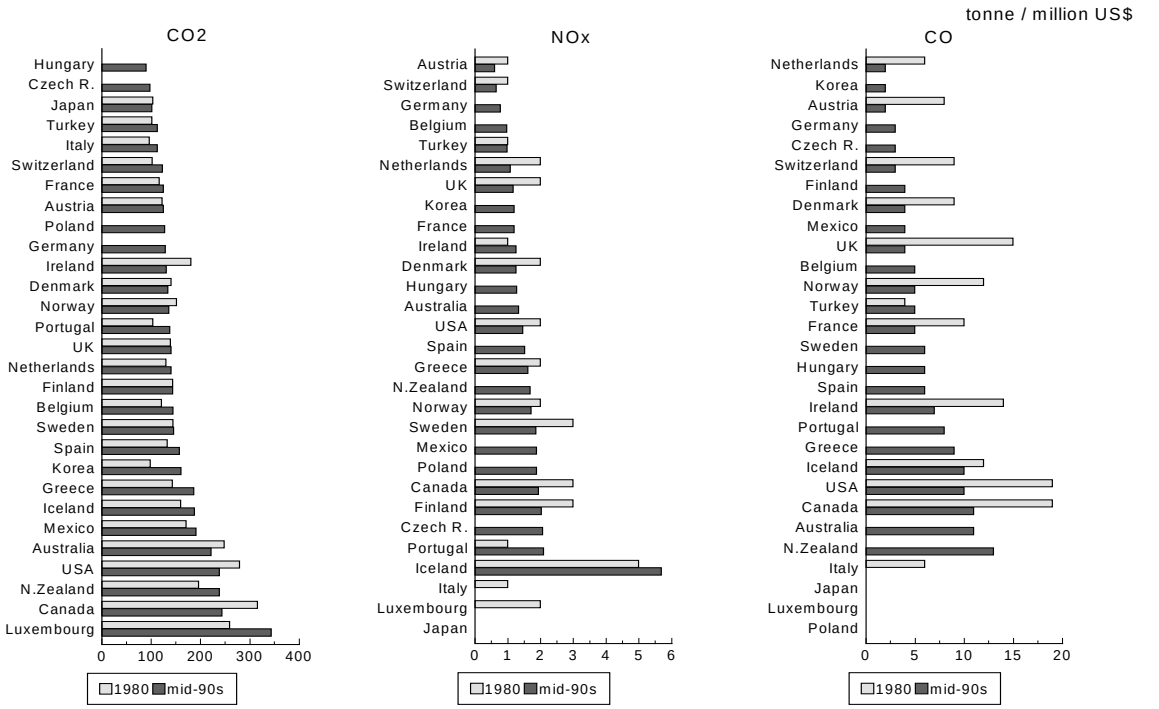
Transport-related air emissions-relative to total emissions



		Share of transport emissions (% of total emissions)											
		early 1980s						mid 1990s					
		CO2	NOx	VOC	Part.	CO	SOx	CO2	NOx	VOC	Part.	CO	SOx
Canada	*	30	66	49	5	76	3	31	57	23	8	62	5
Mexico	*	29	..	..	..	..	..	30	68	52	11	90	6
USA	*	26	47	44	11	86	3	31	49	37	22	87	3
Japan		18	..	..	..	..	..	22	..	..	..	..	..
Korea	*	12	..	..	..	..	..	21	53	..	24	86	20
Australia	*	24	..	..	..	..	..	25	20	29	..	23	..
N. Zealand	*	40	..	..	..	..	..	40	55	65	17	82	19
Austria	*	22	46	27	..	52	2	30	54	14	..	31	6
Belgium	*	14	..	..	..	..	..	22	54	49	..	59	7
Czech Rep.	*	5	..	..	..	..	1	9	52	27	6	33	1
Denmark	*	17	48	71	..	74	5	20	47	53	..	69	5
Finland		15	61	..	..	..	2	19	64	29	23	67	3
France	*	20	..	..	..	87	4	36	77	46	..	63	15
Germany	*	13	..	..	..	..	..	21	61	32	11	55	2
w. Germany	*	15	49	40	7	71	3	..	66	31	14	64	9
Greece	*	25	63	48	..	..	20	26	46	57	..	68	6
Hungary	*	9	41	..	3	30	3	12	54	48	12	61	2
Iceland	*	29	96	75	..	97	43	38	96	76	..	99	32
Ireland	*	19	42	44	9	85	2	21	47	34	..	76	5
Italy	*	20	48	..	39	91	5	28	..	..	..	..	..
Luxembourg	*	12	52	45	..	..	6	45	..	..	..	..	..
Netherlands	*	16	59	46	..	76	6	21	62	42	41	60	21
Norway	*	31	76	46	23	82	12	42	75	21	25	70	13
Poland		6	..	37	..	..	..	8	36	37	3	..	2
Portugal	*	31	64	56	13	..	4	32	63	31	..	71	6
Spain	*	25	..	..	..	..	..	36	62	45	..	59	6
Sweden	*	24	70	..	..	..	9	37	80	38	..	79	24
Switzerland		30	74	45	15	87	8	43	72	30	26	80	7
Turkey		23	45	..	..	24	..	23	44	..	..	44	..
UK	*	17	50	38	17	155	2	25	59	36	26	88	4

A. MEASURED INDICATORS - SELECTED EXAMPLES (cont'd)

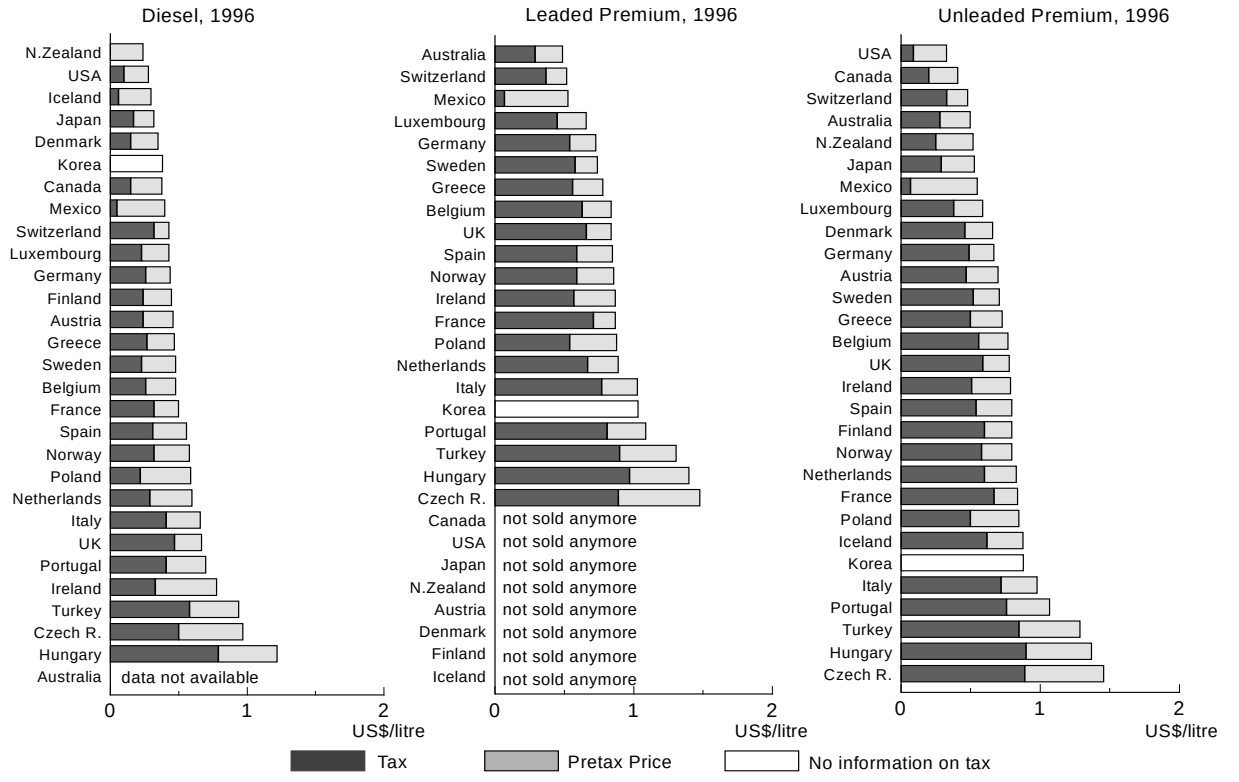
Air Pollution, Transport-related air emissions-emission intensities per unit of GDP



		Transport emissions per unit of GDP, mid-1990s tonne / million US$						Transport emissions per unit of GDP, change since 1980 %					
		CO2	NOx	VOC	Part.	CO	SOx	CO2	NOx	VOC	Part.	CO	SOx
Canada	*	244	1.9	1.1	0.25	10.6	0.21	-23	-39	-58	4	-44	-37
Mexico	*	191	1.9	0.5	0.08	3.9	0.24	12	..	..	..	..	..
USA	*	239	1.5	1.2	0.10	10.2	0.08	-15	-34	-47	-34	-45	-42
Japan		102	..	..	..	..	..	-2	..	..	..	..	..
Korea	*	161	1.2	..	0.19	1.9	0.62	63	..	..	..	..	..
Australia	*	222	1.3	1.7	..	11.2	..	-10	..	..	..	..	..
N. Zealand	*	239	1.7	2.1	0.13	12.7	0.16	22	..	..	..	..	..
Austria	*	125	0.6	0.4	..	2.1	0.02	2	-39	-70	..	-74	-76
Belgium	*	145	1.0	0.8	..	4.6	0.09	20	..	..	..	..	..
Czech Rep.	*	98	2.1	0.7	0.09	2.7	0.08	..	..	..	..	..	..
Denmark	*	134	1.3	0.7	0.08	3.9	0.08	-4	-27	-43	73	-59	-72
Finland		144	2.0	0.6	0.14	3.6	0.04	0	-30	..	-35	..	-82
France	*	125	1.2	1.1	..	5.4	0.13	7	..	..	..	-45	-12
Germany	*	129	0.8	0.4	0.04	2.6	0.03	..	..	..	..	..	..
Greece	*	187	1.6	2.2	..	8.5	0.31	31	-2	197	..	..	-68
Hungary	*	90	1.4	0.9	0.22	5.7	0.13	..	..	..	..	..	..
Iceland	*	188	5.7	1.8	..	9.9	0.54	18	4	-12	..	-14	-41
Ireland	*	131	1.3	1.5	..	7.0	0.16	-28	5	26	..	-52	-14
Italy	*	113	..	..	..	..	..	16	..	..	..	..	..
Luxembourg	*	344	..	..	..	..	..	33	..	..	..	..	..
Netherlands	*	141	1.1	0.5	0.07	1.9	0.10	8	-39	-60	-50	-68	-38
Norway	*	136	1.7	0.8	0.07	5.2	0.05	-10	-27	-40	-13	-57	-83
Poland		128	1.9	1.3	0.16	..	0.21	..	..	..	..	..	..
Portugal	*	138	2.1	0.9	..	8.0	0.18	33	49	27	..	..	29
Spain	*	158	1.5	1.1	..	5.8	0.25	19	..	..	..	..	..
Sweden	*	146	1.9	1.1	..	5.6	0.16	1	-28	..	..	..	-57
Switzerland		123	0.7	0.4	0.03	2.7	0.02	20	-36	-65	-26	-70	-77
Turkey		113	1.0	1.0	..	5.2	..	10	3	19	..	19	..
UK	*	141	1.2	0.7	0.05	4.0	0.08	1	-32	-42	-35	-74	-44

A. MEASURED INDICATORS - SELECTED EXAMPLES (cont'd)

Pricing and Taxation, Road fuel prices and taxes



		Diesel fuel (a)						Leaded premium						Unleaded premium (b)					
		Price US$/litre (d)			Taxation (c) % of price			Price US$/litre (d)			Taxation (c) % of price			Price US$/litre (d)			Taxation (c) % of price		
		1980	1990	1996	1980	1990	1996	1980	1990	1996	1980	1990	1996	1980	1990	1996	1980	1990	1996
Canada	*	0.52	0.40	0.38	..	34	40	..	..	n.app.	..	..	n.app.	0.34	0.46	0.42	25	42	49
Mexico	*	..	0.32	0.40	..	13	13	..	0.37	0.53	..	13	13	..	0.49	0.55	..	13	13
USA	*	0.44	0.32	0.29	15	28	36	0.55	..	n.app.	..	..	n.app.	0.63	0.37	0.33	..	27	27
Japan	*	0.66	0.38	0.32	24	36	53	..	..	n.app.	..	..	n.app.	0.95	0.64	0.54	37	47	54
Korea	*	0.91	0.33	0.38	..	..	..	3.60	..	1.03	..	..	..	2.57	0.71	0.88	..	..	..
Australia		..	0.24	..	..	19	..	0.48	0.49	0.50	19	45	59	..	..	0.50	..	..	55
N.Zealand	*	0.65	0.36	0.25	2	21	1	0.83	0.62	n.app.	28	46	n.app.	..	0.61	0.52	..	46	48
Austria		0.82	0.53	0.47	33	45	52	0.90	0.75	n.app.	42	56	n.app.	..	0.72	0.70	..	53	67
Belgium		0.52	0.46	0.48	34	47	54	0.95	0.80	0.84	53	65	75	..	0.75	0.77	..	63	73
Czech Rep.		..	..	0.97	..	55	51	..	..	1.49	..	72	60	..	..	1.45	..	68	61
Denmark	*	0.37	0.21	0.35	0	0	44	0.90	0.70	n.app.	59	69	n.app.	..	0.65	0.67	..	62	70
Finland		..	0.60	0.45	..	59	54	0.93	0.68	n.app.	36	55	n.app.	..	0.63	0.80	..	51	75
France	*	0.69	0.47	0.50	47	57	64	0.98	0.85	0.87	58	74	81	..	0.83	0.84	..	73	80
Germany		..	..	0.44	..	..	59	..	..	0.72	..	..	74	..	..	0.67	..	..	74
w.Germany		0.66	0.43	..	41	51	..	0.76	0.64	..	49	63	..	..	0.59	..	..	60	..
Greece		0.60	0.36	0.48	13	27	57	1.40	0.85	0.79	42	64	72	..	0.81	0.73	..	55	68
Hungary		..	..	1.22	..	18	65	..	..	1.40	18	52	70	..	..	1.37	..	..	66
Iceland	*	..	..	0.30	..	..	20	..	..	n.app.	..	..	n.app.	..	..	0.88	..	..	70
Ireland		0.69	0.66	0.79	28	51	42	0.96	0.96	0.87	48	67	66	..	0.93	0.79	..	65	65
Italy		0.55	0.60	0.66	8	60	62	1.41	1.09	1.03	61	75	75	..	1.07	0.98	..	74	73
Luxembourg		0.45	0.34	0.43	17	33	54	0.70	0.59	0.66	44	49	68	..	0.56	0.59	..	52	65
Netherlands		0.47	0.44	0.60	23	43	48	0.82	0.85	0.89	52	64	75	..	0.81	0.83	..	62	72
Norway		0.31	0.25	0.58	1	15	55	0.72	0.69	0.87	52	64	68	..	0.63	0.80	..	61	72
Poland		..	0.70	0.59	..	30	37	..	0.92	0.88	..	41	62	..	..	0.85	..	..	59
Portugal		0.84	0.88	0.69	7	52	59	2.24	1.40	1.09	61	68	74	..	1.34	1.07	..	64	71
Spain		0.64	0.54	0.56	25	49	55	1.29	0.80	0.85	35	63	69	..	..	0.80	..	..	67
Sweden		0.33	0.43	0.48	8	27	49	0.67	0.70	0.74	49	65	79	..	..	0.71	..	..	74
Switzerland		0.82	0.51	0.42	51	59	75	0.79	0.52	0.52	51	59	71	..	0.48	0.48	..	55	69
Turkey		0.88	1.06	0.94	..	55	61	1.51	1.14	1.30	..	53	69	..	..	1.30	..	..	66
UK		0.77	0.59	0.67	40	53	70	0.88	0.75	0.84	46	62	79	..	0.71	0.77	..	58	76

B. ECMT RESOLUTION NO. 98/1 ON POLICY APPROACHES TO INTERNALISING THE EXTERNAL COSTS OF TRANSPORT

[CEMT/CS(98)7]

Ministers of Transport of the ECMT, meeting in Copenhagen, 26-27 May 1998:

REITERATING

- that adequate and efficient transport systems are of fundamental importance to the economies of all ECMT Member Countries and play an important role in the lives of their citizens;
- that there exist safety, health and environmental problems for which the transport sector bears a responsibility;
- that difficulties are increasingly apparent in meeting demand for mobility and funding infrastructure developments.

RECALLING

- that the Council of Ministers at Annecy in 1994 established an ad hoc Task Force on the Social Costs of Transport to clarify the issues in the debate on external costs, advise on methods of evaluation and develop appropriate policy options;
- that the 1996 ECMT Hearing of International Non-Governmental Organisations showed general support for the approach to managing the social costs of transport adopted by the Task Force;
- that the Berlin Council of Ministers of 1997 accepted the approach to internalising the external costs of transport set out in the report of the Task Force and called for the drafting of a resolution on policy toward the external costs of transport;
- that Ministers reiterated their support for further consideration of the application of the principle of internalising the external costs of transport in their 1997 Helsinki Declaration and at the 1997 UN/ECE Conference on Transport and Environment in Vienna;
- that the European Commission will make proposals on the development of instruments for reducing the social costs of transport on the basis of the 1996 report Towards Fair and Efficient Pricing in Transport;

CONSIDERING

- that significant welfare gains could be realised through reducing the external costs of transport efficiently and that internalisation aims to achieve this by factoring external costs into markets;
- that through more efficient management of resources and government expenditure, internalisation presents opportunities to reduce budget deficits, increase public spending and/or reduce taxes on labour and capital;
- that internalisation is a key element of policies aimed at fostering sustainable development;

AWARE

- that internalisation can be achieved without a net increase in taxation in the economy as a whole;
- that by improving economic efficiency internalisation can improve the competitive position of enterprise;
- that issues of equity (including the international dimension) need to be considered in developing internalisation policies. Equity issues can and should be addressed by a variety of flanking measures. In this way, internalisation can be made compatible with policies for regional cohesion;
- that the tax systems of many countries may already internalise some external costs, either as a result of overt policy or as a by-product of raising revenue through taxes specific to transport;
- that there are uncertainties in the estimation of external costs and in cost allocation, but these costs are certainly not zero and the lower bound estimates used as the basis for the accompanying report are unlikely to over-value external costs;

- that for some transport services with high external costs, internalisation is likely to lead to price increases but that internalisation should be based primarily upon structuring prices more efficiently, rather than increasing prices overall;
- that for those modes currently associated with high external costs, internalisation will, at the same time as improving efficiency, reduce growth in the volume of transport and any associated socio-economic benefits. However, a well designed policy package need have little impact on GDP and will result in an increase in net welfare when the value of safety and environmental benefits is taken into account.

NOTING

- that the potential for economic instruments to address the social costs of transport has been under-exploited;
- that tax increases that provide no incentive to reduce external costs do not contribute to internalisation;
- that regulations should be dynamic (tightened over time) in order to provide incentives for technological improvement, and that fiscal components of internalisation policy must take into account the expected benefits of such technological improvements;
- that economic indications of individual preference are the ideal basis for the valuation of external costs. However, where satisfactory valuations on this basis do not exist, agreed political targets (e.g. ambient air quality or exhaust emissions standards) are the most suitable basis for a practical internalisation strategy.

AGREE TO THE FOLLOWING PRINCIPLES

- that in the interests of improving economic efficiency, reducing the social costs of transport and increasing economic welfare, internalisation is an important transport policy objective;
- that full internalisation should be viewed as a long term objective, taking account of the wide gap that exists between the present structure of costs and prices in transport markets and the ideal in many countries (and particularly in some transition economies);
- that internalisation policies should be implemented through economic instruments and/or regulations, designed to provide effective incentives for reducing externalities while not resulting in a net increase in taxation in the economy as a whole;
- that Governments must co-operate to develop effective instruments for internalisation that do not discriminate between citizens or companies of different countries;
- that internalisation policies should not discriminate between different modes of transport or between transport and other sectors of the economy;
- that where public financial support for the provision of public goods is necessary, it should be provided, but only through transparent payments under contract;
- that internalisation policy should be implemented in a gradual step-wise manner in order to avoid economic shocks;
- that these gradual changes should be co-ordinated between modes to avoid shifts in modal split that would prove uneconomic in the long term.

RECOMMEND

- that Governments pursue opportunities to provide incentives for internalisation in the development of transport policy both in the context of EU legislation and in the framework of national legislation in all ECMT Member countries;
- that Governments develop economic instruments for the internalisation of transport externalities and that Ministers of Transport co-operate with Ministers of Finance in exploring the possibilities;
- that Governments align the structure of taxation more closely with costs, for example by moving towards more differentiated tax systems in transport and-making greater use of variable charges[7];
- that Governments progressively tighten fuel, emissions and safety standards cost-effectively to stimulate technical improvements towards lower social costs of transport;
- that Governments ensure that existing regulations are respected, notably in regard to social legislation;

7. Italy entered a reservation in view of its concern that fiscal policy is not the remit of Transport Ministers.

- that where existing legislation related to the external costs of transport proves difficult to enforce, notably in the areas of road safety and environmental protection, regulations are reviewed with a view to rendering enforcement more practicable and effective;
- that special attention be given to reducing acute externalities, such as in urban areas, in the shorter term;
- that Governments ensure coherence in the valuation of costs and benefits, both private and external, used in project appraisals and environmental impact assessments and in developing both investment and internalisation policies;
- that Governments ensure that the electronic charging systems for using roads under development in a number of Member countries are compatible to a degree that minimises the costs of using such systems, avoids the need for individual vehicles to be equipped with several different systems and avoids the creation of delays at national frontiers;
- that Governments undertake appropriate public education measures to prepare the ground for the introduction of internalisation policies;
- that first steps towards a gradual and progressive internalisation of the external costs of transport be taken in individual Member countries as soon as possible.

INSTRUCT the Committee of Deputies

- to monitor the development of internalisation policies in ECMT Member Countries;
- and to report on progress towards the application of this Resolution within three years.

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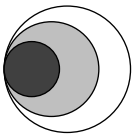
TRANSPORT/ENVIRONMENT INDICATORS

THE EXPERIENCE OF FINLAND*



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* By Mr. Markku Lehtonen, Ministry of Environment, Finland.

EXECUTIVE SUMMARY

Finland's Ministry of Transport and Communications has for some years already taken an active role in promoting the integration of environmental concerns into the activities of the transport sector. In 1994, the Ministry adopted its first environmental programme, called the "Action Programme for Reducing the Adverse Effects of Transport on the Environment". In June 1999, a new programme, "Environmental Guidelines for the Transport Sector", was adopted. The programme forms the basis for an ISO 14 001 environmental management system for the entire administrative sector, outlining the sector's long-term policy goals and targets, and the ways of achieving them.

Environmental indicators have been applied to monitor progress in reducing the adverse impacts of transport on the environment already in the framework of the 1994 "Action Programme", and they will play a role also in monitoring progress during the new programme period. However, the role of indicators in the annual monitoring of integration of environmental concerns into the transport sector is clearly subordinate to the largely qualitative assessment and evaluation of the fulfilment of the environmental programme's objectives. The main uses of indicators are to provide internationally comparable data on transport related environmental pressures and to help monitor the long-term environmental changes brought about by the transport sector's operations.

I. ENVIRONMENTAL GUIDELINES FOR THE TRANSPORT SECTOR

In 1994, the Ministry of Transport and Communications adopted its first environmental programme, called the "Action Programme for Reducing the Adverse Effects of Transport on the Environment". The programme established goals and objectives for the actors in the administrative sector of transport and communications with the aim of minimising adverse environmental effects. Implementation of the programme has been monitored annually.

In June 1999, a new programme, "Environmental Guidelines for the Transport Sector", was adopted, to form the basis of an ISO 14 001 environmental management system for the entire administrative sector over the coming five years. The programme outlines the long-term policy goals and targets, and the ways of achieving them. The joint guidelines for the whole sector are complemented by individual programmes and environmental management systems for each mode of transport.

The guidelines detail long-term goals and means with timetables and a list of responsible bodies and partners to be involved in the work. The guidelines also underline the need for co-operation, not only between the Ministry of Transport and Communications and the agencies in its administrative sector, but also with other ministries, local authorities, regional bodies, organisations and companies. Indeed, the programme is a product of close collaboration between the administrative sector of the Ministry of Transport and Communications and representatives of the different modes of transport. In total, approximately 50 parties were involved in the preparation of the Guidelines.

The programme builds primarily on three sources: The Council of State Decision-in-Principle on the Promotion of Ecological Sustainability from June 1998, the "Guidelines for Transport Sector Operations until 2020, adopted by the Ministry of Transport and Communications in December 1997, and the results from the annual monitoring of the earlier environmental programme from 1994. The programme adapts the guidelines for sustainable development incorporated in the Decision-in-Principle

to the particular needs of the transport sector. Also the targets and means included in the "Guidelines for Transport Sector Operations until 2020" are further specified in the programme. The basic principles for the activities of the transport sector are, therefore, defined in the three areas of sustainability – economic, social and cultural, and ecological sustainability. "The Environmental Guidelines for the Transport Sector" focuses on defining the measures needed for promoting ecological sustainability.

The programme classifies the actions needed for enhancing ecological sustainability under six topics:

- reducing greenhouse gas emissions;
- taking environmental impacts into account in developing transport systems;
- preventing pollution;
- reducing transport-related emissions;
- reducing exposure to noise;
- promoting ecological sustainability.

For each of the above-mentioned topics, the guidelines define detailed objectives, with timetables for their achievement, and points out the responsible agency and the bodies with which co-operation will be needed to ensure the achievement of the objective. The responsible agencies are required to further refine and operationalise these general objectives into more specific goals and targets in their operational and financial plans.

II. MONITORING AND ASSESSMENT

Both indicators and more qualitative assessments are used to monitor the achievement of the goals and targets set out in the "Environmental Guidelines for the Transport Sector". Interviews with key persons at the agencies responsible for the programme are complemented by information obtained through indicators to form the basis of annual monitoring. These monitoring results are made available on the website of the Ministry of Transport and Communications. More detailed monitoring reports will be prepared every two or three years and published in the Ministry's publication series.

Various administrative sectors (including that of the Ministry of Transport and Communications) are required to submit a report by summer 2001 to the Finnish National Commission on Sustainable Development on the progress made towards sustainable development and the impact of the programme in their own administrative sectors. The Commission will request relevant non-government sectors to assess the situation by summer 2001. This assessment can be seen to constitute "control" by outsiders of environmental performance of the transport sector. In addition, the environmental performance of the Finnish transport sector is assessed by the OECD and the EU in their indicator and monitoring programmes.

A comprehensive evaluation of the progress towards sustainable development will be drawn up based on the reports prepared by the administrative sectors. This review will be finalised by 2002 for the 10-year follow-up meeting of the United Nations Conference on Environment and Sustainable Development.

III. SELECTING ENVIRONMENTAL INDICATORS FOR THE TRANSPORT SECTOR

Environmental indicators are used to help measure progress towards the goals specified in the environmental programmes for the transport sector. The main criteria used in selecting the appropriate indicators were environmental relevance, international comparability, and applicability of the information provided by the indicator. Each of these criteria will be further elaborated on in the following.

1. Environmental relevance

The indicator system should be capable of providing a representative picture of the environmental pressures caused by the transport sector, and of their impact on the environment. Therefore, the indicator set should consist of a balanced combination of pressure, state, and response indicators. Moreover, the system should be sufficiently sensitive to anthropogenic changes in the environment so as to function as an "early-warning system". Finally, the indicators must describe issues that the Ministry of Transport and Communications can influence.

2. International comparability

The indicator system has to lend itself to measuring the achievement of the explicitly stated objectives of Finland's environmental policy. It must also enable comparison of Finland's achievements with those of other countries. Of particular importance is the consistency of the indicator system with the corresponding systems used in the EU, the OECD, and the UNCSD.

3. Applicability of the information

The most important goals with respect to the applicability of the information were:

- the indicators should be consistent with the information systems used in the Ministry of the Environment;
- guideline, threshold, reference or target values should be determined for individual indicators in order to help the user to understand the significance of the numerical values;
- the selection of indicators must be based on scientifically and technically sound theories;
- the choice of indicators and theories behind them should preferably be based on international standards or internationally agreed upon principles;
- it must be possible to integrate the collected information into economic indicators and forecast models;
- the data and information needed should preferably be available through the existing systems of data collection or it must be reasonably cost-effective to integrate the data into the existing systems;
- the quality of the information must fulfil the standard statistical requirements;
- it must be possible to update the information with regular intervals.

In total, 116 indicators were examined in light of the above-mentioned criteria. As a result, the following indicators were selected to be used in monitoring progress towards the goals established in the "Environmental Guidelines for the Transport Sector".

The set is not to be considered as “headline indicators”, but it represents a sample of those indicators which it was possible, given the availability and reliability of data, to use in monitoring the programme. The need to collect information for international data needs (e.g. EU, OECD, UNCSD) was an important criterion when selecting the preliminary indicator set.

The indicators presented in Tables 1a and 1b below have been selected with a view to providing a comprehensive picture of environmental concerns and the direction of the development in the transport sector. In the context of the environmental programme for the transport sector, it was not considered relevant to monitor issues that are important for only one or a few individual transport modes. Instead, each agency describes these issues in its own environmental reports.

The indicator set will be continuously improved and complemented as more experience is gained. The efforts to develop the concept of an indicator-based transport and environment reporting mechanism (TERM) for the EU play a particularly important role in this work. The Steering Group set up to prepare the TERM system has developed a preliminary list of 27 indicators, reviewed data availability for each indicator, developed a conceptual framework for the analysis of those indicators, conducted preliminary consultations with the EU Member States, and established co-operation with other international organisations working in the area of indicators for sustainable transport (e.g. the OECD, ECMT, UNECE, WHO, IEA).

A “zero” version of the indicator report will be published in autumn 1999, and will serve as an input to the Helsinki Summit of EU Heads of State in December 1999. The preliminary TERM indicator set is being reviewed in order to adapt it to the needs of its main users, i.e. the commission and the Member States.

Table 1a. **Selected environmental indicators for the transport sector**

Indicators common to all modes of transport	**Rail traffic**	**Road traffic**	**Air traffic**	**Water traffic**	**All forms of transport, total**
– Annual energy consumption, MJ	X	X	X	X	X
– Carbon dioxide (CO_2), tonnes/year	X	X	X	X	X
– Hydrocarbons, tonnes/year	X	X	X	X	X
– Sulphur dioxide (SO_2), tonnes/year	X	X	X	X	X
– Carbon monoxide (CO), tonnes/year	X	X	X	X	X
– Nitrogen oxides (NO_x), tonnes/year	X	X	X	X	X
– Particles, tonnes/year**	X	X	X	X	X
– Number of people living in noise affected areas (55 dBA)	X	X*	X		X
– Number of people exposed to traffic noise (65 dBA)	X	X*	X		X
– Use of stone and surface deposits, tonnes/year	X	X*	X	X	X
– Percentage of electrically powered traffic	X				
– Space requirement of the infrastructure, square-km	X	X*	X	X	X

Table 1b. **Selected environmental indicators for the transport sector**

Freight traffic					
– Percentage of the output	X	X	X	X	X
– Energy consumption/ tonne-kilometre	X	X	X	X	X
– Carbon dioxide (CO_2), g/tonne-km	X	X	X	X	X
– Hydrocarbons, g/tonne-km	X	X	X	X	X
– Sulphur dioxide (SO_2), g/tonne-km	X	X	X	X	X
– Carbon monoxide (CO), g/tonne-km	X	X	X	X	X
– Nitrogen oxides (NO_x), g/tonne-km	X	X	X	X	X
– Particles, g/tonne-km**	X	X	X	X	X
Passenger traffic					
– Percentage of the output	X	X	X	X	X
– Energy consumption/passenger-kilometre	X	X	X	X	X
– Carbon dioxide (CO_2), passenger-km	X	X	X	X	X
– Hydrocarbons, passenger-km	X	X	X	X	X
– Sulphur dioxide (SO_2), passenger-km	X	X	X	X	X
– Carbon monoxide (CO), passenger-km	X	X	X	X	X
– Nitrogen oxides (NO_x), passenger-km	X	X	X	X	X
– Particles, passenger-km**	X	X	X	X	X

* for public roads.
** only fuel-based particles.

IV. INDICATORS USED FOR MONITORING THE "GUIDELINES"

1. Energy consumption

(MJ/year, tonne-kilometre, passenger-kilometre)

Energy consumption is measured for the transport sector as a whole, in tonne-kilometres for freight transport, and in passenger-kilometres for passenger transport. Energy consumption is at the root of several of the environmental impacts caused by transport, especially the air pollutant emissions.

Of the goals of the "Environmental Guidelines for the Transport Sector", the goals of reducing greenhouse gas emissions, taking environmental impacts into account in developing transport systems, and reducing transport-related emissions are measured through this indicator. Specific energy consumption provides information on the efficiency of energy sector. The greenhouse gas emissions and air pollutant emissions are almost directly dependent on energy consumption, whereas the link between transport planning and energy consumption is much less straightforward. Moreover, there is a considerable time lag between any improvements in land use and transport planning and energy consumption by transport sector.

2. Greenhouse gas emissions

(tonnes/year, tonnes/freight-km, tonnes/passenger-km)

According to the "Environmental Guidelines for the Transport Sector" greenhouse gas emissions from the transport sector in 2010 should not exceed those in 1990. Therefore, the goal is consistent with the one Finland is committed to within the EU burden sharing agreement under the Kyoto Protocol. Greenhouse gas emissions are also measured for freight transport in grams per tonne-kilometre and for passenger transport in grams per passenger-kilometre.

3. Air pollutant emissions

The objective stated in the "Environmental Guidelines for the Transport Sector" is that "vehicle emissions should not exceed harmful levels in terms of health risks or critical loading in terms of acidification". The programme itself does not specify targets for emissions, but notes the goal of developing legislation and standards concerning emission reductions.

The air pollutants monitored through indicators include hydrocarbons (HC), sulphur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_x), and particulate matter (PM). In addition to the total emissions of the sector (tonnes per year) these emissions are being monitored in grams per tonne-kilometre for freight transport and in grams per passenger-kilometre for passenger transport. Total emissions describe the development of the total environmental load from transport sector, while the specific emissions provide information on the efficiency of the transport system.

4. Noise

According to the "Environmental Guidelines for the Transport Sector", the number of people exposed to excessive traffic noise levels in residential areas should be significantly reduced. Two indicators are used for monitoring progress: the number of people living in noise affected areas (with noise levels exceeding 55 dBA), and the number of people exposed to traffic noise (65 dBA). These indicators provide an overview of the trends in noise exposure, but do not, of course, tell either about the subjective perception of noise pollution, or about the distribution of noise exposure according to geographic area, social class, etc. Noise emission figures are not provided separately for freight and passenger transport.

5. Use of stone and surface deposits

(tonnes/year)

This indicator refers to the goal of minimising the use of natural resources, mentioned in the guidelines under the overall objective of preventing pollution. Use of stone and surface deposits poses as such a threat to landscape and biodiversity protection, but it also reflects the degree to which the transport sector has contributed to the "dematerialisation" of economy.

The "Guidelines for the Transport Sector" include a specific goal of harmonising the statistics concerning waste, use of stone aggregate, and the reuse of waste in civil engineering with a view to integrating them into the national statistics.

6. Share of electrically powered traffic

(%)

Two goals in the "Environmental Guidelines" are relevant with respect to this indicator: "reducing emissions from rail and air traffic through improved technology" and "introduction of more environmentally friendly technology". In practice, the share of electrically powered vehicles is still insignificant, whereas rail traffic in Finland is almost fully electrified. This indicator does not, however, measure the progress towards achieving the goal of increasing the use of biomass fuels, which is mentioned as one of the goals of the programme under the overall objective of introducing more environmentally friendly technology.

7. Space requirement of infrastructure

(km^2)

There is no single objective in the "Guidelines" programme relating to the space requirement of transport infrastructure. The indicator can be seen to measure indirectly the goals of avoiding damage to valuable areas and taking environmental concerns into account in land use and transport planning. However, the indicator does not take into account the differences between areas with respect to their ecological and amenity values, but treats all space requirement as equally undesirable.

8. Share of freight and passenger transport in total transport volume

(%)

These indicators do not attempt to directly measure any of the goals or objectives listed in the "Environmental Guidelines for the Transport Sector", but function as background information that is useful in transport planning and policy-making.

Table 2 below presents the objectives of the "Environmental Guidelines for the Transport Sector" and the indicators used for monitoring the progress of the programme in a matrix format.

Table 2. **Indicators and objectives of the "Environmental Guidelines for the Transport Sector**

Indicator/ Objective	Energy consumption	CO2 emissions	Other emissions	Exposure to noise	Use of stone and surface deposits	Electrically powered traffic	Space requirement of infrastructure
◆ Reducing GHG emissions	X	X					
◆ Taking environmental impacts into account in developing transport systems	X						
◆ Preventing pollution					X		X
◆ Reducing transport-related emissions	X		X			X	
◆ Reducing exposure to noise				X			
◆ Promoting ecological sustainability		X					

The present indicator set is highly "emissions-focused", which is understandable, given that emissions lend themselves more easily to quantification than many other aspects relevant to environmental concerns in the transport sector. Two areas of the "Environmental Guidelines for the Transport Sector" are particularly difficult to measure through indicators. On the one hand, taking environmental impacts into account in developing transport systems, and, on the other, promoting ecological sustainability, contain mainly goals and objectives whose fulfilment is difficult to quantify. For instance, enhancing co-operation between administrative sectors in transport planning, and improving strategic planning through the development of EIA and SEA procedures are among the fundamental building blocks of the programme. The ultimate goal of such operational and institutional developments is, of course, to reduce the harmful impact of transport on the environment, but it would not be feasible to monitor the success in these areas using indicators solely relating to the changes in the state of the environment or environmental pressures. Similar not easily quantifiable goal areas in the programme are reforming the tax system, improving consumers' opportunities to select environmentally friendly products, and promoting ecological sustainability through research, development, training and provision of information. To assess progress in these areas, assessments by outsiders as well as continuous self-evaluation by the actors themselves will be needed.

V. SOCIAL ISSUES

For the time being, the indicator set applied to monitor progress in integrating environmental issues into transport sector does not cover issues at the "environment/social interface". In principle, information concerning exposure to noise or air pollution could be disaggregated according to social groups, for instance, but, in practice, gathering such information was not considered a priority under the current circumstances. In Finland, differences in wealth and income between social groups are still very small compared to many other countries, despite some increase in inequality over the past decade.

On the other hand, as stated in the Government Programme for Sustainable Development, fundamental elements in "establishing the social and cultural conditions necessary for ecological sustainability" include "strengthening the joint learning and innovative processes of different social actors, and promoting public initiative and participation and opportunities for the public to have a say in policy-making".

Indicators to measure progress towards these objectives may be hard to come by, but the "Environmental Guidelines for the Transport Sector" can be seen to contribute to these goals in at least two distinct ways: firstly, the programme itself is a result of a participatory process, in which various actors of the society have had a say. Secondly, the monitoring of the programme is made as open and transparent as possible, through assessments by "outsiders" and by making assessment data publicly available on the internet.

VI. CONCLUSIONS

THE ROLE OF INDICATORS FOR MEASURING ENVIRONMENT/TRANSPORT INTEGRATION

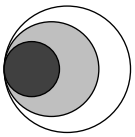
The aim of this paper has been to illustrate the possibilities and limitations for the use of indicators in assessing the integration of environmental concerns into transport policies in Finland. At the level of the transport sector as a whole, the “Environmental Guidelines for the Transport Sector” represents the major tool for integration. Even though indicators play an important role in monitoring the impact of transport sector on the environment, they are only in a subordinate role when assessing the performance of the government with respect to environment/transport integration.

The impacts of changes in government’s policies, processes and practices manifest themselves as changes in the state of the environment only with a considerable time lag. Moreover, indicators as such cannot detect the causal links between policy changes and environmental impacts. Therefore, it is worth to repeat again the fact often emphasised by the OECD: indicators are only one tool in assessing environmental performance, and they need to be interpreted in their policy context and complemented with more qualitative assessments.

The Finnish indicator system is being developed in close interaction especially with the work done within the EU, but also in other international organisations such as the OECD and the UNCSD. On the one hand, international trends and developments have influenced the indicator work in Finland, but on the other, Finland has been active in contributing to the development of indicators at the international level.

TRANSPORT/ENVIRONMENT INDICATORS

THE EXPERIENCE OF ITALY*



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EXECUTIVE SUMMARY

The definition and use of indicators showing the environmental impact of transport activities is being rapidly developed in Italy as part of a number of planning and action programmes. This report will describe three different programmes that promote environmentally sustainable transport at different territorial levels. Each of these has already used or plans to use various systems of environmental indictors.

Section II presents the General Transport Plan currently being prepared and describes the methodologies used in the Strategic Environmental Assessment (SEA) to evaluate the environmental sustainability of the Plan. Section III provides an initial stocktaking of the Urban Traffic Plans introduced in 1992 and assesses how effectively they are meeting their environmental goals. Lastly, Section IV briefly reviews the Sustainable Development Action Plans for implementing Agenda 21 and the outlook for their steering the transport system towards new forms of long-term sustainability.

The conclusion emphasises the potential and usefulness of effective systems of environmental indicators on transport activities, and also presents some methodological approaches and some steps that are necessary to make the current systems more effective, reliable and useful to decision-makers.

I. INTRODUCTION

It is clear that the current trends in the Italian transport system are not sustainable. Demand for transport continues to grow at high annual rates that exceed growth in GDP. At the same time, there is a growing imbalance in the modal distribution in favour of road transport, which is the least environmentally friendly mode of transport. Road transport now accounts for more than 66 per cent of domestic goods transport (for distances greater than 50 km) and nearly 86 per cent of passenger transport.

Although Italy made a commitment under the Kyto Protocol to reduce CO_2 emissions by 6.5 per cent compared to 1990 levels by 2008-2012, current trends indicate that energy consumption in the transport sector will grow by 23 per cent and CO_2 emissions will increase by 18 per cent with respect to the present situation. Consequently, if these trends continue, even technological progress in vehicles and the foreseeable reduction in consumption would not make it possible for Italy to meet its commitments to prevent climate change.

In urban areas, there has been a sharp decline in the use of public transport and a corresponding growth in the use of private cars. Traffic in urban and metropolitan areas constitutes a veritable national emergency. Traffic congestion, air and noise pollution, accidents and the space taken up by car traffic and parking in urban areas have given rise to growing public concern and protest. The problem of road traffic and its impact on the environment and public health has become one of the issues systematically included in policy-makers' programmes. Consequently, the environmental sustainability of the transport system is currently the focus of many national and local initiatives and programmes.

II. THE NEW GENERAL TRANSPORT PLAN

The new General Transport Plan (GTP) is currently in the preparation phase. The Ministry of Transport is required by law to prepare a GTP every ten years. The previous GTP, which was updated a number of times, dated from 1985 and gave only scant attention to the environmental problems connected with transport activities.

The new GTP, which takes into account EU directives and the recommendations of international bodies with recognised competence in this field such as the OECD, has been designed as an experiment in integrated transport/environmental planning and sets explicit sustainable environment objectives. A Strategic Environmental Assessment of the Plan will evaluate to what extent these objectives have been met. This approach was laid out in the *Introductory Document to the Plan* issued in 1998 and the *Guidelines to the New GTP* published in 1999, and was jointly approved by the Ministries of Transport, Public Works and the Environment.

1. Environmental objectives

The system of environmental objectives on which the GTP is based is aimed at meeting the need to:

- comply with the Italian government's international commitments to reduce cross-border pollution and prevent climate change;
- comply with the air quality standards that are progressively being made more stringent by the national legislation transposing EU directives;
- comply with quality standards for the acoustic environment in planning new infrastructure and improve existing infrastructure;
- minimise interference between the infrastructure network and the National Environmental Network (NEN) made up of parks, protected areas and the corridors connecting them with a view to protecting ecological balance and biodiversity;
- improve safety in urban and extra-urban areas and thereby substantially reduce the number of deaths due to accidents.

2. Strategic Environmental Assessment (SEA)

The Strategic Environmental Assessment (SEA) of the GTP is currently being developed[1] in the following phases:

- setting the short, medium and long-term environmental objectives on the basis of a review of the current environmental situation, which is described through a set of quantifiable and measurable indicators; defining environmental management plans at various levels and determining the available financial resources;
- describing the strategic options for action on the basis of scenarios;
- determining the environmental impact of each option using the pressure-state-response model, or its trend designated by the acronym "DPSIT";
- assessing the environmental impact using an effective set of criteria;
- including the environmental assessment in the final decision;

1. The Ministry for Transport appointed 20 Italian and foreign experts to prepare the GTP. They were supported by a group designated by the Ministry of the Environment, consisting of the Agency for New Technologies, Energy and Environment (ENEA) and the University of Rome, which were responsible for the Strategic Environmental Assessment of Plan scenarios.

- ex-post monitoring of the environmental impact of the action.

The selection of the environmental objectives is a preliminary step of great importance. These objectives, given the strategic nature of the GTP, take into account effects of a cumulative nature, such as resource consumption, atmospheric emissions and changes in overall risk factors that are independent of factors tied to specific locations. For one-off impacts, only the potential impact was assessed.

Once the Plan's objectives had been selected, an initial set of specific targets was defined, which in fact should be considered as proper "assessment criteria". The types of indicators that should be monitored to show if each criterion has been met were then defined. Annex A Table 1 provides a full list of the environmental targets and indicators. Annex A Tables 2a to 2e show the indicators in their units of measurement, related to a broader system of indicators representative of all aspects of mobility.

The indicators were selected taking into account whether the data were representative, comparable with international systems of indicators and available from regular and reliable sources.

The indicators selected were also described in terms of the territorial scale to which they are most applicable. The territorial breakdown used is as follows:

- extra-urban level, which is further subdivided into regional and provincial levels;
- urban level, i.e. consisting of the combined figures for individual cities;
- nation-wide level, i.e. giving average figures for all of Italy.

Some of the figures used in the SEA of the GTP can be directly extrapolated from data currently being gathered by a number of national sources, such as managers of individual transport systems, the Ministry of Transport or the Italian Statistical Office Istat. This is the case for vehicle fleet and infrastructure indicators and data on fuel consumption, traffic and mobility and the number of accidents and casualties.

However, some indicators showing physical interference at various territorial levels must be estimated using overlay mapping procedures and therefore require the use of updated thematic cartography. The Ministry for the Environment has many thematic maps covering the entire national territory that show the various impacts on the environment and territory and that can be used to carry out the necessary procedures.

Some figures must be estimated by applying more sophisticated algorithms that require large quantities of data, as is the case for emission indicators. A Community matrix model will be used for these types of indicators.

COMMUTE is the modelling instrument developed for the COMMUTE project financed by the General-Directorate for Transport (former DG VII). On the basis of traffic volume figures, this model is able to estimate values for consumption, emission, noise levels and accident rates for the various sectors of the national multimodal network. COMMUTE uses experimental data collected in other European projects and the data and projections of the MEET project (through 2010) on the following:

- average composition of national fleets;
- average annual distance travelled by the various types of road vehicles;
- typical temperatures used to calculate the cold start emissions and evaporative emissions of road vehicles;
- specific emissions of various types of fuel (and electrical energy) for the production and transport phases throughout the average life cycle.

In the SEA of the GTP, the output of the Ministry of Transport's transport simulation model (SIMPT) will be fed into COMMUTE, which will enable it to assess the changing pressures on the

environment in conjunction with changes in the pattern of the extra-urban network or the pricing and tax policies that determine the general price of transport.

TREMOVE, on the other hand, is the software produced within the AUTOIL 2 programme to assess the impact of policies on urban transport. It also requires input on traffic estimates, and calculates not only consumption and emissions on roads but also the cost of the initiatives being planned. Unlike COMMUTE, TREMOVE is able to simulate the modal distribution of traffic endogenously once price policies have been established. In the SEA of the GTP, TREMOVE's main task will be to estimate consumption and emissions in an urban environment.

Consequently, the SEA of the GTP requires the use of large amounts of data from a variety of sources. The main problems involve the updating and availability of data, and the differences in the reliability of the various sources. To solve these problems, which is essential if the GTP is to be monitored by using the system of indicators selected, a greater effort must be made to co-ordinate national and local information systems and to complete the monitoring networks. Appropriate steps in this regard are provided for in the GTP.

III. URBAN TRAFFIC PLANS (UTP)

The Urban Traffic Plans raised many expectations when they were introduced at the beginning of the 1990s. In fact, the following highly innovative criteria were for the first time established by law:

- the need to consider all aspects of mobility -- car traffic and parking, public transport, pedestrian and bicycle traffic -- in an integrated way;
- the need to define a framework of quantitative environmental objectives aimed at saving energy, reducing noise and air pollution, lowering accident rates and improving the quality and liveability of urban areas;
- the need to build the framework of quantifiable objectives through a participatory process formally approved by town councils;
- the need for a system of indicators to assess whether objectives are being met and a network for monitoring the data necessary for these calculations;
- the need to review the Plan at two-year intervals in order to change the tools and measures aimed at implementing the Plan wherever indicators show that objectives are not being met, while maintaining the jointly established objectives.

Many operational difficulties have been encountered in applying these principles, the most important of which has been inadequate knowledge of environmental conditions at the outset. A survey on 82 Urban Traffic Plans taken by ENEA in 1998 showed that only 60 per cent of communes have set the objective of reducing the environmental impact of traffic and only 28 per cent have set the objective of reducing energy consumption. The percentage of Plans in which energy savings or emission reductions were actually being measured was even lower.

A very wide range of methods for designing objectives and assessing results are still being used, which precludes making comparisons between cities and different situations and ultimately does not contribute to improving national and local decision-making. Lastly, in many cases the plans have not been taken beyond the planning phase to the phase of practical implementation of the proposed action. Although there are cases of well planned UTPs, which have achieved real operational and environmental improvements, in the vast majority of cases the results have not lived up to expectations. Despite the major efforts made thus far to implement monitoring networks and collect

and process data, much remains to be done to find a permanent solution to the lack of data and information on the state of the environment.

1. Indicators of the InPUT project (Innovation in Urban Traffic Plans)

As an example of a response to this situation, it is worth mentioning the experiment carried out by the Region of Umbria in collaboration with ENEA in the framework of the EU's SAVE programme, consisting of the drafting of guidelines for the development of UTPs specifically aimed at saving energy and reducing the environmental impact of transport activities. The InPUT Project is aimed at defining a method for preparing UTPs based on quantitative knowledge of traffic and its implications and the assessment of the possible options through appropriate indicators.

The InPUT Project focuses on four main themes:

- analysis of the relationship between the factors that shape mobility, i.e. urban-planning instruments, the public transport system and the organisation of private traffic;
- introduction of systems for forecasting, analysing and monitoring the trends and causal factors of mobility, as well as active urban traffic control instruments;
- co-ordination of the area's various institutional bodies in order to plan and facilitate regular consultation, exchange of experience and professional growth among the actors involved;
- development of uniform criteria and procedures, in particular with regard to the data and parameters to be collected and monitored, so that comparisons between different cities can be made, which is a necessary step to expand operational experience significantly and increase the effectiveness of the solutions being studied.

The InPUT Project has produced three types of results:

- definition of operational criteria for dividing urban areas into "environmental sectors", i.e. uniform areas for which the admissible pollution, noise and accessibility levels to be guaranteed to residents will be set;
- development of a series of indicators on the impact of urban mobility, which will also include its impact on energy consumption and the environment and which will be compared with the admissible levels set for each area;
- definition of a reference methodology that will make it possible to pool the data available in individual cities in order to facilitate their use by all interested parties and make it easier to define the requirements for the instruments and telematic systems used to manage urban mobility.

A careful choice of indicators is a pre-requisite for making a quantitative assessment of sustainable mobility, but they must then be integrated by a space-time function able to define the limit values for each selected indicator. This function should be applied not only to urban areas as a whole, but also to sub-divisions of urban areas that exhibit uniform characteristics and that must meet specific requirements.

The necessary steps were then taken to identify these areas, starting with basic tax districts and defining criteria for reshaping them into traffic zones and finally environmental sectors. The indicators were also studied in terms of the dynamics of the processes being measured, for which two classes of indicators were defined, namely short and long-term. The first class includes all indicators that can be determined automatically once appropriate telematic systems are available in cities, while the second must be obtained through surveys (see Annexes).

IV. SUSTAINABLE DEVELOPMENT ACTION PLANS FOR IMPLEMENTING AGENDA 21

An appropriate system of indicators constitutes the basis for the "State of the Environment" Reports and the assessment and monitoring component of the new planning instruments for sustainable development. In Italy, these instruments consist of the Sustainable Development Action Plans for implementing Agenda 21 at the national and local level. In the action plans, the transport sector is one of the main targets for achieving general objectives of environmental quality and social well-being in the broad sense.

The close involvement of the communities concerned is undoubtedly one of the most interesting and promising aspects regarding the prospects for change in the transport sector. This implies a capacity to inform and involve the public that strongly emphasises the role and function of indicators as a tool of communication. In the analytical phase of determining the state of the environment, indicators must correctly show the dangers and risks of the initial situation; in the policy setting phase, they must show effectively whether it is possible to attain the objectives set, and must subsequently make it possible to monitor to what extent the action taken has achieved the desired results.

Given the key role and importance of having indicators that are accurate, scientifically valid and can be effectively communicated, many people have recently begun to prepare manuals and "instructions" for selecting systems of indicators. The National Environmental Protection Agency is currently in the process of publishing its manual "Guidelines for Local 21 Agendas in Italy". Even earlier, the Region of Tuscany had prepared a similar document for use by local authorities in Tuscany.

As an example of these indicators, Annex C shows the set of indicators selected in the state of the environment report of the Commune of Bologna and the Region of Tuscany's guidelines on environmental objectives and sustainable traffic and mobility indicators. As can be seen, the mobility indicators are designed to measure directly measurable entities, such as km of network, numbers of cars, m^2 and density of traffic flows, which are understood as pressure factors that make noise and air pollution indicators meaningful. Defining targets on the basis of the objectives set by Agenda 21 is a good way of acting in a timely fashion, without waiting for the necessary scientific studies, starting with objectives for improving the environment that have broad community support.

V. CONCLUSION

In Italy, the systems of indicators for measuring the environmental performance of different modes of transport are very heterogeneous and diversified, particularly at the local level, even though they all concern the transport sector and set similar goals. It is no doubt true that some degree of inconsistency is inevitable and even desirable given the great geographic, environmental and social differences between the Italian regions. Nevertheless, specific work is required to improve co-ordination in order to create the network effect that will make it possible to exchange information and promote synergies among the various actors involved.

The National Environmental Protection Agency is the most appropriate body to perform this task, and has begun to do so by preparing the Manual for the Local 21 Agendas. In fact, the Agency has not only been asked to co-ordinate the regional environmental agencies, but also to manage the

national information system to which all Italian regions are linked in order to provide and revise information on the state of the environment.

As regards the content of transport indicators, the emphasis urgently needs to be shifted from “equipment” indicators (infrastructure, vehicles, etc.), which are often misleading, in order to develop more systematic knowledge of the interrelation between the various components of demand present in traffic flows and problems of air pollution, excessive noise levels and the rate and seriousness of accidents.

This shift must go hand in hand with developing, alongside the traditional supply-side policies, the new policies for managing the demand for mobility on which the prospects of a sustainable transport sector are largely based. In this way, the system of indicators will be able to make a real contribution to improving the decision-making process and to enabling the transport system to make significant strides towards genuine sustainable development.

ANNEXES

A. ENVIRONMENTAL TARGETS OF THE NEW GENERAL TRANSPORT PLAN

Table 1. **Environmental Targets of the New General Transport Plan**

IMPACT	TARGET	INDICATORS	REFERENCE DOCUMENTS
Energy consumption	Minimization of fossil fuel consumption (linked to reduction in CO_2 emissions)	Fossil fuel consumption	None (links with Kyoto protocol and resulting Committee of Ministers for Economic Planning resolution, CIPE, 19 November 1998)
Greenhouse effect	-18-20% CO_2 equivalent emissions (with respect to trend) by 2008/2012	CO_2 emissions	CIPE resolution (19 November 1998) to meet requirements of Kyoto international protocol
Acid rain	By end 2000: So_x –35% compared with 1985 NO_x –30% compared with 1990 VOC –30% compared with 1990	SO_x, NO_x, VOC emissions	Geneva Convention EU V Action Programme
Tropospheric ozone pollution	Bringing total NO_x and VOC emissions to 0.28 Mt and 0.37 Mt respectively by end 2010	NO_x and VOC emissions	Environment Ministry: Guidelines for a national strategy to combat ozone pollution
Accident rate	-2,600 deaths and –105,000 injuries as a result of road accidents by end 2010	Number deaths and injuries due to road accidents	European action programme for road safety (COM 93/246 and COM 97)
Air pollution	Minimization of emissions and concentrations of carbon monoxide (CO), nitrous oxides (NO_x), volatile organic compounds (VOC), benzene (C_6H_6), fine particles (PM10), sulphur dioxide (SO_2) within residential or wildlife areas	Emissions (and "virtual" concentrations) of CO, No_x, VOC, C_6H_6, PM_{10}, SO_2 within urban areas or wildlife zones	Several laws and decrees: DPCM 28/3/83, DPR 24/5/88, DM 15/4/94, DM 23/10/98, DM 21/4/99
Noise pollution	Noise pressure levels no higher than 60 dBA during the day and 50 dBA at night	Noise emissions	Law 447/95, DPCM 14/11/97
Interference with protected nature areas or areas of historical/ archeological significance	Elimination of potential interference	Extension of interference (length or surface area)	Regulations to protect parks and reserves
Interference with areas of outstanding natural, scenic, historical/ archeological significance not under protection	Minimization of interference	Extension of interference (length or surface area)	Possible protection regulations
Water pollution	Minimization of interference with water bodies	Extension of interference (length or surface area)	None pertinent to plan targets
Hydrogeological risk	Minimization of interference with areas at risk	Extension of interference (length or surface area)	Law 183/89, D.L. 180/98
Soil and land degradation	Minimization of interference with areas of a high commercial value Minimization of land occupation and fragmentation	Extension of interference (length or surface area) Size of areas occupied or included	None pertinent to plan targets

Table 2a. **Infrastructure and vehicle supply indicators**

Mode of transport	Indicator	Unit of measurement	Application scale	Models/ Estimates	Notes
Road/Rail	• Network density	Km/km^2	Extraurban	SIMPT	Also for sections of specific areas
	• Infrastructure supply	Km/inh.	Extraurban	SIMPT	Also for sections of specific areas
Air	• Infrastructure supply	No. runways/inh.	Extraurban	SIMPT	Also for sections of specific areas
Sea	• Infrastructure supply	No. commercial quays/tonne freight produced/imported	Extraurban	SIMPT	Also for sections of specific areas
Ferroutage	• Infrastructure supply	Interport capacity/ tonne of goods produced/imported	Extraurban	SIMPT	Also for sections of specific areas
Road	• Motorization rate	Vehicle/inhabitant	Overall	Dept. Motor Vehicles	Also for sections of specific areas
	• Technological make-up of vehicle supply (pass. & freight)	Percentage of various technologies	Overall	MEET/ COMMUTE	Using COPERT II classification

Table 2b. **Mobility indicators**

Mode of transport	Indicator	Unit of measurement	Application scale	Models/ Estimates	Notes
All	• Passenger mobility demand	Pass/year	Overall, urban, extraurban	SIMPT + CNT	Overall and by mode
	• Freight mobility demand	Tonne/year	Overall, urban, extraurban	SIMPT + CNT	Overall and by mode
	• Passenger transport volumes	Pass-km/year	Overall, urban, extraurban	SIMPT + TREMOVE + CNT	Overall and by mode
	• Freight transport volumes	Tonne-km/year	Overall, urban, extraurban	SIMPT + TREMOVE + CNT	Overall and by mode
	• Passenger traffic volumes	Vehicle-km/year	Overall, urban, extraurban	SIMPT + TREMOVE + CNT	Overall and by mode
	• Freight traffic volumes	Vehicle-km/year	Overall, urban, extraurban	SIMPT + TREMOVE + CNT	Overall and by mode
Road, rail, air	• Average annual distance travelled	Km/inh.-year	Overall, urban, extraurban	SIMPT + TREMOVE + CNT	Overall and by mode. Also for sections of specific areas

Table 2c. **Economic indicators**

Mode of transport	Indicator	Unit of measurement	Application scale	Models/ Estimates	Notes
All	• Average price for passenger transport	Lire/pass-km Lire/veh.-km	Urban, extraurban	SIMPT + TREMOVE	Overall and by mode of transport
	• Average price for freight transport	Lire/tonne-km Lire/veh.-km	Urban, extraurban	SIMPT + TREMOVE	Overall and by mode
	• Average cost passenger transport	Lire/pass-km Lire/veh.-km	Urban, extraurban	SIMPT + TREMOVE	Overall and by mode, including monetary value of time
	• Average cost freight transport	Lire/tonne-km Lire/veh.-km	Urban, extraurban	SIMPT + TREMOVE	Overall and by mode, including monetary value of time
	• Average external costs passenger transport	Lire/pass-km Lire/veh.-km	Urban, extraurban	Various studies	Overall and by mode. External costs will also be assessed on the basis of results of impact models
	• Average external costs freight transport	Lire/tonne-km Lire/veh.-km	Urban, extraurban	Various studies	Overall and by mode. External costs will also be assessed on the basis of results of impact models
	• Fuel price	Lire/Litre	Overall	Industry Ministry	
	• Total taxes	Lire/pass-km Lire/tonne-km	Overall	Tax regulations + SIMPT	Estimate

Table 2d. **Technical-functional and environmental efficiency indicators**

Mode of transport	Indicators	Unit of measurement	Application scale	Models/ Estimates	Notes
All	• Average length of passenger transfers	Km	Urban, extraurban	SIMPT (extraurban) CNT (urban)	Overall and by mode. For urban contexts, estimate based on CNT data
	• Average distance travelled per unit of freight transported	Km	Urban, extraurban	SIMPT (extraurban) CNT (urban)	Overall and by mode. For urban contexts, estimate based on CNT data
Road	• Average length of transfers	Km	Urban, extraurban	SIMPT (extraurban) TREMOVE (urban)	By vehicle class (cars, freight vehicles, etc.)
All	• Average and commercial speeds of passenger traffic	Km/h	Urban, extraurban	SIMPT (extraurban) TREMOVE (urban)	By mode of transport
	• Average and commercial speeds of freight traffic	Km/h	Urban, extraurban	SIMPT (extraurban) TREMOVE (urban)	By mode of transport
	• Passenger vehicle occupation factor	Pass/vehicle	Overall, urban, extraurban	SIMPT (extraurban) TREMOVE (urban)	By mode of transport and vehicle class (car, bus, motorcycle)
	• Freight vehicle load factor	Tonn/vehicle	Overall, urban, extraurban	SIMPT (extraurban) TREMOVE (urban)	By mode of transport and vehicle class (light and heavy vehicles)
	• Freight vehicle use coefficient	%	Overall, urban, extraurban	SIMPT (extraurban) Estimates (urban)	By mode of transport and vehicle class (light and heavy vehicles)
	• Average energy efficiency passenger transport	J/pass*km	Overall, urban, extraurban	COMMUTE/ SIMPT (extraurban) TREMOVE (urban)	By mode of transport and vehicle class (car, bus, motorcycle)
	• Average energy efficiency freight transport	J/tonn*km	Overall, urban, extraurban	COMMUTE/ SIMPT (extraurban)TREMOVE (urban)	By mode of transport and vehicle class (light and heavy vehicles)
	• Average specific emissions passenger transport	g/pass*km	Overall, urban, extraurban	COMMUTE/ SIMPT (extraurban) TREMOVE (urban)	By mode of transport and vehicle class (car, bus, motorcycle)
	• Average specific emissions freight transport	g/pass*km	Overall, urban, extraurban	COMMUTE/ SIMPT (extraurban) TREMOVE (urban)	By mode of transport and vehicle class (light and heavy vehicles)
	• Accident risk	Accidents/ /(pass-km)	Extraurban	SIMPT + COMMUTE	By mode of transport
	• Death risk	Deaths/ /(pass-km)	Extraurban	SIMPT + COMMUTE	By mode of transport
	• Specific noise emissions	Watt/km	Urban and extraurban	SIMPT + COMMUTE	By individual infrastructure

Table 2e. **Summary energy-environment assessment indicators**

Mode of transport	Indicator	Unit of measurement	Application scale	Models/ Estimations	Notes
All	• Passenger transport consumption	Toe/year	Overall, extraurban, urban	SIMPT + COMMUTE + TREMOVE	By mode of transport
	• Freight transport consumption	Toe/year	Overall, extraurban, urban	SIMPT + COMMUTE + TREMOVE	By mode of transport
	• CO_2 emissions	Tonne/year	Overall, extraurban, urban	SIMPT + COMMUTE + TREMOVE	By mode of transport
	• NO_x emissions	Tonne/year	Overall, extraurban, urban	SIMPT + COMMUTE + TREMOVE	By mode of transport
	• VOC emissions	Tonne/year	Overall, extraurban, urban	SIMPT + COMMUTE + TREMOVE	By mode of transport
	• SO_2 emissions	Tonne/year	Overall, extraurban, urban	SIMPT + COMMUTE + TREMOVE	By mode of transport
Road	• CO emissions	Tonne/year	Urban	TREMOVE	By vehicle category
	• C6H6 emissions	Tonne/year	Urban	TREMOVE	By vehicle category
	• Particle emissions	Tonne/year	Urban	TREMOVE	By vehicle category
	• NOx emissions per urban inhabitant	Tonne/inhab-year	Urban	TREMOVE + Overlay mapping	By vehicle category
	• SO2 emissions per urban inhabitant	Tonne/year	Urban	TREMOVE + Overlay mapping	By vehicle category
	• CO emissions per urban inhabitant	Tonne/inh.-year	Urban	TREMOVE + Overlay mapping	By vehicle category
	• VOC emissions per urban inhabitant	Tonne/inh.-year	Urban	TREMOVE + Overlay mapping	By vehicle category
	• C6H6 emissions per urban inhabitant	Tonne/inh.-year	Urban	TREMOVE + Overlay mapping	By vehicle category
	• Particle emissions per urban inhabitant	Tonne/inh.-year	Urban	TREMOVE + Overlay mapping	By vehicle category
All	• Number of inhabitants subjected to noise levels above 60/50 dB	Non-dimensional	Urban	COMMUTE + Overlay mapping	Traffic data calculated by TREMOVE will be used
	• Number of accidents	Non-dimensional	Overall, urban, extraurban	SIMPT + COMMUTE	Also by individual infrastructure
	• Number of deaths/injuries	Non-dimensional	Overall, urban, extraurban	SIMPT + COMMUTE	Also by individual infrastructure
	• Soil removed	Km^2	Extraurban	Infrastructure scenarios	Also in relation to attributed value of area
	• Interference with nature areas	Km or Km^2	Extraurban	Infrastructure scenarios + overlay mapping	Also in relation to attributed value of area
	• Interference with settlements	Km or Km^2	Extraurban	Infrastructure scenarios + overlay mapping	Also in relation to attributed value/ density residential buildings in area
	• Interference with landscape areas	Km or Km^2	Extraurban	Infrastructure scenarios + overlay mapping	Also in relation to attributed value/ specific features of landscape
	• Interference with waterways	Non-dimensional	Extraurban	Infrastructure scenarios + overlay mapping	Also in relation to importance of various waterways
	• Interference with hydrogeological risk areas	Km or Km^2	Extraurban	Infrastructure scenarios + overlay mapping	Also in relation to degree of risk of individual areas

B. URBAN TRANSPORT INDICATORS

Subset of short-term indicators

Indicator Management

- Trips generated
- Trips induced
- Distance generated
- Distance induced
- Time generated
- Time induced
- Congestion rate
- Average speed
- Linear consumption
- Density of consumption
- NO_x emissions
- NO_x emission density
- CO emission density
- Noise

Subset of long-term indicators

- Accidents (number/year)
- Mobility-related illnesses and deaths (number/year)
- Cost of infrastructure work and restoring acceptable conditions in area (expenditure/year)
- Cost of repairing damage to artistic Heritage (expenditure/year)

C. THE STATE OF THE ENVIRONMENT REPORT OF THE CITY OF BOLOGNA

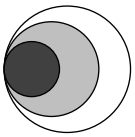
THEMATIC AREAS	INDICATORS
AIR	
▪ Air quality: Nitrogen dioxide	98°- yearly, each measuring point
▪ Air quality: Particulate matter	Average concentration - yearly, each measuring point
▪ Air quality: CO	No. highest average concentration per 8-hour period – yearly, at each measuring point
▪ Air quality: Ozone	No. higher than total maximum hourly concentration of 200 ug/m^3
▪ Adequacy of monitoring network	Monitoring devices in service, type, % valid data
▪ Atmospheric emissions	Annual estimate NO_X SOx CO TSP and VOC emissions % for the sector of origin
▪ Emission controls: cars	No. of controls - emission control certificates ("bollino blu")
▪ Policy response	Emission reduction measures of Urban traffic plan (UTP), UTP objectives, temporary closing of areas to traffic, No. measures taken
NOISE	
▪ Noise level	Day/night - each measuring point, Leq dB(A)
▪ Noise controls: signs installed	No. of controls; % of justified requests for intervention, % of positive results;
▪ Noise zoning	Report on completion
▪ Policy response	Progress report on activities
▪ Improvement plan	
WATER	
▪ Water consumption	Total consumption; per capita consumption
▪ Supply	Abstraction by source %; network losses %
▪ Quality control supply network	Description monitoring network
▪ Water qual human cons chemooo	Average nitrate concentration, organohalogen composition, hardness – yearly, each measuring point, comparison with GV and MPC
▪ Water quality, human consumption: microbiological	Average bacterial load concentration (UFC/ml) – yearly, each measuring point, comparison with GV and MPC
▪ Surface water quality: chemical	Average BOD5, COD, OD, NH4 concentration – comparison with GV and MPC
▪ Surface water quality: microbiological	Average faecal coliform concentration (UFC/ml)
▪ Surface water quality: overall index	Extensive biotic index, EBI
▪ Ground water quality: chemical	Average concentration nitrates, organohalogen composition - yearly, each measuring point
▪ Coverage of sewerage service	% of population served by sewerage network
▪ Coverage of wastewater treatment service	% of population served by wastewater treatment plants
▪ Potential risk of water pollution	Sources of contamination (general indication)
▪ Policy response	Projects and initiatives
LAND, SOIL AND SUBSOIL	
▪ Landslides	% areas affected (active/inactive)
▪ Land subsidence	% areas affected, level of subsidence
▪ Seismic activity	No. seismic events, frequency/intensity
▪ Extent of impermeable surface and land consumption	% area urbanised
▪ Quarries and mines, restoration/clean-up (inactive and active)	No. location, ha, activities (type/volume of material quarried/mined)
▪ Policy response	Report on projects under way, instruments of General Urban Planning Scheme (PRG)
LANDSCAPE AND NATURE	
▪ Agriculture: Useful farm space (UFS) and total farm space (TFS)	ha UFS – types of crops and TFS
▪ Public green spaces: stock	ha by type and district, district surface area occupied by green spaces %, m^2/inhabitant
▪ Wildlife heritage (flora)	Signs indicating protected, rare and endangered flora
▪ Wildlife heritage (fauna)	Mammal, bird, amphibian, reptile, insect species
▪ Policy response	Same as for General Urban Planning Scheme (PRG), and other planned initiatives

THEMATIC AREAS	INDICATORS
URBAN STRUCTURE	
▪ Expansion of built-up areas	ha of undeveloped and urbanised areas
▪ Surface area urbanised	m^2/inhabitant, % of surface area within commune
▪ Construction activity	Housing completed, annual rates of construction growth, n° of unoccupied dwellings unavailable
▪ Development of tertiary functions	Housing converted into office space
▪ Supply of services	Areas and services ensured for each inhabitant, m^2 planned under the General Urban Planning Scheme (PRG), and current m^2, comparison with urban planning standards.
ENERGY	
▪ Total energy consumption	Toe/year. Toe/inhabitant
▪ Energy consumption: fuels	Gasoline, diesel fuel, LPG, and heating fuel: kgOE
▪ Energy consumption	Distribution energy consumption by source, Toe/year, % distribution energy consumption by User sector, electric energy natural gas
▪ Use of renewable energy sources	Incinerator electrical and thermal energy produced (kWh, kWt) energy savings
▪ Greenhouse emissions	Dist % and t/year CO_2 eq by energy sector and type
▪ Policy response	Energy saving initiatives
URBAN WASTE	
▪ Total production – total and per capita	Kg/inhabitant; composition by commodity %
▪ Separate collection, disposal of urban waste by method	Share of household waste in total urban waste production, % composition of household waste by commodity %
▪ Urban waste disposal by method	% type of disposal
MOBILITY	
▪ Private vehicles	Car/100 inhabitants
▪ Parking demand and supply	% by type and demand for parking places
▪ Overall mobility: modal distribution	Share of private cars
▪ Overall mobility: origin and destination	Self-containment index
▪ Traffic flows	Vehicles/year counted entering and leaving commune
▪ Public transport: size of network	Km of network
▪ Public transport: network protected and/or reserved	Km, % of entire network
▪ Public transport: demand	Passengers/km of network (days); trips/inhabitant (year)
▪ Road infrastructure: restricted traffic zones	Km
▪ Road infrastructure: pedestrian areas	m^2
▪ Road infrastructure: cycle lanes	Km
▪ Accident rate	Fatality rate (deaths/accident) and injury rate (injured/accident)
▪ Policy response	Urban traffic plan (UTP): short and long-term objectives

PART E.
AGRICULTURE/ENVIRONMENT INDICATORS

AGRICULTURE/ENVIRONMENT INDICATORS

OECD OVERVIEW*



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* This document draws from the draft OECD Document -- *Environmental Indicators for Agriculture: Methods and Results -- The Stocktaking Report* [COM/AGR/CA/ENV/EPOC(99)80-84], which was discussed by the OECD Joint Working Party of the Committee for Agriculture and the Environment Policy Committee (JWP), at its meeting on 13-15 October, 1999. Delegates should note that the text, tables and graphs in the attached document are provisional, and subject to revision in the light of the discussion at the JWP meeting in October 1999 and any written comments the Secretariat may receive from the JWP.

EXECUTIVE SUMMARY

The impacts of agriculture and agricultural policies on the environment are a major concern in OECD countries, particularly in the context of agricultural policy reform and the achievement of sustainable agriculture. Agricultural policy reform in many countries includes policies to promote sustainable agriculture and address environmental and natural resource issues.

The basic long-term challenge for agriculture is to produce food and industrial crops efficiently, profitably and safely, and to meet a growing world demand without degrading natural resources and the environment. While agricultural productivity has improved substantially, it has often been accompanied by resource degradation, such as soil erosion and water depletion. Agriculture also contributes positively to the environment through provision of landscapes, wildlife habitats, and as a sink for greenhouse gases.

The reform of agricultural policies should improve the domestic and international allocation of resources, reduce incentives to use polluting inputs and farm environmentally sensitive land. Hence, by reducing output and input use the reforms would tend to reverse the harmful environmental impacts associated with commodity and input specific policy measures. In those cases where agricultural policies are associated with maintaining farming activities that provide environmental benefits, policy reform can reduce environmental performance. OECD work has recognised that agricultural policy reform is a necessary, but not always a sufficient condition to improve the environmental performance of agriculture.

While agricultural production has increased significantly over recent decades, the importance of the sector has declined in most OECD countries when measured in terms of GDP or total employment shares. However, it is usually the major activity in terms of land use, and by implication has an important influence on the environment.

Recent OECD Agriculture and Environment Ministerial meetings have emphasised the importance of examining agricultural and environmental policy issues supported by indicators and better information. OECD work on agri-environmental indicators (AEIs) has evolved in the light of these needs, the experiences gained in undertaking the work, and scientific knowledge of agri-environmental linkages.

OECD has identified a number of priority areas for which indicators are being developed to cover primary agriculture's management and use of natural resources and farm inputs: farm management and use of nutrients, pesticides, and water; and, its environmental impact through greenhouse gas emissions; soil and water quality, land conservation; biodiversity, habitats and landscape. The work has defined a common framework, sought to establish standard definitions and methodologies for indicators across countries, and fostered an exchange of country experiences in developing and using indicators.

Progress in establishing indicators across different areas is variable, in particular, because research on issues such as agricultural biodiversity is relatively recent compared to, for example, farm nutrient and pesticide use. Some preliminary results of the OECD AEI work, however, reveal that the environmental performance in agriculture has generally tended to improve over the past 10-15 years for many OECD countries, although the magnitude of improvement varies among countries.

The key objective of future OECD work will continue to establish AEIs that contribute to information on the national state and trends of the environment in agriculture, and integrate indicators into policy analysis and monitoring. Further analysis to understand the social dimension of sustainable agriculture, will need to clearly identify what are the policy relevant issues and questions, before work can begin to establish pertinent indicators. As national and international efforts advance to establish AEIs, it is crucial they provide a consistent methodology to enhance their utility for comparison, and are transparent so stakeholders can understand the indicators and the policy implications based on them.

I. THE AGRICULTURE SECTOR AND ITS POLICY CONTEXT

1. Policy context

The impacts of agriculture and agricultural policies on the environment are a major concern in OECD countries, particularly in the context of agricultural policy reform and the achievement of sustainable agriculture. Agricultural policy reform in many countries includes policies to promote sustainable agriculture and address environmental and natural resource issues. A number of recent international environmental agreements also have implications for agriculture, such as the Convention on Biological Diversity, and the Kyoto Protocol commitments to reduce greenhouse gas emissions.

The basic long-term challenge for agriculture is to produce food and industrial crops efficiently, profitably and safely, and to meet a growing world demand without degrading natural resources and the environment. While agricultural productivity has improved substantially, it has often been accompanied by resource degradation, such as soil erosion and water depletion. Agriculture also contributes positively to cultural landscapes, helps to maintain rural communities, provides habitats for wildlife on agricultural land and acts as a sink for greenhouse gases.

The environmental implications of farmers' actions are not always incorporated in their costs and revenues. For example, fertilisers and pesticides can leach into groundwater, and thus increase the cost of purifying drinking water. Farmers can also refrain from taking actions that would add to environmental services, such as conserving land as habitat for wildlife, where mechanisms by which the beneficiaries compensate farmers for any associated extra costs are lacking.

In many cases environmental problems have been aggravated by agricultural and trade policies that distort price signals by linking support to agricultural commodities, or by disguising the costs of inputs. The economic distortions created by such policies can lead to environmentally inappropriate patterns and location of production, the harmful use of inputs, and discourage the development and use of farming technologies less stressful on the environment (OECD, 1998a).

The reform of agricultural policies should improve the domestic and international allocation of resources, reduce incentives to use polluting inputs and farm environmentally sensitive land. Hence, by reducing output and input use (due to a combination of lower output prices and changes in relative factor prices), the reforms would tend to reverse the harmful environmental impacts associated with commodity and input specific policy measures. In those cases where agricultural policies are associated with maintaining farming activities that provide environmental benefits, policy reform can reduce environmental performance (OECD, 1998b). OECD work has recognised that agricultural policy reform is a necessary, but not always a sufficient condition to improve the environmental performance of agriculture.

2. The Agricultural sector in the broader context of the economy and environment

While the volume of agricultural production has increased significantly over recent decades, the relative importance of the agricultural sector has declined in most OECD countries when measured in terms of its share in GDP or total employment (Annex, Table 1). However, although the agricultural sector is relatively small in most OECD countries it is usually the major activity in terms of land use, and by implication has an important influence on the environment.

The increase in agricultural output and productivity over recent decades has led to the increasing concentration and intensification of production, average farm size has grown and farms have become more specialised, often favouring monocultures. More inputs, especially farm chemicals, are being used (e.g. fertilisers, pesticides) and capital (e.g. machinery, irrigation) being substituted for

labour. These developments have been influenced by technological changes in agriculture and support measures for both agricultural inputs and outputs, as outlined above.

While many of the technological changes in agriculture have provided society with a cheap, reliable and safe supply of food in OECD countries, they have also been associated with negative externalities, such as water pollution from farm chemical run-off. To some extent, the adoption of "green technologies" has helped reduce environmental degradation and conserve natural resources, such as the adoption of the integrated pest management and precision farming.

Gains in agricultural productivity have also contributed to greater concentration of farms, involving both a decrease in farm numbers and an increase in the average area per farm in many OECD countries. Although detailed information is not widely available, increases in farm size often mean wider use of powerful and heavy farm machinery, which can affect, for example, biodiversity, soil quality (e.g. compaction, erosion), and landscape.

Agriculture, however, is not just a source of food and fibre, it also provides other goods and services, such as habitat for wildlife, agricultural landscapes for recreation and tourism, and agricultural land can act as a sink for pollutants. The positive externalities associated with agriculture have become of growing importance in OECD countries with increases in income, education levels and leisure time, leading to a greater demand by the public for recreational, tourist and other pursuits in rural areas. In addition, heightened public awareness has raised concerns about environmental sustainability in agriculture both among farmers and for society as a whole.

II. OECD AGRICULTURE - ENVIRONMENT INDICATORS

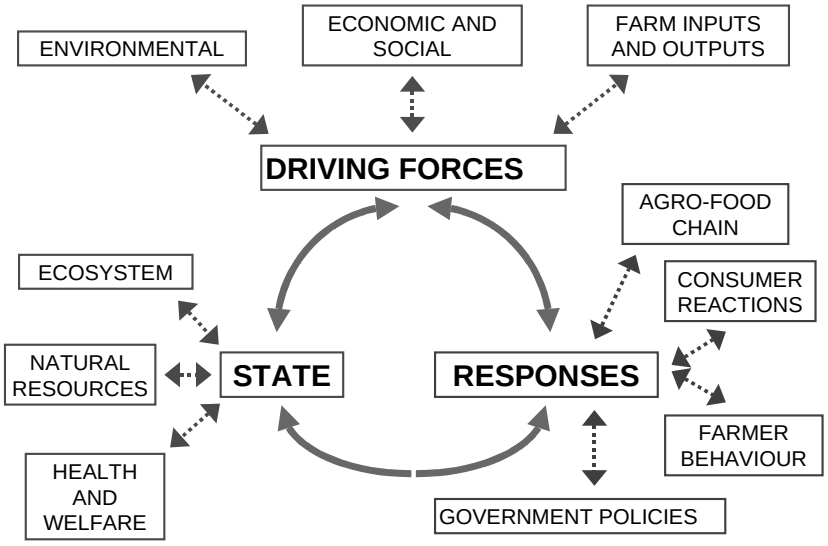
1. OECD work on agri-environmental indicators

OECD work on AEIs has evolved in the light of the needs of policy makers, the experiences gained in undertaking the work, and scientific knowledge of agri-environmental linkages. Recent OECD Agriculture and Environment Ministerial meetings have emphasised the importance of examining agricultural and environmental policy issues supported by indicators and better information. OECD Agricultural Ministers **(**5-6 March 1998), for example, identified a role for OECD to, amongst other tasks, "foster sustainable development through analysing and measuring the effects on the environment of domestic agricultural and agri-environmental policies and trade measures".

The work on AEIs is intended to meet these Ministerial recommendations and contribute to the demands of policy makers and other stakeholders by understanding and analysing agricultural and environmental policies and policy reform; specific agri-environmental policy issues; and contributing to the OECD-wide activity on sustainable development. This work is being undertaken by:

- contributing to the available information on the current state and trends in the condition of the environment and natural resources in agriculture;
- improving the understanding of agri-environmental processes, methodologies and linkages;
- providing a tool to analyse, monitor and evaluate agricultural and environmental policies to help improve policy effectiveness toward promoting sustainable agriculture.

Figure 1. **The Driving Force - State - Response framework**



Source: OECD Secretariat.

2. OECD Framework for Agri-environmental Indicator Development

The OECD is developing agri-environmental indicators (AEIs) within the *Driving Force–State–Response (DSR) framework*. This framework addresses a set of questions related to the linkages between causes, effects and actions (Figure 1). What is causing environmental conditions in agriculture to change, such as, changes in farm chemical input use (*Driving forces*)? What are the effects of agriculture on the environment, such as, the impacts on soil, water, air, and natural habitats (*State*)? What actions are being taken to respond to the changes in the state of the environment, for example, by farmers, such as promoting sustainable agriculture by community based approaches (*Responses*)?

The DSR framework recognises explicitly that agri-environmental interactions and linkages are complex and multi-faceted, while providing a structure within which individual indicators can be placed in context. As with any classification system, the boundaries between drivers, states and responses are unclear in some cases as some indicators can be considered as both driving forces and responses.

The development of OECD agri-environmental indicators essentially involves four steps. *Firstly*, identify the policy issues and questions which indicators should address; *secondly*, identify the indicators and methods of calculation; *thirdly*, develop the conceptual and analytical underpinning of the indicators and indicator linkages; and *fourthly* collect data and calculate indicators.

Within the context of the DSR framework the OECD has identified a number of priority areas for which indicators are being developed to cover primary agriculture's management and use of natural resources and farm inputs: farm management and use of nutrients, pesticides, and water; and, agriculture's environmental impact on: climate change through greenhouse gas emissions; soil and water quality; land conservation; biodiversity, habitats and landscape.

To date OECD has not defined a core set of AEIs, although this is currently under discussion. A detailed list of the AEIs being developed, together with indicators of a contextual nature, such as those covering farm financial resources, are examined in OECD, 1999b; and OECD, 2000, forthcoming.

3. Results to date

3.1 Indicators and recent trends in the management and use of natural resources and farm inputs

Progress in establishing indicators across different areas is variable, in particular, because research on issues such as agricultural biodiversity is relatively recent compared to, for example, farm nutrient use. Some preliminary results of the OECD agri-environmental indicator work, however, reveal that the environmental performance in agriculture has generally tended to improve over the past 10-15 years for many OECD countries, although the magnitude of improvement varies among countries.

Agricultural and environmental policies influence *farm management* practices and capacity. OECD farm management indicators, covering both practices and capacity, help assess sustainability in agriculture. Indicators on *farm management practices* encompass the overall trends of farming methods, and address whole farm management as well as aspects of farm management, such as nutrient, pest, soil, land and irrigation management, which impact on the environment. *Farm management capacity* indicators cover investment by the wider society in the capacity of the agricultural sector to build and transfer knowledge to improve management practices, that will lead toward a more environmentally sustainable agriculture. This covers a broad range of elements, in particular, investment into farmer education, research and development expenditure and development of environmental farm management standards.

Environmental conditions and farming systems vary within and across OECD countries and, consequently, optimal *farm management practices* vary across regions, however, environmentally beneficial management practices are now used more widely than in the 1980s. This trend is especially evident in areas such as environmental whole farm management, organic farming (Annex, Graph 1) and integrated pest management. Regarding *farm management capacity,* for some OECD countries a major part of agricultural research expenditure is spent on agri-environmental research. The education level of farmers varies widely, yet in only half of OECD countries over 20% of farmers have basic or full agricultural training, while most countries have established environmental farm management standards. Also, while voluntary codes of practice are widely used, compulsory standards and regulations are applied, notably for controlling pesticide and nutrient pollution.

The farm *nutrient use* (nitrogen, phosphorus, potash) balance indicator measures the difference between nutrient inputs into and outputs from an agricultural system, establishing a link between nutrient use, changes in environmental quality, and the sustainable use of soil nutrient resources. A persistent surplus indicates potential environmental pollution, while a deficit suggests sustainability problems. The trend in national nitrogen balance surpluses over the last decade is downward or constant for most OECD countries, which suggests that the potential environmental impact from agricultural nitrogen emissions is decreasing or stable (Annex, Graph 2). Some countries with a relatively high nitrogen surplus have significantly reduced their surpluses, although for a few countries surpluses have risen. Regional data suggests that even in counties with a relatively low national nitrogen surplus, nitrate pollution may be experienced while at the same time soil nutrient deficits exist in some areas.

Pesticide indicators are a useful tool to help policy makers monitor and evaluate policies and also provide clear information to the public about human and environmental pesticide risks. Two kinds of indicators are being developed by OECD, one focusing on pesticide use, the other on pesticide risk,

although to date no cross country comparable set of risk indicators exist. The pesticide risk to humans and the environment can be diminished by simply reducing the use of particular chemicals, and the close correlation between trends in pesticide use and risk estimated by some countries tends to confirm this. Overall the trend in pesticide use over the last decade has remained constant or declined in most OECD countries, although for a few countries use has increased (Annex, Graph 3). The decrease in pesticide use was largely due to raising the efficiency of use per unit of output from improvements in pest management practices and technology, and government policies targeting a reduction in pesticide use.

OECD is establishing a number of indicators related to *agricultural water use*, including monitoring trends in agricultural water abstractions, irrigated area, and the price of water charged to farmers. In a number of OECD countries agriculture represents more than half of total water abstractions, but even where competition for water resources between agriculture and other sectors is less pronounced, the growing need to meet societal recreational and environmental demands for water will require that agriculture improves its efficiency of using water. Some OECD countries are beginning to seek the more efficient and effective use of water in agriculture, by moving towards full-cost recovery of water pricing, as a means of adequately valuing water as an input to agricultural production.

Over the past 15-20 years there has been a continuous upward trend in water withdrawals for irrigation in most OECD countries, associated with an increase irrigated land area (Annex, Graph 4). The expansion in irrigated area, has to a large extent been encouraged in most countries by the underpricing of irrigated water and support to irrigation infrastructure development. The price of water paid by farmers in many OECD countries is substantially below that paid by industrial and household users, even when differences in water quality and costs of water conveyancing systems between agriculture and other users is taken into account (Annex, Table 2).

3.2 Indicators and recent trends in the environmental impacts of agriculture

While it is preferable to develop a comprehensive indicator to address both emissions and removals of *agricultural greenhouse gases* (GHGs), covering methane, nitrous oxide, and carbon dioxide, in the short term it is only possible to provide a gross emission indicator of these three gases affecting climate change. Although further work is required to better understand the sink functions of agriculture, the capacity of agriculture as a sink is enhanced by improvements in tillage, crop cover, crop residue and other management practices. The share of agriculture in total gross GHG emissions is generally low, although is over 20% for a few countries (Annex, Graph 5), but is one of the major sources of methane and nitrous oxide, contributing to about 40 per cent of these gasses for OECD countries in total. Moreover, the trend in agricultural emissions of GHGs has declined since the early 1990s, mainly as a result of the reduction in cattle numbers, although in some cases emissions have risen due to increased agricultural production.

The adverse impacts from agriculture on *soil quality* includes, for example, soil erosion, organic matter loss and the diminution of soil biodiversity. Soil degradation can also result from inappropriate irrigation and soil management practices, land clearing, excessive use of farm chemical, and mis-use of heavy machinery. Essentially agricultural policy makers need to balance three key aspects of soil quality, first, sustaining biological productivity, second, conserving environmental quality, and third, protecting plant, animal and human health. OECD agricultural soil quality indicators provide indexes of the “risk” of water and wind soil erosion, and for some countries the “state” of soil quality is measured.

While the extent of soil degradation affects a significant share of the total agricultural area in most OECD countries, there is evidence to suggest that improvements in soil quality are being achieved through adoption of soil conservation practices, encouraged by government policies. Water and wind erosion of soil are a major environmental issue in many countries, relative to other forms of soil degradation, and while the area of agricultural land at high/severe risk to erosion is generally low,

for a few countries more than 10% of farm land is in this risk class. There are few estimates of the value of agricultural production foregone from soil degradation, but those that are completed indicate that this might be in excess of 5 per cent of the total annual value of agricultural production.

The key areas of concern regarding agriculture and *water quality* are related to nitrate pollution in surface and groundwater; phosphorus levels in surface water; water contamination with pesticides; and harmful effects of soil sediments in aquatic environments. An excessive level of nitrates and pesticides in water is a human health concern since it impairs drinking water quality, while excessive concentrations of both nitrate and phosphorus cause ecological problems including eutrophication. OECD agricultural water quality indicators include both “state” and “risk” indicators. “Risk” indicators estimate the potential contamination of water originating from agricultural activities. “State” indicators measure the actual trends in concentrations of pollutants in water against a threshold level.

Agriculture is not the only sector which burdens aquatic environments with pollutants, but in the case of nitrogen and phosphates it is a major contributor, for most OECD countries. Recent estimates indicate that agriculture accounts for more than 40% of all sources of nitrogen emissions and over 20% of phosphorus emissions into surface water for many countries (Annex, Graph 6). An indication of the overall situation and trends for other agricultural pollutants of water, such as pesticides and soil sediment, is more difficult. Extrapolating from trends in nutrient balances, soil erosion losses and changes in pesticide use, would suggest, however, that in many OECD countries impairment of water quality from these pollutants is probably declining, but problems remain in some cases.

Land conservation relates to the potential for agriculture to control soil and water flows from farm land to off-farm areas, such as from water retention capacity, off-farm soil sediment flow control, landslide prevention and groundwater recharge. OECD land conservation indicators include water retention control, based on how much water land retains taking into account land use types, soil types, management practices and other relevant factors; while off-farm soil sediment flow indicators include a risk and state approach. The “risk” indicator takes into account soil types, climatic conditions and farm management practices, while the “state” indicator is based on the actual observation of off-farm sedimentation downstream. So far, little information is available concerning the trends in either of these land conservation indicators across OECD countries.

Agriculture is in a key position with regard to *biodiversity* as it is the human activity occupying the largest share of the total land area for nearly all OECD countries. While the potential set of indicators to monitor biodiversity is very large, a more limited number are being established by OECD, structured within the general framework of *genetic, species and ecosystem diversity*, as defined under the International Convention on Biological Diversity. Together the indicators establish the initial steps in providing a coherent picture of biodiversity in relation to agriculture.

While agriculture can provide a valued habitat for biodiversity, it has also adversely affected biodiversity over recent decades, as a result of a range of different causes, especially from the use of farm chemicals, and land use and land cover changes. There seems broad consensus that losses of *genetic* crop and livestock resources for agriculture have been substantial. Also while information on the impact of agriculture on wildlife *species* is extremely limited, it is evident that agriculture in many countries provides the major habitat area for most wildlife, especially birds and mammals. For a few OECD countries, population trends of wildlife species using agricultural land as habitat indicate a downward trend over the past 10-15 years, part of a longer term trend, although there is some evidence that the decline is slowing or even reversing for some countries.

All land, including agricultural land, provides *habitat for wildlife*, but the composition and quality of habitat on agricultural land is highly variable. Habitats can serve as a buffer-zone and protect natural resources, improve the survival chances of beneficial species that are natural enemies of crop pests, and provide amenity value for society. But agriculture affects wildlife habitat directly by its conversion to agricultural use for cultivation or grazing, and indirectly through disturbances, such as from elevated pollutant discharges. There are four categories of habitat indicators being developed by

OECD, the first three provide indicators to monitor the state and trends in intensively farmed, semi-natural and uncultivated natural habitats on the wildlife in these habitats, while the fourth involves developing a habitat matrix by considering all agricultural land and combining this with information on biodiversity.

The pressures on biodiversity from intensively farmed agricultural areas would appear to have declined slightly in some OECD countries, mainly due to policies that have encouraged the diversion of arable land to fallow or pasture. The intensification of agricultural land use is considered to be one of the main contributors to degrading habitat quality over the past few decades. While it is difficult to provide any systematic view of trends in semi-natural agricultural habitats due to lack of data, there are signs in some countries of a sharp decline in these habitats, such as terraced olive groves, pastoral woodlands and wetlands, although the rate of wetland loss is now decreasing in some cases.

Agriculture plays a critical role in shaping and affecting the quality of the national 'stock' of landscape, because in nearly all OECD countries farming is the major user of land. A broad all encompassing definition of *agricultural landscapes* is that they are the visible outcome resulting from the interaction between agricultural commodity production, natural resources and the environment, and encompass amenity, heritage, cultural, aesthetic and other societal values. The OECD approach being taken to develop agricultural landscape indicators is to reflect these elements by establishing indicators covering landscape environmental descriptors; key cultural features; and areas under public/private management schemes. To provide an objective anchoring for landscape indicators, emphasis is also being given to valuation of landscapes, by linking consumer preferences and valuation of landscape with the costs of landscape provision by farmers.

It is not possible at this stage of the work on indicators to draw any firm conclusions regarding the current state and trends in agricultural landscapes across OECD countries. Even so, there does seem to be a widespread view that the trend is towards the increasing homogenisation of agricultural landscapes over recent decades. This appears closely related with structural changes affecting agriculture, leading to the destruction of landscape features, such as removal of hedges from increasing field size, and, in marginal areas where farming is no longer profitable, agricultural landscapes have been transformed to other forms of landscape.

3.3 Use of the indicators in OECD work and other related activities

OECD work on AEIs has been published in a series of Reports entitled *Environmental Indicators for Agriculture* (see OECD, 1999a; OECD, 1999b; and OECD, forthcoming 2000). AEIs have also been used as supporting information across a range of recent OECD studies, for example, *Agricultural Policies in OECD Countries: Monitoring and Evaluation* (1998 and 1999 editions); various policy related studies, including *Agriculture and the Environment: Issues and Policies* (1998); and *The Environmental Effects of Reforming Agricultural Policies* (1998); OECD country performance reviews, including the *OECD Environmental Performance Reviews* and the *OECD Economic Surveys* of Member countries.

The OECD work has established a common structure and framework, and sought to establish standard definitions and methodologies for indicators across OECD countries. In addition, OECD work is helping to foster an exchange of Member countries' experiences and approaches in developing and using indicators. OECD work is also instrumental in improving the co-ordination of activities across different agencies involved with indicators (i.e. frequently this involves Ministries of Agriculture and Environment as well as government Statistical Agencies and Research Institutes). Equally important is the influence of the OECD on AEI development in Member countries, for example, in Canada (Agri-Food and Agriculture Canada, 1999), France (Institut Francais de l'Environnement, 1997), and in the United Kingdom (Ministry of Agriculture, Fisheries and Food, 1999).

It has been acknowledged in recent European Union Heads of State Summit Meetings (Cardiff and Vienna, 1998) that OECD work on AEIs is providing a valuable input into considering the integration of environmental concerns into agriculture, one of the themes discussed at the EU Summit

Meeting in Helsinki, during December, 1999. OECD is also closely co-ordinating its indicator effort with other activities in this area, for example, those under the FAO, the Convention on Biological Diversity (CBD), the UNEP, and some non-governmental organisations, such as the World Conservation Union (IUCN).

III. EXPLORING THE LINKAGES BETWEEN THE SOCIAL DIMENSION OF SUSTAINABLE DEVELOPMENT AND AGRICULTURE

Many rural economies still largely depend on agricultural activities, which also affect and shape the social life of local communities. In other words, agriculture retains a central role in maintaining social viability in rural areas. Nevertheless, there is increasing recognition that problems in rural areas, such as depopulation, poverty, unemployment, and amenity loss, might best be addressed not only through agricultural policy measures, but in a broader rural development context.

In March 1998, OECD Agricultural Ministers highlighted the contribution of agriculture to the socio-economic viability of rural areas, and noted the importance of policy interventions where costs and benefits for some functions of agriculture are not properly accounted for. Ministers concluded that reform of agricultural policy and increased use of more specifically targeted policy measures could enhance rural viability, improve resource use efficiency, and provide environmental benefits (OECD, 1998c).

The Ministerial meeting highlights the increasing interest in assessing the role of social capital in the context of sustainable development concerns (Atkinson, *et al*, 1997). Social capital reflects existing relationships of trust within a community that serve to facilitate the transactions that make a community physically healthy, socially progressive, and economically vigorous. Low levels of social capital typically result in low trust, community disagreements, and inability to solve problems or achieve goals.

There are several alternative ways that the social dimension of agriculture in the context of sustainability might be measured, including focusing on demographic characteristics; income changes and distribution; number of people entering or leaving agriculture; health of the agricultural labour force; level of education; and social interactions, attitudes and institutions. There are also other aspects that are generally perceived as relevant to the social dimension of sustainable agriculture, such as spatial isolation, costs of service delivery, and delays in communication. These aspects, however, are not specific to agriculture and could be considered in a broader rural development context.

Three aspects of the social dimension of sustainable agriculture might possibly be explored, if work is to be further developed in this area. First, the *social potential of agriculture* suggests identifying those issues, and related indicators, that can enhance social conditions in agricultural and rural communities, such as education and development of institutions and structures to raise environmental awareness. Second, the *social state or conditions in agriculture* implies identifying which issues can reflect the current state and recent current trends of social conditions in agriculture, such as the health consequences of pesticide application on the agricultural labour force. Third, the *consequences for the agricultural sector* of changes in the *potential* and *state* of social conditions in agriculture, such as the interest of young people to enter into farming.

It is clear that any further work to better understand the social dimension of sustainable agriculture, will need first to identify more clearly what are the key policy relevant issues and questions. Also it will be important to define what are the linkages between the social, economic and environmental dimensions of sustainable agriculture, before work can begin to identify and establish pertinent indicators.

IV. FUTURE CHALLENGES IN AGRI-ENVIRONMENTAL INDICATOR DEVELOPMENT

The underlying objective of OECD work will continue to establish AEIs that contribute to information on the state and trends of the environment in agriculture in OECD countries, and to integrate indicators into policy analysis and policy monitoring. Some of the *key future challenges in indicator development* relate to data issues, spatial scales; temporal dimensions; valuation of the environmental costs and benefits of agricultural activity; and analysis of linkages between the different dimensions of sustainable agriculture and sustainable development.

The availability of *relevant data* on agricultural systems and on the environment varies across OECD countries. Moreover, many indicators have been constructed from national data, which are not intended to reveal the specific contribution of agriculture to environmental change. Shortages of baseline data have continued to inhibit the development of indicators. Further work is required to systematically collect data to measure the indicators, improve data quality and fill gaps in data series.

The *spatial scales* to measure AEIs varies from the field, farm, watershed, through to the ecozone and national levels. Developing and measuring indicators for a range of spatial scales is constrained by the ability to extrapolate data from the field/farm level to higher levels and the trade-offs that occur with gains in coverage at higher levels but loss of the detail/variation at lower scales. From the OECD perspective data need to be aggregated to the national level with some expression of the variation around the national average indicator trend value.

The variations in the *temporal dimensions* of different environmental effects of agriculture range from the short term, such as the impact on wildlife from pesticide use; to the long term, which may involve decades in the case of soil erosion. The impacts on the environment from agricultural policies, economic and societal pressures may also have different time lags and consequences, which is also important as a key focus of sustainable development is intergenerational concerns. Most indicators, however, use a time series approach showing recent trends, which presents a challenge for indicator construction in terms of the current-future trade-off.

Balancing economic imperatives (e.g. sufficient food production), with environmental impacts (e.g. conserving landscapes and reducing water pollution) and social concerns (e.g. preserving rural communities), requires some means of weighing up these impacts, such as through the use of cost-benefit frameworks. Use of a cost-benefit framework highlights the need to develop AEIs that use a *common monetary unit*, so that trade-offs and priorities can be more easily gauged by policy makers. The concept of sustainable development emphasises *the links between the economic, social and environmental dimensions.* OECD indicators have begun to recognise these dimensions of sustainable agriculture, for example, through including information on farm financial resources (economic); consideration of educational issues (social) and water quality (environmental) indicators.

It needs to be recognised that the process of developing AEIs is one of evolution and refinement, and that some indicators can be established more rapidly than others. As different indicators are developed the linkages between them can be analysed to help better interpret trends in specific indicators. For example, changes in indicators of nutrient use (*driving force*), can be linked to resulting variations in water quality (*state*) and related to the consequent changes in farm management practices (*responses*).

As national and international AEI efforts advance, it is important that they can help to interpret trends in environmental conditions in agriculture and agricultural sustainability. Also, these efforts should provide a consistent methodology to enhance their utility for international comparison and improve their transparency so stakeholders can understand the indicators and the policy implications based on them.

ANNEX. TABLES AND FIGURES

Table 1. **Key agricultural indicators for OECD countries**

	Employment in agriculture as % total civilian employment, 1996	GVA in agriculture % GDP, 1996	Agricultural commodities[1] % total exports, 1997	Agricultural commodities[1] % total imports, 1997	Change in final agricultural output in 1990 prices & PPPs, 96/86 (%)	Agricultural land % total land use[2] 1992-94	Change in the number of farms 1985-87 to 1995-97 (%)
Australia	5	3	19	5	30	60	-35
Austria	-	1	5	7	-2	42	-19
Belgium	-	1	11	11	19	45	-38
Canada	4	2	8	5	20	8	..
Czech Republic	6	-	5	7	-	55	..
Denmark	4	2	22	11	10	64	-46
Finland	7	1	4	7	-12	9	..
France	5	2	14	10	13	55	-41
Germany	3	1	5	10	9	49	-36
Greece	-	6	27	15	5	72	-20
Hungary	8	-	15	5	-	66	..
Iceland	..	..	1	9	0	23	..
Ireland	11	4	12	8	19	64	-31
Italy	7	3	7	12	5	55	-16
Japan	5	-	0	11	-	14	-26
Korea	12	5	1.4*	7.5*	22	22	-33
Luxembourg	-	1	..	..	4	..	-40
Mexico	-	-	6	7	-	54	..
Netherlands	4	3	23.2*	13.7*	13	58	-24
New Zealand	9	5	49	8	32	64	..
Norway	5	1	1	5	2	3	-32
Poland	22	5	12	9	-	61	..
Portugal	12	3	6	12	12	43	-44
Spain	9	4	15	10	19	61	..
Sweden	3	0	3	7	-7	8	-24
Switzerland	5	2	3	7	-1	38	-20
Turkey	45	17	20	8	-	52	..
United Kingdom	2	1	7	9	-	72	-13
United States	3	2	10	4	21	46	..

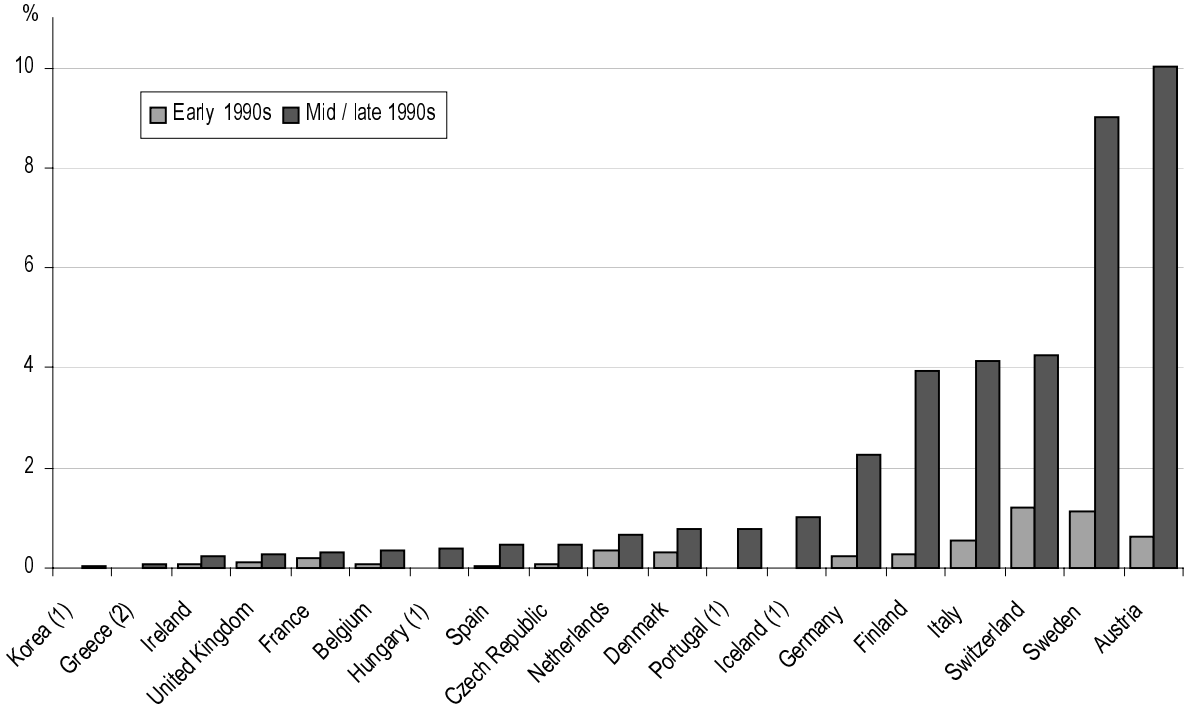
Notes: -: not applicable, ..: not available.
1. The categorisation of commodities includes: agricultural commodities, agricultural processed products and agricultural raw materials.
2. The share for Belgium includes Luxembourg.
* Data refer to 1996.
Source: OECD Secretariat.

Table 2. **A comparison of agriculture, industrial and household water prices:** selected OECD countries, late 1990s[1]

	Water Prices			Agriculture Water Price as %	
	Agriculture US $ / m^3	Industry[2] US $ / m^3	Households US $ / m^3	Industry Water Price %	Household Water Price %
Australia	0.0195	n.a.	1.64	..	1.2
Austria	1.005	n.a.	1.05	..	95.7
Canada	0.00185	1.59	0.7	0.1	0.3
France	0.004935	0.95	3.11	0.5	0.2
Greece	0.0515	n.a.	1.14	..	4.5
Italy	42	13330	1820	0.3	2.3
Netherlands	1.33	1.075	3.16	123.7	42.1
Portugal	0.0175	1.255	1	1.4	1.8
Spain	0.0485	1.075	1.07	4.5	4.5
United Kingdom	0.0205	1.675	3.4	1.2	0.6
United States	0.0459	0.505	1.25	9.1	3.7

Notes: 1. For detailed notes, see sources noted below.
2. For agriculture, industry and households, prices are the median values for the range of prices for each category.
Source: OECD (1999c; 1999d; 1999e).

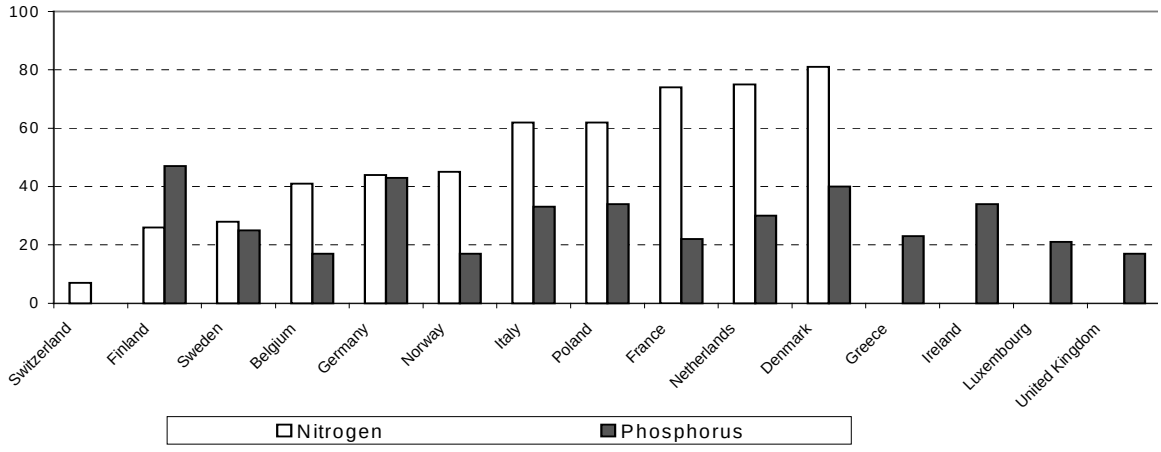
Graph 1. **The share of the total agricultural area under organic farming**



Notes:
1. Data are not available for the early 1990s.
2. The value is negligible for the early 1990s.

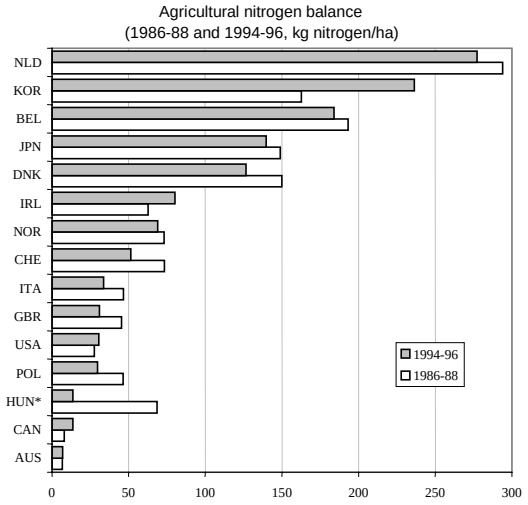
Sources: OECD Agri-environmental Indicators Questionnaire, 1999; Eurostat; Welsh Institute of Rural Studies.

Graph 2. **Percentage share of agriculture in total emissions of nitrogen and phosphorus into surface water,** early-mid 1990s



Source: Chapter 9 Water Quality, Annex Table 2, in OECD, Environmental Indicators for Agriculture: Methods ands Results -- The Stocktaking Report [COM/AGR/CA/ENV/EPOC(99)81].

Graph 3



Notes:

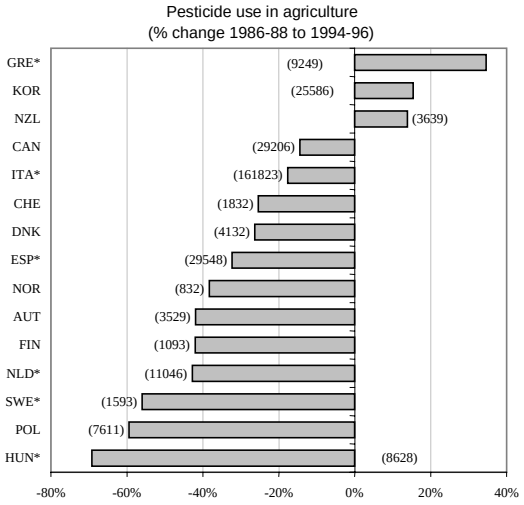
Nitrogen (N) balance in kg per hectare of total agricultural land = N inputs (fertiliser, manure, etc.) minus N plant uptake, which if > 0 = N surplus; if < 0 = N deficit.

*1986-88 to 1993-95

Data are preliminary estimates.

Source: OECD Agri-environmental Indicator Database.

Graph 4



Notes:

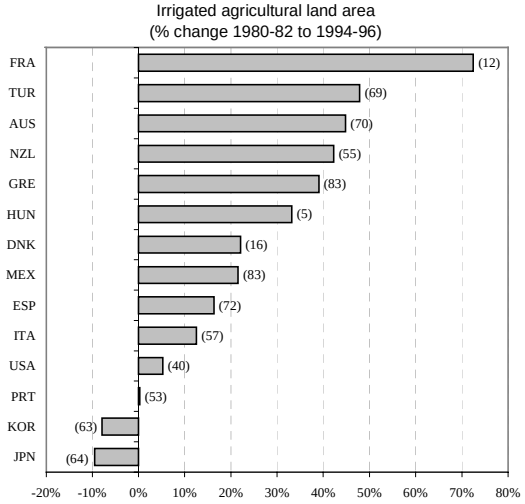
1994-96 time series are not available for Australia, Belgium, Iceland, Japan, Luxembourg, Mexico and United States.

(..) Total use of pesticides in tonnes of active ingredients 1994-96, except Canada 1994.

* Total use of pesticides in tonnes of active ingredients 1994-95.

Source: OECD, Environmental Database.

Graph 5

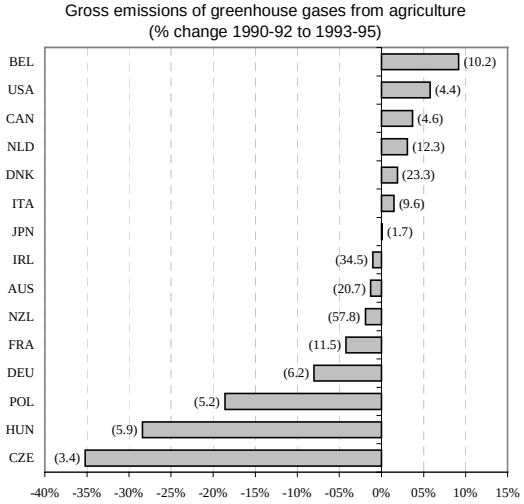


Notes:

(..) % of irrigation water for agriculture in total abstractions 1995, except Greece and Italy 1980, Australia 1985, Portugal and United States 1990.

Source: OECD, Environmental Database.

Graph 6



Notes:

Gross greenhouse gas (GHG) emission data (excluding GHG sinks) covers the main agricultural GHG gases-- carbon dioxide (CO_2), methane, nitrous oxide-- converted to CO_2 equivalent using Global Warming Potentials for 100 years.

(..) Share of agricultural gross emissions in total gross emissions 1993-95.

Source: OECD Agri-environmental Indicator Database.

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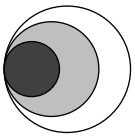
AGRICULTURE/ENVIRONMENT INDICATORS

THE EXPERIENCE OF AUSTRALIA*



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EXECUTIVE SUMMARY

Australia is committed to sustainable development and to its measurement using reliable scientific indicators.

Because global understanding of sustainable development and its measurement are evolving rapidly, the best frameworks and indicators to measure performance will be flexible and adaptive to take advantage of improving understanding and application.

In Australia, the institutional, social, environmental and sectoral diversity of agriculture pose special challenges in developing frameworks and indicators to measure progress towards sustainability. Australian governments have developed five key indicators and 19 attributes of agricultural sustainability based on guiding principles of: sustaining or enhancing farm productivity; minimising or avoiding adverse impacts on the natural resource base; minimising chemical residues; maximising net social benefits from agriculture; and having flexible farming systems to manage risk from market and climate variability. Analysis of the indicators in 1998 shows strong progress in many areas, notably natural resource management, but continuing problems in others, including soil acidity, sodicity and water quality.

Australian experience with sustainability measures in agriculture and other sectors suggests that:

- Indicators can be most effectively applied if they are part of a framework with a well-defined scope and a set of clearly stated objectives against which performance is to be judged.
- Indicators should be capable of guiding management decisions. Therefore they need to be relevant at the scale of the management unit. Ideally, objectives at national and international levels should be consistent with those at lower levels. Activities at the lower levels should contribute to the outcomes sought at higher levels of abstraction. As far as practicable therefore, there should be meaningful and articulated linkages between indicators at different scales.
- There is a need to develop systems of indicators that are useful within individual industry sectors and which also contribute to reporting and management at local, regional and national levels. Input from social, economic and environmental disciplines needs be integrated at various scales and levels of the process. The better the understanding of the relationships between economic, social and biophysical factors, the more useful the indicators are likely to be in guiding effective decision-making.

These findings suggest that more attention needs to be directed to the frameworks within which indicators are developed. A carefully designed framework leads to indicators that are relevant at the level of management unit and provides an overall assessment at the broader scale through “generic” indicators.

In Australia and elsewhere, policies and programs for sustainable development are increasingly directed at the unit of the catchment, region or other equivalent management unit. Scientific research into sustainable development is also increasingly directed at experiments at the scale of the management. These trends reflect growing recognition that approaches at this scale are fundamental both to management and to the scientific understanding needed to inform management. A consequence of this focus on the management unit for both research and policy is that the two activities converge – the future will see research and policy as integrated adaptive aspects of advancing sustainable development.

I. INTRODUCTION

Australia's size and diversity of environments, production systems and institutional arrangements pose special challenges in progressing sustainable development and in formulating and applying approaches to measure performance. Australia is committed to ecologically sustainable development, and to monitoring progress through indicators that are robust, reliable and science based.

We first provide a brief overview of how Australian agriculture has measured progress towards sustainable development. Drawing on this experience, we then discuss lessons learned under the headings of: scope, scale and sector. We present our view on the role of social indicators and conclude with a discussion of future directions.

Australia is the world's sixth largest country and is comprised of arid, tropical, sub-tropical, temperate and alpine zones. It is a federal nation divided into six States and two mainland Territories, each with its own internal government and capital city. The population of 19 million is unevenly distributed with 84% of the people living in 1% of the area.

The gross value of Australia's agricultural commodities in 1997-98 was over USD 18.2 billion, with exports accounting for USD 5.3 billion. The relative reliance of the Australian economy on natural resources is an important reason for the focus on the sustainable development of those resources. There are significant problems with land degradation resulting from past land management practices that were poorly matched to land capability. Land clearing, over-stocking, cropping on marginal land and introduced species such as rabbits and feral goats have led to a range of problems including erosion, salinisation, acidification and poor soil structure. A focus of government programs is to identify and implement management practices that can remedy these problems.

II. MEASURING PROGRESS TOWARDS SUSTAINABLE DEVELOPMENT

Work in Australia on indicators for sustainable agriculture gained momentum in the early 1990s during the preparation of the National Strategy for Ecologically Sustainable Development.

Under our federal system, the State and Territory Governments and the Commonwealth Government have complementary responsibilities for natural resource management. The process of developing a nationally coherent framework that would allow Australia to assess progress towards sustainable agriculture was therefore progressed through a co-operative arrangement involving nine governments (The Standing Committee on Agriculture and Resource Management, SCARM). Sustainable agriculture was defined in terms of five guiding principles (Table 1), the basic components of which are shown in Figure 1.

Developing a set of national indicators for sustainable agriculture was a challenging task, given the diversity of Australia's agricultural landscapes and industries, and the complex issues that the national framework attempted to address. The links between socio-economic and biophysical aspects, including the off-site effects of agriculture, are key issues in the concept of agricultural sustainability. Indicators that reflect such linkages require a conceptual framework and methodology which goes beyond the existing measures of profitability and success, and allow the status of the resource base to be reflected in the overall worth of the industry.

Five key indicators and 19 attributes (Table 2) form the basis of the national indicator framework and, when considered in parallel, provide an overview of the sustainability of Australian agriculture. The indicators cover economic, environmental (on-site and off-site) and social (managerial and off-site) aspects. An example of one of the indicators is given in Inset 1.

Table 1. **Definition of sustainable agriculture and the five guiding principles for assessing sustainability**

Sustainable agriculture:

the use of farming practices and systems which maintain or enhance: the economic viability of agricultural production; the natural resource base; and other ecosystems which are influenced by agricultural activities.

Guiding principles:

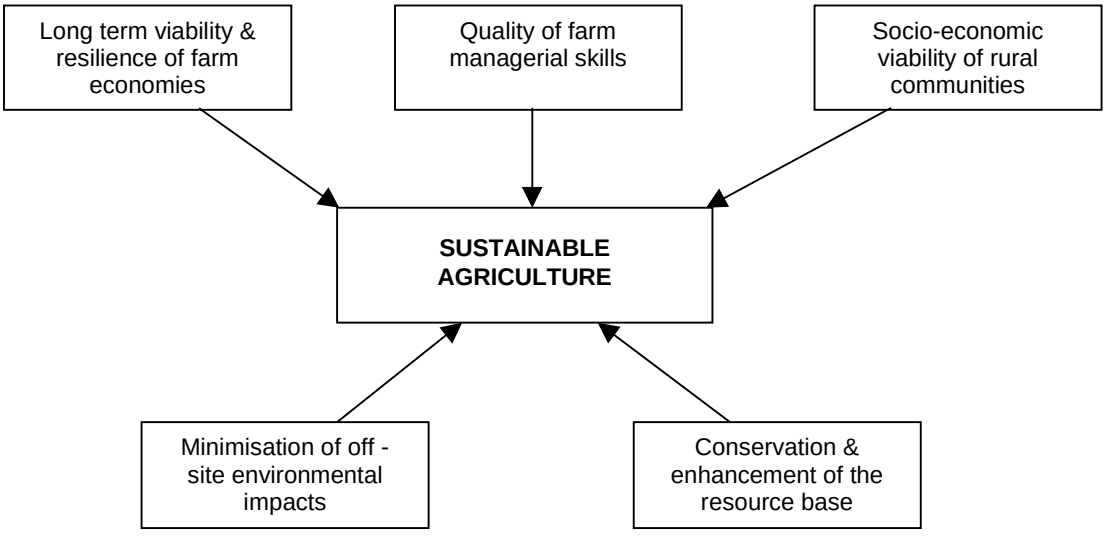
- Farm productivity is sustained or enhanced over the long term
- Adverse impacts on the natural resource base of agricultural and associated ecosystems are ameliorated, minimised or avoided
- Residues resulting from the use of chemicals in agriculture are minimised
- The net social benefit derived from agricultural is maximised
- Farming systems are sufficiently flexible to manage risks associated with the vagaries of climate and markets

Source : SCARM, 1993.

The indicators and attributes aim to provide tools to assist policy makers and managers at national and regional scales. They are intended to provide early warning of deleterious environmental and other changes for trace-back inquiries on causes, and also for comparison between farming practices, management decisions or systems' performance. Indicators will not necessarily be able to predict such changes, but they can bring them to our attention, give them relative importance, and assist in making decisions for action or investment.

Development of indicators for sustainable agriculture is an iterative process. Because of their scope, it is recognised that the current set of national indicators may have limited application in informing management decisions at certain scales, and in providing definitive policy guidance for future agricultural development. However, some States are building on the national scale work, to provide a more meaningful, regional perspective for the State and its land managers. An example is given under "Scale".

Figure 1. **Basic components of sustainable agriculture**



Source: SCARM, 1998.

Table 2 **Indicators and attributes used to analyse the sustainability of Australian agriculture**

Indicator	Attributes
• Long-term Real Net Farm Income	Real net farm income Total factor productivity Farmers' terms of trade Average real net farm income Debt servicing ratio
• Natural Resource Condition	Nutrient balance: P and K Soil condition: acidity and sodicity Rangeland condition and trend Agricultural plant species diversity Water utilisation by vegetation
• Off-site Environmental Impacts	Chemical residues in products Salinity in streams Dust storm index Impact of agriculture on native vegetation
• Managerial Skills	Level of farmer education Extent of participation in training and Landcare Implementation of sustainable practices
• Socio-Economic Impacts	Age structure of the agricultural workforce Access to key services

Source: SCARM, 1998.

Inset 1. **Dust Storm Index**

The Dust Storm Index (DSI) illustrates the application of the national framework.

The DSI is one of four attributes under the indicator relating to off-site environmental impacts (the other three attributes are: chemical residues in products; salinity in streams; and impact of agriculture on native vegetation).

Dust storms in Australia are natural events, triggered by climatic conditions, but their frequency and intensity in some regions can be accelerated by agricultural practices that expose soil surfaces to prevailing wind action. The main off-site effects of wind erosion are associated with long-distance transport of dust, which can be a major contributor to particulate air pollution in rural and urban areas.

To determine agriculture's contribution to wind erosion it is necessary to first determine the level of erosion that would have occurred naturally without the land-use changes imposed by agriculture, and to compare this with actual erosion levels.

A model relating to Effective Moisture (Em), which quantifies the influence of rainfall and evaporation (as they affect vegetation) on wind erosion, was used as a surrogate measure of wind erosion under natural conditions. Actual wind erosion was estimated using meteorological data on the occurrence of dust events (dust storms, local dust and dust haze). These were combined into a Dust Storm Index (DSI). The difference between actual (DSI) and predicted (Em) wind erosion gave an estimate of the Accelerated Erosion Index (AEI) – the primary cause of which is local or regional agricultural activity.

Data from 72 meteorological stations across Australia, and for three time periods between 1965 and 1996, were interpolated to provide a national picture of accelerated wind erosion through the past 30 years. The information was presented at a regional level, based on the 11 identified agro-environmental regions.

Whilst the national study has arguably come as close as any to accurately describing agricultural impacts on broadscale wind erosion in Australia, some caution is required in interpreting the results. This is due to some acknowledged weaknesses of the data (e.g. spatial representativeness of meteorological observations), the scale issues and the modelling methodology (e.g. the Em model does not describe all the natural factors influencing wind erosion). Nonetheless the study did highlight some important facts. It illustrated that the extent and patterns of soil erosion had changed over the decades, and that different regions have also responded differently over time.

The study's key finding was that soil erosion, as measured by the Dust Storm Index, has decreased in the past ten years due to changed farming practices which reduce the area of bare soil. However, areas of concern still exist in southern Western Australia and the semi-arid interior of Queensland and New South Wales.

In 1998, SCARM produced a full-scale national analysis of the state of Australian agriculture (in 11 agro-ecological regions) using the national indicators. The report indicates progress in a number of areas but also points to a number of issues that are still facing agriculture. For example, in the area of natural resource management, the report noted that improved management practices such as conservation farming were contributing to a decrease in the level of wind erosion. In contrast, the report also noted that soil sodicity and acidity were increasing and that stream water quality was deteriorating.

The report also highlighted that while there are data for the physical attributes such as land condition and water quality, there were difficulties, for example, in terms of their consistency across Australia and their availability for use in the national assessment. Some suggestions for further work are provided in the report. The report provides a ten year snapshot and it is proposed to repeat the exercise in 5 years time, using methods and data developed through other government programs.

A wide variety of organisations and government programs are involved in the development and use of indicators of sustainable development. They include the various research and development corporations, state of environment reporting agencies at both the State and Commonwealth levels, the Bureau of Rural Sciences, the Standing Committees of Ministerial Councils, the Murray Darling Basin Commission and the National Land and Water Resources Audit.

Water is the critical resource limiting agricultural production in Australia. Australia is the driest of the continents, second only to Antarctica, and has an extremely unpredictable rainfall. Close to three-quarters of its area is semi-arid, yet the nation uses an estimated 14.6 cubic kilometres of water annually, 70% of which is used for irrigated agriculture. Australia's available water resources are comparatively large. This is due to the large capacity water storage systems that have been implemented in response to our variable climate. There is also a range of different climates across the variety of Australia's landscapes. These factors point to the need for some caution in applying indicators relating to water resources at the broad national level without appropriate contextual information. Nonetheless, as the example in Inset 2 illustrates, assessments relating to water use intensity can be significant at the regional level and can underpin significant policy decisions by governments.

III. LESSONS LEARNED

Australia's experience with indicators of sustainable development for agriculture, combined with experience in other sectors such as forestry and fisheries illustrates a number of important points, which are conveniently grouped under the headings of scope, scale and sector.

1. Scope

There is increasing emphasis on the need to develop indicators within an overall framework (see for example, FAO 1999). The framework should have a well-defined scope and should link indicators with clearly stated objectives.

The SCARM indicators were developed to measure performance at a national level towards the goal of sustainable agriculture. Sustainable development was interpreted in terms of the five guiding principles. While the development of SCARM indicators has been important in telling us how Australian agriculture is faring generally, it has not given us sufficient detail at the regional and industry sector levels to guide decision making at these levels. Developing appropriate indicators at the regional and industry sector scales requires management objectives at these scales to be clearly defined. It also requires an understanding of the impacts of different management actions.

An approach developed initially for fisheries (Chesson and Clayton 1998) may be useful in establishing a closer link between indicators and management actions. The approach evaluates performance by looking at both the positive and negative contributions of an activity (e.g. agriculture) or an entity (e.g. a nation) to sustainable development. The contributions are divided first into the direct effects on humans and the effects on the environment (which then affect humans indirectly). The two components are then repeatedly subdivided to whatever level is appropriate to the management context. An incomplete, hypothetical example is shown in Figure 2. This approach has proved very convenient to apply in fisheries and is more readily accepted by industry because it allows a statement of the benefits of the activity as well as the costs.

Inset 2. **Intensity of water use and water stress in the Murray-Darling Basin**

An audit (MDBMC 1995) of the Intensity of Water Use and an assessment of its impacts on Water Stress in the Murray-Darling Basin triggered a major change in the recognition of the impact of water diversions on environmental values and the sustainability of irrigated agriculture. The response to the audit was a major policy decision to cap future diversions at the 1994 levels, with water trading to optimise use of the limited water resource.

The Murray-Darling Basin is Australia's largest river basin and accounts for approximately half of its agricultural production.

River health in the Basin was continuing to decline as a result of the increasing demands for water to be diverted from the system. Increased diversion of water from rivers has a direct impact on water quality, particularly by increasing salinity. Manufacturing industries in the Basin, the heavy industries of the Iron Triangle in South Australia, and the city of Adelaide all require high quality water. Irrigated agriculture, the largest user of water in the Basin, is directly affected, with horticultural crops such as grapes among the first casualties of rising salinity.

It was also apparent that diversions could significantly increase from current levels, making the situation worse. Consequently, a comprehensive Water Audit was initiated to establish the facts relating to water use in the Basin. The Audit included:

- a description of the current level of development of the resource;
- identification of recent trends;
- projection of these trends into the future; and
- assessment of the likely impacts of these developments on the environment.

Key findings of the Audit that highlighted the seriousness of the situation included:

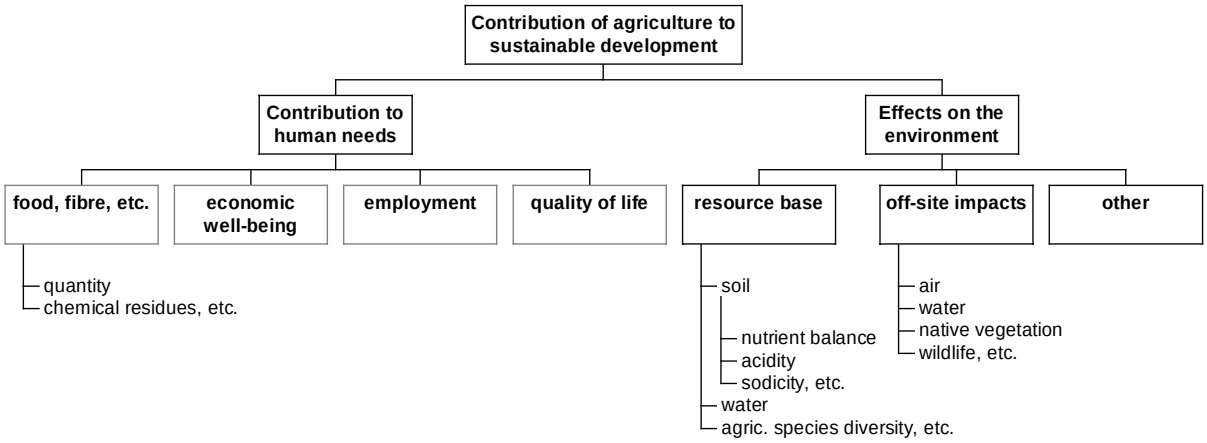
- an 8% increase in water diversions between 1988 and 1994, with the potential for this to increase by a further 14.5% if no action is taken;
- an increase in severe drought-like conditions in the lower end of the system where it enters the sea. Water shortages that would have occurred in one in twenty years under natural conditions are now happening in six out of ten years. This could rise to three out of four years if no action is taken;
- a significant decline in native fish populations. In South Australia, the commercial catch of native fish has dropped to under 20% of what it was in the 1950s, largely as a result of river regulation; and
- an increase in salinity as measured at key reference points. A 2% increase between 1988 to 1994 was predicted to rise by a further 6% if no action is taken.

Following consideration of the Audit by governments involved in the Murray-Darling Basin, an immediate moratorium was placed on further increases in diversions. An Interim Cap was established at the 1993–94 level of development, with the final Cap agreed in 1997.

The Water Audit, a rigorous examination of the Water Use Intensity with key findings as explained above, underpinned the major policy decision of governments to intervene and significantly change the diversion entitlements and management rules (including those for irrigation) in the Basin in the interests of sustainable use of a limited resource.

Information from: Agricultural Water Use, a paper presented by Mr L. Russell, Department of Primary Industries and Energy, Australia to the OECD Workshop on Agri-environmental Indicators, York, September 1998 (OECD 1998); and An Audit of Water Use in the Murray-Darling Basin, June 1995, Murray-Darling Basin Ministerial Council (MDBMC 1995).

Figure 2. **An incomplete, hypothetical example of a hierarchical framework applied to agriculture**



2. Scale

Australia needs to develop indicators that are useful across scales and jurisdictions, from local to national. Some indicators are readily applied at any scale (area, yield, etc.). Other indicators only make sense at a particular scale (soil compaction, nutrient levels, stream health) and require a level of abstraction to be applied at a broader scale. For example, nutrient levels may be an appropriate indicator at a local scale, the extent of eutrophication may be an appropriate indicator within a river system and the proportion of major river systems that are eutrophic may be an appropriate indicator at a national scale.

In rural Australia, natural resource management issues (including their social and economic dimensions) are usually most adequately addressed at the catchment or regional scale. Federal and State government initiatives, including actions under the National Landcare Program, are targeted at the regional scale.

Complementary action at other levels or scales (e.g. individual property, local and national levels) is also important.

At the local scale, action by landholders has been promoted through property management planning. Whilst initially focussing on biophysical aspects, property management planning has evolved to focus on 'whole systems' approaches including economic and social issues associated with farming enterprises.

At the other end of the spectrum, at the national level the National Decade of Landcare Plan provides a framework for integrated action by governments, individuals and the community to address land degradation until the year 2000. Systems of indicators are needed to measure progress at each of these scales.

At the same time that the indicators of sustainable agriculture were being developed at the national level, the State of South Australia began a project for assessment within the State using the same methods. The goal was to translate the national approach to provide a meaningful regional perspective for the State and its land managers. In some cases the indicators could be applied down to local statistical areas. In other cases, the indicators were unable to be taken below the level of the national study.

South Australia was able to develop or adapt some indicators to better suit their purposes. For example, the national study used a water utilisation index of rainfall by plant cover because information on water use efficiency was not available for all types of vegetation. South Australia, however, had the data and appropriate modelling to develop measures of water use efficiency for two key crops (wheat and barley) over three decades.

Approaches taken at a coarser scale (e.g. at the national or international level) should not constrain the use of more detailed approaches at a finer scale (e.g. regional or local) when such approaches are feasible. If they do, there is a risk that the most important benefits of indicators, namely the ability to prompt management changes, will be lost as the indicator system moves to the lowest common denominator.

In Australia, agencies responsible for state of environment reporting have dealt with this issue by identifying a core set of indicators (ANZECC 1998). While each jurisdiction reports on a broad range of indicators as appropriate for its own purposes, a core set of generic indicators has been identified which is applicable across scales and jurisdictions. This approach is directly relevant to agriculture when national or international comparisons are contemplated.

3. Sector

Indicators must be useful to the individual industry sectors and be linked to management actions. Ideally, they should also be able to be combined or aggregated in some way across industry sectors so that they contribute to reporting and decision-making at regional and national levels. Little work has been done on this issue to date. There is some overlap between the national agriculture indicators and forest indicators in the area of agro-forestry, but in general, development of indicators in each sector has proceeded separately.

The approach used in fisheries, where indicators are developed to answer the question “How does an activity contribute to sustainable development?” rather than “Is this activity sustainable?” provides a conceptual basis for combining indicators across industry sectors. If the contributions (both positive and negative) are correctly attributed to each industry then it is possible to determine the overall contributions of, say, a nation.

4. The role of social indicators

It is well-recognised that sustainable development requires the integration of social, economic and environmental information, but methods need to be developed. The Bureau of Rural Sciences has recently produced a social atlas which displays social data spatially (Haberkorn et al 1999). The need to develop more robust social indicators is clearly an important lesson for the future. While there have been some attempts to identify and measure the social aspects of sustainable development in agriculture, these have tended to be somewhat restricted in focus and definition and not well supported by the scientific literature.

There is an increasing realisation that socio-demographic, psychological and attitudinal factors play an important role in moving individuals and industries towards more sustainable resource management practices. Some of our sustainable resource management policies and programs are predicated on changing knowledge, skills and attitudes in the assumption that changed behaviours will follow.

There is also growing recognition that moving to more sustainable agricultural industries and practices will require structural adjustment in some industries and/or regions. Structural adjustment processes tend to impact on the supporting rural community and understanding these social impacts

is important for assisting them through the adjustment process. Another issue is the lack of a robust conceptual framework that identifies social indicators relevant to ESD in agriculture. For example, there are conflicting research findings on the relationships between farmer age and sustainable resource management practice and farmer education levels and practice.

However, there are several processes underway in Australia to identify national level social indicators that can also be used at the local or regional scale. While these are largely in the development phase, they represent an important step forward in our understanding of indicators of sustainable development. They include indicators of:

- farmers' capacity to move to sustainable resource management practices being developed and trialed as part of the National Land and Water Resources Audit;
- community resilience or social capital such as the Community Sensitivity Index trialed in the Regional Forests Agreement process and social indicators of resilience under development by the Bureau of Rural Science and other Commonwealth agencies;
- community dependence on resources such as the Township Resource Cluster Analysis approach currently being tested in relation to a number of agricultural industries; and
- community advantage/disadvantage such as the Australian Bureau of Statistic's Socio-economic Index For Areas.

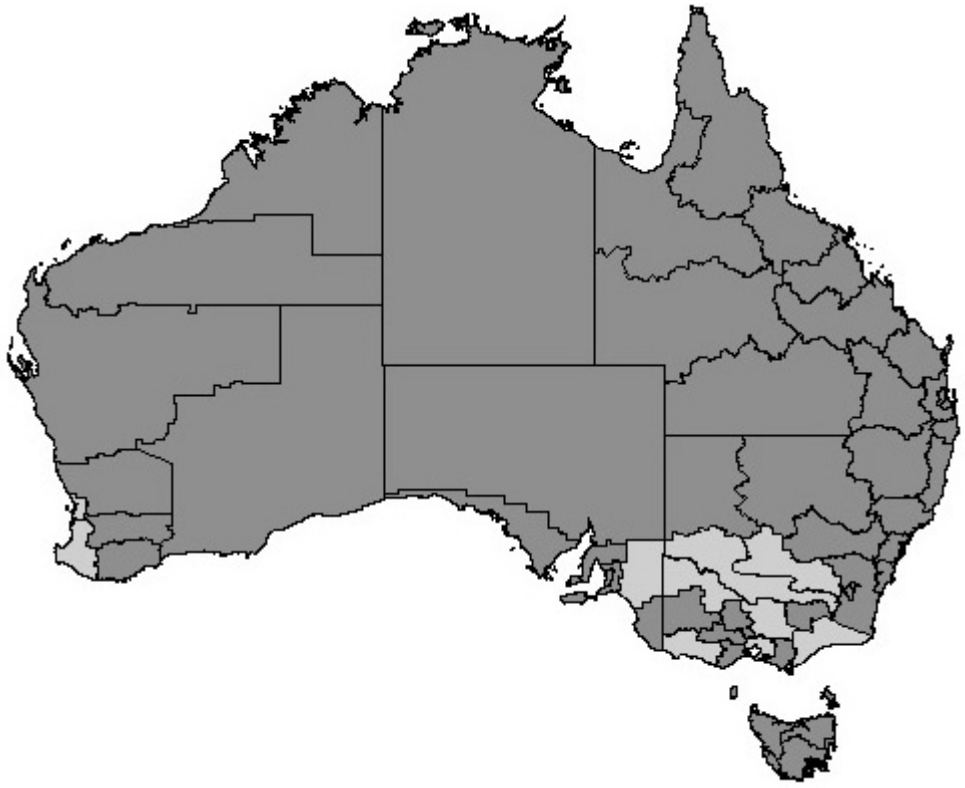
Sustainable development requires more than just collecting a set of indicators from each discipline. As discussed under 'Scope', indicators of sustainable development must be linked to well-defined objectives. In specifying the objectives, the community will be informed by social, economic and environmental information.

For example, an objective regarding the desired use of a particular area of land should reflect not only the bio-physical properties of the land, nor simply the use that might provide the best long-term economic return, but also consider other potential uses of that land, the interrelationships between land use and the local community, and any other aesthetic, spiritual or traditional values associated with that land. Specifying the objective is not the exclusive domain of social science, economics or the bio-physical sciences, but is part of a political process.

Once objectives have been specified, indicators follow. Depending on the objective, the indicator may be purely social, economic or environmental or a mixture of some or all of these. An environmental indicator might be measured in economic terms (e.g. the value of lost production due to salinity). A social indicator might be measured in bio-physical terms (e.g. the area of wilderness as an indicator of how well a social need is being met or the links between community vitality and agricultural profitability).

Figure 3 provides an example of how geographical information systems can facilitate the integration across disciplines. The map identifies areas that have reliable rainfall *and* fast growth in the value of agricultural production *and* a high age dependency ratio (persons aged 0 to 14 or over 65 years as a percentage of the total population). It is the result of one of an unlimited number of queries that can be applied to the data base that contains social, economic and bio-physical data. This particular data base will be available on the Bureau of Rural Science's web site (http://www.brs.gov.au). Tools such as this offer great potential for increasing our understanding of relationships between bio-physical, economic and social domains.

Figure 3. **Using geographical information systems to integrate bio-physical, economic and social data**



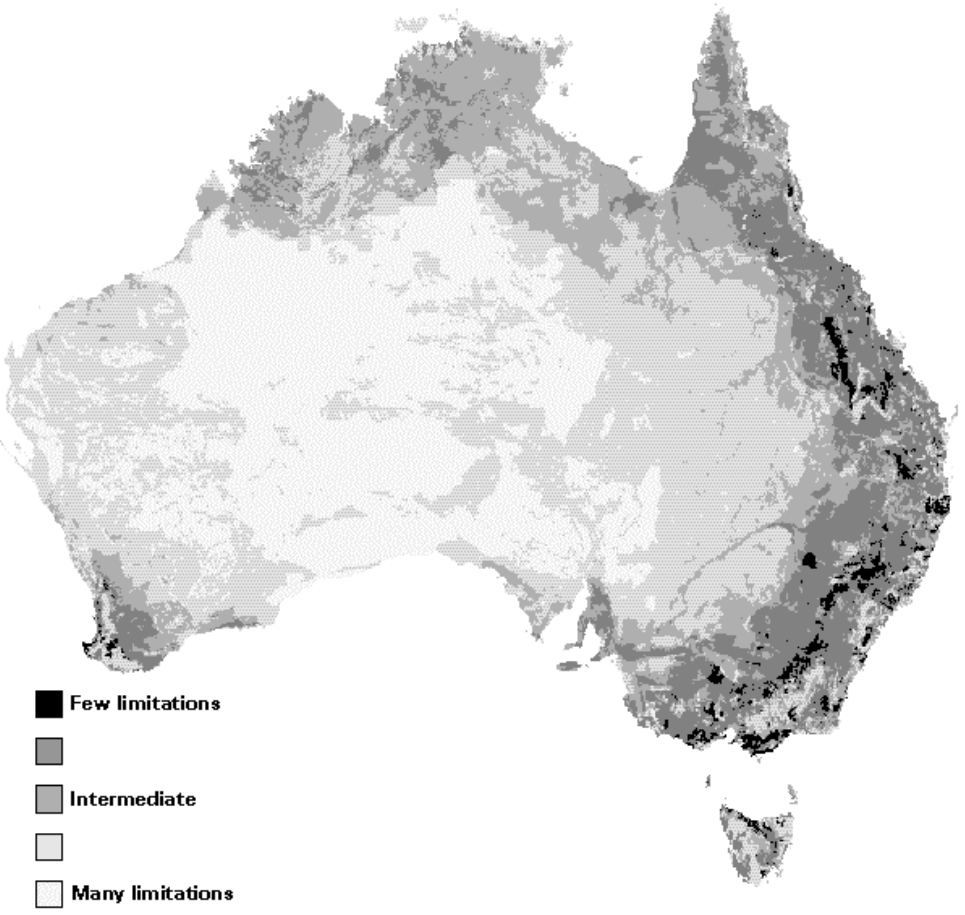
Note: The lighter areas have reliable rainfall and fast growth in agricultural production and a high dependency ratio.

IV. FUTURE DIRECTIONS

Australia is seeing the result of 200 years of agricultural practices that have not all been appropriate for the Australian environment. The challenge is to identify what uses are appropriate and what measures can be taken to reverse the damage of the past. Australia is developing a Natural Resource Management Policy Statement that is expected to define future directions. The Land and Water Resources Audit and associated projects are helping to better specify objectives and guide the selection of appropriate indicators to evaluate progress against these objectives.

Translating broad objectives for sustainable development into operational objectives that are relevant to management decisions requires an understanding of the capability of the land to sustain various uses. Such an understanding is being developed through the creation of a land use and management information system which integrates biophysical, social and economic characteristics. Components of the information system include land use, vegetation, soils, catchment characteristics and social and demographic characteristics and trends. These components complement existing information on surface water features, a national digital elevation model and climatic features. This work is being carried out in association with the National Land and Water Resources Audit. Figure 4 shows one scenario of potential limitations for a wide range of agriculture based on soil properties, water availability, vegetation type, degraded lands, transport networks, stock densities and crop yields.

Figure 4. **Potential limitations for agriculture based on soil properties, water availability, vegetation type, degraded lands, transport networks, stock densities and crop yields**



To ensure that objectives and their indicators exist within a coherent framework, the Bureau of Rural Sciences has generalised the fisheries framework and is exploring its applicability to other sectors. The Bureau is also investigating methods for integrating across sectors and across different spatial scales.

V. CONCLUSIONS

Our understanding of sustainable development and the means by which to measure it are recent and evolving rapidly. This requires a flexible and dynamic approach to accommodate insights and improvements.

The main conclusions of this paper are that:

- Indicators can be most effectively applied if they are part of a framework with a well-defined scope and a set of clearly stated objectives against which performance is to be judged.

- Indicators should be capable of guiding management decisions. Therefore they need to be relevant at the scale of the management unit. Ideally, objectives at national and international levels should be consistent with those at lower levels. Activities at the lower levels should contribute to the outcomes sought at higher levels of abstraction. As far as practicable therefore, there should be meaningful and articulated linkages between indicators at different scales.
- There is a need to develop systems of indicators that are useful within individual industry sectors and which also contribute to reporting and management at local, regional and national levels. Input from social, economic and environmental disciplines needs be integrated at various scales and levels of the process. The better the understanding of the relationships between economic, social and biophysical factors, the more useful the indicators are likely to be in guiding effective decision-making.

These conclusions indicate future directions for the development of indicators of sustainable development. Australia is actively pursuing these, recognising that much work remains to be done.

There has been much discussion about the desirable properties of indicators and further work is still needed in the identification, measurement and interpretation of indicators for particular purposes. The Australian experience suggests, however, that more attention needs to be directed to the frameworks within which indicators are developed.

We suggest that it is the framework, not the individual indicator, that is most usefully specified at the global or national level. The framework defines the scope and the broad components that need to be addressed. Within this framework, particular sectors or regions will identify the sub-components at the scale relevant to them and develop indicators to measure progress with respect to their clearly defined objectives. For example, at a global level the framework might specify water quality as one of its components. Individual states then specify sub-components (salinity, eutrophication) that are relevant to their situation. These sub-components are further elaborated at the regional and local level where indicators are specified and measurements taken.

A carefully designed framework leads to indicators that are relevant at the level of management unit and provides an overall assessment at the broader scale through “generic” indicators. “The proportion of catchments meeting their water quality objectives” is one example of a “generic” indicator. “The area of critical habitat” is another example. The type of area to be included in this “generic” indicator and the method of measuring it would be determined at the level of the management unit taking into account such things as the species under consideration and the ecological context.

In Australia and elsewhere, policies and programs for sustainable development are increasingly directed at the unit of the catchment, region or other equivalent management unit. Scientific research into sustainable development is also increasingly directed at experiments at the scale of the management. These trends reflect growing recognition that approaches at this scale are fundamental both to management and to the scientific understanding needed to inform management. A consequence of this focus on the management unit for both research and policy is that the two activities converge – the future will see research and policy as integrated adaptive aspects of advancing sustainable development.

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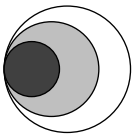
AGRICULTURE/ENVIRONMENT INDICATORS

THE EXPERIENCE OF THE NETHERLANDS*



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* By Rob Versfeld, Directorate for Strategy and Programming, Directorate-General for Environmental Protection, Ministry of Housing, Spatial Planning and the Environment, the Netherlands.

EXECUTIVE SUMMARY

Many challenges are present in the Dutch agricultural sector: environmental problems like acidification, eutrophication and the dispersion of pesticides. There are also opportunities such as development of organic farming and nature management.

Environmental indicators are used in the Netherlands to show the distance to the target, to give insight in the environmental situation (ad hoc or structural) or to assist enforcement. There are indicators for driving force, pressure, state, impact and response.

Many (end-of-pipe) measures have been taken, but targets have not yet been met. Broadening of environmental policy towards economic and social aspects is necessary to meet the environmental targets. This was the reason for the Netherlands to start the discussion about the interface between economy and the environment by drawing up the Policy Document on the Environment and the Economy in 1998. Recently, the discussion has started about the social dimension and the environment.

The economy is the driving force for a lot of agricultural environmental problems. Within environmental policy indicators are used like: value added in the agricultural sectors, the area where organic farming is used, amount of livestock, energy use, water use, supply of pesticides and use of pesticides. Environmental policy influences economic conditions. Indicators are used like: environmental costs of the agricultural sector, the sum of manure tax (for farmers exceeding loss standards) and cost-effectiveness of acidification in the agricultural sector (compared with other sectors).

The use of social indicators within the environmental policy is not yet as developed as for economic indicators. But examples can be mentioned in this field already. For example, when economic instruments in environmental policy are developed, the effects on purchasing power of different income groups are taken into account.

Further development of the interface between the dimensions of sustainable development and the use of indicators in the future is necessary. In the Netherlands this will be done in the National Environmental Policy Plan and other areas.

I. AGRICULTURE AND THE ENVIRONMENT

1. The Dutch agricultural sector: an impression

The Netherlands is a densely populated country. In 1997 the Netherlands had 376 inhabitants per square kilometre, in the same range as Japan (331 inhabitants/km^2). The sector structure is relatively energy intensive (e.g. transport and the energy intensive industry). Together with the high population density and level of welfare, this causes extensive environmental pressure per square kilometre. This is an important reason for improving the environmental quality and for the long tradition in environmental policy. This effort has resulted in significant reduction of emissions per capita or per unit GDP, but the Netherlands still has one of the highest environmental pressures per square kilometre in the world.

Some figures concerning agriculture and the *environment:* the nitrogen balance (N inputs -/- N plant uptake) is the highest of the OECD: 275 kg N/ha in 1994-96. The pesticide use has gone down from 1985 till 1990, but in the recent years as light increase has been registered, especially in the use of fungicides. Agriculture's share of acidification (NH_3) declined until a few years ago. In recent years the emission of ammonia is more or less constant, but the emission target is much lower than the current emission.

These are some figures of the major environmental problems in agriculture: livestock waste (manure), ammonia and chemical pesticides. Other types of environmental problems caused by agriculture include emissions of heavy metals and contaminants, waste, anthropogenic parching (groundwater depletion), climate change and odour. A lot of opportunities are also present: nature conservation, biodiversity, agrotourism, etc.

To reduce the emission of N and P e.g. the so-called Restructuring Act will have to reduce the amount of livestock by 25%. International developments are having an increasing impact on national environmental and agricultural policy. The introduction of milk quotas has led to a reduction in the numbers of dairy cows per hectare, linked to an increased production per cow. In recent years the common agricultural policy has also led to a reduction in meat herds. Nowadays the implementation of the EU Nitrate Directive has high political attention in the Netherlands.

Some figures concerning agriculture and the *economy*. The amount of employment in agriculture is 4% of the total civilian employment in 1996. The total value added in agriculture is 3% of the total GDP in 1996. The decline in the number of farms in the recent eight years is 2.25% a year. The number of farms was 105 000 in 1998.

The Policy Document on the Environment and the Economy sets forth a number of joint action programmes to be carried out by the government and the agricultural sector. For example, the agricultural sector will examine whether the integrated approach adopted in the glass horticulture sector (drawing up of a business plan, certification schemes, agro-ecolabel, etc.) is applicable to other sectors, the combination of economic and ecological functions of the countryside and the possibilities for the glue and paint industries of using natural proteins in water-based paints and glues in order to promote the use of agricultural raw materials in the non-food industry.

The most important message of the Policy Document on the Environment and the Economy is to realise decoupling of economic growth and environmental pressure, and the most important task is to take account of environmental values in prices.

Some figures concerning agriculture and the *social dimension.* The working population consists for 42% of women. The age of farmers is for 46.6% higher than 55 year. The number of e.g. primary & secondary schools is still declining in rural areas.

The Kingdom of the Netherlands consists of 12 provinces, more than 600 municipalities and more than 100 water boards. Environmental policy is drawn up and implemented at both the national level (by the Government and the Parliament) and at the level of the provinces, municipalities and water boards. The most important ministries for environmental agricultural policy are the ministries of Agriculture & Nature Management and Fisheries, the ministry of Housing, Spatial Planning and Environment, and the ministry of Transport, Public Works and Water Management. Environmental policy for the agricultural sector is shaped in discussion with these authorities, agricultural organisations and other businesses in the chain, such as farm suppliers and product processors. The large number of stakeholders makes the agricultural policy-making a complicated process.

2. The Dutch agricultural sector: environmental indicators

Three groups of indicators publications can be distinguished:

- Documents of the Dutch Independent Environmental Agency (RIVM). The RIVM publish every year the Environmental Balance (chiefly ex post) and every four years the Environmental Outlook (chiefly ex ante). Indicators are the most important elements in these reports.
- The National Environmental Policy Plan (every four years) and the Environmental Programme (every year). These documents, signed by the four most relevant ministries, make use of the environmental indicators. The documents discuss all elements of environmental policy.
- More sector-specific policy documents. Indicators are also very important for policy documents like the Multi-Year Pesticides Plan, the glass horticulture covenant, etc.

The showing force, pressure, state, impact, response (DPSIR) model is a good model for the environmental indicators in the Netherlands. The pressure, state, impact and response indicators will be elaborated in the next paragraphs. The driving force indicators are socio-economic indicators and will be discussed in paragraph 2.

Sets of D, P, S, I and R indicators have been developed separately in the Netherlands in the past. The interaction between response and pressure indicators, for example, will get more attention in the near future. The interaction between pressure and state indicators has already been discussed in some way in the Netherlands, but this will also be enhanced. For instance the response-indicators can be used in combination with other indicators of the DPSIR- model, to valuate the cause and effect relations in the policy theory.

3. Pressure-indicators

Environmental targets have been set for the agricultural sector. Table 1 below indicates the objectives adopted for each environmental theme and what the targets are for the near future.

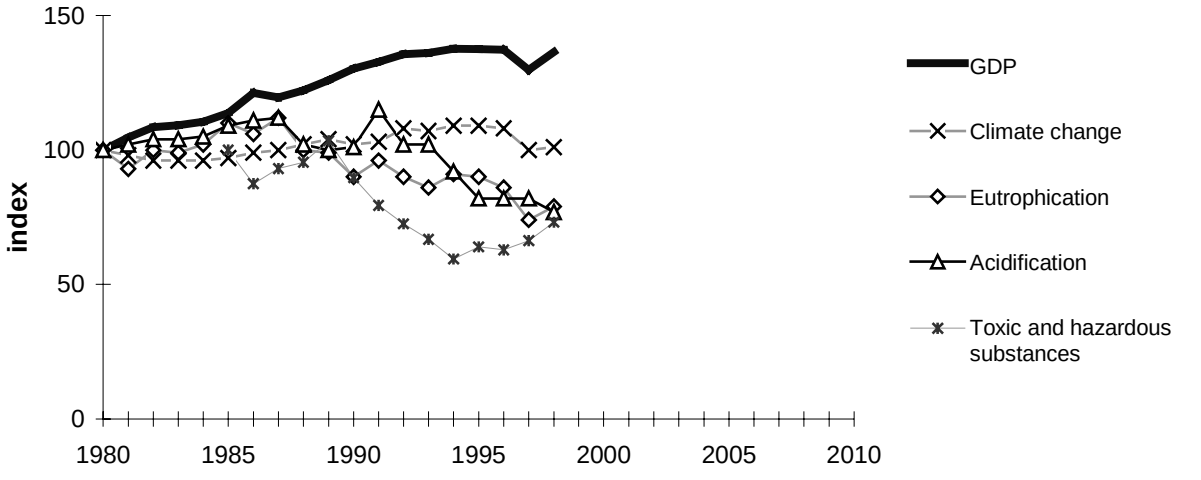
Table 1. **Environmental pressure targets for the Dutch agricultural sector**

	2000	**2003**
• Eutrophication[1]		
Grasslands (loss standard)[1]		
nitrogen (N)	275	180/140 (dry sandy soils)
phosphate (P_2O_5)	35	20
Arable (loss standard)[1]		
nitrogen (N)	150	100/60 (dry sandy soils)
phosphate (P_2O_5)	35	20
	2000-2005	**2010**
• Acidification due to ammonia (NH_3)	70% reduction relative to 1980 70 mln kg emissions in 2005	80% reduction relative to 1980 45 mln kg emissions in 2010
• Toxic and hazardous substances[2]: pesticide emissions	50% reduction in use at least 50% reduction to air at least 75% reduction to soil and groundwater 90% reduction to surface waters	
• Climate change	Multi-Year Energy Agreement with glass horticulture: 50% improvement in efficiency	glass horticulture in 2010: 65% energy efficiency

1. To be identified.
2. For 2010, some targets have yet to be identified.

These targets are published in the above mentioned documents. The purpose is to show the distance to the target. These objectives are also aggregated to environmental themes. The purpose of showing the aggregated figures is to give a good overview of the overall environmental progress in the agricultural sector to Parliament and the public in general.

Figure 1. **Target group agriculture**



4. State-indicators

There are also state targets for acidification, eutrophication, toxic and hazardous substances, and anthropogenic parching (groundwater depletion). These are set out in Table 2. Every target is monitored and is an indicator published in one (or more) of the documents mentioned on in section 1.2.

Table 2. **Environmental state-targets for the Dutch environment**

Theme	Target
Acidification	Average for the Netherlands as a whole, a maximum of 400 acid-equivalents per hectare per year, form both Dutch and foreign emissions, in order to fully protect even the most sensitive ecosystems
Eutrophication	Surface waters: ◆ max 0.15 mg total P for all surface waters (annual average) ◆ max 2.2 mg total N for stagnant, eutrophication-prone waters (summer average) Groundwater: ◆ max 50 mg nitrate per litre ◆ target value: 25 mg nitrate per litre
Toxic and hazardous substances	◆ exceedances of the MPR (maximum permissible risk levels) resulting from emissions will be eliminated for all substances in the near future: if possible before 2000 ◆ exceedances of the target value resulting from emissions will be eliminated for all substances in the longer term: if possible before 2010
Anthropogenic parching (groundwater depletion)	Reduction of the area affected by parching by 25% in the year 2000 and by 40% in the year 2010

5. Impact-indicators

Impact-indicators show the overall result of all kind of pressures and states. The part that the pollution of the agricultural sector plays on a specific impact is difficult to distinguish. Impact-indicators in Dutch documents are for instance the number of birds, butterflies, trees, the vitality of certain trees, metals in ales, metals in human blood, the number of skin-cancers, etc.

6. Response-indicators

A set of 32 response-indicators for the environment as a whole was developed last year, to be used as an early warning system. The indicator set is an instrument to measure the progress of the central government, provinces, municipalities and water boards. The indicators have to give a signal when the implementation is not going well. The indicators do not cover all the issues, but if anything goes wrong in the implementation, one of the indicators has to give a signal. The indicators do not say anything about the effectiveness of an instrument.

At the moment, the set of response-indicators is being tested: is it working, is it the right set and does it send the right signals? Some of the indicators are related with the agricultural sector, but many of them are more general and measure the progress of permitting and enforcement.

Approximately half of the 32 indicators has something to do with the agricultural sector. Three examples of these indicators are:

- the total of permits in the agricultural sector adapted to a covenant or national law as a percentage of the total;
- the total of permits given to livestock firms in concentration areas that meet with a recent ammonia reduction plan as a percentage of the total of livestock firms that are obliged to have permits in concentration areas;
- the amount of breaches of the law as a percentage of the amount of firms audited.

The reason for gathering these response indicators is different from the purpose of those in the field of pressure and state. There are no "targets for response", like there are targets for environmental pressure and state. The purpose of the response indicators is a kind of enforcement in the form of an early warning system.

II. AGRICULTURE AND SUSTAINABLE DEVELOPMENT

The Netherlands has a good environmental performance of emissions per capita or per unit GDP. If we look to environmental pressure per square kilometre for the country as a whole, the Netherlands has one of the highest environmental pressures in the world. A lot of (end-of-pipe) measures have been taken, but more measures have to be taken. Broadening of environmental policy towards economic and social aspects is necessary to reach the environmental targets within sustainable development.

1. Sustainable development: different indicators for different purposes

The economist Tinbergen once said: different instruments for different purposes. This is also applicable on indicators. If the purpose is different, the set of indicators will also be different. If you look at sustainable development, two purposes can be distinguished: describing the *situation* of economic, social and environmental aspects, and describing the *interface* between economic, social and environmental dimensions.

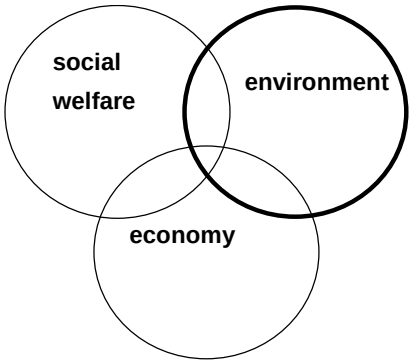
Describing the *situation*. The three dimensions of sustainable development have to be developed simultaneously. It seems less desirable to develop the economy, without improving the social and environmental conditions. To monitor the situation of the three dimensions, indicators have to be developed for the environment (emission of N, P, NH_3, pesticides, etc), economy (GDP of agriculture, competitiveness of agriculture, profits on investment, etc.) and the social dimension (viability, income equality, etc.). An interface between the different indicators is not necessary. The *purpose* of describing the situation is to watch the development in the different dimensions of sustainable development. This kind of indicator will not be elaborated in this paper.

Describing the *interface*. This aim is for the ministry of the environment to improve the environmental impact (in the DPSIR-model). It is possible to reduce the environmental pressure caused by the agricultural sector by environmental policy. The effect of environmental policy depends on the specific economic and social conditions. To assess the policy-effectiveness, these conditions have to be known. It could help the environmental policy to integrate the environmental dimension into the social and economic policy. It is also necessary to assess the influence of environmental policy on the social or economic situation, for sustainable development means improvement in all three dimensions; environmental, social and economic part. For these reasons insights, and sometimes indicators, are useful to describe the interface of environment with either economic or social

dimensions. The *purpose* of describing the interface is to improve the effect of environmental policy on social and economic conditions and vice versa.

The interface between the three dimensions of sustainable development will be elaborated in this paper by using Figure 2.

Figure 2. **Three dimensions of sustainable development and the interfaces**



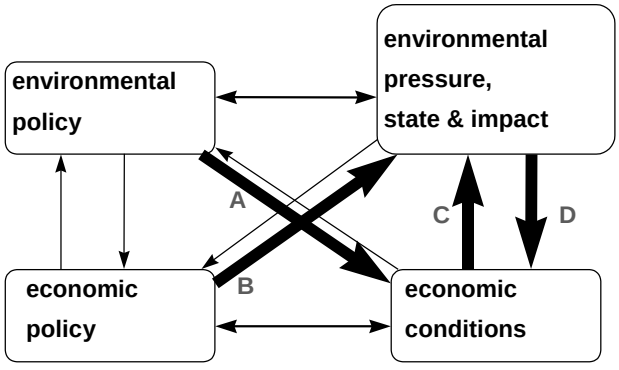
The discussion about the model to be used for explaining the relation between social welfare and environment, and economy and environment, is still ongoing. The next paragraphs present not established models, but models under discussion. All possible interactions will be showed in the figures with arrows. The important interactions are showed with bold arrows. Only the important arrows are elaborated in the text.

First the environmental - economic links will be highlighted and secondly the environmental - social links.

2. The linkage between economy and the environment in the agricultural sector

Within the interface of environment and economy, elements of the DPSIR-model can be distinguished. This is showed in the next figure. The bold arrows will be discussed.

Figure 3. **The environmental - economic links**



Economic conditions ⇒ environmental conditions (arrow C):

Livestock, fertiliser use, pesticide use, use of energy in the glass horticulture, etc. The relationship between these driving forces and the resulting pressure is called eco-efficiency. The Dutch Environmental Agency publishes indicators like: value added in the agricultural sectors, the area with organic farming, amount of livestock, energy use, water use, supply of pesticides and use of pesticides.

Economic policy ⇒ Environmental conditions (arrow B):

Most of the EU-money is spend on agriculture. Most of the money is spent for economic reasons: to make the agriculture more profitable and competitive in a world economy. In a free economy without this EU-policy, the agricultural sector probably would have another size with other ecological consequences. This arrow is not really a direct arrow from economic policy to environmental conditions, but via driving forces (= the economic conditions in this figure).

Environmental conditions ⇒ economic conditions (arrow D):

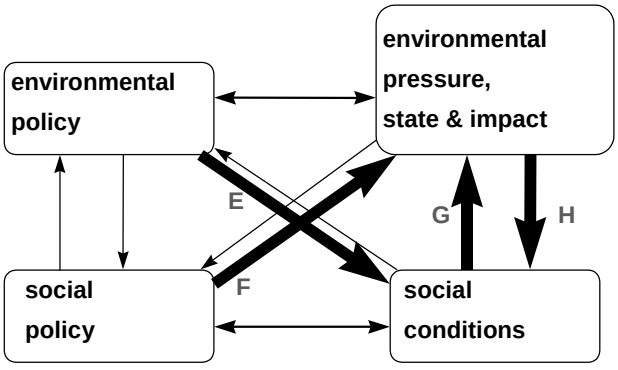
The agricultural sector itself suffers loss from e.g. industrial emissions and sewage overflows, but also from its own contribution to acidification. Farmers in areas with a lot of pig farms are sometimes limited in their choice for vegetation through the acidification and can e.g. only cultivate corn. Reduced acidification could influence the profitability of the farm. The sector therefore has an interest in a good environmental policy.

Environmental policy ⇒ economic conditions (arrow A):

All kind of environmental instruments influence the economic conditions and the resource use, economic processes and consumption. For this reason policy-makers of the ministry of economic affairs are interested in the plans of the policymakers of the ministry of the Environment. Examples are the energy covenant for the glass horticulture, energy taxes and reconstruction law to reduce the amount of livestock. All these instruments influence the price of the product or regulate in a direct way the number of products. The Dutch Environmental Agency publishes indicators like: environmental costs of the agricultural sector, the sum of manure tax (for farmers exceeding loss standards) and cost-effectiveness of acidification in the agricultural sector (compared with other sectors).

3. The linkage between social and the environment in the agricultural sector

Figure 4. **The environmental - social links**



Social conditions ⇒ environmental conditions (arrow G):

All kind of demographic aspects are very important. The agricultural sector is a very characteristic sector compared with other sectors: being a farmer is a way of life. The sector consists of a lot of medium and small enterprises, with only few large firms. The social cohesion is very high, e.g. environmental co-operation. The level of education is not very high. Environmental education is also not very high. Running a firm is becoming more and more complicated in recent times and new (environmental) policy is beyond the control of farmers. These and other social conditions determine the way driving forces cause environmental pressures. The social conditions effect the environmental pressure via economic driving forces.

Social policy ⇒ environmental conditions (arrow F):

Education, building a better image of the agricultural sector, rising environmental awareness, stimulating study-groups, implementation of quality-standards, etc. are instruments that influence the social conditions, which influence environmental pressures via driving forces. This is a rather indirect way of influencing the environmental pressures, state and impact.

The consequences of environment on social elements: some relevant issues.

Environmental conditions ⇒ social conditions (arrow H):

Organic farming rises the quality of life (social conditions of the farmer), less odour rises the quality of life of citizens, an environmental friendly farmer in the neighbourhood improves the perception of citizens towards farmers. Agro-tourism, organic farming and other ways of broadening farm-activities create new employment.

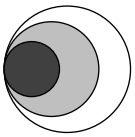
Environmental policy ⇒ social conditions (arrow E):

All kinds of environmental policy have influences on the social situation in the agricultural sector. For example the Reconstructuring Act forces some farmers to quit farming and look for other jobs. Farming is a way of life, the need to find another job therefore has severe social impact. Policies like rising the price of energy force entrepreneurs in the glass horticulture to raise their scale of production. This sometimes results in moving the firm to other regions in the Netherlands, with all kind of social consequences. Another example is permitting, which has caused a lot of agitation in the past.

PART F.
ENERGY/ENVIRONMENT INDICATORS

ENERGY-ENVIRONMENT INDICATORS

OECD OVERVIEW



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EXECUTIVE SUMMARY

Energy is essential to the economies of OECD countries and to the every day lives of their citizens. The structure of a country's energy supply and its energy intensity, along with changes over time are key determinants of environmental performance. The environmental impacts of energy activities vary with levels of total energy use and energy mix as well as with the structure of energy use by end use sector and related economic growth and structural changes. The integration of environmental concerns in energy policies has progressed in the 1980s and 1990s. However, it is recognised that the combination of institutional integration and of market based incentives has not been sufficient to reach some key objectives of sustainable development (e.g. climate change) and that a more integrated approach is required including the greater use of economic and societal instruments. In this context, the availability of meaningful indicators for the energy sector is essential to shed light on policy questions and monitor the effectiveness of policy intervention.

Since the Council of Ministers meeting of 1989 gave the OECD the mandate to better integrate environment and economic policies, the OECD has taken an active role in developing energy-environment indicators, in co-operation with the International Energy Agency (IEA). A first set of energy-environment indicators was published in 1993. In 1995, the IEA launched a project to further develop energy indicators at a more detailed level to help analyse energy end-use efficiencies and related CO2 emissions. Since then, the regular use of energy-environment indicators in OECD Environmental Performance Reviews and in other analytical work has provided useful feedback on their policy relevance and interpretation.

From this experience it was possible to designate a small list of core indicators that have proven their usefulness and that are available for most OECD countries. This responds to the increasing interest by Member countries in a reduced number of indicators selected from existing larger sets to capture key trends and draw attention to key issues of common concern.

CORE LIST OF OECD ENERGY-ENVIRONMENT INDICATORS

SECTORAL TRENDS OF ENVIRONMENTAL SIGNIFICANCE	Energy Intensities	◆ Total primary energy supply and intensities
	Energy Mix	◆ Total primary energy supply by source
	Energy Use	◆ Total final energy consumption by sector
INTERACTIONS WITH THE ENVIRONMENT	Air Pollution	◆ Energy related air emissions and intensities
	Water Pollution	◆ Oil released through accidents
	Waste	◆ Radioactive waste (spent fuel) from power generation
ECONOMIC AND POLICY ASPECTS	Expenditure	◆ Public and private PAC expenditure by energy sector
	Pricing And Taxation	◆ Energy prices and taxes
	Subsidies	◆ Subsidies to energy sector and energy users

This core list is expected to be supplemented as necessary i) to adapt to individual countries specific features and ii) to respond best to its specific uses. It is recognised that the interpretation of the indicators in context is essential.

The OECD has recently engaged in the development of social-environment indicators to complement its sets of economic-environment indicators. This work has been undertaken in recognition that, to date, insufficient attention has been dedicated to the social aspects of sustainable development. This paper briefly explores some of these aspects for the energy sector. It is hoped that it will spark a discussion at the conference aimed at identifying the key issues of the social-environment interface.

I. INTRODUCTION

The purpose of this paper is to review the development and use of indicators to measure progress towards sustainable development in the energy sector. It draws on work carried out in the 1990s by the OECD and the IEA on energy-environment relationships and related indicators and benefits from OECD experience in using indicators in environmental performance reviews. It i) examines the policy context and conceptual frameworks for indicators, ii) presents existing indicators and their use in OECD work and iii) identifies a small list of core indicators. It finally discusses selected social issues that are considered important for achieving sustainable development and that are not yet adequately covered in the indicator set.

II. POLICY CONTEXT

1. Importance and scope of sector

Energy is a major component of OECD economies, both as an essential factor input to most other economic activities (whether it be agriculture, industries or services, including transport) and as an industrial sector in itself. It is also essential to the everyday lives of citizens, heating their houses and supplying power for most domestic services as well as providing them with the capacity to travel.

The energy sector refers to the extraction, conversion, transport and consumption of energy and the disposal of energy wastes; it encompasses coal and other solid fuels, oil, gas, nuclear power, hydropower and other renewable energies (e.g. solar, wind, geothermal, biomass and tidal energies) and their conversion products such as electricity.

Energy is also a fundamental part of the globalisation process. Energy markets have become more diversified and increasingly transparent. Energy is treated more and more as a service best delivered through competitive markets. As a result, the sector is undergoing significant structural changes in OECD countries (e.g. deregulation, privatisation, mergers).

A country's energy intensity and supply structure along with changes over time, are key determinants of environmental performance and sustainability of economic development. Future developments in this sector will thus be central to the achievement of environmental and sustainable development goals.

1.1 Environmental impacts

Energy production and use can affect the environment in many ways. The environmental impact of energy activities varies with levels of total energy use and with the energy mix i.e. composition of energy use by energy source (fossil fuels, nuclear, hydro, etc). The use of cleaner fuels and technologies may reduce these impacts. It also depends on the structure of energy use by end-uses, as well as on economic growth and related structural changes. While climate change is at the top of the political agenda, it is recognised that the environmental impacts of the energy sector are broader than climate change in the same way as climate change not only depends on energy use but also on other activities e.g. agriculture, forestry. They include:

- traditional local or regional air pollution related to the combustion of fossil fuels (e.g. urban smog, acid rain, indoor air pollution) and related damages (e.g. health and ecological damages);

- global air pollution related to the emission of greenhouse gases such as CO2 and CH4 generated by fossil fuel production, transport and use. Discussions on the contribution of the energy sector to greenhouse gas emissions has further added to the local and regional concerns for the health and ecological damages relating to energy;
- land use for a range of energy activities and notably for mining and for hydroelectric resevoirs;
- risks relating to the various stages of the nuclear fuel cycle, including those connected with the transport and disposal of radioactive materials and with accidental releases of radioactivity;
- risks relating to the extraction, transport and use of fossil fuels (e.g. mining accidents, fires, explosions, spills, etc).

1.2 Sectoral trends of environmental significance

Energy intensities and efficiencies

Energy demand is influenced by a number of factors including both the growth and structure of economic activity and of the energy sector (energy efficiency, energy mix, national and international energy prices, markets and technological changes). Factors such as climatic conditions, household structures and consumption levels also play a role alongside regulatory and fiscal policies and energy conservation.

Over the last 25 years, OECD Member countries have been successful in reducing the amount of energy needed to provide goods and services. Improvements in energy intensity (energy per GDP) were mainly triggered by the two oil shocks in 1973-1975 and 1979/1980. During this period, the production and use of energy adapted to the changes in energy prices and many governments instituted a range of programmes to improve energy efficiencies and energy conservation. As a result, in a number of countries, growth in energy demand was strongly decoupled from GDP growth in 1974-75 and in 1980-82. In more recent years, however, improvements in energy use per unit of output have been small.

Energy mix

The environmental impacts of energy production and use vary greatly according to the mix of different energy sources thereby making environmental assessment of fuel choice complex. Fossil fuels produce a wide range of environmentally harmful side effects of a regional and global nature whereas the environmental impacts of renewable energy are generally more site specific and local in nature (e.g. effects on land use). Shifts from coal and oil to gas and nuclear are often considered environmentally positive from the perspective of air pollution. However, they can also present environmental challenges of their own (e.g. accidents in coal mines, oil spills, nuclear waste disposal concerns).

End-uses

The underlying trends of total final energy consumption differ greatly according to the end use sector and the efficiency of its energy use. It is, therefore, necessary to understand the specific features and trends of each sector to ensure policy measures are relevant and appropriately targeted.

In terms of final energy consumption, transport has been the most quickly growing sector. This is due primarily to passenger cars and freight transport, and to a lesser extent to sea and air travel. The commercial and residential sectors have also contributed strongly to growth in energy use. In contrast, final energy consumption in the industrial sector in the OECD as a whole has fallen slightly. This is mainly a result of energy efficiency improvements of industrial processes, but also of declines in the share of GDP deriving from highly energy intensive industries in selected larger economies.

Electricity use share of total final energy consumption has increased over the past 25 years which has implications for the growth in total energy supply and resulting environmental impacts. This is partly the result of increased use of electric appliances and equipment in the residential and commercial sectors.

2. Policy integration

Economic forces and structural changes in major economic sectors, including energy, are closely linked to environmental conditions and trends and can thus enhance or counteract the benefits of environmental policies and technological progress. The integration of environmental concerns into energy decision making is therefore a key to improving environmental performance and moving towards sustainable development in the energy sector, as well as to cost effectiveness in response to environmental challenges. It cannot be limited to the development or improvement of a few technologies but will require a more holistic approach including greater use of economic and societal instruments and better integration of decision making in relevant policy areas including physical planning, transport and industrial sectors.

2.1 Government policy measures

Government policy measures in the energy sector include a variety of information programmes, voluntary agreements with industry, laws and regulations (for energy efficiency, monopoly enterprises, and parts of grid based energy services), direct economic incentives, pricing and taxation, support for research and development, safety and environmental protection.

During the 1970's and 1980's, the regulatory and fiscal context established by OECD governments and other countries had major impacts on energy markets. More recently, there has been increasing attention to the potential benefits arising from the use of market based incentives and many OECD countries have undertaken programmes of market reform and liberalisation in the energy sector, especially in relation to electricity and gas. This has introduced competition through the supply chain and third party access to key energy infrastructure. This reform process may affect the level of energy prices, related energy use and mix. It may lead to greater penetration of gas, reductions in overcapacity and introduction of innovations.

Due to its scope and size, the energy sector has also been a key focus of environmental and sustainable development policies particularly in relation to air pollution and climate change. Policy measures aim at controlling emissions, accidents relating to oil transportation, nuclear safety and waste management, and improving the environmental performance of power plants. Generally a mix of instruments (e.g. regulatory, economics, voluntary and information instruments) is used.

2.2 Energy prices and taxes

Energy prices play a major role in determining energy use and influence fuel and technology choices. They should internalise as far as possible certain externalities such as the environmental costs of energy production and use. In other terms they should reflect the polluters pays principle to which Member countries have subscribed. Privatisation and increased competition contribute to relating price-signals more closely to underlying costs and to closer scrutiny of subsidies.

All OECD countries apply energy taxes or levies to a certain extent, primarily for fiscal reasons. Taxation can also influence consumer behaviour. Tax differentials on energy products are perhaps most noticeable in the transport sector (e.g. between gasoline and diesel). Primarily as a result of concern about climate change and in recognition of the relations between prices and energy demand, a number of OECD countries have also increased existing taxes on certain forms of energy and introduced environmental taxes such as carbon taxes aimed at reducing energy use and

emissions. Irrespective of their purpose, taxes in general influence overall energy demand and the fuel mix, which in turn affects environmental pressures caused by energy activities.

3. The role of sustainable development indicators

Energy plays an important role in a country's environmental performance and the sustainability of its development. Sustainable development of the energy sector depends on finding ways of meeting energy demand needs that are environmentally sound, socially equitable, and economically viable. In this context the availability of meaningful data and indicators is essential for identifying and monitoring key policy decisions and for keeping track of progress towards environmental and sustainable development goals.

III. OECD WORK ON ENERGY-ENVIRONMENT INDICATORS

1. Background and mandate

The OECD and the IEA have been active in the field of energy and the environment since the early 1970s. In 1989, the OECD Council meeting at Ministerial level called for a next generation work programme on environmental economics, to integrate environment and economic decision making more systematically and effectively. With this mandate, the OECD has taken a leading role in this domain, in close co-operation with the International Energy Agency (IEA). The commitment of OECD and IEA Member countries to policy integration and sustainable development has been reiterated at several occasions:

- In 1993, IEA Ministers adopted a new set of "Shared Goals" which summarise IEA Members' overall approach to energy policy. The Shared Goals expressly refer to sustainable development; six of the nine stated goals deal directly with the environment, efficiency and clean technology dimensions of energy. In 1994, 1995 and 1999, IEA Ministers reaffirmed the aim to create a policy framework consistent with the IEA Shared Goals and to achieve the balance reflected in those Goals between energy security, sustainable economic development and environmental protection. (Annex B)
- OECD Environment ministers at their meeting in Paris (2-3 April 1998) agreed on a number of "Shared Goals for Action" as an expression of their commitment to sustainable development. These included "…promoting an integrated policy approach which encourages coherence among economic, environmental and social policies, by associating Ministerial colleagues in other key policy sectors, such as transport, energy, industry, trade, tourism, agriculture, fisheries and freshwater management, in integrating the environmental dimension into sectoral policies…".

In recent years, concerns over the contribution of energy activities to greenhouse gas emissions have further added to the demand for work on energy and the environment. The UN Framework Convention on Climate Change and subsequent agreements call for effective actions to reduce or stabilise greenhouse gas emissions, which have profound implications for energy markets, and policies. During the 1990's the OECD, therefore, has worked on a range of energy related climate change issues in close co-operation with the IEA.

2. Results to date

2.1 The OECD set of indicators for the integration of environment concerns into energy policies

The OECD has been developing indicators to better integrate environmental concerns into energy policies[1] since 1989. This work led to the identification of an initial set of energy-environment indicators in 1990 in consultation with the IEA. It was first published in 1993[2], and energy-environment indicators were thereafter regularly featured in OECD publications on environmental indicators. The data used to calculate OECD indicators stem from regular OECD and IEA publications (e.g. OECD Environmental Data-Compendium 1999, IEA Energy balances) and from other international sources. In 1995, the IEA launched a project to further develop sets of "energy indicators" at a more detailed level[3].

2.2 Purpose

The main purpose of OECD energy-environment indicators is to provide a basis for monitoring the integration of environmental concerns into energy policies and to identify how different driving forces and policy instruments interact and affect the environmental impacts of energy activities. Particular attention is given to the national level and to indicators to be used in an international context. The indicators are not designed to provide a full picture of energy-environment relationships, but rather to draw attention to selected issues that require further analyses. They need to be supplemented with additional information and interpreted in context to acquire their full meaning and to capture more specific linkages between energy use and human activities.

The main purpose of the IEA energy indicators is to show, at a more detailed level, how economic and human driving factors shape energy use and ultimately CO2 emissions. Particular attention is therefore given to disaggregated indicators and to specific energy end-use patterns and efficiencies. These indicators supplement the OECD set of macro-level indicators and are designed to be used in energy and climate change policies.

2.3 Use

These indicators are regularly used in OECD environmental performance reviews, in IEA energy policy reviews and in other analytical work. In practice, the indicators have proven to be essential for monitoring the sectoral energy-environment interface and the integration of economic and environmental decision-making. The continuous use of energy-environment indicators in OECD environmental performance reviews of Member countries, has also helped to further amend and refine the indicators to improve their policy relevance and measurability.

2.4 Links with other international initiatives

The OECD's work on energy-environment indicators has been, and will continue to be, co-ordinated with other international indicator initiatives such as the development of sectoral indicators by the European Commission following the conclusions of the Cardiff and Vienna Summits and work carried out on sustainable development indicators by the UN Commission on Sustainable Development.

1. This work is part of a broader work programme on sectoral indicators which covers the energy, transport and agricultural sectors.
2. Indicators for the integration of environmental concerns into energy policies, OECD, Paris, 1993. An updated version of this monograph is being prepared.
3. Indicators of Energy Use and Efficiency, The Link between Energy and Human Activity.

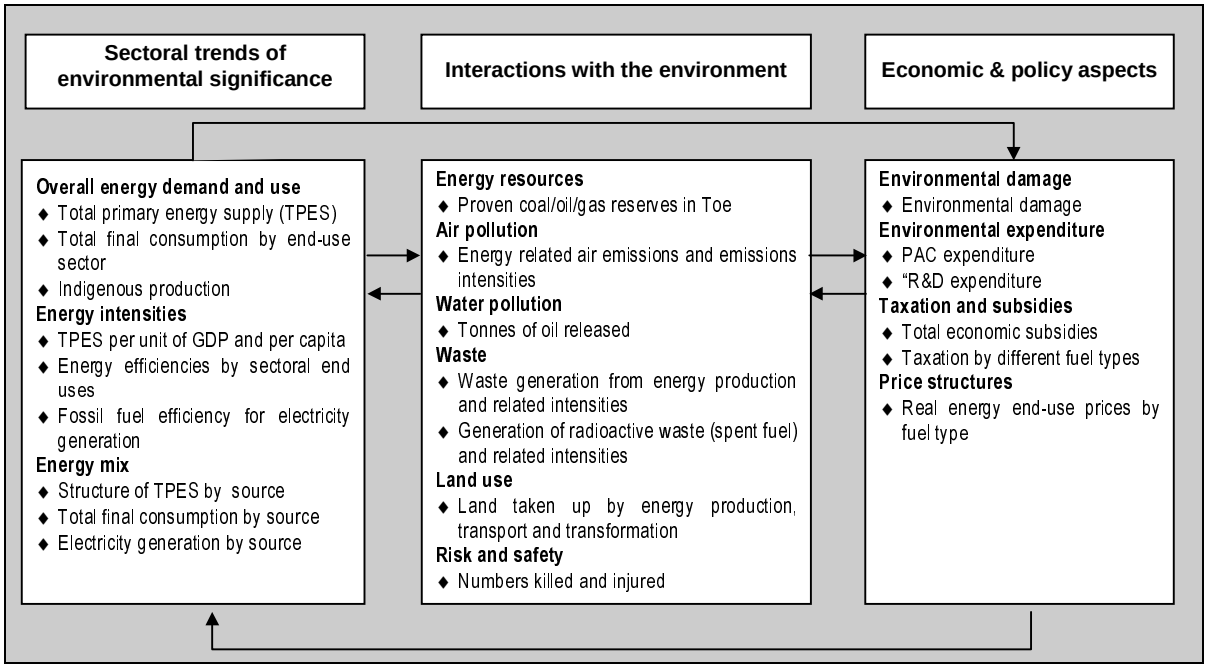
The IEA's work on energy indicators is closely co-ordinated with a similar initiative under the European Union Save programme and related national initiatives.

2.5 Framework

The framework used for developing energy-environment indicators is that adopted for all OECD work on sectoral indicators. It is based on an adjusted pressure-state-response (PSR) model taking into account the specificities of the various sectors (Inset 1). The indicators are structured around three themes:

- energy trends and patterns of environmental significance (i.e. indirect pressures and/or related driving forces);
- interactions between energy and the environment (direct pressures, and resulting environmental or social conditions);
- economic and policy aspects of the energy and environment interface (e.g. environmental damage, environmental expenditure, economic and fiscal instruments, trade aspects).

Figure 1. **OECD energy-environment indicators-overall framework**



3. Core indicators

Over the past decade, the OECD has accumulated experience not only in developing and measuring energy-environment indicators, but also in using these indicators in policy analysis and evaluation. From this experience it is possible to designate a small list of core indicators that have proven their relevance and usefulness in OECD work and that are presently available for a majority of OECD countries. This responds to the increasing interest by Member countries in a reduced number of indicators selected from existing larger sets.

This "core list" of indicators will serve as a minimum set capturing key trends and drawing attention to selected key issues of common concern to OECD countries. It could thus provide a building block for a small set of sustainable development indicators for use in the OECD's work. The list is expected to be adapted to the country's specific situation and to specific uses, and to be supplemented with additional information and indicators whenever necessary. As for all indicators, it is important to recognise that they are only one tool and that their interpretation in context is essential.

Nine indicators have been selected, three reflecting sectoral trends of environmental significance, three reflecting environmental impacts, and three reflecting key economic and policy aspects (Table 1). These indicators should show the most recent situation as well as trends over longer time periods, at least 10-20 years, to reflect investment timeframes.

Table 1. **Core list of OECD energy-environment indicators***

SECTORAL TRENDS OF ENVIRONMENTAL SIGNIFICANCE	Energy Intensities	◆ Total primary energy supply and intensities
	Energy Mix	◆ Total primary energy supply by source
	Energy Use	◆ Total final energy consumption by sector
INTERACTIONS WITH THE ENVIRONMENT	Air Pollution	◆ Energy related air emissions and intensities
	Water Pollution	◆ Oil released through accidents
	Waste	◆ Radioactive waste (spent fuel) from power generation
ECONOMIC AND POLICY ASPECTS	Expenditure	◆ Public and private PAC expenditure by energy sector
	Pricing And Taxation	◆ Energy prices and taxes
	Subsidies	◆ Subsidies to energy sector and energy users

** based on "Indicators for the integration of environmental concerns into energy policies", OECD, 1993 and 2000 (forthcoming)*

3.1 Sectoral trends of environmental significance

The structure of a country's energy supply and the intensity of its energy use, along with changes over time, are key determinants of environmental performance and sustainability of economic development.

Energy intensities and efficiencies: Total primary energy supply and intensities

Energy intensity represents the structure of an economy both in economic and energy terms. In particular, indicators describing energy intensities, expressed as energy supply per unit of GDP and per capita, reflect, at least partly, changes in energy efficiency.

The interpretation of energy intensity ratios, however, needs to i) take into account differences in countries' specific contexts (socio-economic structures, climatic conditions, technological development, etc.) to examine whether trends are sustained over a long time period, and ii) consider additional information and indicators including indicators on energy efficiencies in end-use sectors, such as those being developed by the IEA.

Energy mix: Total primary energy supply by source

Structural changes in the energy supply mix have a major effect on environmental performance as environmental effects differ greatly from one source of energy to another.

The supply structure varies considerably among countries. It is influenced by demand from industry, transport and households, by national energy policies and by national and international energy prices. Indicators describing the energy mix, i.e. the structure of energy supply, in terms of primary energy source as a percentage of total energy supply, and changes over time are closely related to consumption and production patterns and to environmental effects.

Energy use: Total final energy consumption by sector

The overall improvement in pollution levels from reduced energy consumption is not necessarily directly proportional to the reduction in energy use. However, other things being equal (mix of energy sources, etc.), reduced total energy use can generally be expected to alleviate environmental pressures at all stages of the fuel cycle (production, transport and use). An indicator on the structural changes of total final energy consumption in sectors such as transport, housing, agriculture, industry and services helps assess the cost effectiveness of policy measures concerning energy end-use and to highlight differences between stationary and non-stationary trends in energy consumption. When carrying out more detailed assessments, this indicator should be complemented with more specific indicators on sectoral intensities (e.g. energy per value added in the manufacturing sector, energy per capita in the residential sector).

3.2 Interactions with the environment

Energy production and use have environmental effects that differ greatly by energy source. Fuel combustion is the main source of local and regional air pollution and greenhouse gas emissions; other effects involve water quality, land use, risks related to the nuclear fuel cycle and risks related to the extraction, transport and use of fossil fuels.

Air pollution: Energy related air emissions and intensities

Energy related air pollution affects the environment at local, regional and global levels. Fossil fuel production, transport and use are important sources of air pollutant emissions such as SO_x, particulates, NO_x, VOC and CO2. Several of these pollutants are responsible for health impacts particularly for urban populations. Carbon dioxide, which is predominantly emitted from fossil fuel combustion, is an important contributor to the greenhouse effect and plays an important role in countries' progress towards achieving their commitments under the Climate Change Convention.

Water pollution: Oil released through accidents

The release of oil products into fresh and sea water, as well as the salted and acid drainage from coal mines are important environmental problems associated with energy production.

Waste: Radioactive waste (spent fuel) from power generation

The actual or potential environmental effects of nuclear energy differ from those of fossil fuel generation. Whereas nuclear energy is clean in terms of air pollution it entails risks of accidental releases of radioactivity and the need to manage the storage of radioactive waste. Spent fuel arisings are one part of the radioactive waste generated at various stages of the nuclear fuel cycle. Radioactive waste also arises from decontamination and decommissioning of nuclear facilities, and from other activities. The impact of nuclear waste on humans and the environment depends on the level of radioactivity and on the conditions under which the waste is managed. Therefore, for more detailed analysis, it may be necessary to consider indicators broken down by the level of radioactivity.

3.3 Economic and policy aspect

Expenditure: Public and private PAC expenditure by energy sector (on air)

Efforts to reduce environmental pressures imply public and private expenditure to finance pollution abatement and control at national level. Levels of pollution abatement and control (PAC) expenditure give a general indication of how much the energy sector spends on controlling and reducing pressures from pollution or nuisances. This expenditure can be further disaggregated by medium (air, water, waste) and by the sector undertaking the measures (public sector, businesses, households).

Pricing and taxation: Energy prices and taxes

Pricing and taxation are key variables for the energy sector. Price signals play a key role in determining the ability to achieve an efficient allocation of energy resources, including by internalising environmental costs. Energy end-use prices influence overall energy demand levels and fuel mix, which in turn largely determine environmental pressures caused by energy activities. Though price elasticities vary considerably by end-use sector, historical and cross-country experience suggests that the overall price effect on energy demand is strong and that increases in energy prices have reduced energy use and hence its environmental impact. Energy taxation, until recently has been developed primarily to raise revenue and promote reduced energy dependence. However, the use of taxation to influence energy consumer behaviour and to internalise environmental costs is increasing.

Subsidies: Subsidies to energy sector and energy users

Energy is among the most subsidised sectors in the OECD. The bulk of the subsidies are to support the nuclear, coal and oil sectors as well as a number of energy intensive industries. Results from OECD case studies found that reform of support measures in the energy sector could reduce CO2 emissions (potentially significantly) and lead to reductions in other environmentally damaging emissions. Subsidies to specific fuels and energy use can promote sustainable energy development in the short term for example in renewable energy fuels. However, this may lead to market distortions, and divergences from an economically efficient energy supply level and mix.

IV. SOCIAL ASPECTS OF SUSTAINABLE DEVELOPMENT OF THE SECTOR

The development of a set of indicators of sustainable development for use in the energy sector requires complementing the existing set of indicators which focus on environmental and economic aspects with indicators that more directly reflect the social aspects of sustainable development.

Section 2 presented the principal environmental and economic indicators that the OECD currently uses for analysis of the energy-environment interface. This section explores the scope of social issues, in particular, the interactions between the social and environmental dimensions of sustainable development. Broader social issues are not considered in detail, in this section, as further exploratory work is required in this area. It is however recognised that these issues are important in terms of the energy sector and should therefore be further developed to ensure that the social element of sustainable development is fully covered.

Energy activities and related environmental effects interact in many ways with social aspects. On the one hand, a number of social factors act as driving forces behind energy trends and patterns (e.g. household consumption patterns, mobility, disposable income levels and distribution, socio-demographic changes such as the average size of households). On the other hand energy activities play an important role in the daily lives of citizens, by heating their houses and supplying power for most domestic services (household appliances and other electrical goods) and providing them with the capacity to travel to their workplace on business and to pursue holiday activities. There are, however, negative social side effects related to the energy sector. These effects and related external costs are often unevenly distributed among population groups and are not sufficiently addressed by energy policies. Energy and environmental policies may also have social implications which are unevenly distributed among population and income groups.

Six categories that contribute to the description of the social/environment interface of sustainable development have been identified (Table 2). For some categories, such as health, some indicators are

already in use. However, on the whole, development of indicators to reflect the social/environment interface is still at a preliminary stage and requires further discussion.

Table 2. **Preliminary list of social-environment-energy issues**

Health	◆ Exposure to emissions (air) ◆ Accidents (fatalities and injuries) ◆ Safety at work
Employment	◆ Employment in the energy sector (e.g. coal, nuclear, oil) ◆ Working conditions and hours ◆ Unions ◆ Quality of jobs ◆ Employment effects (direct, indirect, net)
Demographic aspects	◆ Demand for energy (relate to population and household growth and structure, consumption patterns, household energy efficiency)
Poverty and socio-economic inequity	◆ Affordability of different energy sources ◆ Environmental justice. Proportion of poor living near energy facilities.
Environmental democracy	◆ Access to environmental information ◆ Public participation in energy sector decision making ◆ Choice of energy services and products ◆ Access to energy services
Environmental awareness and education	◆ Environmental education and training ◆ Consumer use of energy saving products ◆ Influence on consumer actions

The social aspects of sustainable energy should be addressed more fully in future work, an effort that will require identification and prioritisation of key issues. This section briefly explores some issues at the social-environment interface of the energy sector but in order to give proper consideration to such issues, it will be necessary to develop appropriate indicators.

Inset 1. **OECD work on environmental indicators**

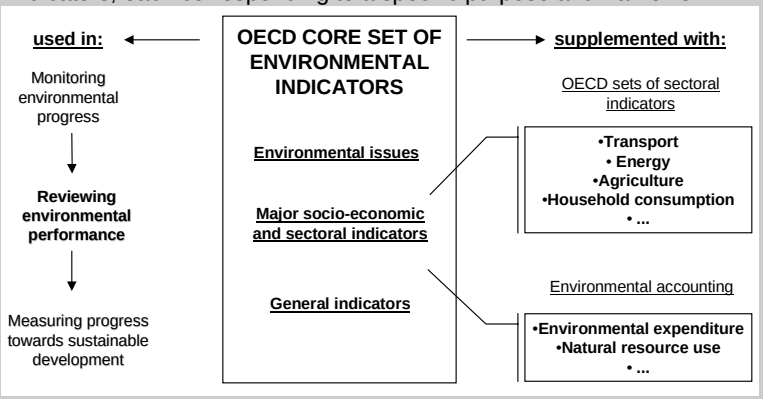
Environmental indicators have been part of the OECD's work on environmental information and reporting since the late 1970s. A specific programme on environmental indicators using a harmonised approach was initiated in the early 1990s, responding to the request of G7 summits (Paris, Houston, and London) and the OECD Council. In 1991, the OECD Council Recommendation on Environmental Indicators and Information called for further development of reliable, readable, measurable and policy-relevant environmental indicators to better measure environmental performance and better integrate environmental concerns into sectoral policies. In 1998, the OECD Council Recommendation on Environmental Information asked OECD countries to further develop and use indicators to measure environmental performance, and to establish indicators of progress concerning the implementation of national and sub-national policies on the environment, eco-efficiency and sustainable development.

The OECD environmental indicators programme recognises that there is no universal set of indicators; rather, several sets exist, corresponding to specific purposes. Indicators can be used at international and national levels in state of the environment reporting, measurement of environmental performance and reporting on progress towards sustainable development. They can further be used at national level in planning, clarifying policy objectives and setting priorities. The OECD work focuses principally on indicators to be used in national, international and global decision making, yet the approach may also be used to develop indicators at sub-national level.

SEVERAL TYPES OF INDICATORS

The OECD work includes several types of indicators, each corresponding to a specific purpose and framework:

- the OECD Core Set of environmental indicators, to keep track of environmental progress;
- several sets of sectoral indicators, to promote integration of environmental concerns into sectoral policy making;
- indicators derived from environmental accounting, to promote integration of environmental concerns into economic policies and sustainable use and management of natural resources.



All these indicator sets are closely related to each other, the OECD Core Set being a synthesis and representing a minimum set of indicators common to OECD countries and common to different uses and purposes.

APPROACH AND RESULTS

In developing harmonised international environmental indicators, OECD countries adopted a pragmatic approach, which led to:

- agreement on a common conceptual framework, based on a common understanding of concepts and definitions and on the pressure-state-response (PSR) model;
- identification of criteria to help in selecting indicators and validating their choice: all indicators are reviewed according to their policy relevance and utility for users, analytical soundness and measurability;
- identification, definition, measurement, publication and use of the indicators;
- provision of guidance on how to use the indicators (stressing that indicators are only one tool and have to be interpreted in context).

The results of this work, and in particular its conceptual framework, have in turn influenced similar activities by a number of countries and other international organisations.

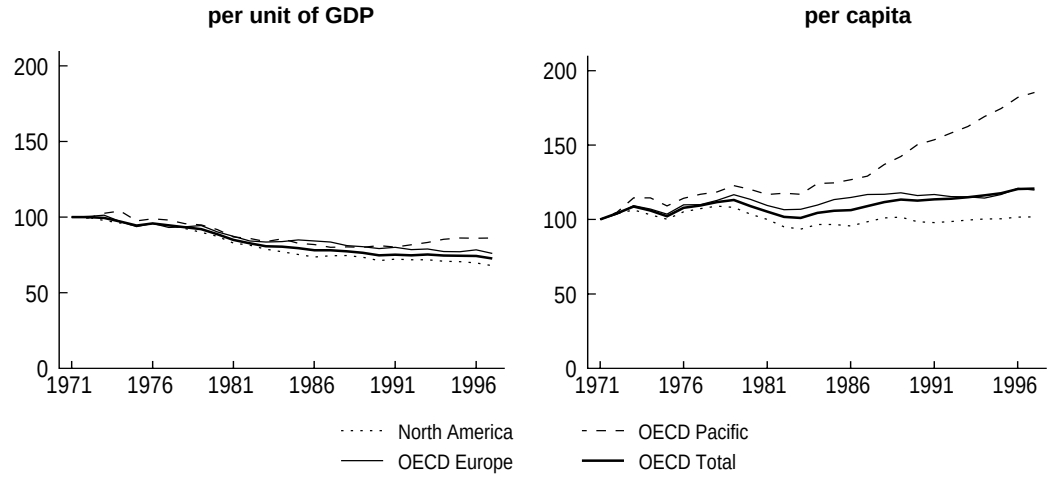
USES

The OECD's environmental indicators are regularly used in environmental performance reviews and in other analytical and evaluative work. This creates a synergy in which feedback is provided on the indicators' policy relevance, analytical soundness and measurability. Beyond these applications, they also provide building blocks for sustainable development indicators.

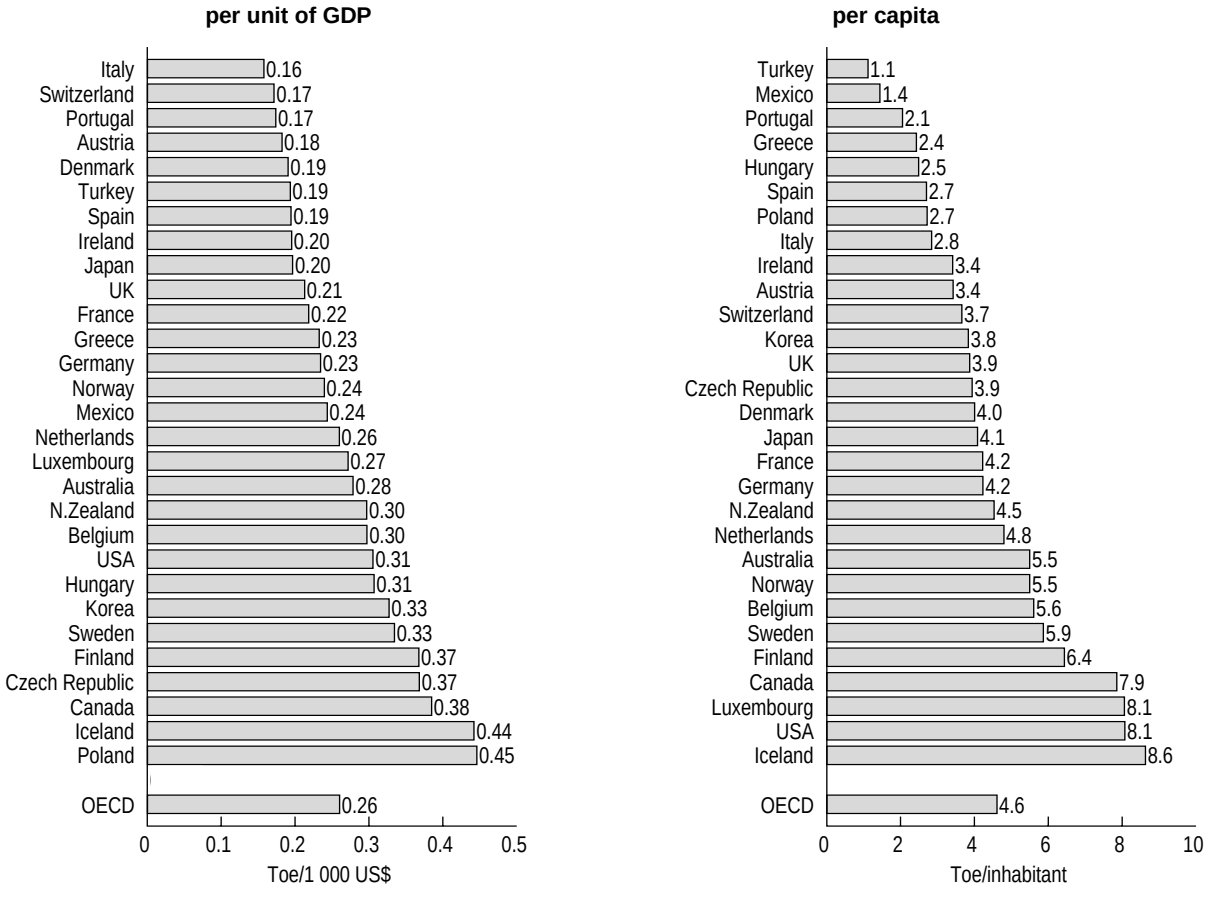
ANNEXES

A. MEASURED INDICATORS-SELECTED EXAMPLES

Energy Supply Intensities, trends since the 1970s



Energy Supply Intensities, state, 1997



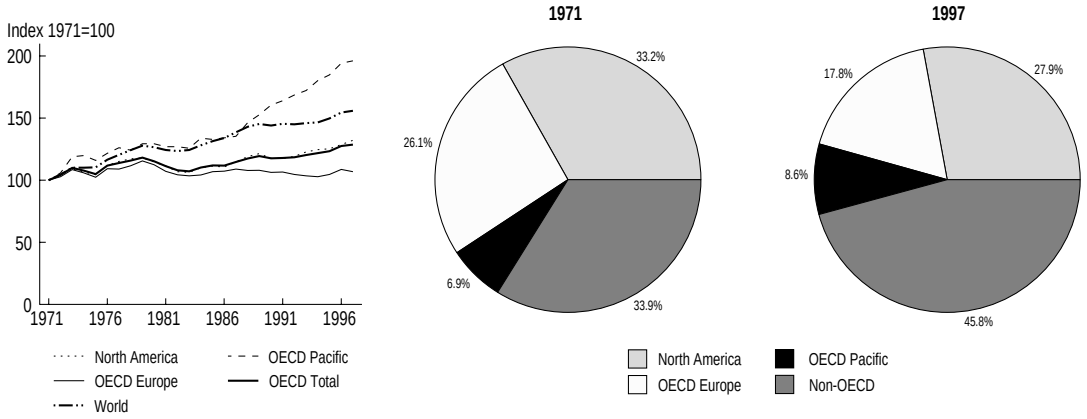
Energy Supply Intensities, state and changes

	Total Primary Energy Supply			Intensity per unit of GDP (a)			Intensity per capita		
	(Mtoe)	Change (%)		(Toe/1 000 US$)	Change (%)		(Toe/capita)	Change (%)	
	1997	1970-80	1980-97	1997	1970-80	1980-97	1997	1970-80	1980-97
Canada	238.0	38.4	23.3	0.38	-9.1	-18.2	7.9	19.8	0.1
Mexico	141.5	116.9	43.1	0.24	14.5	2.8	1.4	59.4	1.5
USA	2162.2	16.3	19.3	0.31	-14.4	-24.2	8.1	4.7	1.5
Japan	514.9	34.7	48.6	0.20	-12.7	-12.3	4.1	19.6	37.6
Korea	176.4	112.1	303.0	0.33	2.1	7.2	3.8	79.4	234.4
Australia	101.6	37.1	44.4	0.28	0.2	-16.3	5.5	19.6	14.8
New Zealand	16.7	28.0	80.3	0.30	9.7	19.2	4.5	14.8	54.1
Austria	27.8	28.1	18.4	0.18	-10.3	-17.8	3.4	26.7	10.1
Belgium	57.1	14.6	23.9	0.30	-17.8	-7.5	5.6	12.3	19.8
Czech Rep.	40.6	2.6	-13.5	0.37	..	..	3.9	-2.6	-13.3
Denmark	21.1	-2.7	7.0	0.19	-22.0	-26.8	4.0	-6.3	3.9
Finland	33.1	40.6	30.1	0.37	0.2	-10.0	6.4	35.5	21.0
France	247.5	29.3	30.2	0.22	-6.6	-6.0	4.2	21.8	19.7
Germany	347.3	18.4	-3.7	0.23	-9.5	-37.6	4.2	17.5	-8.1
Greece	25.6	97.2	60.1	0.23	24.5	21.5	2.4	79.8	46.9
Hungary	25.3	46.0	-12.4	0.31	..	..	2.5	40.9	-7.8
Iceland	2.3	59.0	58.6	0.44	-14.0	5.2	8.6	43.0	33.9
Ireland	12.5	35.6	47.2	0.20	-14.6	-33.1	3.4	17.6	36.8
Italy	163.3	25.7	17.8	0.16	-11.5	-12.7	2.8	19.9	15.6
Luxembourg	3.4	-12.1	-6.8	0.27	-32.0	-57.1	8.1	-18.2	-19.2
Netherlands	74.9	31.9	15.2	0.26	-1.1	-21.7	4.8	21.6	4.5
Norway	24.2	36.3	28.7	0.24	-14.2	-22.5	5.5	29.4	19.4
Poland	105.2	47.6	-15.7	0.45	..	..	2.7	35.0	-22.4
Portugal	20.4	71.9	98.2	0.17	8.2	27.4	2.1	51.6	95.9
Spain	107.3	78.8	56.5	0.19	26.4	2.7	2.7	62.0	47.4
Sweden	51.9	8.0	26.7	0.33	-10.8	-1.6	5.9	4.5	19.0
Switzerland	26.2	26.6	25.7	0.17	4.8	1.2	3.7	24.2	12.1
Turkey	71.3	72.0	127.6	0.19	15.5	1.6	1.1	37.8	58.8
UK	228.0	-2.9	13.3	0.21	-19.8	-24.5	3.9	-4.1	8.4
N America	2541.7	20.7	20.8	0.31	-13.8	-22.3	6.4	4.1	-1.8
OECD Pacif.	809.6	39.7	72.3	0.23	-9.4	-6.7	4.2	22.6	53.2
OECD Eur.	1716.3	22.7	15.1	0.23	-8.9	-26.4	3.4	15.3	5.6
EU-15	1421.2	19.9	16.7	0.22	-10.8	-19.7	3.8	14.8	10.7
OECD	5067.5	23.4	24.7	0.26	-11.8	-22.4	4.6	11.4	9.1
World	9521.5	34.3	33.0	..	..	..	1.6	11.8	1.4

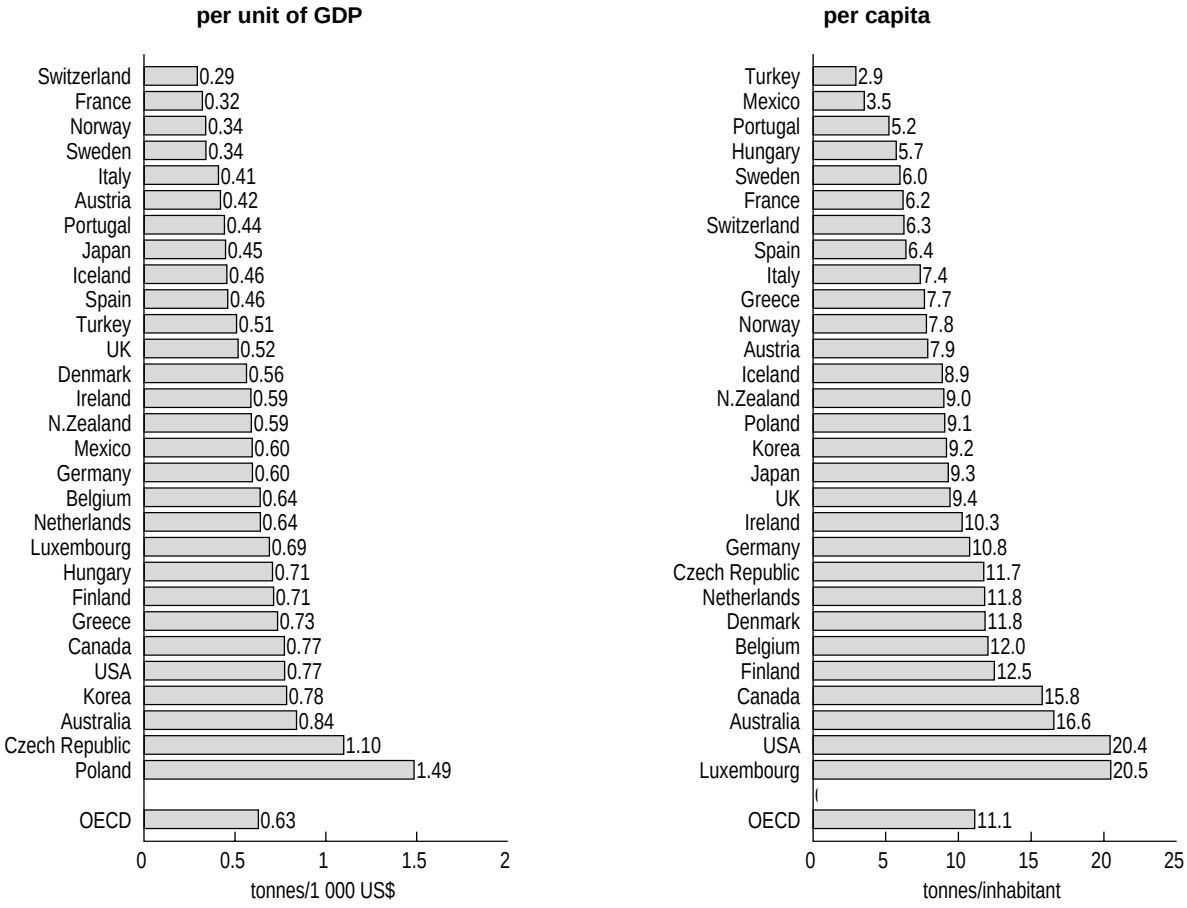
Notes:
a) Includes electricity trade.
b) GDP at 1991 prices and purchasing power parities.

Source: IEA-OECD.

Air Pollution, CO2 emissions from energy use, trends and structure by OECD region



Air Pollution, CO2 emission intensities, state, 1997



Air Pollution, CO2 emissions from energy use, trends and intensities

	Total Emissions			Intensity per unit of GDP (a)			Intensity per capita		
	(Mt)	Change (%)		(tonnes/1000US$)	Change (%)		(tonnescap.)	Change (%)	
	1997	1970-80	1980-97	1997	1970-80	1980-97	1997	1970-80	1980-97
Canada	477	27.0	11.0	0.77	-16.6	-26.4	15.8	9.9	-9.8
Mexico	346	141.3	39.2	0.60	27.3	0.0	3.5	77.2	-1.3
USA	5470	12.4	14.3	0.77	-17.3	-27.4	20.4	1.2	-2.8
Japan	1173	23.6	27.9	0.45	-19.9	-24.5	9.3	9.7	18.4
Korea	422	136.8	237.0	0.78	13.9	-10.4	9.2	100.2	179.6
Australia	306	36.5	42.8	0.84	-0.3	-17.3	16.6	19.0	13.5
New Zealand	33	15.2	83.3	0.59	-1.3	21.2	9.0	3.3	56.7
Austria	64	18.5	8.2	0.42	-17.0	-24.9	7.9	17.2	0.6
Belgium	123	1.9	-3.5	0.64	-26.8	-27.9	12.0	-0.1	-6.7
Czech Rep.	121	-2.5	-26.8	1.10	..	..	11.7	-7.4	-26.6
Denmark	62	-0.5	-0.2	0.56	-20.2	-31.7	11.8	-4.2	-3.0
Finland	64	46.9	7.3	0.71	4.7	-25.8	12.5	41.6	-0.2
France	363	13.3	-25.2	0.32	-18.2	-46.0	6.2	6.7	-31.2
Germany	884	8.2	-18.4	0.60	-17.2	-47.1	10.8	7.4	-22.1
Greece	81	109.2	66.7	0.73	32.1	26.5	7.7	90.8	52.9
Hungary	58	39.1	-28.1	0.71	..	..	5.7	34.3	-24.4
Iceland	2	18.2	25.7	0.46	-36.1	-16.6	8.9	6.3	6.1
Ireland	38	29.4	38.9	0.59	-18.5	-36.9	10.3	12.2	29.0
Italy	424	28.0	13.4	0.41	-9.9	-16.0	7.4	22.1	11.2
Luxembourg	9	-22.8	-29.4	0.69	-40.2	-67.5	20.5	-28.1	-38.8
Netherlands	184	20.3	17.2	0.64	-9.8	-20.4	11.8	10.8	6.2
Norway	34	14.4	14.7	0.34	-28.0	-31.0	7.8	8.6	6.4
Poland	350	41.1	-20.8	1.49	..	..	9.1	29.0	-27.1
Portugal	52	81.1	103.7	0.44	14.0	30.9	5.2	59.8	101.3
Spain	254	75.8	30.5	0.46	24.3	-14.4	6.4	59.3	22.9
Sweden	53	-21.8	-27.6	0.34	-35.4	-43.7	6.0	-24.3	-32.0
Switzerland	45	5.3	6.0	0.29	-12.8	-14.6	6.3	3.4	-5.4
Turkey	187	87.6	156.6	0.51	26.0	14.6	2.9	50.3	79.1
UK	555	-8.7	-6.5	0.52	-24.6	-37.6	9.4	-9.8	-10.5
N. America	6294	16.2	15.2	0.76	-17.0	-26.0	15.9	0.2	-6.4
OECD Pacif.	1934	31.7	51.7	0.54	-14.5	-17.8	10.0	15.6	34.9
OECD Eur.	4007	13.8	-5.0	0.53	-15.5	-39.3	7.9	7.0	-12.8
EU-15	3209	10.6	-5.1	0.49	-17.7	-34.7	8.6	5.9	-10.0
OECD	12235	16.9	11.7	0.63	-16.5	-30.5	11.1	5.5	-2.3
World	22784	26.5	22.1	..	..	..	3.9	5.3	-6.9

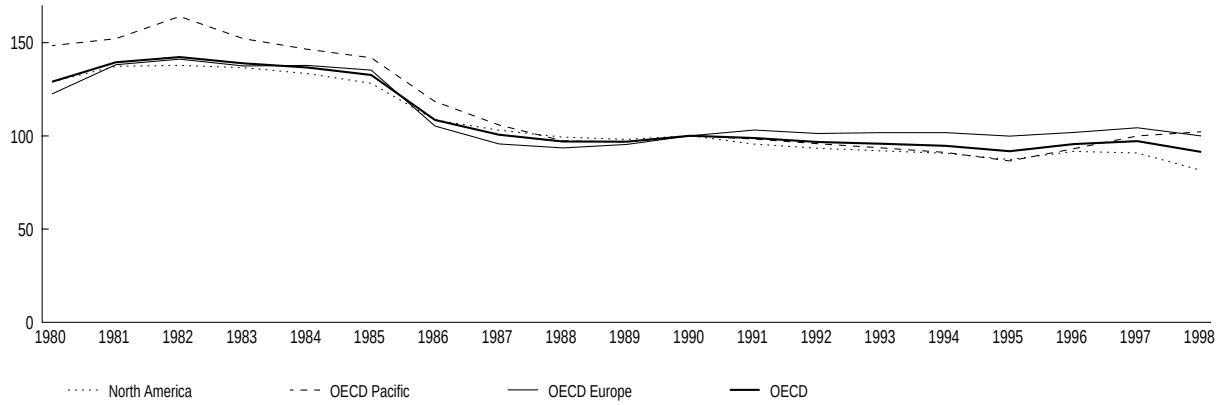
Notes:

a) Anthropogenic CO2 emissions from energy use only. Oil held in international marine bunkers is not included. Oil and gas for non-energy purposes and the use of biomass fuels are excluded. Peat is included.

b) GDP at 1991 prices and purchasing power parities.

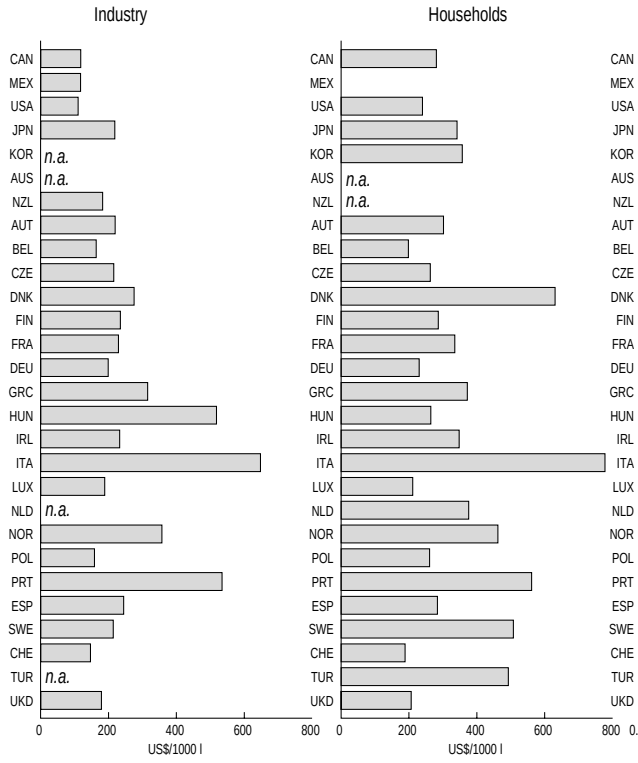
Source: IEA-OECD.

Energy Prices and Taxes, real energy end-use prices

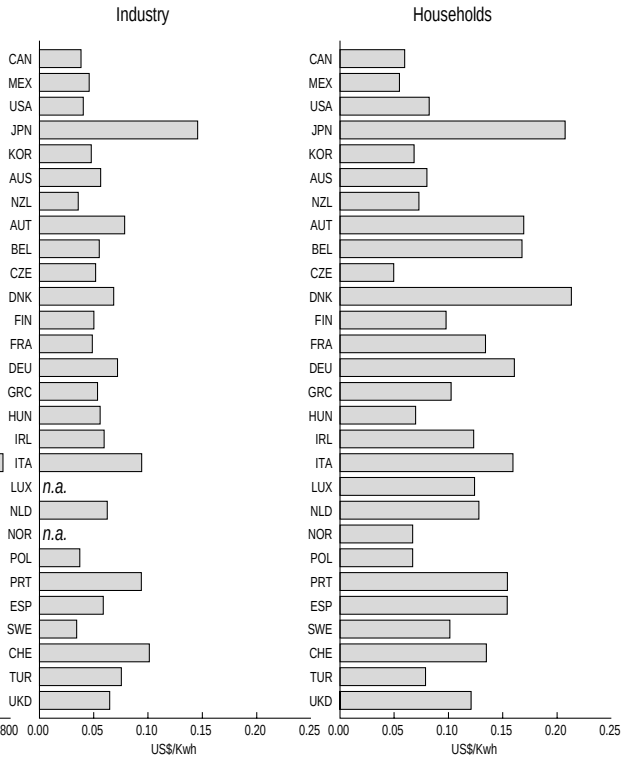


Energy Prices and Taxes, selected energy prices for households and industry

Light fuel oil



Electricity



Energy Prices and Taxes, selected energy prices and taxes for households and industry

	Industry						Households						Real energy end-use prices
	Light fuel oil		Natural gas		Electricity		Light fuel oil		Natural gas		Electricity		
	US$/1000 l (b)	Tax (%)	US$/$10^7$ kcal (c)	Tax (%)	US$/kWh (b)	Tax (%)	US$/1000 l (b)	Tax (%)	US$/$10^7$ kcal (c)	Tax (%)	US$/kWh (b)	Tax (%)	Change (%) since 1980
Canada	118	..	71	..	0.038	..	281	..	170	..	0.060	..	-8.2
Mexico	118	13	94	13	0.046	13	..	..	..	..	0.055	13	68.1
USA	111	..	119	..	0.040	..	240	..	263	..	0.082	..	-58.4
Japan	219	5	463	5	0.146	7	342	5	1288	5	0.207	7	-66.8
Korea	..	..	..	..	0.048	..	357	..	..	..	0.068	..	24.4
Australia	..	..	136	..	0.056	..	..	..	332	..	0.080	..	-5.9
New Zealand	183	_	209	5	0.036	_	..	..	380	14	0.073	11	-31.2
Austria	220	20	175	_	0.078	_	302	45	415	28	0.169	22	-43.3
Belgium	164	9	131	c	0.055	..	198	25	410	21	0.168	18	-35.6
Czech Rep.	215	26	160	_	0.052	_	263	18	177	18	0.050	18	2.0
Denmark	275	14	c	c	0.068	17	630	64	645	28	0.213	60	-11.7
Finland	235	29	138	14	0.050	8	287	42	168	29	0.098	25	-36.1
France	229	39	153	..	0.049	..	335	43	427	17	0.134	28	-30.0
Germany	199	23	190	13	0.072	8	230	33	417	19	0.161	14	-42.5
Greece	316	53	x	x	0.053	..	372	60	x	x	0.102	15	-45.7
Hungary	518	61	117	_	0.056	_	265	x	164	11	0.070	11	23.8
Ireland	233	25	172	_	0.060	_	348	28	420	11	0.123	11	-55.3
Italy	648	67	171	10	0.094	18	778	72	698	43	0.159	27	-3.9
Luxembourg	189	3	..	..	..	..	211	14	297	6	0.124	6	-37.8
Netherlands	..	..	123	7	0.062	_	376	45	357	29	0.128	24	-7.8
Norway	357	17	x	x	..	..	462	32	x	x	0.067	30	45.1
Poland	159	_	134	_	0.037	_	261	18	247	18	0.067	18	68.1
Portugal	535	58	..	..	0.094	_	561	60	x	x	0.154	5	-67.7
Spain	245	35	138	_	0.059	5	284	44	533	15	0.154	18	-23.4
Sweden	214	31	..	..	0.034	..	508	65	..	..	0.101	36	2.5
Switzerland	147	6	239	1	0.101	_	189	11	440	7	0.135	6	-71.0
Turkey	..	..	172	7	0.075	14	493	64	235	7	0.079	17	3.8
UK	179	26	106	_	0.065	_	206	27	331	5	0.121	5	-31.4

Notes:
Abbreviations:(..)= not available;(-)= nil or negligible;(x)= not applicable;(c)= confidential
a) Data refer to 1998 or to the latest available year. Varying definitions can limit comparability across countries.
b) US$ using current exchange rates.
c) US$ per 107 kcal (GCV basis) using current exchange rates.
Source: IEA-OECD.

B. INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The 23 Member countries of the International Energy Agency (IEA) seek to contribute to create the conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, they therefore aim to create a policy framework consistent with the following goals:

Diversity, efficiency and flexibility within the energy sector are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

Energy systems should have the ability to respond promptly and flexibly to energy emergencies. In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

- The environmentally sustainable provision and use of energy is central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should where practicable have regard to the Polluter Pays Principle.
- More environmentally acceptable energy sources need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA Members wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not admit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.
- Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by Governments and all energy users are needed to realise these opportunities.
- Continued research, development and market deployment of new and improved energy technologies make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with non-member countries should be encouraged.
- Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.
- Free and open trade and a secure framework of investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.
- Co-operation among all energy market participants helps to improve information and understanding, and encourage the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

The "Shared Goals" were adopted by IEA Ministers at their 4 June 1993 meeting in Paris.

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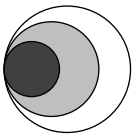
ENERGY/ENVIRONMENT INDICATORS

THE EXPERIENCE OF NORWAY*



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* By Mr. Frode Brunvoll and Mr. Henning Høie, Division for Environmental Statistics, Statistics Norway.

EXECUTIVE SUMMARY

Norway has rich energy resources. 3–4 per cent of the world's oil production is extracted from Norwegian reserves, and Norway has the largest hydropower resources in Europe. Both the exploitation and the use of these resources have significant environmental impacts. Extraction of oil and gas lead to discharges of oil and related substances to the sea and emissions to air. Development of hydropower resources necessitates interventions on fresh water systems and landscapes and thereby influences biological diversity and cultural and natural landscapes.

The use of energy/environmental indicators in policy making has so far not been systematic. Starting this year (1999), the environmental authorities have introduced a result-monitoring and reporting system for environmental performance. All sectors, represented by the various ministries, will contribute to this reporting system. This enables social and economic policy goals to be considered more easily within environmental policies. In this reporting system, goals at various levels are formulated for the environmental issues where environmental policy is defined. The defined issues are:

- sustainable use and protection of biological diversity;
- outdoor recreation;
- cultural heritage and cultural environments;
- eutrophication and oil pollution;
- substances (chemicals) hazardous to human health and the environment;
- waste and recycling;
- climate change, air pollution and noise;
- international environmental co-operation and the environment in polar regions.

Within each issue, a set of indicators is being developed to measure the extent to which the formulated goals are reached. Energy as such is not regarded as an environmental topic and energy/environment indicators are placed under issues where extraction, production and the use of energy have environmental significance. The most important of the defined issues are Climate change, air pollution and noise. In addition there are some energy/environment indicators under the issue Eutrophication and oil pollution. None of the other issues contain energy/environmental related indicators.

Apart from the official indicator set mentioned above, two initiatives by the Nordic Council of Ministers are so far the most important attempts to establish common indicator sets at national level. One led to a report on Nordic environmental indicators that was published in 1997. The set of environmental indicators presented in that report was based to a large degree on the OECD core set, and the PSR framework, but with some adjustments to meet certain special conditions in the Nordic countries. There are plans for updating and further development of this indicator set. Indicators on energy use were placed under the issue Climate change. The other initiative was a project on Climate Change Indicators, which was assigned to Statistics Norway and Statistics Sweden who jointly prepared a report by the end of 1998. This report gives a rather broad inventory of potential climate change indicators. The indicators presented in the inventory were structured according to a somewhat modified PSR-framework; driving force–pressure–state–response. This indicator set contains several indicators connected to energy resources and use, for example energy related indicators derived from the NOREEA system.

I. ENERGY CHARACTERISTICS OF NORWAY

1. Energy resources

Norway has large energy reserves, and extracts far larger quantities of energy commodities than are needed for domestic use. In 1998, extraction of energy commodities was between eight and nine times consumption. This is mainly accounted for by oil and gas extraction. Norway has about 1 per cent of the known remaining petroleum reserves in the world, but accounted for between 3 and 4 per cent of world production in 1998. This indicates that the rate of extraction is relatively high.

In addition to its petroleum resources, Norway has the largest hydropower resources in Europe.

2. Energy use

Norway's per capita energy use is more than three times higher than the average for the world as a whole, and 15 per cent higher than the average for the OECD countries. The large proportion of energy-intensive manufacturing, the cold climate that necessitates the use of large amounts of energy for heating, and the scattered pattern of settlement are factors that contribute to this.

In 1998, electricity contributed 46 per cent of the total national consumption of energy commodities (outside the energy sector), a larger share than in almost any other country in the world. This large share of electricity consumption is due to energy supply for heating and energy-intensive manufacturing being based on traditionally low-priced and plentiful electricity from the large hydropower resources.

3. Environmental impacts of extraction, production and use of energy

The abundant energy resources and the large share of electricity production from hydropower resources make the pattern of environmental impacts from energy extraction, production and use different in Norway compared to most other OECD countries. The environmental impacts may be divided into three groups:

- emissions to air that may lead to climate change, acidification, formation of ground level ozone, and local environmental problems;
- discharges to sea during extraction and transport of oil and gas. Such discharges may damage marine life;
- land and water course interventions connected to development of new energy production, such as dams, roads, plants, and power lines. This may have effects on biological diversity, cultural heritage sites, cultural and natural landscapes and the areas' value for recreation.

Since Norway has a large petroleum sector, a substantial share of the national emissions to air originates from this sector. In 1996, 60, 21, and 30 per cent of NMVOC, NO_X, and CO_2 emissions respectively derived from the energy sectors. The petroleum sector, including oil transport, is also a major source of discharges of oil to the sea, and also represents a permanent risk of larger oil spills (for example shipwrecks, blowouts). The extent of this risk is largely dependent on safety measures.

Production and consumption of electricity based on hydropower resources cause no emissions to air. As practically all production of electricity is based on these resources, the most serious environmental impact of electricity production is caused by the interventions in connection to the development of the resources (point 3 above).

II. ENERGY/ENVIRONMENT INDICATORS USED IN ENVIRONMENTAL POLICY

1. Result-monitoring and reporting for environmental performance

The Norwegian Government is now establishing a new management tool to aid environmental policies. The system is called result-monitoring and reporting system for environmental performance, and is structured along the 8 issues of national priority (result areas) defined in the Norwegian environmental policy[1]. These are:

- sustainable use and protection of biological diversity;
- outdoor recreation;
- cultural heritage and cultural environments;
- eutrophication and oil pollution;
- substances (chemicals) hazardous to human health and the environment;
- waste and recycling;
- climate change, air pollution and noise;
- international environmental co-operation and the environment in polar regions.

For each of the issues, national goals for what to achieve have been formulated. These goals involve both strategic goals for the general level of environmental quality and the direction of environmental development, as well as more specific result goals and goals for governmental actions. Indicators to measure to what degree these goals are reached are being developed.

The reporting system is closely linked to tools for dissemination of information, to systems for monitoring the environment, and for reporting results from the sectors involved. This will provide a basis for political decisions necessary to carry out the environmental polices and for public awareness.

Annually the government will submit a white book to the Norwegian Parliament, where the state of the environment, the Government's environmental policy and to what extent policy goals are being reached are presented. This type of report was published for the first time in October 1999 (Ministry of the Environment 1999b).

An important element of this system is the so-called sectoral environmental action plans. The Government will clarify the responsibility for achieving the environmental policy objectives through these action plans based on the principles of management by objectives and cost effectiveness across sectors. The action plans will be presented as part of the different ministries' annual budget proposals as well in the above-mentioned white paper to the Parliament. The most important ministries for dealing with energy related questions are the Ministry of Oil and Energy, the Ministry of Transport and the Ministry of the Environment.

By establishing such a system of goals and corresponding indicators, and involving the sectoral authorities at governmental level (ministries) directly in the process, the Government is implicitly taking into consideration what is required in economic and social politics to reach the environmental goals. Hopefully, this will contribute to a unified governmental policy for ecological sustainable development in Norway, since consensus from all sectors is involved.

1. Ministry of the Environment (1999a and 1999b).

2. Energy/environment related indicators in the result-monitoring and reporting system

In this system, natural material and biological resources of economic significance are not included. Natural resources are defined as assets of economic value and are normally allocated to the economic sector. Use of the resources, however, has impacts on the environment (and on the social sector). By defining natural resources this way, it is easier to avoid double counting of the impacts of resource use.

Energy as a natural resource is therefore not a separate issue in the environmental policy of the government. Consequently, the energy indicators are connected only to the environmental impacts of energy production and use. These are, as mentioned in Section 1.3, biological and cultural impacts of hydropower production, various kinds of pollution from the petroleum sector, and pollution from the use (combustion) of energy commodities. The issues defined in the Norwegian environmental policy (Annex 1) that would involve such indicators are:

- sustainable use and protection of biological diversity;
- cultural heritage and cultural environments;
- eutrophication and oil pollution;
- climate change, air pollution and noise

The indicators connected to energy extraction and use defined so far are shown in Annex 1.

III. ENERGY/ENVIRONMENT INDICATORS IN OTHER INDICATOR SETS

In the following, two initiatives by the Nordic Council of Ministers to establish common indicator sets at national and regional (Nordic) level are presented. In addition to these, it should be mentioned that Statistics Norway has calculated energy use and emissions to air from different modes of transport, where actual utilisation of transport capacity is taken into account (Statistics Norway 1997 and Holtskog and Rypdal 1997). This work can be a valuable basis for selection of energy/environment indicators for the transport sector.

1. Indicators of the state of the environment in the Nordic countries

At the request of the Nordic Council of Ministers, and based on recommendations in The Nordic Strategy for the Environment 1996-2000, a report on Nordic environmental indicators was published in 1997[2]. The objective was to arrive at a form of reporting – directed primarily at decision-makers – where the same sets of data (indicators) are reported at regular intervals, to make it possible to follow changes in the state of the environment over time.

The set of environmental indicators presented in that report was based to a large degree on the OECD core set, and the PSR framework, but with some adjustments to meet certain special conditions in the Nordic countries. The issues covered are:

- climate change;
- ozone layer depletion;
- eutrophication;
- acidification;
- toxic contamination;

2. Nordic Council of Ministers (1997).

- urban environmental quality;
- biodiversity;
- cultural landscapes;
- waste;
- water resources;
- timber resources;
- fish resources;
- agricultural land resources

The only indicators in that report connected directly to energy production or use were two response indicators in the chapter on climate change; use of non-fossil energy as a share of total energy use and gasoline prices and taxes. The example given in Annex 2 is based on the 1997 report but has been updated and re-edited.

One basic and important element of the Nordic indicator report was the evaluation of the *pressure* and *state* indicators by means of symbols (Inset 1). Together with the other main elements, graphs (data) and short descriptive texts, they completed the indicator presentation. One of the proposals for improvement of this indicator report is to include such a qualitative evaluation through the use of symbols for *response* indicators as well. This manner of qualitative evaluation has been adopted by the European Environment Agency (EEA 1999), and by the Norwegian Government in their first presentation of the result-monitoring and reporting system.

Inset 1. **Qualitative evaluation of pressure and state indicators in the Indicators of the state of the environment in the Nordic countries**

☺ Positive development with regard to pressure or state.
😐 Small or no changes in pressure or state. Can also indicate uncertain development.
☹ Negative development with regard to pressure or state. Can also indicate lasting high pressure or poor state.

Source: Nordic Council of Ministers, 1997.

Though several improvements have been recognised, both the pilot report from 1994 (Statistics Norway 1995) as well as the first official report from 1997 have initiated a discussion attracting attention to the concept of indicators and the pressure–state–response framework that probably has had some impact on both regional, national and more local indicator initiatives.

2. Inventory of climate change indicators for the Nordic countries

The Nordic Council of Ministers has established a co-operation group between the energy and the environmental sector. This group initiated a project on Climate Change Indicators in recognition of the fact that environmental indicators have received increasing attention

- as an aid in quantifying changes in the state of the environment;
- as a means of identifying and giving priority to important environmental issues;
- for their usefulness for evaluating the state of the environment, and pressures on the environment, in relation to national goals and international requirements;
- as a tool for comparisons of environmental performance between countries.

The project was assigned to Statistics Norway and Statistics Sweden who jointly prepared a report by the end of 1998 (Nordic Council of Ministers 1999). This report gives a rather broad first inventory of potential climate change indicators. The indicators presented in the inventory were structured according to a somewhat modified PSR-framework; *Driving force/Pressure–State–response.* The indicators connected directly to energy resources and use are in the driving force and response categories. The related emissions are in the pressure category (Annex 3).

3. Economic and social aspects of indicators – the NAMEA approach

One of the approaches for measuring environmental performance considered in the inventory is NAMEA (National Accounting Matrix including Environmental Accounts). The NAMEA system, which connects national economic data with environmental data, is a tool for creating indicators linking environmental impacts to economic activities. Emissions of greenhouse gases and energy use are among the themes in these accounts.

In Annex 4, Figure 1 taken from the Norwegian NAMEA-approach NOREEA (NORwegian Economic and Environmental Accounts), shows indicators of economic activity together with energy use and emission data for selected branches of industry – the so-called "industry profiles". Taking mining and manufacturing as an example, Figure 1 shows that this sector accounts for over 40 per cent of the total industry energy use and is also responsible for 30 per cent of the total industry contribution to atmospheric emissions that contribute to global warming. This industry's contribution to value added is only 13 per cent.

Development of time series and environmental performance indicators or benchmarks based on data in the NOREEA-matrices will be valuable tools for evaluating different sectors' or industries' environmental efficiencies. Examples of such indicators or benchmarks are "NOK value added per unit emitted", "emissions per unit of energy used", and "emissions per hour of employment" (Hass and Sørensen 1998 and 1999). As an example, in Annex 4, Figure 2 shows emissions of NO_X per unit of energy used in various sectors. The big difference in levels between sectors is mainly explained by differences in emission factors and in energy mix. A large share of the energy use in households and manufacturing industries is hydroelectricity. The cleaning effect of catalytic converters that were introduced on new cars around 1990 is clearly shown for the sectors domestic transport and private households.

ANNEXES

A. ENERGY-ENVIRONMENT RELATED INDICATORS

A.1. Energy-Environment indicators used for monitoring and reporting on environment policy

ISSUE 1. SUSTAINABLE USE AND PROTECTION OF BIOLOGICAL DIVERSITY

Result goals	Indicators (of achievement)
▪ None connected directly to energy issues (but indirectly in goals for land use).	▪ None connected directly to energy issues

ISSUE 3. CULTURAL HERITAGE AND CULTURAL ENVIRONMENTS

Result goals	Indicators (of achievement)
▪ None connected directly to energy issues (but indirectly in goals for land use and acid rain).	▪ None connected directly to energy issues

ISSUE 4. EUTROPHICATION AND OIL POLLUTION

Strategic goal: Fresh water resources and marine waters should be of sufficient quality to ensure the maintenance of species and ecosystems, and attend to people's health and well-being.

Result goals	Indicators (of achievement)
▪ Oil spills from oil operations are not to cause unacceptable damage to health or environment. The risk of environmental damage and other inconvenience from acute pollution shall be at an acceptable level (criteria for this goal are under development)	▪ Volume of oil in water discharged from petroleum activities ▪ Amount of oil reported from illegal discharges ▪ Amount oil waste delivered to reception facilities ▪ Number of wrecks that involve environmental hazards due to possible acute discharges ▪ Number and volume of acute discharges causing environmental damage ▪ Number of approved private and municipal plans for emergency situations ▪ Governmental state of preparedness

ISSUE 7. CLIMATE CHANGE, AIR POLLUTION AND NOISE

-CLIMATE CHANGE

Strategic goal: The concentration of greenhouse gases should be stabilised at a level that prevents harmful anthropogenic influence on the climatic system

Result goals	Indicators (of achievement)
▪ Greenhouse gas emissions may not rise by more than 1 % from the 1990 level by the period 2008-2012	▪ Status of the international negotiations, including number of countries that have ratified the protocol. ▪ The level and extent of means such as taxes, regulations and subsidies. ▪ Extent of the utilisation of local and new renewable energy sources.

-AIR POLLUTION (LONG-RANGE TRANSBOUNDARY AIR POLLUTION)

Strategic goal: Emissions of SO_2, NO_X, NMVOC and NH_3 should be reduced so that the impacts on natural systems are within limits of nature's tolerance, and so that human health and the environment are not harmed.

Result goals	Indicators (of achievement)
	▪ Share of ecosystems in Norway, and in the total area where the protocol for these emissions apply, that is protected against exceedance of critical loads for acidification, ground level ozone and eutrophication.

- Emissions of sulphur dioxide (SO2) shall be maximum 22000 tonnes in 2010, which corresponds to a 58 % reduction compared with the 1990 level.
- Emissions of nitrogen oxides (NOX) shall be maximum 156000 tonnes in 2010, which corresponds to a 28 % reduction compared with the 1990 level.
- Emissions of NMVOC from the Norwegian mainland and Norwegian economic zone south of 62° N shall be reduced by 30 % (base year 1989) as soon as possible. In addition, VOC emissions shall be maximum 195000 tonnes in 2010, which corresponds to a 37 % reduction compared with the 1990 level.

- Share of emissions that is covered by means (taxes), and the intensity of the use of these (NOK per unit emission) in the various sectors.
- Share of emissions that is covered by means (taxes), and the intensity of the use of these in the various sectors.
- Share of emissions that is covered by means (taxes), and the intensity of the use of these in the various sectors.

-LOCAL AIR POLLUTION

Strategic goal: Local air pollution should be prevented and reduced, so that the consideration for human health and well-being is ensured

Result goals

- By year 2005, the average 24h concentration of particulates (PM10) shall not exceed 50 µg/m3 more than 25 days per year, and by 2010 not more than 7 days per year.
- By year 2010 the average 1h concentration of nitrogen dioxide (NO2) shall not exceed 150 µg/m3 more than 8 hours per year.
- By year 2005, the average 24h concentration of (SO2) shall not exceed 90 µg/m3.
- By year 2010 the average annual concentration of benzene shall not exceed 2 µg/m3 as background level in cities.

Indicators

- Under development

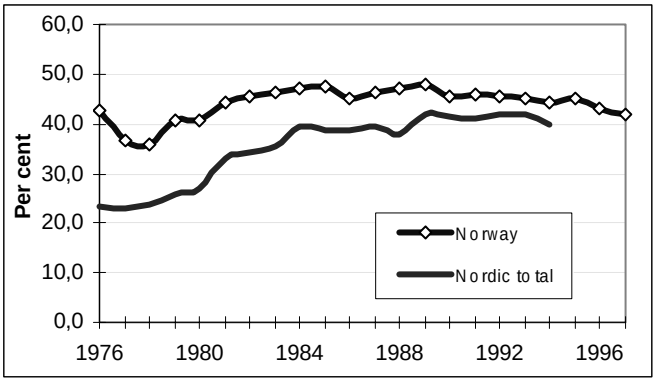
Source: Ministry of the Environment (1999a and 1999b)

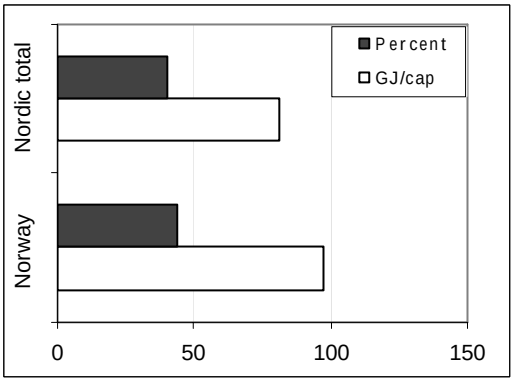
A.2. Response indicators for the issue climate change

Indicator: Consumption of non-fossil energy as a percentage of total energy consumption

There is yet no practical way of removing carbon dioxide from flue gases. The only way to reduce emissions is to burn less fossil fuels.

The use of non-fossil fuels in Norway has accounted for between 40 and 50 per cent of the total energy consumption since the mid 1970s. The total energy use in Norway (energy sectors included) has increased by about 60 per cent since 1976, and since the proportion fossil/non-fossil is virtually unchanged since the mid 1970s, so has the use of fossil fuels. About 40 per cent of the total energy used in Norway consists of electricity generated from hydropower. The following two figures show the use of non-fossil energy as a share of total energy use (1976-1997) and non-fossil energy as per cent of total energy use and per capita (1994)



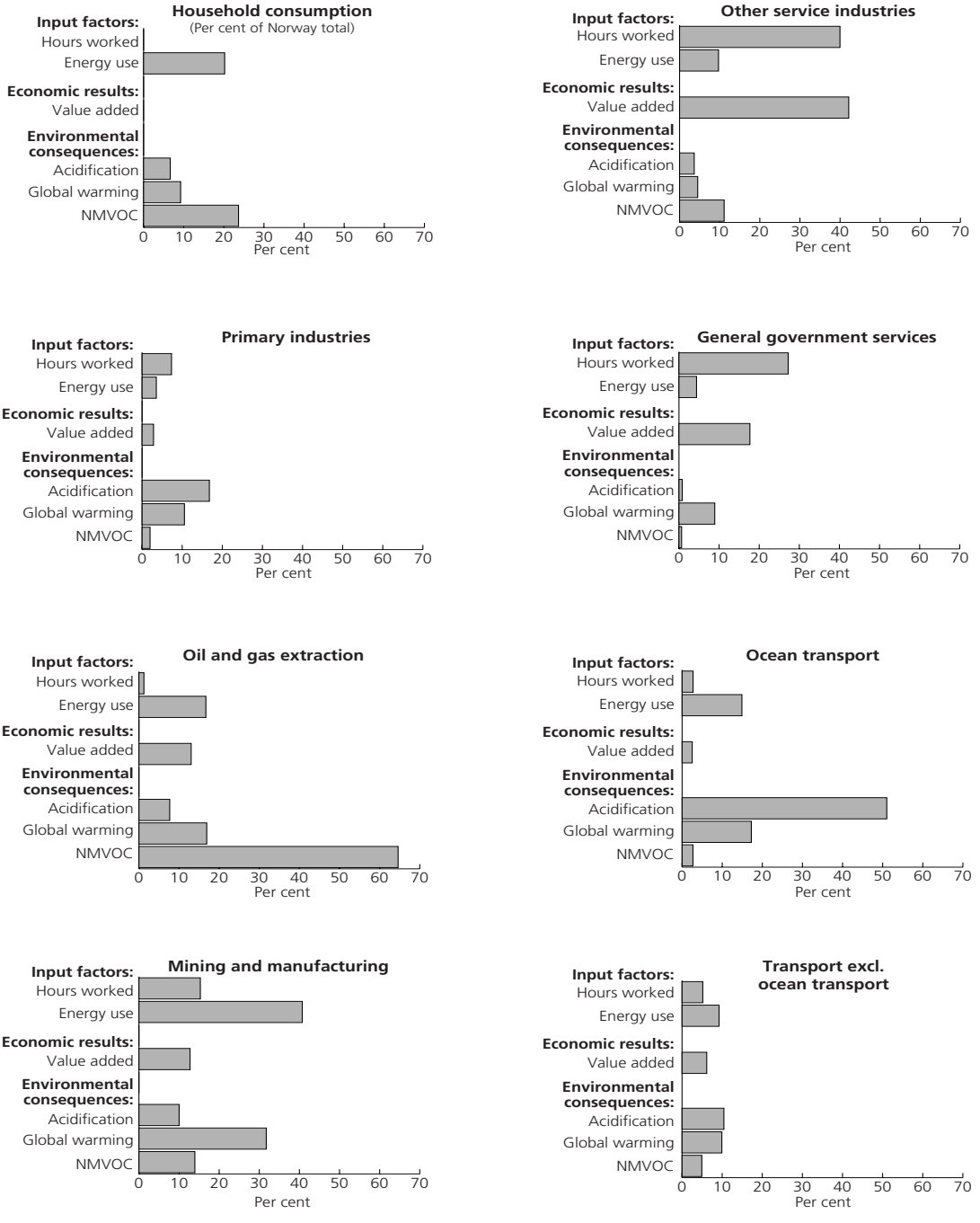


A.3. Energy indicators included in the inventory of climate change indicators

Driving force indicators	**-Natural resources**	-Reserves of non-renewable energy sources -Renewable energy sources -Annual production capacity for hydropower
	-Economic conditions and production	-Examples of "industry profiles"
	-Housing and building structure	-Part of population in big blocks of flats -District heating as part of total residential heating -Energy sources for heating in different types of buildings -Residential area
	-Energy production and trade with energy	-Primary energy production -Secondary gross energy production -Electricity production -Trade with energy -Net imports of electricity
	-Energy use	-End use of energy, index -End use of energy, commodities -End use of energy, consumer groups -End use of energy, per capita
Pressure Indicators	**-Actual emissions**	-Emission of all greenhouse gases. -Index (GWP) -Per capita -Emissions of carbon dioxide -Total emissions, time series -Per emission source -Emissions of methane per emission source
	-Adjusted emissions or energy use	-Energy consumption adjusted for temperature variations -Emissions of CO_2 equivalents per unit GDP
Response indicators	**-Response indicators for CO_2**	-Environmental taxes and prices of selected fuels - Gasoline prices and taxes - Indices of energy prices, industry - Indices of energy prices, households -Taxes on electricity -Energy production from new renewable energy sources -Non-fossil energy use -Energy efficiency and energy intensity -Energy efficiency in power plants -Industrial energy use per unit production -Industry oil consumption per unit production -Residential energy intensity -Transport -Specific gasoline consumption, passenger cars -Number of electric cars

B. THE NAMEA APPROACH

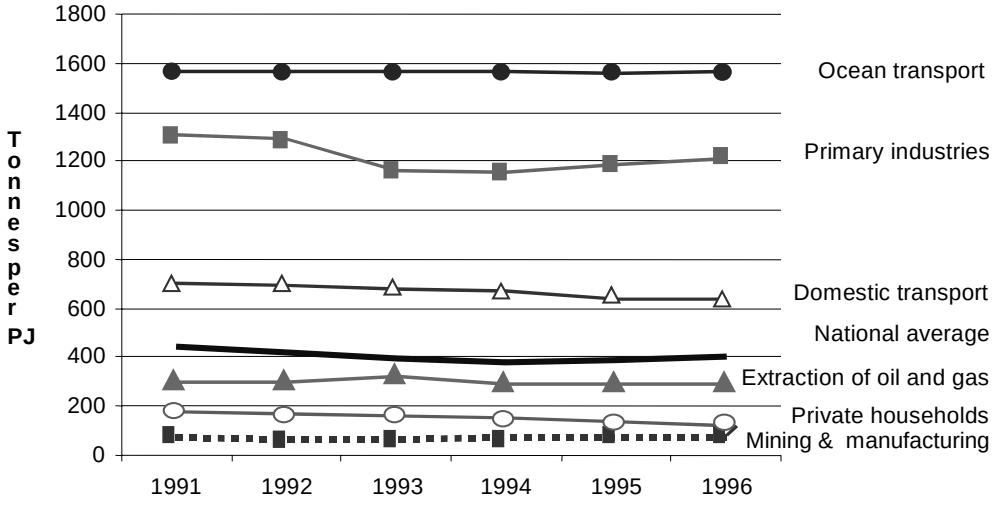
Figure 1. **Household and industry profiles**
Shares of total for activities, Norway 1993



Input factors, economic results and emissions to air.

Source: Hass and Sørensen, 1998

Figure 2. **Emissions of NOx per unit energy used in various sectors** (1991-96)
Tonnes per PJ



Source: Hass and Sørensen, 1999

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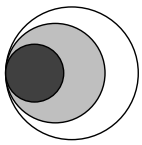
ENERGY/ENVIRONMENT INDICATORS

THE EXPERIENCE OF FRANCE*



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EXECUTIVE SUMMARY

Energy management (EM) policy, because of its characteristics and its results, is a vital prerequisite of sustainable development. Since the first oil shock, France has conducted an ambitious EM policy. Institutionally, this has translated into the creation of specialised agencies in charge of implementation. In 1992, by setting up ADEME (Agence de l'Environnement et de la Maîtrise de l'Énergie), the French Government established a vehicle for meeting the Kyoto requirements. In 1999, ADEME's budget was increased fivefold in order to give new impetus to EM policy. Funding for energy policy has been erratic, but consisted of more than FF 70 billion in government money between 1973 and 1999 to develop markets and techniques. All consumer sectors have been involved, due to a multiplicity of instruments—both economic (aid to research, decision-making and demonstration; direct investment subsidies; tax deductions, etc.) and non-economic (information, communication and so on)—that over time have been used to various extents and to supplement regulatory and tax measures. This policy has been the subject of close independent scrutiny, with regard both to programmes (CIME report, 1998) and to the oversight system discussed herein.

Given the volume of public funding involved, it is easy to understand why ADEME has set up a detailed system for assessing the energy efficiency policy that has been in place since practically the 1980s. The aim is to evaluate the Agency's own action, situating it in relation to other players and placing it in its economic and energy contexts. To this end, ADEME has developed an innovative methodology based on a set of over 300 energy efficiency indicators grouped together in a special database (DATAMED). The indicators calculated are either economic indicators (energy intensity) or physical or techno-economic indicators such as unit consumption and energy savings, which are more akin to an engineer's approach. Clearly, this last category of indicators is based on a bottom-up analysis of energy consumption at a highly detailed level, i.e. that of end uses of energy (e.g. for heating) and consumer equipment (e.g. cars). An annual budget of FF 15 million is earmarked for collecting this information.

The choice of indicators and their interpretation are deliberately geared to a strategic approach that aims to evaluate the policies implemented. This evaluation is used in the scheduling of ADEME actions, as well as in budget talks and in formulating contractual policy with the State. Each year, ADEME issues a report on recent trends in energy efficiency, the main findings of which are published by the Ministries of Industry and the Environment. These indicators were recently calculated in CO_2 terms in order to monitor the results of the policy to combat the greenhouse effect.

This methodology has made a substantial contribution to the European Commission's international comparisons of energy efficiency indicators (ODYSSEE ADEME-SAVE project). It is also used by the World Energy Council (WEC, 1998).

I. POLICY CONTEXT

1. Energy management and sustainable development

The aim of any energy policy is to contribute to the sustainable development of society (IFEN,1999). This concept can be linked directly to the following three main objectives: security of supply, economic growth and competitiveness, and limitation of environmental harm. The incorporation of sustainable development into the energy equation undoubtedly entails a compromise between these three objectives.

Of all energy policy options, the development of renewable sources of energies and the enhancement of energy efficiency (EE) are no doubt the ones most likely to meet the criteria of sustainable development. By cutting energy consumption while at the same time delivering equivalent services, energy management (EM) can limit risks in the following areas in particular:

- Slowing the exhaustion of scarce (and particularly fossil) resources. In this respect, it serves the cause of intergenerational equity.
- Introducing greater flexibility in the management of the energy system.
- Serving the cause of "governance" by virtue of the multiplicity of players involved in its implementation, fostering local development, and the policy of information (labelling, standards, etc.).
- Limiting pollution emissions at the local (air pollution), regional (acidification) and global (greenhouse effect) levels.
- Improving consumers' living standards and corporate competitiveness by reducing energy bills.
- Steering qualitative aspects of technical progress towards clean and efficient technologies.
- Contributing to and blending in with all socio-economic processes, and especially lifestyles and societal choices, through necessary linkages with other sectoral policies (transport, city planning, industrial policy).

2. The context: emissions on the decline, except for CO_2

Energy, by its production or consumption, contributes, in some cases to a major extent, to pollution trends at the local, cross-border and global levels. France has undertaken a number of technical and behavioural actions, driven by regulatory and market forces that have resulted in varying long-term trends in pollutant emissions (Table 1).

Table 1. **Trends in selected energy-related pollutants in France**

Pollutants	Total 1960	Total 1980	Total 1990	Total 1998	% Energy 1998	Δ 1990-98 Total emissions	
SO_2 (kt)	1773	3208	1269	837	80%	↘↘	(-34%)
NO_x (kt)	855	2032	1882	1654	93%	↘	(-12%)
VOCNM(Mt)	Nd	nd	2957	2341	52%	↘	(-21%)
CO (kt)	9392	15894	11054	8013	75%	↘↘	(-28%)
CO_2 (Mt)	269.8	442.9	468	493	80.5%	↗	(5.3%)
CH_4 (kt)			3056	2640	15%	↘	(-14%)
N_2O (kt)			314	280	6%	↘	(-11%)

Maximum: SO_2: (3783) 1973; NO_x (1882) 1980; CO (17884) 1974; CO_2: (495) 1973.

Source: Citepa 1999.

It can be seen that energy's responsibility is paramount in total emissions of certain pollutants, such as SO_2 (80%), NO_x (93%) and CO_2 (80%) in 1998 for example. On average, it can be said that trends in local air pollution is towards are significantly improving, whereas the situation with greenhouse pollutants is less favourable—particularly with regard to CO_2, of which emissions are on the rise. It can be seen, for example, that in France there has been a decoupling of emissions and economic growth, except in the case of CO_2.

In this context, EM policy is a vital option, *inter alia* because nuclear concerns limit the possibilities for adjusting electric power generation in the short and medium terms.

3. New priorities in French energy management policy related to the greenhouse effect

Ever since the first oil shock, France has had an ambitious EM policy. Institutionally, this has led to the creation of specialised agencies whose objectives have been strengthened over time. The history of this policy can be divided into five periods:

- 1974-82: Following the first oil shock, the Agence pour les Économies d'Énergie laid the groundwork for a policy of energy conservation. The main instruments involved regulatory measures, communications and initial aid for capital investment in industry.
- 1982-86: Following the second oil shock, France considerably stepped up the human and (especially) financial resources allocated to government action by creating the Agence Française pour la Maîtrise de l'Énergie. This agency involved a far broader interpretation of the notion of energy management, putting more emphasis on the economic aspects of energy savings. Alongside a strengthening of regulations and the launching of major research programmes, a highly ambitious programme of direct subsidies for consumer investment was initiated. It was during this period that the budget allotted for EM was greatest, and the results most significant (2 Mtoe of energy savings per year).
- 1986-97: The collapse of oil prices and a more liberal policy orientation prompted a very significant easing of government EM efforts, with a practically total halt to direct investment subsidies. However, new environmental objectives, involving the greenhouse effect in particular, gave new impetus to EM policy, leading to the creation of the Agence de l'Environnement et de la Maîtrise de l'Énergie.
- 1999: But it was only in 1999 that this new concern was actually reflected in a resurgence of EM, the budget for which increased fivefold.

It is in this fairly erratic context of energy efficiency efforts, which have become ambitious once again, that the need to assess the results of the action taken has proven indispensable.

II. CALCULATING AND TRACKING ENERGY EFFICIENCY INDICATORS IN FRANCE

1. Why are energy efficiency indicators necessary ?

Energy efficiency indicators were defined in the above context:

- *To define and track energy efficiency objectives and individual targets, for CO_2* for example. Under the Kyoto Protocol, France undertook to stabilise CO_2 emissions at their 1990 level by 2008. To meet the target, France will have to institute EM policies and take measures that are ambitious, particularly in the French context of limited supply-side options. As a

benchmarking system, these indicators are increasingly used to fine-tune sectoral objectives.

- *As a tool of evaluation.* The institutional operator in charge of EM programmes, which have varied considerably in terms of scope and instruments used, must be able to answer a number of questions: What has been the economic efficiency of the measures? What is the impact of public policy? How can public funding be optimised? To a certain extent, the indicators provide answers to these questions being asked by the Ministries of Finance, Industry and the Environment, in particular when the programme in question is significant. It is necessary, however, to supplement this approach with a more microeconomic assessment of the programmes.
- *As a tool for planning and scheduling*. Implementation of energy efficiency policy is based on a great number of technological and behavioural options. It is important that an accurate assessment of the factors that determine energy efficiency trends be made in respect of each end use so that future actions can be planned more effectively.
- *To make international comparisons.* As activities and international negotiations become increasingly globalised, means of comparison are needed in order to take stock and test the effectiveness of measures in other contexts.

The usefulness of indicators has therefore been clearly established, but the particularity of the French approach is that it orients its methodology towards the evaluation of energy efficiency policies. Annex 1 attempts to present a linkage between indicators and policies in respect of transport. However, indicators must obviously not be substituted for political decision-making.

2. What types of indicators ?

2.1 "Energy" indicators of sustainable development

International organisations (such as OECD, the UN, FAO, the European Commission and Eurostat) have already worked extensively on typologies and on defining energy-related indicators in the context of sustainable development. Such indicators may be divided into five major families: i) context indicators (energy prices, self-sufficiency, energy's share of aggregate emissions, and so on); ii) environmental impact indicators (aggregate emissions, emissions by form of energy, by sector, per capita or per unit of GDP); iii) energy market share indicators (consumption by form of energy, electric power generation by form of energy); iv) energy taxation indicators; and v) energy efficiency indicators.

Here we shall focus on indicators that track energy efficiency, the other energy indicators being better known. If the broad concept of EM is adopted, activity indicators (equipment rates, production, traffic) should also be considered in order to gain a more comprehensive assessment.

2.2 The case of energy efficiency evaluation in France

Work on EE in France started long before sustainable development became a prominent issue. The methodology was fully operational in 1980, and AFME developed the Datamed database, which is still being used to track the evaluation of EE. This techno-economic database contains some 3 000 time series covering 25 years of demographic data, economic statistics, activity data (stocks of various types of machinery and vehicles, industrial output, types of traffic, etc.), energy statistics (broken down by usage) and technical data (unit consumption of consumer appliances and equipment). From these primary data, more than 300 EE indicators have been developed. This large number of indicators reflects our determination to assess energy efficiency in all its forms and aspects—economic, technical and behavioural—as precisely as possible and to address all of the

questions posed by policy-makers. It is possible, however, to present just a limited number of key aggregate indicators (Box 1).

Box 1. **Main energy efficiency indicators**

1. Economic indicators: energy and carbon intensity

- primary energy intensity, final intensity (electricity and fuel);
- energy intensity at constant economic structure (idem.);
- sectoral energy intensity (industry, transport, residential, services);
- energy intensity of industry at constant VA structure, by branch (30);
- carbon intensity: same degree of disaggregation as for energy intensity.

2. Techno-economic indicators

2.1 Descriptive techno-economic indicators: unit consumption

Industry:

- toe or kWh/production unit for energy-intensive industries (10);
- toe or kWh/production index for light industries (20);
- toe or kWh/production unit by process produced.

Residential:

- toe or kWh/dwelling: by type of energy, by type of use (heating, cooking, hot water, special uses), by type of dwelling (individual house, apartment house), by age of dwelling (new/existing), by type of heating (central, individual);
- toe or kWh/m2: idem.;
- toe or kWh/electrical appliance.

Services:

- toe or kWh/m^2 by branch of service (8);
- toe or kWh/bed (health care), per student (education), per night (hotels);
- toe/employee.

Transport:

- toe/vehicle/year per type of vehicle and fuel for road transport (cars, trucks, busses, etc.);
- l/100 km per type of vehicle and fuel and for standard new car consumption;
- goe/tkm per type of vehicle for freight transport, goe/pkm for passengers.

2.2 Explanatory techno-economic indicators: energy savings

- energy savings (unit consumption effect) with the same breakdown as for the descriptive indicators (base 1973, 1986, n-1);
- technology-generated energy savings (technology effect) for road vehicles, for new dwellings;
- behaviour-induced energy savings (behaviour-management effect);
- impact of energy substitutions on demand for energy;
- comfort effect for dwellings (percentage with central heating);
- mileage effect for cars.

All of these indicators are also calculated in terms of CO_2

By definition, energy savings is a conceptual notion, because there is no meter to measure its production or consumption, as there is with electricity or fuel. What it involves is using less energy to deliver an equivalent final service. The assessment of energy savings is therefore based on a number of conventions which need to be discussed.

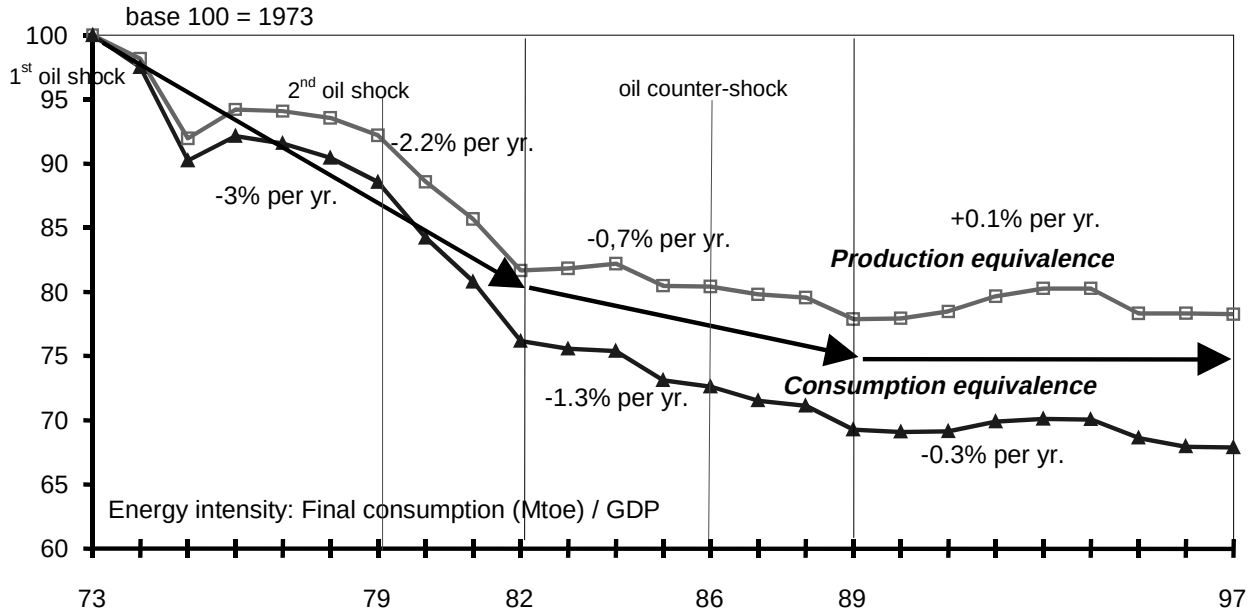
Although there are a great number of typologies, none of which are fully satisfactory, our work focuses on "economic" and "techno-economic" indicators. These may be descriptive or contextual (e.g. unit consumption) or explanatory (e.g. energy savings, structural effects).

3. Interpretation and use of energy efficiency indicators

3.1 The economic approach: energy or carbon intensity

Economists prefer energy intensity or carbon intensity indicators to assess overall energy efficiency. These ratios are computed by dividing energy consumption (primary, final, transport, etc.) expressed in physical units (e.g. Joules, kWh, toe) by a macroeconomic indicator (e.g. GDP, value added, final consumption, etc.). The result is a monetary indicator (e.g. toe/FF) expressing the quantity of energy necessary to produce one unit of GDP or value added. A drop in energy intensity therefore corresponds to an improvement in the energy efficiency of the energy system. Figure 1 shows, for France, the trend in final energy intensity per unit of GDP over a long period of time.

Figure 1. **Trend in final energy intensity per unit of GDP in France, 1973-97**



Source: ADEME-DATAMED, 1999.

In 25 years, energy efficiency has risen by 30%, but the pace of change has varied sharply from one period to another: more than 3% per year between the two oil shocks, roughly 1% per year until the oil counter-shock and a very steep slowdown at present due to the unfavourable context of energy prices, structural effects, an easing of government energy management policies and growth in special uses of electricity. It is still impossible, however, to separate out these various components of change with this indicator. The essential message remains that there has been a de-linking between energy consumption and economic growth.

The indicator can be refined by separating the influence of the economy's structural change (i.e. less agriculture and heavy industries, more transport, light industries and services) from energy efficiency proper, which is closer to the truth (see Annex B). For example, in France, since 1992 the

structural shift in the economy, which for nearly two decades had continuously contributed to a reduction in the energy intensity of GDP, has no longer offset the loss in efficiency, in particular because of the return of heavy industries.

It is also possible to compute an indicator of energy intensity adjusted for the effects of foreign trade, which is a good source of international comparisons (see CGP-CIME).

Such indicators can be broken down further by major consuming sectors, as shown in Annex C. It is plain to see that energy efficiency improved sharply in industry (40%) and somewhat in the residential/service sector (10%), while remaining at practically the same level in 1997 as in 1973 in transport.

It is also general practice to separate the intensity of fuels from that of electricity. Here one sees contrasting trends, with intensity declining for fuels but rising fairly markedly in the case of electricity, due in part to the spread of new uses (Annex B).

An indicator of this sort can easily be established for CO_2 emissions. When looking at the trend in the OECD area over a very long period of time, it can be seen that the CO_2 intensity of GDP traced a bell curve over the course of economic development (IEPE).

In conclusion, energy intensities are the most widely used indicators because they are informative, easy to compile and comparable between countries. However, their interpretation is very limited because of the level of aggregation involved.

3.2 Unit consumption: descriptive techno-economic indicators

Energy efficiency can also be tracked from more of an engineer's perspective, which aims for maximum precision. For this, specific or unit consumption (UC) trends are measured at the most disaggregated possible level, i.e. in respect of particular uses, processes, products or consumer devices. The underlying methodological approach is of the bottom-up variety. These indicators generally involve a ratio in physical terms between energy consumption and a unit of service (production, traffic, housing, type of device, etc.).

For a given consumer device, it is possible to define a variety of UC ratios, for which trends and meanings differ. In respect to trucks, for example, one could compute l/100 km, toe/vkm or toe/tkm, and for dwellings, toe/dwelling, toe/m² or toe per capita. When such ratios cover new items, they are good indicators of technical progress (e.g. standard fuel consumption for new cars) or of regulatory compliance (consumption by new dwellings).

Such UC information can either be calculated, by dividing total consumption by total stock or production, or obtained via surveys, which is more satisfactory if the surveys are representative of the population of consumers. Annex D illustrates the long-term trends in unit consumption for a variety of sectors, such as cars, dwellings and paper-cardboard.

The requirements of our chosen level of disaggregation entail a highly detailed statistical system on final energy uses and stocks of consumer equipment. Government and energy producers finance a statistical system of this kind (CEREN, 1999), which costs about $3 million per year to cover the industrial and residential-service sectors. Transport statistics are covered by various multi-partner surveys (SECODIP, 1999), and figures broken down by type of vehicles are summarised in the transport accounts published by INSEE (INSEE, 1999). At the level of detail at which we work, not all of the data are official statistics; they also require input from the most reliable possible estimates. In the future, deregulation of the energy sector may have a negative impact on the production of statistical data such as these.

These unit consumption figures are used whenever a reference system is needed for a programme launch and, of course, for follow-up. Illustrations of this include voluntary agreements in industry, unit consumption of new dwellings, which shows the effectiveness of building insulation standards, the consumption of household appliances, which tracks the impact of the European Union

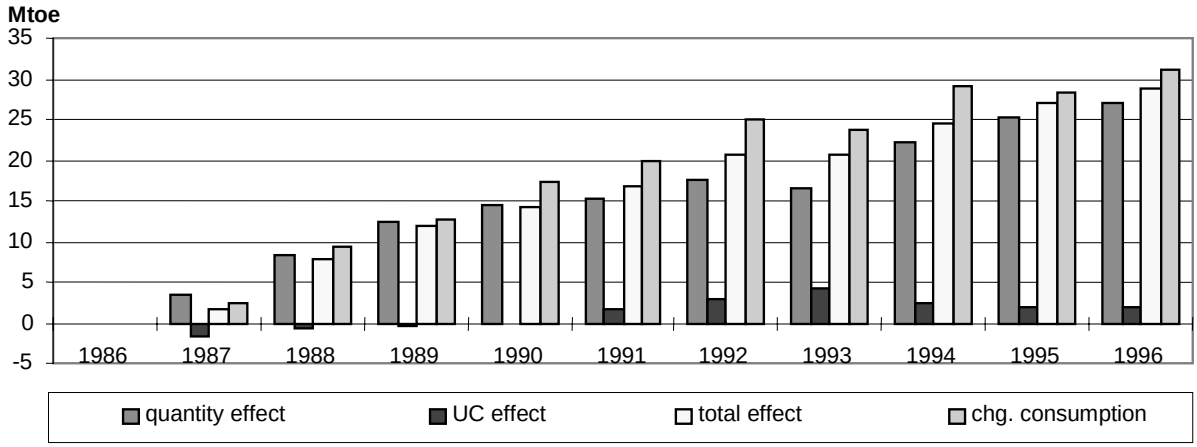
Directive on the labelling of such devices, standard consumption of new cars to trace the results of carmakers' research programmes and, in the near future, the European car industry's voluntary commitment on pollution emissions.

3.3 Energy savings: explanatory techno-economic indicators

The indicators discussed above are descriptive or contextual. We have developed explanatory indicators which aim, in respect of the change in energy demand over a given period, to distinguish the respective impact on demand of a number of factors (techno-economic effects). Accordingly, we define an activity indicator that measures the impact of a change in activity (e.g. a rise in output, the number of dwellings, traffic, etc.) on the demand for energy. This is interpreted as the impact on demand of demographics, economic growth and lifestyles. Similarly, we determine a "unit consumption effect", taken as energy savings, which measures the impact of changes in unit consumption on the demand for energy. These effects may be calculated for the populations of consumers (about 300) and then re-aggregated. Figure 2 presents the overall results for France since 1986 (ADEME, 1999).

Since 1987, the general trend no longer appears to be towards net energy savings, apart from a slight upswing in 1994 and 1995. Thus, between 1986 and 1996, final consumption rose by some 2 Mtoe directly attributable to the rise in unit consumption of energy, all sectors combined, in addition to a 28 Mtoe increase attributable to growth in the population, dwellings, stocks of various types of equipment, industrial output and traffic.

Figure 2. **Consumption growth and explanatory effects,** 1986-96



Source: ADEME-DATAMED.

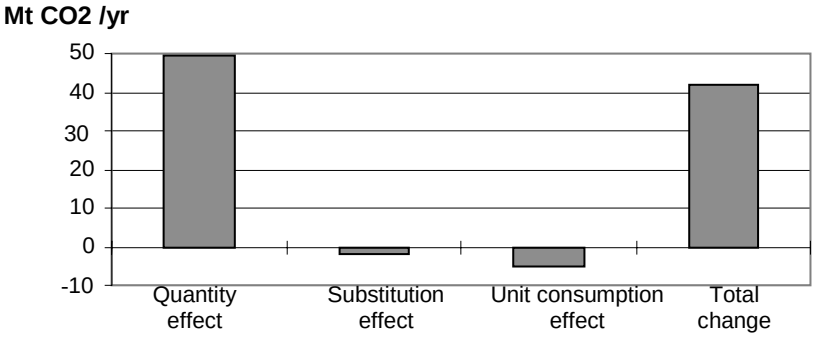
This overall trend masks divergent patterns by sector. Annex E1 shows that energy savings are still being achieved in the residential-service sector, but that they have practically ceased in industry and that there are now dissavings in the transport sector.

The above assessment can be improved by making a distinction between technical savings obtained by introducing devices that are more efficient and those stemming from changes in behaviour (Annex E2).

The unit consumption effect can be broken down further into other factors, such as energy substitutions, the mileage effect, structural considerations (e.g. a higher percentage of individual homes), lifestyles (e.g. more central heating), and so on. Similarly, it is possible to assess the energy conservation impact of modal shifts in transport (see Annex E3).

All of the indicators presented above can be transcribed in terms of the quantity of CO_2 avoided. The main difficulty is in attributing an emission coefficient for electricity. Figure 3, corresponding to Figure 2, shows the variation in aggregate energy-related CO_2 emissions. Here we have introduced a substitution effect corresponding to the impact on CO_2 emissions of energy substitutions in electric power generation.

Figure 3. **Change in aggregate energy-related CO_2 emissions**, France 1986-96



Source: ADEME-DATAMED.

III. EFFICIENCY INDICATORS AND THE DECISION-MAKING PROCESS

It should be borne in mind that the more transparency and consensus there is on how indicators are defined, calculated and interpreted, the easier it is to ensure their relevance and use them in decision making. Such consensus is based primarily on:

- The quality and degree of "officialness" of statistics and ratios, and in this case of the numerator (energy consumption) and denominator (the need or service). It is also necessary to ensure that there is coherency between the energy and activity nomenclatures—an issue that has not yet been totally resolved.
- Methodological consensus, if the indicators involve methodological problems (impact of economic structural effects, stocks of consumer equipment, adjustments for climate, degree of disaggregation, etc.).

These two criteria affect the acceptability of data, because in many cases it is necessary to use disaggregated data that are "semi-official" (consumption from heating, cars, etc.), and re-aggregation entails special methodology. It is for this reason that ADEME has undertaken a process of "officialising" these indicators with the Ministries in order to reach a methodological consensus.

These indicators provide scientific and technical expertise that have an impact on public policy-making at a number of different levels:

- ADEME, which is in charge of EM and environmental policies, uses these indicators as tracking instruments and a source of information when formulating internal planning strategies, as a supplement to the evaluation of programmes of a more microeconomic nature. They are incorporated into the annual activity report, and they are also used with outside parties, and government in particular, in giving the Agency's action quantitative visibility in budget negotiations. It must be accepted, however, that it is still difficult to distinguish the portion of overall EM results that is due to the Agency's own actions from what is caused by other public players (e.g. tax cuts which depend on the Ministry of

Finance, sectoral policies such as programmes to support construction, rehabilitation, and so on). Despite the methodological difficulties involved, ADEME has recently embarked upon an evaluation in connection with negotiations for a planning contract with the State covering the period 2000-2006. "Commitment indicators" are to be defined (toe saved, CO_2 avoided, etc.) according to a typology corresponding to the scope of action of the various players involved. First-tier indicators would correspond to direct effects of the programmes (support for investment, for instance), second-tier indicators would reflect indirect effects (assessment), and a third tier would incorporate all partners and effects of the activity.

- These indicators, which are the subject of an annual report, are used in a number of official publications (DGEMP, 1999; Les comptes de l'environnement, 1999; and IFEN, 1999). They are also used to assess past trends and for long-term planning and forecasting (Boisson, 1999; Enerdata, 1999) and assess the French programme to combat the greenhouse effect (MIES, 1999).
- The evaluation committee (CIME) has also made intensive use of the indicators as programme evaluation tools and at an overall level. It has striven in particular to tie these indicators in with the government's EM effort (Bosseboeuf, Richard, 1998).

IV. CONCLUSION

Since the first oil shock, France has had an ambitious EM policy, which is carried out at an institutional level by specialised agencies. Because of the substantial government funding associated with the policy, ADEME has developed a system to evaluate it. The methodology is novel in two respects: i) the desire to harness this instrument for the assessment of government policies; ii) the highly disaggregated level of analysis by final use of energy. In order to address all concerns and aspects of energy efficiency, some 250 indicators are monitored each year over a long period. This methodology has been applied jointly in the ODYSSEE database (ADEME, 1999) by the 15 EU countries in connection with the SAVE programme (Bosseboeuf et al, 1999). Now, the focus will be on working, within EUROSTAT, to adopt an official list of energy efficiency indicators in Europe. Similarly, the World Energy Council (WEC) (Moisan, 1998) has asked ADEME to establish an energy efficiency indicator unit. In combination with the work of the IEA, this research is expected to yield reliable and comparable indicators of sustainable development.

It is our conviction that EM will remain a top priority of public energy policies in a field of energy in which market mechanisms are tending to develop rapidly. In this context, government will have to ensure that high quality, disaggregated statistics are produced.

ANNEXES

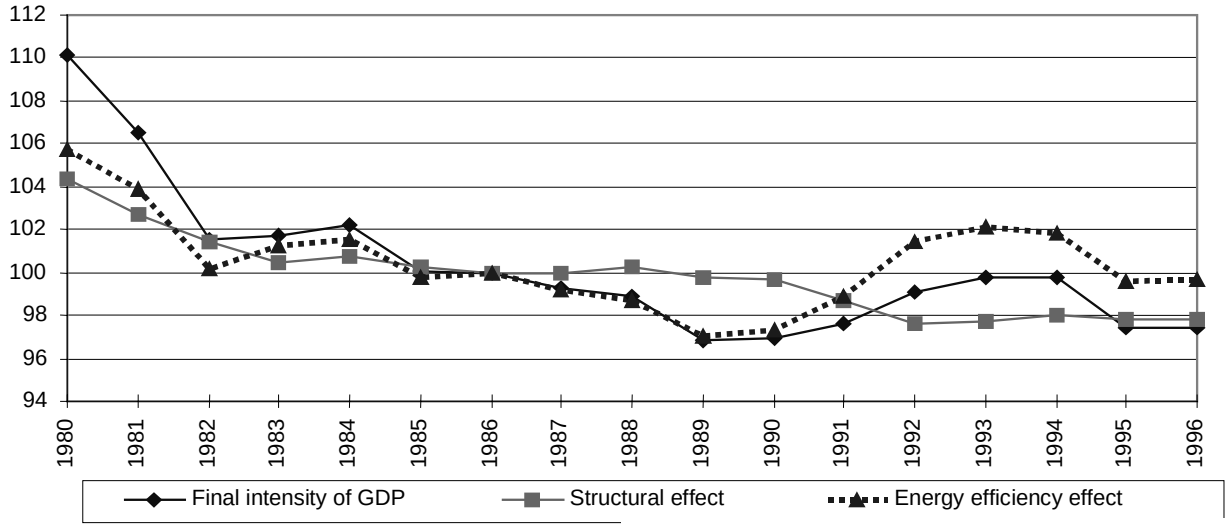
A. INDICATORS AS POLICY EVALUATION INSTRUMENTS: TRANSPORT

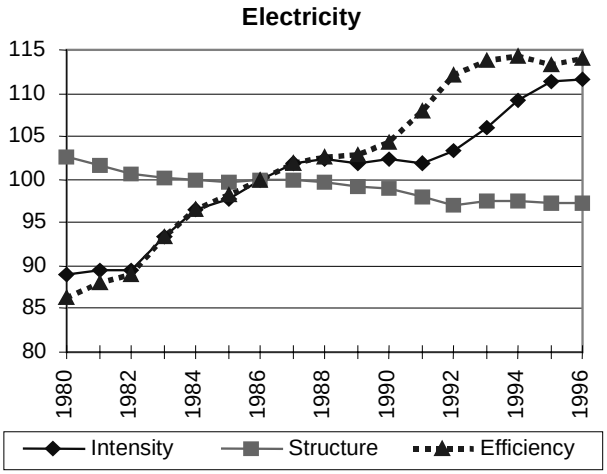
Issues	Indicator	Policies/programmes	Observation
◆ Impact of car technology	tested specific consumption of new cars; adjusted for fleet structure	Public R&D support for manufacturers, voluntary agreement with CECA	convergence, saturation setting in, impact of fleet structure, price impact (econometrics), impact of manufacturers' voluntary agreement (gCO_2/km)
◆ Impact of fuel substitution for cars	useful energy	Pricing policy, green tax, regulation	assessment depends on the goal (energy saving or CO_2)
◆ Energy efficiency policies versus environmental and transport policies			
◆ Fuel economy versus energy price for cars			rebound effect for cars (mileage and power increases)
◆ Modal split for passenger transport	koe/pkm - actual and at constant modal structure	State support for road infrastructure versus public transport, urban planning	has not played a major role. To show the relatively low impact evaluate the transport organisation impact on energy efficiency
◆ Modal split for freight	Idem koe/tkm		ditto, but impact certainly larger
◆ Impact of transit and international traffic			elasticity of transit traffic to GDP of foreign trade
◆ Air (CO_2)			
◆ Energy efficiency and development in transport: dematerialisation of the GDP	tkm/ton tkm/vkm, share of transit		greater distances, opening of markets, liberalisation, impact of logistics, counter oil shock
◆ Behaviour versus technology			

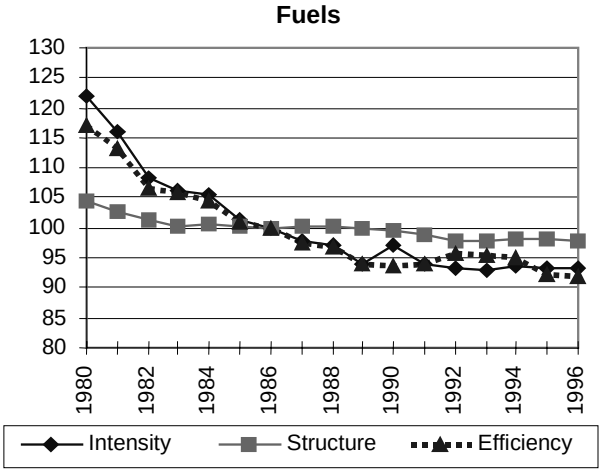
Note: Other issues for the record: impact of urban sprawl on energy efficiency (not covered), relationship between energy efficiency policies and environmental (catalytic converter) and transport policies (difficult to treat).

B. ENERGY EFFICIENCY AND STRUCTURAL CHANGES IN THE ECONOMY

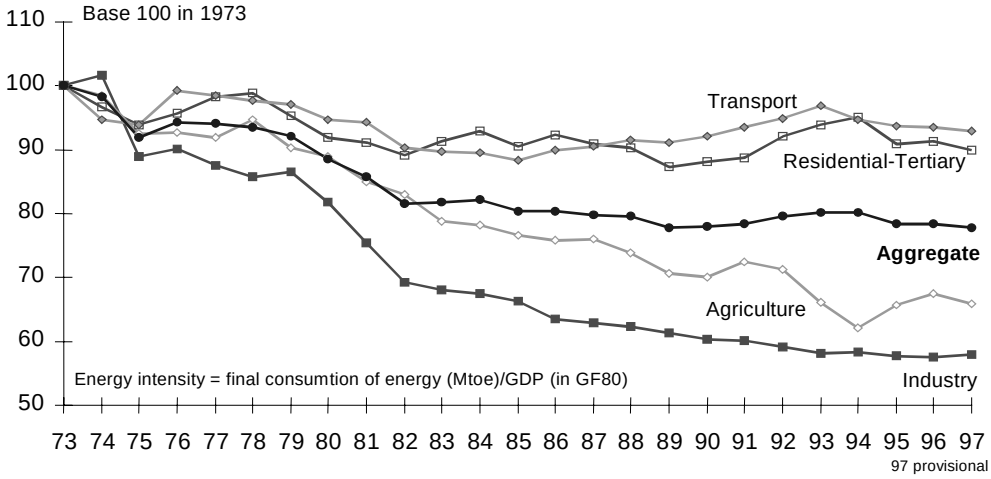
Impacts on energy intensities of GDP, 1980 to 1996, base 100=1986





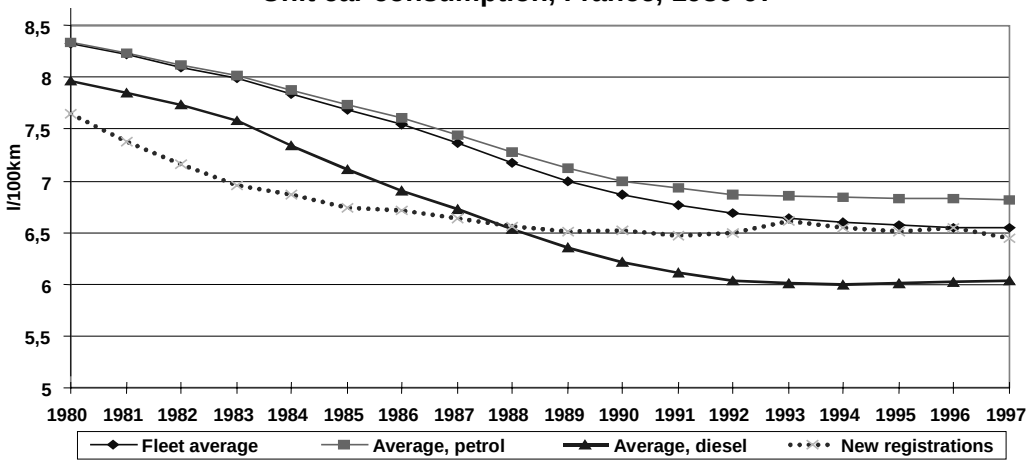


C. SECTORAL ENERGY INTENSITY TRENDS IN FRANCE, 1973-97



D. DESCRIPTIVE TECHNO-ECONOMIC INDICATORS: UNIT CONSUMPTION

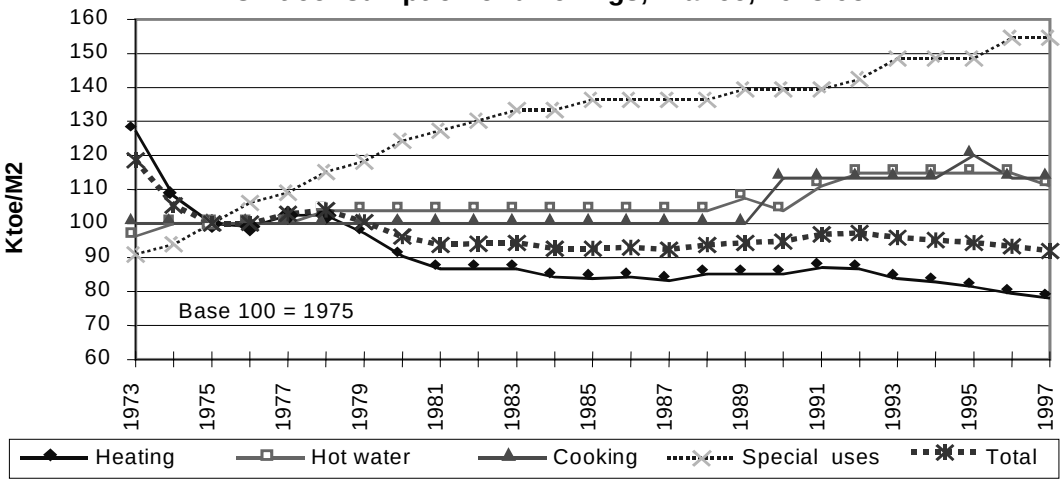
Unit car consumption, France, 1980-97



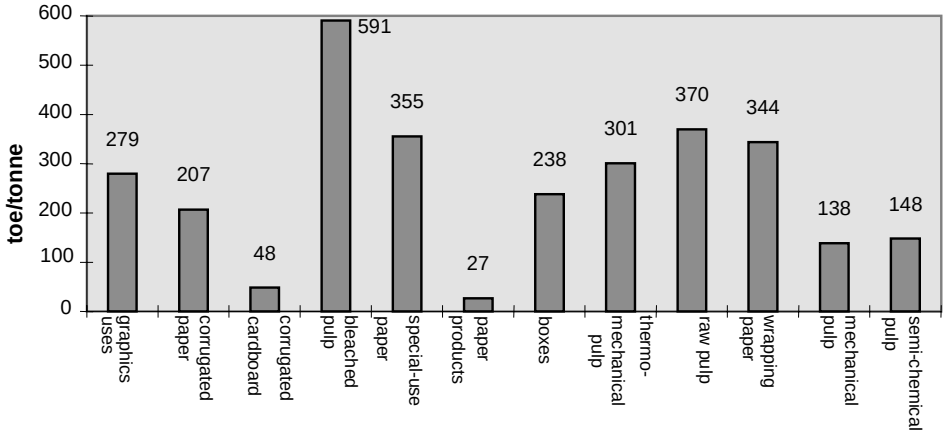
Note: Significant improvement in standard new car consumption of some 1 litre per 100 km until 1988 was followed by a stabilisation, reflecting a saturation of technological gains, and the French public's preference for cars that are more comfortable and heavier. This saturation is reflected in mediocre fleet performance, regardless of the type of fuel used.

Source: ADEME-DATAMED

Unit consumption of dwellings, France, 1973-95



Unit consumption of the cardboard industry by product and process, France, 1997

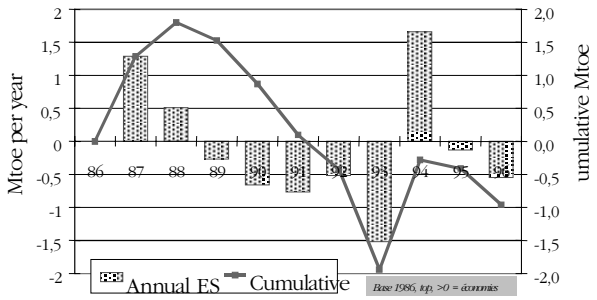


Source: ADEME from CEREN.

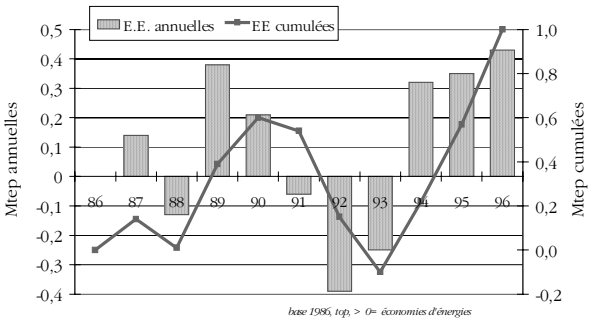
E. EXPLANATORY TECHNO-ECONOMIC INDICATORS

E1. Energy savings in France by sectors, 1986-1996, (base 1986)

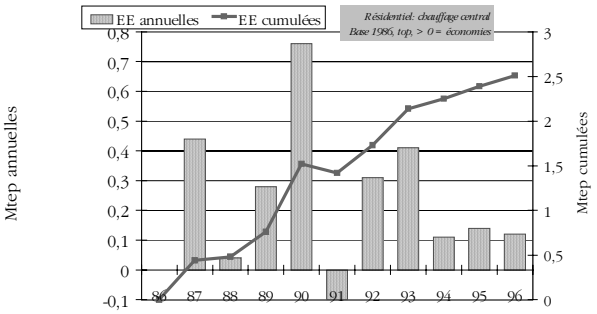
Industry



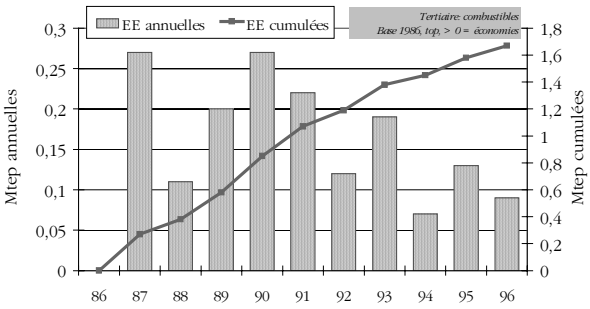
Transport



Residential



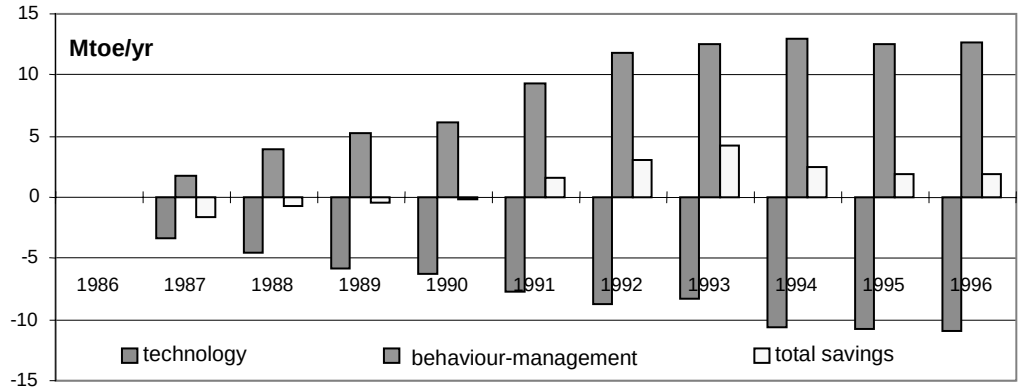
Services



Note: Left: "Mtoe per year"; Right: "Cumulative Mtoe"; Horizontal: "Annual ES" / "Cumulative ES"; "Base 1986, toe, > 0 = energy savings"; "Residential: Central heating" ; "Services: Fuel"]

Source: ADEME-DATAMED.

E2. Energy savings and behaviour, 1986-96



Source: ADEME-DATAMED.

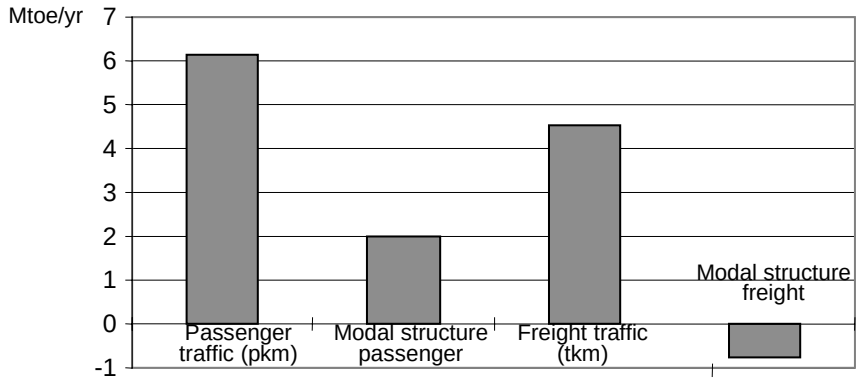
The category of apparent energy "dissavings" actually masks two opposing phenomena:

- Fairly steady energy savings from technology, due in particular to insulation standards for new dwellings and improved efficiency of road vehicles, although this has been losing momentum since 1994.
- Utilisation factors which are tending to increase unit energy consumption while achieving higher satisfaction levels of well-being and need (heating for longer periods and at higher temperatures, more miles driven, more hot water per capita, more special uses of electricity, etc.); here, a form of saturation can be observed since 1993-94.

Some of these behaviour-management "dissavings" are objective (more energy consumed for the same service because less attention is being paid to everyday management of energy consumption), while others are attributable to strides in comfort and equipment and the emergence of new uses that generate new consumption of energy. Restricting the scope of "energy savings" to uses that are not affected very much by the latter phenomenon gives a more accurate picture of the savings or "dissavings" actually achieved, or a more accurate measure of the "hard core" of energy savings.

E3. Energy consumption in transport

Transport: energy consumption impacts of changes in traffic and modal structure, 1996



Source: ADEME-DATAMED.

At a constant modal structure, and excluding energy savings, the growth in passenger traffic would have boosted annual consumption by 6 Mtoe in 1996. But modal shifts, due in particular to greater use of passenger cars and air transport, added some 2 Mtoe/year, i.e. double the amount of savings recorded at the same date by all transport.

In the case of freight, the modal shift seems to work in the same direction as energy savings, rather than the opposite. In fact, it is essentially a perspective effect stemming from the way energy is recorded for rail traffic, which shows higher unit consumption per tkm than for road transport (inclusion of the SNCF's ancillary consumption, electricity conversion coefficient, etc.).

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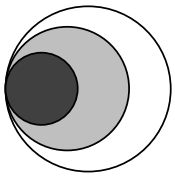
Towards sustainable development
Indicators to measure progress



OECD Rome Conference Proceedings

VOLUME III
SUSTAINABLE DEVELOPMENT IN ITALY

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Sustainable Development in Italy

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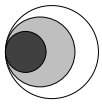

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A. ITALY TOWARDS SUSTAINABILITY: PRESENT SITUATION AND TRENDS*

* By Mario C. Cirillo, Liliana Cortellini, M. Paola Dosi, Walter Ganapini, Rocco Ielasi, Rosanna Laraia, Roberta Pignatelli (Italian Agency for the Protection of the Environment - ANPA) and Laura Mancini (Italian Health Institute).

EXECUTIVE SUMMARY

Six years have elapsed since the establishment of the *National Plan for Sustainable Development* which implements Agenda 21, and five years since the *OECD Environmental Performance Reviews* were introduced, yet even though significant progress has indeed been made in Italy, a number of issues still need to be dealt with.

Italy is still one of the OECD countries characterised by the lowest energy intensity. More extensive use of natural gas, together with the regulations reducing the sulphur content in liquid and solid fuels, have brought about a notable decrease in sulphur compound emissions, making it possible to meet the requirements of the Helsinki protocol. In recent years, emissions of the other pollutants began to reflect the positive effects of vehicle renewal in the transport sector and the implementation of cleaner processes, technologies and techniques in industry. The Sofia protocol commitments concerning nitrogen oxides emissions have thus been fulfilled. The expected further increase in energy efficiency and wider use of renewable energy sources should consolidate present trends towards a reduction of conventional pollution emissions, and should help - together with the carbon tax - to meet the national target for greenhouse gas reduction (§2.1).

In agriculture the use of pesticides and fertilisers has decreased, and biological farming techniques are being implemented on an increasingly larger scale. Measures have been put in place to curb the environmental impact of livestock farming (§2.4). Significant qualitative and quantitative improvements have been observed in the management of the natural heritage (§3.3) .

Urban waste production is rising steadily, but at the same time the rate of separate collection and of waste processed in composting plants is increasing, and the amount of waste disposed of in landfills is decreasing. Per capita production of hazardous waste is one of the lowest of the European Union. Under a new framework of regulations, clean-up work has begun in some of the more critical areas of Italy (§2.5).

The quality of inland surface water and, in many areas, groundwater, is not satisfactory. Despite recent improvements, about 450 kilometres of coast remain temporarily or permanently unsafe for bathing, chiefly as a result of inadequate sewerage treatment systems. The whole body of current national regulations on water quality has recently been reorganised (§3.2). An initial systematic response to hydro-geological degradation is being set in motion; it begins by identifying those areas that are particularly at risk of landslides and floods, and by developing adequate safeguard measures (§3.5). Many areas in Italy remain threatened by pollution from industrial activities, as well as by risks of potentially hazardous accidents in industrial plants (§2.2).

At present, the transport sector consumes the highest amount of energy, producing a variety of impacts on the environment (greenhouse gas emissions, air and noise pollution, negative effects related to infrastructures, and so on), while passenger and freight transport, especially in the cities, continues to fall short of needs (§2.3).

Urban and metropolitan areas certainly represent one of the most serious environmental issues, encompassing a host of problems such as traffic-induced air and noise pollution, waste disposal, and water consumption and quality. In the course of the ‘90s, however, the reorganisation which has been under way in the public administration of cities began to produce some positive effects even on the environment (§3.4).

In Italy a process of administrative decentralisation and bureaucratic simplification is in progress, with a view to reorganising the roles and tasks assigned to the State, regional and local administrations, increasing the effectiveness of local action programmes, further sharpening the role of Italy in the European and, more generally, the international context. The more rapid adoption of European directives, as well as the consolidation - in terms of resources and skills - of the National Environmental Protection Agency (ANPA), are just two indicators that things are moving in the right direction.

I. INTRODUCTION

The National Plan for Sustainable Development, approved in 1993, defines national objectives, with a view to adjusting to Agenda 21, as well as the actions and tools to be implemented in such sectors as energy, industry, agriculture, transport, tourism, and waste disposal (Ministry of the Environment, 1993).

In its conclusions, in the *OECD Environmental Performance Reviews* (1994), the group on Environmental Performance sets out a series of recommendations. The Ministry of the Environment - ENEA (1999) conducted a thorough analysis of these recommendations, on the basis of current trends emerging in our country.

Some years have elapsed since the publication of those two documents, and even though significant progress towards sustainability has indeed been made in Italy, a number of issues still need to be dealt with. A number of specific features of the "Italian system" and its complexities need to be taken into account:

- Italy's geographical position in the centre of the Mediterranean basin, but also adjacent to Central Europe, makes it a natural connecting point between North and South.
- Local and regional aspects characterise several economic phenomena, in both the positive and the negative sense (Balcet, 1995). For instance, on the one hand, there are industrial districts which are primarily systems of small- and medium-sized enterprises, deeply rooted in the local context, and, on the other, the mafia's economic activities, which are so powerful in environmentally significant sectors, such as waste disposal.
- The North-South gap is clearly evident even in the environmental management sector.
- Italy boasts an artistic and cultural heritage which is unique in the world, has been built up over thousands of years, and must be considered as an integral and fundamental part of the national environmental heritage.
- Italy is conducting a process of administrative decentralisation and bureaucratic simplification, in which it is reorganising the roles and tasks of the State, and regional and local administrations.

II. DRIVING FORCES

1. Energy

During the period 1985-97, global energy consumption in Italy rose from 146 to 176 Mtoe, with a 1.54% average annual growth rate, in line with the European average, while the demand for electricity has increased by an annual average annual rate of 2.83%. This accounts for the different trends in the two following indicators, primary energy intensity and electricity intensity. In the period examined, the former decreased by 4%, while the latter rose by 11.6%, confirming a growing demand for electricity in end uses. Italy is, however, one of the OECD countries with the lowest energy intensity.

In 1997, 54.1% of the national primary energy input consisted of petroleum products, followed by natural gas (27.3%) and coal (7.5%); the remaining 11.1% derives from geothermal, hydroelectric and other renewable sources (6.3%), as well as imported electricity (4.8%). Oil use still predominates – this, in fact, is one of the specifics of the Italian situation – even though the average annual growth

rate in the period 1985-97 (+0.86%) is lower than the global energy consumption rate (+1.54%). It is worth noting that the same period is characterised by an increased use of natural gas (with a 4.7% average annual rise), a decrease in coal use (annual rate, -1.75%), and significant increase in imported electricity (annual rate, +4.18%).

Considering energy consumption on a sector basis, transportation is the sector with the highest energy consumption (30.5% of the overall national value, in 1997). Where the largest increases have been registered in such consumption, with 3.06% average annual growth rates, between 1985 and 1997, this is mainly due to individual car transport consumption. Domestic, commercial and institutional uses (29.4% of the overall national value, in 1997, with a 0.87% average annual growth rate in the period 1985-97) and industrial use (29.2% of the overall national value, in 1997, with an annual average growth rate of 1.40% in the same period, and consumption essentially stabilising as of 1995) follow.

Wider natural gas use, together with new more stringent regulations concerning the sulphur content in liquid and solid fuels, have brought about strong reductions in sulphur emissions. This has allowed the requirements of the Helsinki protocol to be met (within the framework of the Geneva Convention on trans-boundary air pollution), according to which, by 1993, Italy was committed to reducing such emissions by 30% in comparison to 1980. In recent years, emissions of the other pollutants began to reflect both the positive effects of vehicle renewal in the transport sector. This has enabled – among other things – the Sofia protocol commitments to be met relating to nitrogen oxides emissions, with such emissions stabilising by 1994, compared to 1987.

However much this may be counterbalanced by the growing number of vehicles and miles covered and the implementation of cleaner processes, technologies and techniques in the industrial sector, where environmental certification systems are still not extensively used.

The expected increase in the energy effectiveness of thermoelectric plants in Italy – one of those sectors in which privatisation and liberalisation are taking place – through the introduction of the combined natural gas cycle in a significant number of existing plants, a more extensive use of renewable energy sources, as well as interventions aiming at developing energy effectiveness in end uses of energy, if effectively finalised, should consolidate present trends towards a reduction of conventional pollutant emissions. This will help (in conjunction with the expected application of carbon tax) towards the achievement of the national greenhouse gas reduction target, as defined by the European Union, in view of the implementation of the Kyoto Protocol (6.5% reduction (on 1990) in annual emissions of greenhouse gases, calculated as an average for the period 2008-12).

2. Industry

In recent years, the environmental impact of industrial sector has decreased, both in terms of emission per product unit and per generated value unit, and in overall terms, at least for some pollutants: sulphur dioxide emissions decreased by 60% in 1980-90, and by 31% in 1990-97, while nitrogen oxides emissions decreased by 5% in 1980-90, and by 17% in 1990-97. Environmental innovation is still weak and seems to reflect a more general loss of competitiveness on the part of the Italian system, as well as a reduction in technological and scientific capacity. In fact, Italy (Ambiente Italia, 1999):

- registers a decrease in the technological content of industrial value added;
- makes 7% of what the United Kingdom takes from its technology sales;
- records a number of Internet accesses (about 360,000 sites, compared with the 8,500,000 European) and personal computers (113 for every 1,000 inhabitants) below that of almost all its European partners, while its high telephone density (81 lines for every 100 inhabitants) does not in fact represent greater access to information;

- spends half the average OECD amount on research and development (1.1% compared with 2.2%).

From the legislative point of view, specific measures have been introduced, in particular, industrial risk and clean-up operations. The responsibility for defining “areas at risk of environmental crisis” and the related programmes for environmental reclamation and prevention has recently been transferred to the Regions, and priority is now to be focused on the environmental reclamation of polluted sites. Further action has been geared towards implementing the Seveso directive on the risk of severe hazards in industrial plants, the adoption of directive EC/96/82 (Seveso 2), the extension of decision making powers for Environmental Impact Assessment, the simplification of administrative procedures and the recent adoption of the IPPC (Integrated Pollution Prevention and Control) directive. Among the programmes for industrial sites, particularly important is the one conducted in Porto Marghera, a large industrialised zone in which about 50% of the Italian chemical industry is concentrated, situated in the highly vulnerable Venice lagoon area.

Environmental taxation, which in 1991 accounted 13% of the revenue (3.3% of the GDP), decreased by as much as 9% in 1998 (2.6% of the GDP): rather than transferring labour-related taxes to deductions connected with the environment and pollution, the reverse has occurred. Financial and insurance tools (environmental risk and environmental damage insurance) have, however, been developed in Italy, largely as a private initiative.

Voluntary agreements (the National Agreement on Energy and Environment, agreements with large industries such as Fiat, Montedison and Pirelli, designed to reduce greenhouse gas emissions, the establishment of the Kyoto Club, and others) are becoming more common, whereas tools for use in follow-up and monitoring action are still lacking.

The Ecolabel-Ecoaudit Committee, the official Italian body for the implementation of the tasks outlined by the European regulations, was set up in 1997, and ANPA has been identified as the technical support organisation for EMAS and Ecolabel activities. To date, 21 industrial sites in Italy have been registered with EMAS (almost all are located in Northern Italy, and 60% are part of large enterprises). The national accreditation committee has released ISO 14000 accreditation to five organisations; three of these five are also accredited as EMAS controllers. To date, 165 companies possess an ISO 14001 certificate; in addition 19 companies/sites are registered with EMAS.

The ratio calculated (ISO certificates/EMAS registration) is 7.8 in Italy, compared to the European average of 2.3 (excluding the German contribution - 5.9) points to a lack of participation in the EC scheme, despite the fact that Italy is one of the highly industrialised countries in Europe. There are several reasons for companies preferring ISO 14001 to EMAS: for instance, the fact that companies are well acquainted with the ISO standards, already established in the industrial sector, and the expectation of wider recognition by the international market.

Public incentives have been devised recently; ANPA has provided both guidelines and support manuals in order to promote the participation of small- and medium-sized enterprises in the EMAS system. As a further contribution to the extension of ISO and EMAS, in mid 1999 the Agency set up a national network to disseminate - at local and national level - information collected at the global, national and regional levels. The Agency acts directly as the promoter and co-ordinator of this project, which also sees the co-operation of the Regional and Provincial Environmental Protection Agencies (ARPA, APPA) as the main focal points.

At present, over 40 companies publish Environmental Reports and this number is increasing. They are in line with the future creation of national environmental accounting systems integrated with National Economic Accounts, particularly for the Industrial Sector, complementary to the Household and the Public sector. This economic environmental integration is carried out by EUROSTAT and supported by European Environment Agency. The pilot projects and implementation studies covering the Member States, include some significant experience at national level made by ISTAT (Italian Statistics Institute) and ANPA (e.g. NAMEA-air emission). ANPA is promoting at regional and local level some natural resource accounts (e.g. land and water accounts) as well as methodological

initiatives concerning material flow accounts, in co-operation with Ministry of the Environment and ISTAT. A very innovative bill on environmental satellite accounts introduced at Public Administration level, was proposed and was recently approved by the Senate. If definitely approved - and adequately enforced - it could provide a useful support for decision making.

Italy is one of the few countries which has not its own Ecological Quality Mark, and to date it participates marginally in the creation of the European brand (just one licence out of the 51 ones released).

3. Transport

During the period 1990-96, mobility demand rose from 728 to 837 billion passengers-km for passengers (+15%), and from 247 to 275 billion tons-km for freight (+11%). This increase has not been curtailed by advances in telecommunications and information technology, nor by adaptations made to the town planning and land use management tools, which still are not clearly focused on reducing mobility demand. For the first time, the decree on sustainable mobility in urban areas (27 March 1998) provided means for rationalising and reducing mobility demand, or at least for modal splitting.

The largest share of transport activity is by road. With its 31 million vehicles in circulation during 1997, Italy holds the record in Europe for private car density (54 cars for every 100 inhabitants). The increase in the use of other modes of transport has echoed the mobility demand trend, with the exception of urban public transport, which has registered significant losses. Air transport has risen notably, although it caters for only a limited share of the demand (Table 1). Also freight transport is characterised by a similar trend, with road transportation still taking the lead, and accounting for 76% of the total tons-km, with the exception of oil pipelines (Table 2). Public expenditure for road transport infrastructure has made a sizeable contribution to this sector, with a trend to reduction emerging only during the ‘90s. Investments in the railways sector have, on the contrary, been more contained and, until the ‘80s, did not begin to attain levels comparable to those seen in the road sector (ISTAT, 1996).

In the period 1975-96, energy consumption doubled in this sector, compared with the rise of about 30% in overall national end consumption. Moreover, road transport is currently the largest contributor to nitrogen oxides, non-methane volatile organic compounds, carbon monoxide and benzene emission and its share of the total emission of these pollutants is increasing (cf. §3.4).

In 1997, the number of road accident fatalities again increased on that of previous years. On the one hand, the number of accident felt in relative terms. On the other the significant decrease registered in road deaths, in absolute terms, during the ‘70s and ‘80s did not continue during into the ‘90s decade. On the contrary, the number of injuries remained stationary (ACI-ISTAT, various years).

Table 1. **Domestic passenger traffic by means of transport in Italy**
(millions passenger-km and percentage composition)

Year	Railways and other fixed systems	Air traffic	Collective extra-urban transport	Waterways	Collective urban transport	Motorcars and motorcycles	Total
1960	31,704	194	16,438	433	14,365	59,761	122,895
	(26%)	-	(13%)	-	(12%)	(49%)	(100%)
1970	35,130	1,439	21,938	928	13,825	234,422	307,682
	(11%)	(1%)	(7%)	-	(5%)	(76%)	(100%)
1980	43,376	2,867	41,777	1,589	20,583	350,949	461,141
	(9%)	(1%)	(9%)	-	(5%)	(76%)	(100%)
1990	48,588	6,416	72,339	2,493	16,183	582,717	728,736
	(7%)	(1%)	(10%)	-	(2%)	(80%)	(100%)
1996	53,432	7,871	77,774	2,643	15,919	678,967	836,606
	(7%)	(1%)	(9%)	-	(2%)	(81%)	(100%)

Source: Ministry of Transport, 1998. “Conto Nazionale dei Trasporti”.

Table 2. **Domestic goods traffic by means of transport in Italy**
(millions tons-km and percentage composition)

Year	Railways	Shipping	Air transport	Road transport	Oil pipelines	Total
1960	16,853	7,972	2	37,234	757	62,818
	(27%)	(13%)	-	(59%)	(1%)	(100%)
1970	18,966	26,549	9	58,658	9,074	113,256
	(17%)	(23%)	-	(52%)	(8%)	(100%)
1980	19,090	31,315	19	119,629	11,744	181,797
	(11%)	(17%)	-	(66%)	(6%)	(100%)
1990	21,912	35,783	33	177,945	11,512	247,185
	(9%)	(14%)	-	(72%)	(5%)	(100%)
1996	24,050	40,003	30	198,295	13,037	275,415
	(9%)	(14%)	-	(72%)	(5%)	(100%)

Source: Ministry of Transport, 1998. "Conto Nazionale dei Trasporti".

The difficult process of opening up the sector to the market and to privatisation is still in process for rail and road infrastructure. This process involves with the reorganisation of railway development to promote freight transport, and to reconvert high-speed projects into high capacity projects, and the redefinition of a series of road projects designed without a consistent framework, often under local pressures.

For the first time in Italy, a Government paper, outlining the direction taken in the New General Transport Plan, has been jointly drawn up by the Ministries of Transport, Public Works, and the Environment. This document introduces several innovative principles, such as the reduction of the environmental impact and negative externalities generated by the transportation system, and the need to focus on the demand management and reduction.

4. Agriculture and Tourism

In the agricultural sector, the number of farms adhering to the Community regulation 2078/92 ("agro-environmental measures") is increasing, after a slow start in the first two years of implementation due mainly to the delay on the part of regional and local administrations in drawing up guidelines for farm managers. The overall area of Italy covered by the application of the regulation has increased by 128%, from 706.000 ha in 1995 (ISTAT, 1998) to 1.600.000 in 1997 (INEA, 1999). The measures been implemented are those concerning the reduction of fertilisers and pesticides use (593.000 ha in 1997), and the practices of ecological farming (525.771 ha in 1997) and organic farming (310.996 ha in 1997). The following trends were registered, during the period 1995-97 (in surface of the farms implementing the various measures):

- reduction (or maintained reduction) in the use of fertilisers and pesticides: +122%;
- introduction or maintenance of biological farming methods: +314%;
- implementation or maintenance of extensive agriculture: +429%;
- use of environmental-friendly systems and maintenance of agricultural landscape: +63%;
- management of disused lands and forests: +155%;
- land set aside for environmental purposes covering a twenty-year span: +390%;
- land use management for public and recreational purposes: +389%.

In the period 1991–95 the use of pesticides – in terms of kilograms per hectare of agricultural land – was 13% down on the previous five years; a similar reduction was recorded for the use of chemical fertilisers per hectare, during the same period.

In Italy, organic farming has developed at one of the highest rates in Europe, rising from 200,000 hectares of agricultural land in 1995 to 564,000 hectares in 1997. This development is due to several factors: the implementation of Community regulation 2092/91 on organic farming, the interest shown by consumers which has produced a heavy demand, and the incentives provided by the EEC regulation 2078/92. In 1997 the number of "organic farms" monitored by certification bodies reached 31, 118, a 70% increase on 1996. Most of these farms are located on the islands (44% of the total) and in southern areas (25%), and the remaining 31% is distributed in central or northern regions.

The number of cattle and swine decreased in 1987-97 (–18% and –6% respectively), and resulted in a lower environmental pressures being exercised by these livestock categories. Since the early '90s the regions with the highest livestock density (Emilia Romagna, Veneto, and Lombardia), have produced their own regulations on the handling and spreading of animal manure, with a view to reducing groundwater and surface water nitrate pollution by diffused sources. These Regions anticipated the adoption of the nitrate Directive (676/91) into national law which took place this year with the passing of the law on water (152/99).

The environmental impact indicators used in the tourism sector (hotel capacity utilisation ratio, arrivals per 100 residents, arrivals per km^2, etc.) show that the increased number of tourists may represent a risk of danger for the environment and the cultural heritage, particularly when these flows are concentrated in certain areas and in certain periods of the year (ISTAT, 1998b). Altogether, Italy officially records 290 million tourists per day, which is certainly an underestimate. Consumption by tourists accounts to some 131,000 billion Italian lire (10.7% of overall consumption), and the value added of direct tourism industry corresponds to 3.8% of the national value added.

49% of all tourism is concentrated in a handful of Regions (Veneto, Trentino-Alto Adige, Emilia Romagna and Toscana), in which, moreover, some 41% of all expenditure by tourists and 43% of that of foreign visitors is registered (CISET-IRPET, 1998); in southern Italy and the islands, on the on the hand, tourists represent only 19% of the national total value, and 21% of the total tourism expenditure, with only 12% of foreign tourism. At national level, 61% of tourists are concentrated in seaside, mountain, lake and hill resorts. Cultural and business tourism account for 24% of the national flow, both sectors being focused in the Regions of Veneto (particularly Venice), Toscana (Florence) and Lazio (Rome), where the impact of tourism is considerable, particularly during July and August, when more than 40% of the annual flow can be registered in these areas alone.

While in some areas (seaside and mountain resorts, cities with a high concentration of works of art, vulnerable natural areas) it may become necessary to limit or, at least, to alter the way tourist facilities are used, in some interior and marginal areas the development of environmental tourism may even contribute to the enhancement and/or conservation of the historical, cultural and natural heritage, in addition to human settlements, as has been shown by the positive experience of the parks created in the regions of Abruzzo and Tuscany. Although concentrated in just a few areas (approximately 60% of all available "official" accommodation is to be found in Tuscany and the province of Bolzano–ISTAT, 1999), the development of agri-tourism, or farm holidays – which is just one aspect of this kind of tourism –confirms that such an approach has potential.

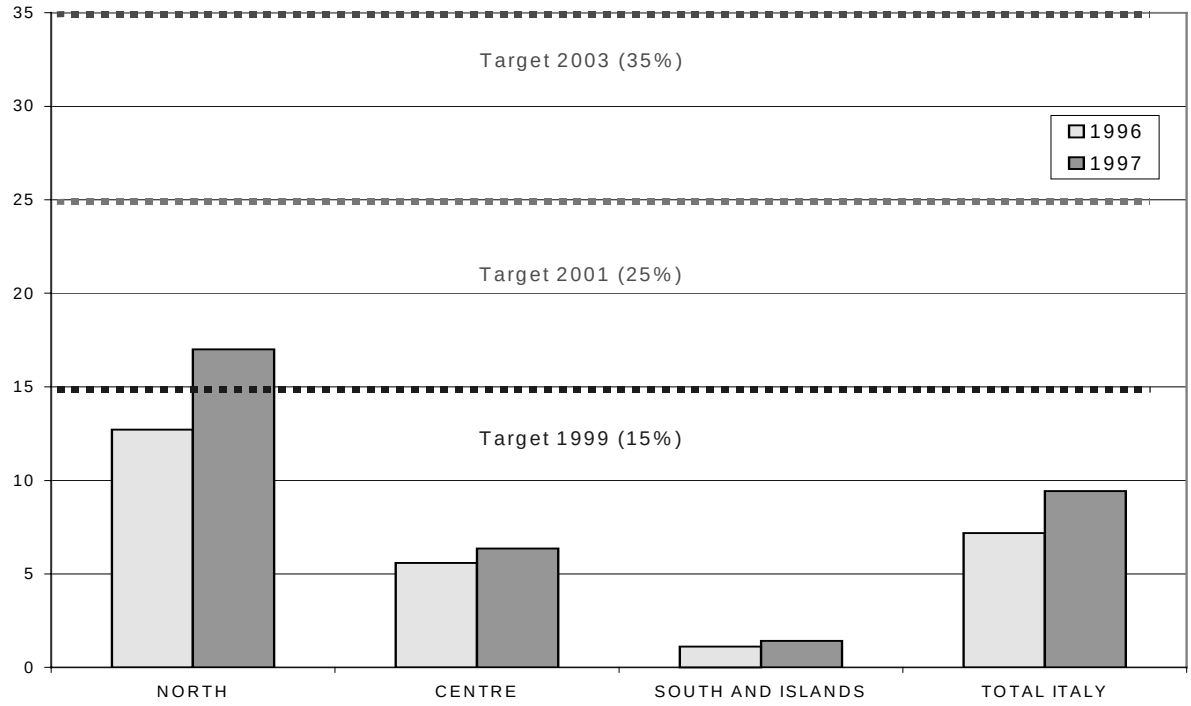
5. Waste

In 1997 the amount of urban waste generated in Italy was about 26.6 million tons, equivalent to a per capita generation of 462 kg/year (lower than the European average of 507 kg/year). The 1997 total shows an increase of 2.5% on the estimate for the previous year (ANPA - Osservatorio Nazionale sui Rifiuti, 1999a). At the same time, an increase on 1996 has been observed both in the GDP (+1.5%) and in household consumption (+2.5%).

In 1997, a 2.2% rise on the previous year was registered in separate waste collection, with approximately 2.5 million tons being collected by this method, which represent 9.4% of all waste

generated in 1997 (17% in the north, 6% in the centre, and 1% in the south) (Figure 1). Paper and glass account for the highest fraction of separately-collected urban waste, organic materials follow.

Figure 1. **Urban waste separate collection per geographical area** (% of total)



ANPA – Osservatorio Nazionale sui Rifiuti, 1999a

In 1997, about 80% of urban waste was disposed of in landfills (-3%, compared with 1996), 9.5% was treated in sorting and composting facilities with the production of RDF (Refuse Derived Fuel) (+4%), 6.6% in incinerators (+0.6%), 3.9% in other kinds of treatment facilities (biological, stabilisation/solidification, material recovery plants). Data show that most urban waste is still disposed of in landfills. It is important to note however, that 1997 is the reference year for future monitoring of the implementation of reforms.

The total quantity of waste generated by economic activities is estimated at 60.9 million tons in 1997, 92% of which is not hazardous, 6% hazardous, and 2% not classified. Manufacturing activities producing the largest amounts of hazardous waste are the chemical and pharmaceutical industries (19.3% of all production), followed by metal and related alloys (16.8%), while non hazardous waste is mainly by the building industry (36.6%), waste and water treatment facilities (13.9%), ceramics and glass factories (7.8%), and the food industry (7.2%) (ANPA - Osservatorio Nazionale sui Rifiuti, 1999b).

Per capita generation of hazardous waste in Italy (59 kg/year) is among the lowest in Europe, being higher only than that indicated by Greece, Sweden, United Kingdom, but much lower than that of France and Germany (respectively 123 and 112 kg/year). The quantity of waste generated by economic activities per GDP unit is equal to 60 kilograms/1000 Euros (1997, at current rates); on a national basis, the production of hazardous waste is equal to 3.6 kilograms/1000 Euros, with peak values recorded by the chemical industry (approximately 42 kilograms/1000 Euros). These figures probably underestimate the real situation.

The amount of waste generated by economic activities and managed in 1997 is equal to 46.7 million tons. 45% of which is disposed of in landfills, 26% is treated in licensed facilities for materials and energy recovery (11.7 million tons and 0.5 million tons respectively). These indicators show that the new policies promoting recovery are yielding their first significant results.

The Italian framework law on waste (Law 22/97) implements the European framework directive on waste, as well as the hazardous waste, packaging and packaging waste directives. Law 22/97 introduces the European Waste classification and the European scale of waste management principles: waste minimisation and prevention at source followed by recovery (reuse, recycling and energy recovery) and safe disposal. In addition Law 22/97 promotes clean technologies, the Ecolabel, EMAS, integrated networks of recovery and disposal facilities, alongside voluntary agreements between public administrators and economic operators in order to create real opportunities for recycling waste.

Concerning separate collection, targets have been set which are to be reached within six years of the introduction of Law 22/97 (15%, 25% and 35% respectively by 1999, 2001 and 2003). An economic incentive is also provided in the form of a link between reaching the targets and the landfill tax. The law also establishes the new regulations for the clean up of contaminated sites, while Law 426/98 provides a "National program for the clean up and restoration of polluted sites" for contaminated sites which, because of their public interest, may receive up to 50% of the funding needed for such operations. Finally the law, by adopting the Directive EC/94/62, redesigns packaging and packaging waste management system, on the basis of the principle "polluter pays" and "shared responsibility" among all actors involved in packaging life cycle.

III. PRESSURE AND STATE

1. Atmospheric emissions and air quality

Emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x) and carbon dioxide (CO_2), in relation to both the GDP and the population, are below the OECD average. Since the '80s, it has been found that anthropogenic SO_2 emissions are unconnected to the GDP and the consumption of fossil fuels, and during the period 1980-97 they decreased by 61% (Figure 2). The situation is different for NO_x: the annual rate of increase during the period 1986-92 is even higher than that of fossil fuels, and only in 1993 embarked on a downtrend, unlike both the GDP and the fossil fuel consumption rates (-15% in the period 1992-97). Even more closely linked to the trend in fossil fuel consumption is the rate of CO_2 emissions which, for the time being, still show no sign of decreasing.

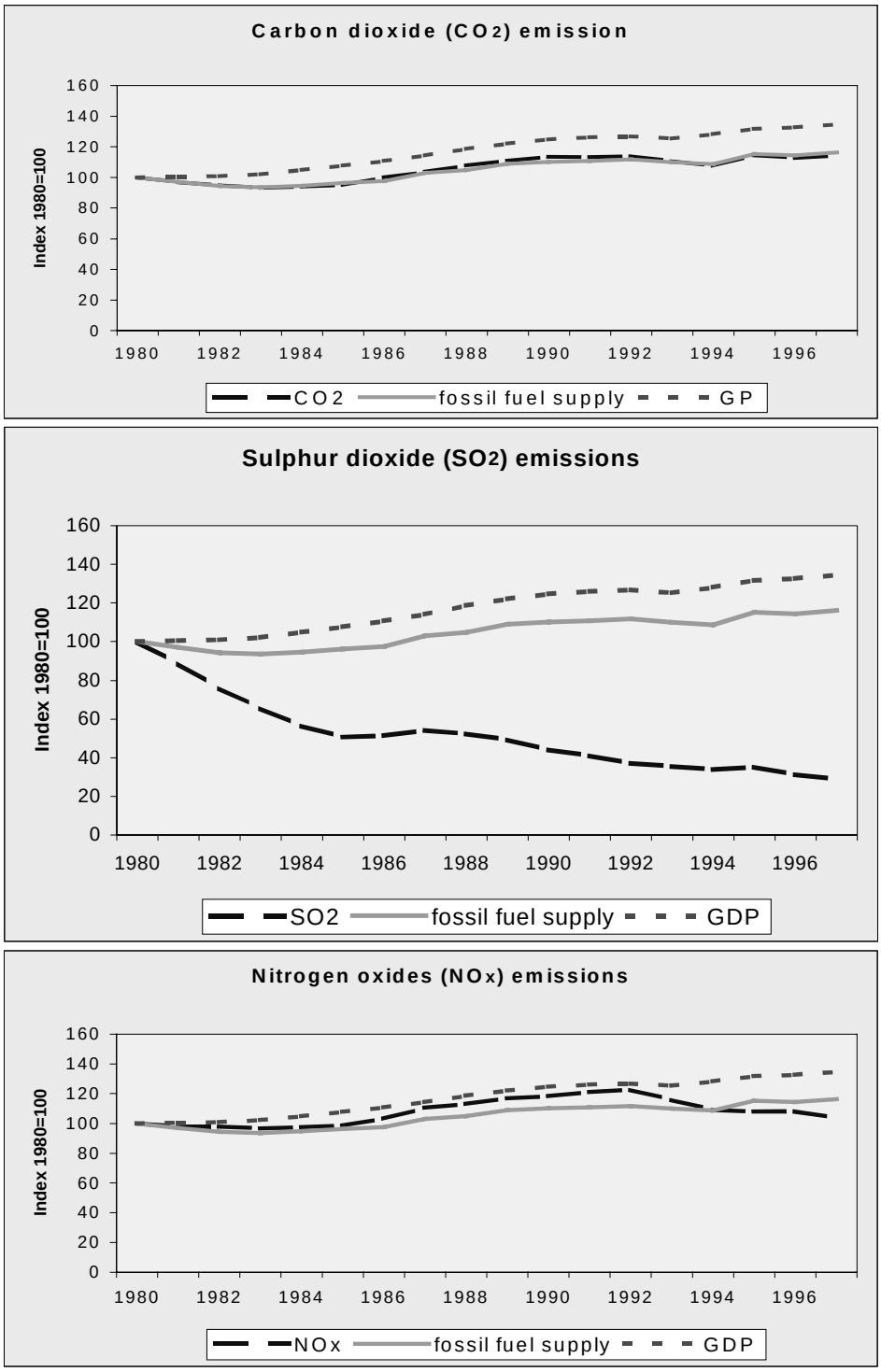
Energy production continues to be the sector which predominates by far in the national $S0_2$ emission rates: the *combustion - energy and conversion industry* sector registered a contribution of 63% to anthropogenic emissions in 1997.

The sectors which make the largest contribution to NO_x emissions are *road transport*, which in 1997 accounts for 53% of overall emissions, *combustion - energy and conversion industry* (17% of the total at 1997), *combustion - industry* (12%), and *other mobile sources* (12%).

For CO_2, the sectors accounting for most of the emissions are, in order, *combustion - energy production and conversion industry* (31% of total CO_2 emissions in 1992), *road transport* (24%), *combustion - manufacturing industry* (19%), and *combustion - non-industrial* (domestic and agriculture) (16%).

In the case of other macropollutants - in particular non methane volatile organic compounds (NMVOC) and carbon monoxide (CO) - a downtrend has been observed in recent years, which is a result of the combined *effect* of measures implemented in industry (for solvents, in particular, as far as NMVOCs are concerned) and the renewal of the fleet of vehicles in circulation. The sectors making the largest contribution to anthropogenic NMVOC emissions are *road transport* (50% of the total at 1997) and *solvent use* (25%). More than 70% of CO emissions can be attributed to road traffic.

Figure 2. **Air pollutant emissions in Italy** (1980-1997)



Source : ANPA, 1999a

For micro-pollutants, it is important to note the decrease in lead emissions, and the significant reduction in cadmium and mercury emissions occurred during the ’90s, primarily due to the abatement of suspended particles in the *combustion - energy and conversion industry* sector. During the ‘90s, significant reduction also occur in dioxins and furans emissions.

Air quality in Italy is affected by atmospheric pollutant emission trends: a substantial decrease in sulphur oxides concentrations began to be visible in the mid ‘80s, whereas the situation of other pollutants remains critical, especially in urban areas (cf. §3.4). Ozone is giving rise to growing concern in both urban and rural areas (ANPA, 1999a).

2. Water resources

In Italy water demand for the various primary uses continues to rise and, simultaneously, surface water deteriorates. According to a recent estimate, of the 52 billion cubic metres available with the current regulation capacities, about 40 is actually utilised (IRSA, 1999); about 20 goes to agriculture, while a gradual reduction is being observed in industry (Table 3).

Table 3. **Water consumption in Italy in 1990**
(million cubic meter)

	Domestic and Commercial	Industry	Agriculture	Energy	Total
North - West	2,268	3,520	8,193	1,863	15,844
North - East	1,453	1,648	5,277	2,538	10,916
Centre	1,618	1,482	970	72	4,142
South	1,803	879	3,506	36	6,224
Islands	798	457	2,191	-	3,446
TOTAL	7,940	7,986	20,137	4,509	40,572

Source: IRSA, 1999.

In the case of domestic, commercial and institutional uses, a substantial increase on the previous decade occurred in water withdrawal during the '80s. This was accompanied by increasingly less efficient distribution, a trend which has stabilised during the '90s. Current unit consumption of water delivered is about 300 litres/inhabitant/day, although – mainly as a result of losses - the water drawn is often above 400 litres/inhabitant/day. It must not be forgotten, however, that in many areas of southern Italy the low level of consumption is to some extent "imposed" by the inadequacy of services. In addition, even if the action taken might lead one to believe that the situation is improving in a number of urban areas in the south, the problem of scarcity will reappear as a result of peak demand in some areas (tourist resorts for example). The volume of piped potable water losses is the equivalent of about one quarter of the total volume drawn. With regard to the sewerage networks, about 20% of the population is served by networks which have significant functioning problems. For the water networks, Italy has an average loss of 35%, with peaks of 40-50% in southern Italy and the islands.

The cost of water is one of the critical points to be resolved if its management is to be more efficient (Table 4). Improving the efficiency of the distribution networks does not depend on the rates users pay to the water company, but rather on the fees paid by the company to the State, which are altogether insufficient (about 1 lira per cubic metre) to justify the substantial investments that are needed to raise the efficiency of the networks. Appropriate changes in these fees could also promote the extension of efforts to rationalise use in agriculture or to re-use wastewater.

Table 4. **Fees for water use**

Destination	Unit of measure (1 module= 3,000,000 m3)	1994 prices (Italian Lire)	1933 prices in Italian Lire (at 1994 current rates)
Agriculture	Module	70,400	255,785
	Hectare	640	2,558
Public	Module	3,000,000	255,785
Industry	Module	22,000,000	Not available
Hydroelectric	Nominal kW	20,467	15,347

Source: Bartolomeo et al., 1995.

The knowledge of the state of the environmental quality of water at a national level cannot be considered satisfactory, given the shortcomings that continued to exist both in approach (lack of definition of environmental quality targets) and in regulations (measures essentially focused on the definition of emission limits) until legislative decree 152/99 was enacted. Monitoring is carried out in ten regions of Italy using the minimum set of indicators on a greater number of waterways and not restricted to the water bodies listed as significant under decree 152/99 (ANPA-ARPAT-CTN-AIM, 1999). Since monitoring first began as an implementation of legislative decree 130/92, considerable effort has been made but, at the same time, there is a lack of quantitative uniformity in applying the regulation and a diversity of approaches are being adopted by the Regions (ANPA-Ministry of the Environment, 1999).

Recent estimates indicate that, on a national scale, 77% of the population equivalent is linked to the sewerage networks, while 63% is treated by the plants in operation. Considering domestic and commercial discharges only, it is estimated that, in the chief towns of the Provinces, 68% of the population is connected to treatment plants (in southern Italy this drops to 57%); not included here are several large cities such as Milan, Florence, Palermo or Catania. Shortcomings and inadequacies are widespread, however: only 56% of the population lives in main municipalities which have at least 75% of the inhabitants connected to the treatment plant.

A large gap exists between the theoretical installed treatment potential and the benefits obtained in terms of water quality which, at least in part be attributed to the poor management of treatment plants and the increase in the number of sewerage networks which are depositing the untreated waste in water bodies. It is estimated that the equivalent of about 20% of the inhabitants connected to the network are not served by a treatment plant: thus sewage which beforehand was disposed of in the soil or distributed over the smaller drainage network, and partly treated "naturally", concentrates in the water bodies which must support loads above their self-purification capacity.

Legislative decree 152/99 incorporates two important European directives (91/271 on wastewater treatment and 91/676 on the protection of water from pollution caused by nitrates from agricultural sources), and marked the reorganisation of all current regulations on water quality. One of the main innovations is that the "discharge standard" is no longer the only criterion for assessing the compatibility of an effluent; in line with the future European directive on water, the concept of water body quality target has now been introduced. It is planned that Regions, together with the Watershed Authorities, will approve "Protection plans" which define a quality target for each water body, establish the acceptable loads which are compatible with the self-purification capacity of the water body and, on this basis, define the discharge limits. Under this decree, once fully implemented, a complete monitoring system should be put in place for both surface water and groundwater, the cost of which is estimated to be between 30 and 40 billion Italian lire (Boeri et al., 1999). Considering that much of the action envisaged by the law is already in progress in several areas of Italy, it is calculated that the increase in monitoring costs deriving from the adoption of the decree would amount to a maximum of 10 billion Italian lire.

Particular importance is given to the protection of land from the desertification processes under way. A National Committee to Combat Desertification has been established in September 1997. This

Committee has prepared the First National Communication to the UNCCD and the National Program to Combat Desertification, which is going to be approved by the Interministerial Committee for Economic Planning ; it will also co-ordinate the preparation of the Regional Plan of Annex 4 Countries (Greece, Italy, Portugal, Spain, Turkey). The Ministry of the Environment has promoted the establishment of a National Observatory on desertification in the national park on the island of Asinara, in co-operation with the municipality of Porto Torres. In Matera, it has set up a Centre of Studies to gather more traditional knowledge for the purpose of combating desertification, in co-operation with the region of Basilicata (Ministry of the Environment, 1999).

3. Nature

Through the system of protected areas in Italy, more than 2,500,000 hectares - the equivalent of 8% of the total area of the peninsula - are under special protection. The recent Law 426/98 ("New action in the environmental field") has strengthened the management of parks and nature reserves, and procedures have been set in motion to establish five new national parks.

At present, the situation is satisfactory as far as concerns the basic management of parks, but the processes of integrating the park system into the specific socio-economic context of the surrounding area need to be speeded up.

4. Urban areas

In a survey of the average level of satisfaction among Italians in relation to several "themes", negative scores were given - regardless of where respondents lived, their socio-economic status, and other factors – for air quality, the presence of greenery in cities, traffic, public transport, street cleanliness (Abacus, 1998).

An average 12% increase occurred in the per capita generation of urban waste during the period 1994-98. A parallel increase was also noted in separate collection: of the 103 main municipalities of the Provinces, separate collection is above 25% in 10 (no municipality in 1994), in 23 it is above 15% (3 municipalities in 1994), while in some 32 municipalities, all in central-southern Italy, it is still below 5%. With regard to potable water, 80% of the municipalities declared a per capita consumption rate of less than 400 litres/day in 1998; 34 municipalities have an average nitrates concentration below 5 milligrams/litre, and 80% register a level below 15 milligrams/litre (Legambiente, 1999).

In the cities, road transport is responsible for more than 60% of NO_x and NMVOC emissions and for over 90% of CO emissions (Table 5).

The trend over time of pollutant emissions from transport in urban areas depends on two contrasting elements. On one side, the rise in the number of vehicles in circulation and the simultaneous increase in distances travelled (both overall and specific), which leads to an increase in emissions. On the other, the renewal of the fleet of vehicles in circulation (in particular, cars without catalytic converters being replaced by those fitted with converters, old diesels and motorcycles being replaced by new ones), which brings about a decrease in emissions. The result of these actions is a drop in emissions from road transport from 1992 onwards. It is important to note that about one third of NO_x emissions from both cars and heavy vehicles is registered in urban areas; similarly, more than 70% of the NMVOC and CO due to road transport is emitted in urban areas.

The problem of high SO_2 concentrations was resolved some time ago (sulphur dioxide emissions in domestic sector decreased of 60% in the period 1980-90 and of 31% in 1990-97). Regulations on the protection of air quality in urban areas put in place during the '90s, and in particular the introduction of alert and alarm levels for traditional pollutants and quality targets for benzene, PAH[1]

1. Polycyclic aromatic hydrocarbons.

and PM10[2], has led to a generalised improvement in the situation with regard to CO and NO_2, while O_3 concentrations are climbing. On the basis of the few data available, critical situations also emerge for benzene and PM10 concentrations. Recent legal measures on the content of benzene and aromatic hydrocarbons in gasoline, as well as on criteria for the adoption of traffic restrictions and on the development of alternative solutions to the use of private transport, are all designed to address these problems, but the reduction of travel still is not effectively addressed.

The artistic and cultural heritage, widespread throughout Italy, is particularly concentrated in several cities where deterioration processes due to air pollution are pronounced. A comprehensive effort has been made by the Institute for Restoration to build a nation-wide map of the risk affecting the cultural heritage. The main objective of the project is to develop a tool which, on the basis of knowledge of the driving forces (pollution sources) and pressures (type and amount of emissions from various sources), characterises, with the help of both experimental and modelling instruments, the exposure of works of art in the various territorial contexts, thus allowing the planning of control and conservation measures to be optimised.

Table 5. **Urban emissions of sulphur dioxide, nitrogen oxides, volatile organic compounds and carbon monoxide in Italy,** 1990*

Considered Municipalities	**Population Density**	**Sulphur Dioxide**		**Nitrogen Oxide**		**Volatile Organic Compounds**		**Carbon Monoxide**	
	Inhabitants/km2	kt	t/km2	kt	t/km2	kt	t/km2	kt	t/km2
municipalities with more than **250,000** inhabitants	2719	58	16	112	32	291	82	1185	335
(17% of Italian population, 1% of Italian land)		(17% from transport)		(71% from transport)		(65% from transport)		(97% from transport)	
municipalities with more than **150,000** inhabitants	2050	67	12	133	23	348	60	1398	240
(21% population, 2% land)		(17% from transport)		(69% from transport)		(65% from transport)		(96% from transport)	
municipalities with more than **100,000** inhabitants	1409	109	11	179	17	414	40	1627	158
(26% population, 3% land)		(12% from transport)		(59% from transport)		(64% from transport)		(96% from transport)	
municipalities with more than **50,000** inhabitants	869	126	5	222	9	559	24	2134	91
(36% population, 8% land)		(13% from transport)		(62% from transport)		(62% from transport)		(95% from transport)	
TOTAL ITALY (**)	187	1648	5	1939	6	2055	7	7825	26
		(6% from transport)		(49% from transport)		(46% from transport)		(71% from transport)	

(*) for each pollutant, emissions are reported in kt, and emission density in t/km2.

(**) Emissions from volcanoes are not considered, which are considerable for sulphur oxides.

Source: ANPA, 1999a

2. Particles of an aerodynamic diameter of less than 10 microns.

Turning to the implementation of local Agenda 21 processes, so far 42 municipalities in Italy have joined the European Sustainable Cities campaign. In point of fact, however, the number of administrations in Italy which are seeking to address the sustainability issue is considerably higher: the Italian Co-ordination of Agenda 21 sees the participation of 65 municipalities, 12 Provinces, 6 other local administrative bodies including several Regions. ANPA is supporting local Agenda 21 processes by preparing and disseminating guidelines (ANPA, 1999b).

5. Hydro-geological risk

Hydro-geological risk has become one of the critical environmental aspects in Italy, primarily because of the repetition of "exceptional" events which in recent years have caused a series of catastrophic episodes, with severe consequences to man and the environment. Among the causes linked to the recurrence of such events are land being used for purposes not in line with what would instead be its natural vocation, for instance the expansion of urban centres or productive settlements in the flood plains, and the use of procedures which upset the environmental equilibrium. The action which followed such events often has been characterised by an emergency-driven approach, with all the negative consequences this brings in terms of the duration, efficiency and effectiveness of the work done.

Law 267/98, which converts the previous decree-law 189 (the Sarno law), attempts to overcome the emergency-driven approach which to date has characterised the handling of these problems, and to base itself on the logic of prevention. In such a perspective, attention is focused on the matter of risk-mapping, which is seen as the first step in identifying areas in which the evolution of the land that is induced by human intervention has produced situations incompatible with its natural vocation, thereby generating hazardous situations. This mapping is in preparation for the recovery action programmes which will range from enforcing restrictions to relocating settlements.

IV. CONCLUSIONS

An attempt can be made to divide the environmental indicators briefly described in the document into three categories:

- Indicators for which definite processes of improvement have been under way for some time: this is the case of sulphur dioxide emissions and the corresponding air concentrations, which represented a considerable problem mainly for the large cities in the north during the ’70s and into the early ’80s. At the time, Milan was described in several international documents as one of the most polluted cities in the world. Further examples are energy intensity and carbon intensity, which began to decrease notably in the first half of the ’80s, at a rate which tended to drop, however, almost to zero during the ’90s. While for sulphur dioxide further decreases are possible but at significantly rising marginal costs, in the case of energy intensity and carbon intensity the "leap in quality" due to improved energy efficiency mainly in thermoelectricity generation (with the introduction of combined natural gas cycles) and in transport, should lead to further notable decreases in these indexes during the decade 2000-2010.
- Indicators for which processes of improvement have begun to be noted only recently: belonging to this category are perhaps most of the indicators examined. This is the case of nitrogen oxides emissions and other macro and micro-pollutants. It also applies to separate waste collection, water consumption and air quality in cities, protection of the natural heritage, use of chemical fertilisers and pesticides, the spread of organic farming, farm holidays and ecological holidays.

- Indicators in stationary or worsening conditions: these are indicators relating to aspects whit significant impact on the environment and the quality of life, but which have not yet been improved by remedial action programmes. This is the case of carbon dioxide emissions, of passenger and freight mobility with the related problems of congestion and pollution in and around urban areas and large road infrastructures, waste production, hydro-geological risk, the environmental risks and degradation associated with some industrial poles.

Dealing incisively with the problems exemplified by the indicators in category 3 means resolving definitively a number of difficulties which still today, in spite of the efforts of a succession of decision-makers governing public matters during the '90s, continue to condition Italy's passage towards modern and sustainable development. Several, although by no means all, of these difficulties are outlined below.

There is a need to accelerate the process of integrating environmental policies into sector policies, at central, regional and local levels, and particularly in southern Italy and the islands. More specifically, as part of the difficult process of administrative decentralisation and simplification of bureaucratic procedures, effective action must be taken to harmonise regional and local environmental policies with the national policy, which is increasingly being seen as a link between local and European / supranational issues. One specific example is that of checking that local environmental targets are consistent with the national targets which derive from commitments to implement European directives and from the signature of international conventions, such as those on trans-boundary pollution and climate change.

Efforts must be stepped up to bridge the environmental gap existing between the North and South of Italy, in terms of both environmental information (ANPA, 1999c) and the implementation of effective policies. In this respect, it is important to point out that the establishment of regional environmental protection agencies is almost completed (with the only exception of Sicily and Sardinia), and that ANPA has launched a special project "Agency system in southern Italy and the islands" which is designed to promote the operational capacity of regional agencies in the south by means of twinning arrangements with agencies in the centre and north of Italy.

With regard to co-operation in the international field, even though Italy has been actively present to a much greater extent during the '90s, this presence needs to be made even more incisive and effective, enhancing the role of Italy as the virtuous link between the Mediterranean and central and northern Europe.

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B. GUIDELINES FOR PREPARING THE NATIONAL SUSTAINABLE DEVELOPMENT PLAN*

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I. POLITICAL MANDATE

In December 1993, the Italian government approved an initial document aimed at implementing Agenda 21. The current document has been drafted in response to a mandate from the Ministry of the Environment (Ministerial Decree GAB/DEC/884/99 of 1 April 1999) which has requested a new strategic approach.

What is required is a set of guidelines that will provide a common and binding reference framework for government action at different levels and that will apply to all the actors involved.

II. DEFINITION OF GUIDELINES FOR SUSTAINABLE DEVELOPMENT

The first part of the work consists in defining guidelines for sustainable development, as well as the political and institutional basis for such development.

There are no official texts which can readily be drawn upon in order to establish this definition; both the European Union and the UN set out general directions and aims for policy, but provide no guidance on objectives. Reference has therefore been made to a wide variety of texts of varying political and institutional relevance.

Priority has obviously been given to the principles established by the UN and the guidelines -- of a more objective nature -- drawn up by the EU and the OECD. Consideration was then given to the choices made by other countries with regard to their national plans for sustainable development and to a number of strategic guidelines drawn up by scientific or non-governmental organisations that have attracted particular interest from the UN and the EU.

These elements were then combined with directions specifically tailored to both the positive (opportunity to capitalise on labour/cultural/historical resources) and negative aspects (e.g. historical shortcomings in territorial management, the imbalance between North and South) of the situation in Italy.

This provided the basis on which to draw up a comprehensive set of rules (principles and guidelines), objectives and instruments.

Particularly close attention was paid during this stage of the work to the need for a systematic, straightforward and clear approach, as required of an issue that is characterised by approximation and a lack of precise definitions.

A number of the principal conclusions reached are set out below.

1. Long-term directions

The long-term strategic policy goal identified in the report is that of minimising the use of natural resources. This objective, which has been established either on a scientific basis or within the framework of NGOs and subsequently implemented by a number of European countries, identifies the cause of environmental damage as the excessive and inappropriate use of the materials which constitute the environment; the use of environmental resources is taken in the broad sense and applies primarily to the abstraction of virgin natural resources.

This therefore represents a shift in the focus of policy from the reduction of outputs to the restriction of inputs, in other words a shift from physical effects to physical causes. The priority area for the application of sustainable development policies is therefore the economy, the system which governs the flows of materials and energy between the natural and human spheres.

The outcome is the abandonment of the sectoral approach to environmental topics and the purely prescriptive nature of this approach, with a command constraint, in order to meet the need to formulate a policy that focuses on causes and that can encourage technological innovation and the structural reform of society. This is intended as a follow-up to one of the main requirements of all international and Community programme documents relating to sustainable development.

2. Integrated objectives

Minimising the use of natural resources is a key concept in the process of change. However, in setting out the requirements of government policy, it is necessary to proceed in a less structured manner. A comprehensive integrated system of objectives has therefore been drawn up, embracing the ecological, economic and social dimensions of sustainability. Besides the objective of economic development:

- with regard to ecological aspects, the objectives relate to the minimisation of abstractions of virgin natural resources, the minimisation of environmental pressures, the safeguard of biodiversity, and territorial development;
- with regard to social aspects, the objectives relate to employment, safety (protecting against damage to health and property), cultural quality (landscape, cultural goods, material culture).

Overall, this set of objectives must serve as a factor in the steering and verification of all actions by government, at both the central and local level, and of the initiatives taken by other actors in the development process.

3. Efficiency of the plan

The formulation of a long-term strategic objective can help to clarify the direction of policy and indicate the scale of the innovative efforts required.

This policy direction will then be placed within a reasonable time-frame (intermediate objectives, initiating actions, monitoring of outcomes), while ensuring that all due care is exercised when taking actions that will affect the economic dynamics and material conditions of citizens. It must also be placed on a solid footing, that is to say by quantifying from time to time, whenever possible, the linkages between objectives and by remedying solely qualitative considerations in other cases.

It should nonetheless be noted that specifying objectives does not resolve the problem of the Plan's efficiency, particularly in view of the complexity and scale of the change requested. The main problem with regard to the Plan in practical terms lies in the public decision-making process; in other words, how to direct decision-makers to ensure that they do not diverge from the programme's requirements.

An appropriate response to this calls for a change of attitude towards the singularly prescriptive command-control approach. When faced with such complex issues, what matters most is not so much what is established (in terms of formalising a command or objective in a legal text or plan), as the ability to undertake coherent and appropriate actions in the direction required.

These problems are the central focus of attention in the design of the provisions of the new Plan. The response is primarily aimed at the integration of policies and the specification of individual and appropriate methodologies for assessment, policy steering and verification.

4. Integrated policies above the sectoral level

Guidelines and instruments for the integration of policies above the sectoral level have primarily been drawn up with regard to:

- knowledge enhancement;
- technological research and development;
- education and training;
- measures to influence markets (taxes, tariffs, incentives, voluntary instruments);
- integrated territorial management;
- simplification and improvement of administrative measures.

The basic criterion is that all institutional actors (Ministries, regional and local governments) should all share the same system of rules and objectives and the same instruments for knowledge, assessment and verification.

5. Integrated sectoral policies

The report does not deal comprehensively with specific issues in individual sectors, but concentrates on the main aspects of issues related to strategic objectives. It then sets out policy directions which tailor all the principles, guidelines and objectives contained in the general section to the specific characteristics of each sector. This provides a basis on which to determine the strategies to be pursued and actions to which priority should be given.

In addition to the sectors identified by the European Union (industry, agriculture, energy, transport, tourism, services), great attention has been paid to specific problem areas such as those relating to infrastructure, products and waste, water resources and the urban environment.

6. Assessment instruments

Priority with regard to methodologies for assessing ecological sustainability has been given to the implementation of:

- materials accounts at the national, regional, local and firm level;
- national input/output matrices for material flows.

Attention has been paid in particular to problems concerning the effective use of indicators in the decision-making process. The following have therefore been drawn up:

- a limited number of basic indicators to reflect trends in the system;
- procedures for preventive verification (not only in environmental terms but also administrative, economic and social terms) of provisions and for the subsequent monitoring of results.

These instruments are tailored to the planned objectives and are not a necessary condition for the plan to be efficient.

7. Markets and externalities

The Plan eschews an interventionist approach towards economic activities and instead pursues flexible objectives towards steering markets towards the efficient use of materials and land by correcting the distortions generated by current economic policies. From this standpoint, the process of

market liberalisation to which Italy has committed itself must be accompanied by the gradual internalisation into market prices of external costs that are currently invisible.

Against this background, a central role has been assigned to the specification (in accordance with the plan's objectives) of guidelines for fiscal reform in an ecological sense, which was decided by Parliament at the beginning of the year and delegated to the Government (Law No. 133, article 11, of the Law of 13 March 1999).

8. Social and environmental quality

The final chapter of the Plan calls for intervention in response to specific environmental pressures in order to clarify the relationship, at governmental level, between the initiation of strategy towards sustainable development and ordinary managerial activities. The common goal is to guarantee the environmental quality that is a basic requirement of sustainable development policies.

The Plan then addresses a number of topics/objectives with a strong social component, particularly those relating to safety, health, new opportunities for entrepreneurs and employment.

III. REVISION OF THE PLAN

The current situation, marked by a continuing lack of certain information, does not allow an optimum response to be given to the political mandate, particularly with regard to the use of guide indicators and the in-depth assessment of policy implications. To remedy this problem a number of specific measures have been put forward (foreshadowing the provisions of the new law on environmental accounting) that will make it fully possible to manage strategic planning by the time of the first revision of the document.

With regard to the revision process itself, the two-yearly interval provided could be used to further the debate over the choices made in the Plan and subsequently to refine policies and implementing instruments.

C. GUIDELINES FOR STRATEGIC ENVIRONMENTAL ASSESSMENT (S.E.A.)*

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I. INTRODUCTION

Under the new regulations for structural funds, particular significance has been attributed to the environmental assessment of plans and programmes that are to be submitted for community funding.

The promotion of a harmonious, well-balanced and sustainable development of economic activities, and a high level of environmental protection and upgrading, are among the objectives and tasks of the European Union and its community listed by the Amsterdam Treaty. The environment has thus become a matter of the uppermost significance; it cuts across all the different sectors of investment considered by the development plans that are designed to implement community policies. In particular with reference to the programming of structural funds and with the specific aim of defining sector and local strategies to promote development which is truly sustainable. Suitable partnerships are to be set up between central and local institutions to ascertain whether investment programmes for community This is being done with a view to integrating and optimising contributions from the different professional sectors working in their respective fields within the area of the country concerned, thereby ensuring that the nature-ecosystem and scenic-cultural components are properly represented in assessments.

The assessment is divided into three phases - the retroactive, intermediate and retrospective - all of which have been devised to measure impacts in relation to the main targets set by the funds and to analyse the effects on specific structural problems.

Upon request, these assessments are made available to the public.

The retroactive assessment is conducted ahead of the definition of Plans[1] and Operational Programmes[2], and is an integral part of the latter.

As far as environmental matters are concerned, it evaluates the environmental situation in the areas covered by action programmes, the measures devised to guarantee that community environmental regulations are observed and the means for integrating environmental matters into the various sectors of intervention. The retroactive assessment entails: a quantified description of the current environmental situation; an indication of the short and medium-term targets, bearing in mind the environmental management plans defined and agreed upon at national, regional and local level, the funds made available and the main results of the previous programming phase; an assessment of the foreseeable impact of the strategy and the action programmes on the environmental situation. In addition, the retroactive assessment gauges the quality of implementation and monitoring methods. It also takes into account what has been learnt from assessments relating to the earlier stages of programming.

The intermediate assessment takes into consideration the initial results of action programmes, the extent to which they are consistent with the retroactive assessment, the relevance of the targets and the degree to which they have been attained. It also checks that funds are being managed correctly and the quality of monitoring and implementation.

The retrospective assessment is intended to show how resources have been used, how effective and efficient action programmes have been and what impact they have had, and how consistent they are with the retroactive assessment. This assessment must also be such that it

1. For Italy, the reference is the Development Programme for Southern Italy and the Islands (PSM - Piano di Sviluppo per il Mezzogiorno 2000-2006) (regions Target 1). In the Community Regulations and EU Manual, this is the equivalent of the Regional Development Plan (RDP).
2. Operational Programme for Target 1, Single Programming Documents for Target 2.

generates knowledge of how the economic and social aspects merge. It revolves around the successes and failures registered in the course of implementation, how things were done, what was achieved, and how long results can be expected to last.

In order to take into account the positive synergies between the priorities of economic development and environment and, at the same time, to ensure that the environmental dimension is duly considered, measures had in fact been introduced in the management of the 1994-99 funds to measure the impact of regional plans and programmes. Given such requirements and the need to improve understanding and provide general guidelines, and in order to define a consistent community approach, the departments of the Commission handling environmental matters, in close co-operation with Directorates General XVI (Regional Policy and Cohesion) and VI (Agriculture), published a Manual for the environmental assessment of regional development plans and structural funds programmes of the European Union.

The environmental assessment methodology proposed by the Manual is the Strategic Environmental Assessment (SEA).

The Manual stresses the need to involve environmental authorities in the preparation of plans and the assessment of their implications. The environmental authorities are called upon to perform a highly significant role. In the course of the elaboration, assessment and monitoring of plans and programmes, environmental authorities cooperate with authorities in the sector by:

- analysing and providing data on the state of the environment and natural resources which are designed to meet the needs of the authorities that will be using them
- identifying and proposing sustainable development targets for the major sectors
- participating in the elaboration of draft plans and programmes and proposing alternative solutions which promote sustainable development and seek to lessen any eventual conflict between economic and environmental targets
- identifying and proposing a set of indicators to measure the state of the environment and the extent of environmental integration and sustainability in the various economic sectors
- conducting a strategic evaluation of the environmental impact of proposed plans and programmes, and expressing an opinion on their sustainability
- supporting the process of incorporating assessment results into the proposed plans and programmes
- identifying selection criteria which promote environmentally sustainable projects
- co-operating during the phases of implementation, monitoring, in course and retrospective assessment.

The diagram (Figure 1) is intended as a summary representation of the role of environmental authorities in the various stages of integrating environmental themes into the programming process.

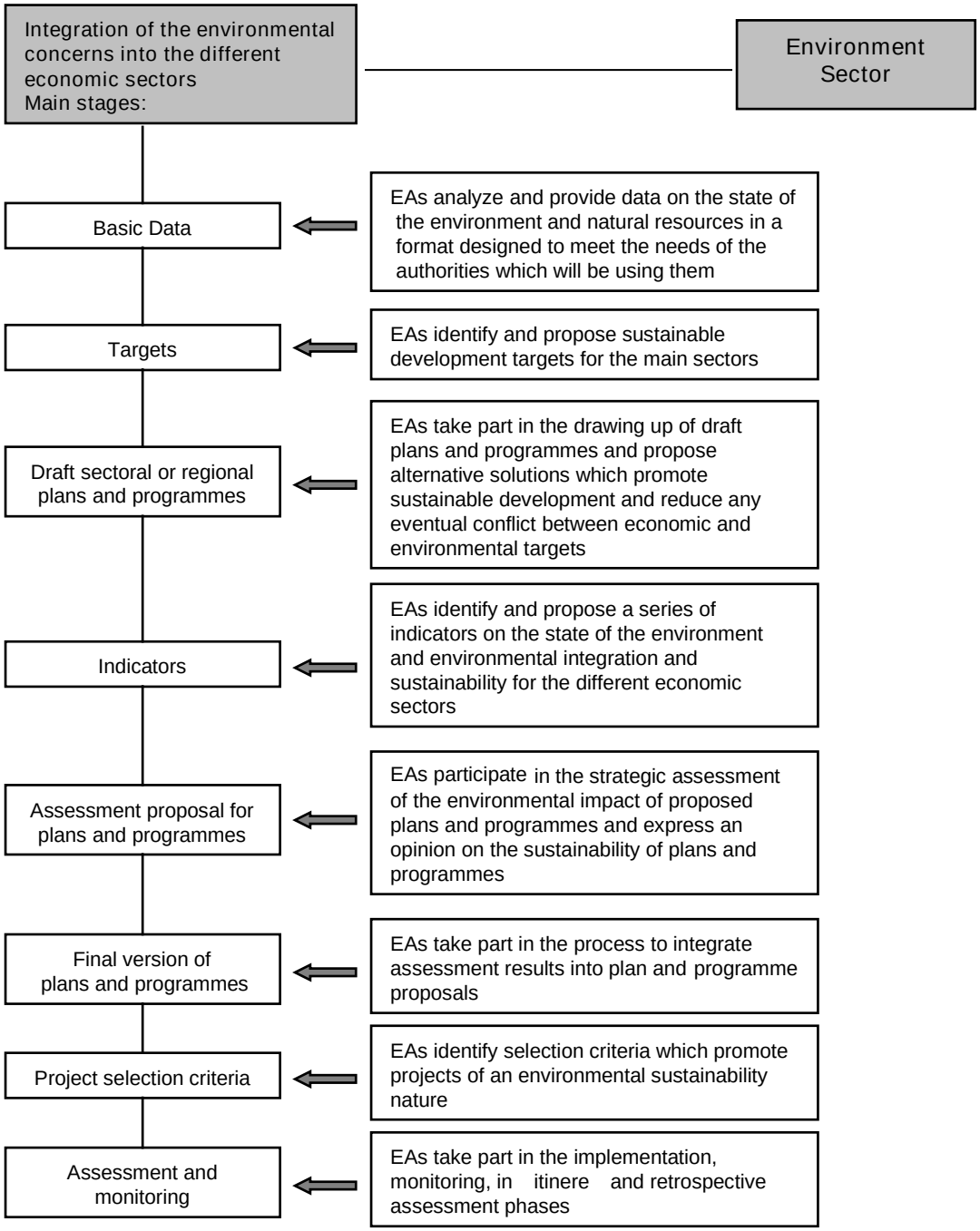
The roles and tasks of the authorities concerned are illustrated in Table 1.

This document was jointly prepared by the Environmental Impact Assessment department at the Ministry of the Environment and the Environmental Protection Agency (ANPA) in co-operation with the Regions, with the support of the technical secretariat established for this purpose at the head office of the Ministry of the Environment, on the basis of the manual mentioned above and the documents prepared by the Environment Steering Group.

In Italy, the central institutions designated to handle environmental protection in its various components - nature, ecosystem, landscape, historical-cultural aspects- are the Ministry of the Environment and the Ministry of Cultural Heritage. Within this framework, and in view of the need for increasingly effective integration on a local scale of programmes to safeguard the historical-cultural dimension of the environment, the environmental authorities - specifically appointed by the regional authorities and recognised by the European Commission – constitute the environmental authority

network in Italy. Each one works on regional programming in conjunction with its corresponding local administration, according to the system shown in Figure 1 and Table 1.

Figure 1. **Role of environmental authorities (EA) in sustainable regional development**



In defining the practical methods for integration, this document, sister to the Manual prepared by the European Community, offers immediate support to the environmental authorities in their conduct of the tasks listed above. More generally, it supports their participation in the programming process, thereby providing the Regions with the methodological input they need to activate

programmes that can also be sustainable in the long term, and outlining procedures for co-operation and consultation among the authorities concerned.

The guidelines make reference to various types of indicators based on the DPSIR model. Specific attention is given to performance indicators which quantify the effectiveness of measures in relation to the targets that have been set for each one.

It is important to point out, however, that only an outline sample of performance indicators can be given, since their adequacy and significance can only be properly identified and examined once the measures envisaged by action programmes have been set in motion.

Table 1. **Responsibilities of Development and Environment authorities**

Development authority	**Authorities responsible for environmental matters**
a) examine the implications of the current environmental situation for the strategy, objectives and priorities of the plan	a) examine the results of all the preceding programming periods in terms of impacts on the environment and on sustainable development
b) identify further requirements relating to resources (human, financial) and further needs on matters of data collection and analysis	b) elaborate a detailed description of the environmental situation in the Region and a summary with comment on the targets of legislation and policies in the environmental field
c) elaborate reference data on economic and social trends of the Region	c) present the information in such a way that the development authorities can understand the significance of the document for the respective development sector
	d) draw up a list of environmental indicators available/in use, and of any other indicator considered necessary
	e) identify further needs related to resources (human, financial) and further needs in matters of data collection and analysis, above all with regard to the potential indicators destined to measure the impact of the plan/programme.

These performance indicators are, of course, linked to indicators of a more general nature which are related to the contribution of the plan or programmes to the attainment of environmental policy targets. More often than not, such indicators are measurable in qualitative rather than quantitative terms.

Great care must be exercised when checking their availability and reliability, in addition to the uniformity and comparability of data obtained.

A further recommendation must be made in this introduction: that when the information available does not permit an objective quantification, the tools described below can still be used to assess the extent to which the planned actions and measures are consistent with the environmental sustainability targets and their probable impact on the environment in terms of quality.

In particular, in the early stages of the implementation of these guidelines and definition of the plan or the programmes, the environmental authorities must pose themselves three crucial questions:

- which critical factors are related to high-risk situations, or assume greater significance, and should therefore be given special consideration during the programming phase?

- what are the main factors which, in the area of reference, determine (either individually or cumulatively effects) the critical environmental factors?
- what kind of programming decisions are able to exercise a positive influence on these aspects, with a view to eliminating/reducing critical environmental factors, decreasing the pressure of productive sectors, and improving the quality situation?

It goes without saying that these aspects, together with a more detailed definition of the tasks of the environmental authorities, which will also take into account the achievement of environmental sustainability targets, will be addressed in greater depth in the course of the support activities organised by the Ministry of the Environment, in co-operation with ANPA and other horizontal administrations.

II. STRATEGIC ASSESSMENT

The SEA phases conducted in the preparation of the plans and programmes for structural funds are outlined in Table 2.

1. Assessment of the environmental situation - elaboration of reference data

The selection and presentation of information about the state of the environment and the natural resources of a Region, and the positive and negative interactions between these contexts and the main sectors of development destined to be financed by structural funds, is described below on the basis of the methodology adopted by the Environmental Protection Agency (ANPA) for the collection of information about the state of the environment.

With reference to the environmental themes identified, the representation of the environmental situation is based on the collection of a priority set of Pressure and State indicators. By means of pressure indicators, it is possible to reconstruct the overall pollutant load generated by the manufacturing sector, together with the *impact* on environmental quality, and state indicators are able to represent the present status of environment.

Organised in this way, the data provide a framework of reference for the definition of sustainable development targets.

These targets are seen as a response to the critical factors highlighted by the description of the environmental situation and its evolution which, in turn, provides the information needed to set priorities, identify indicators that are able to assess, in a co-ordinated system, the foreseeable impact of the plans and allow it to be monitored.

The economic activity sectors considered are those which are the focus of community action. The environmental themes selected, are related to the themes identified by the European Environment Agency.

The indicators proposed for the description of the environmental situation represent a possible forward route: the core set of indicators meets a two-fold selection criterion:

- the ascertained availability of data at regional level; and
- the significance of their role as describers.

The assistance provided by the Ministry of the Environment and the Environmental Protection Agency, together with the Culture Ministry for the historical-cultural and scenic aspects, should enable

any of the Regions encountering data collection problems to put together a set of indicators during the data retrieval and/or organisation phases.

On the basis of currently available data and the specific features of their catchment area, the Regions will be required to identify definitively the information that can be gathered and eventually the data that will need to be acquired in subsequent programming and checking phases.

The assistance provided through the network of environmental authorities will also be extended to the identification of sustainability targets and the setting up of the assessment process.

Table 2. **Phases of Strategic Environmental Assessment**

Phases of SEA	Description
1. Evaluation of environmental situation – elaboration of reference data	Identify and present information on the state of the environment and natural resources of a Region, and on the positive and negative interactions between these contexts and the main sectors of development destined to receive structural funds
2. Targets, aims and priorities	Identify targets, aims and priorities for both the environment and sustainable development which member States and the Regions should achieve through development plans and programmes financed by the structural funds
3. Draft development proposal (plan/programme) and identification of alternatives	Guarantee that the environmental targets and priority are fully integrated into the design of the plan and programme which defines the development targets and priorities for the Regions concerned, the kinds of initiatives that can receive contributions, the main alternatives for achieving the development targets of the Region in question and a financial plan.
4. Environmental assessment of draft proposal	Evaluate the implications, from the environmental point of view, the development priorities envisaged by plans and programmes and the degree to which environmental considerations have been integrated into their targets, priorities, aims and indicators. Analyse the extent to which the strategy defined in the document facilitates or hinders the sustainable development of the Region in question. Examine the draft document in terms of its compliance with regional, national and community policies and legislation on the environment.
5. Indicators in environmental field	Identify environmental and sustainable development indicators designed to quantify and simplify the information in order to facilitate, for those responsible for the decisions and for the general public, the understanding of interactions between the environment and key problems in the sector. These indicators will have to be quantified to contribute to the identification and explanation of changes over time.
6. Integration of assessment results into final decision on plans and programmes	Contribute to the development of the final version of the plan or programme, taking the assessment results into account.

2. Targets, aims and priorities

The ultimate aim of the strategic environmental assessment is to ascertain whether development plans and operational programmes correspond to the sustainable development targets, by checking their overall environmental impact, in other words, their direct effect on the quality of the environment. Figure 2 below summarises the links between pressures and the quality of the state of the environment and identifies the environmental targets as a response to the critical factors highlighted.

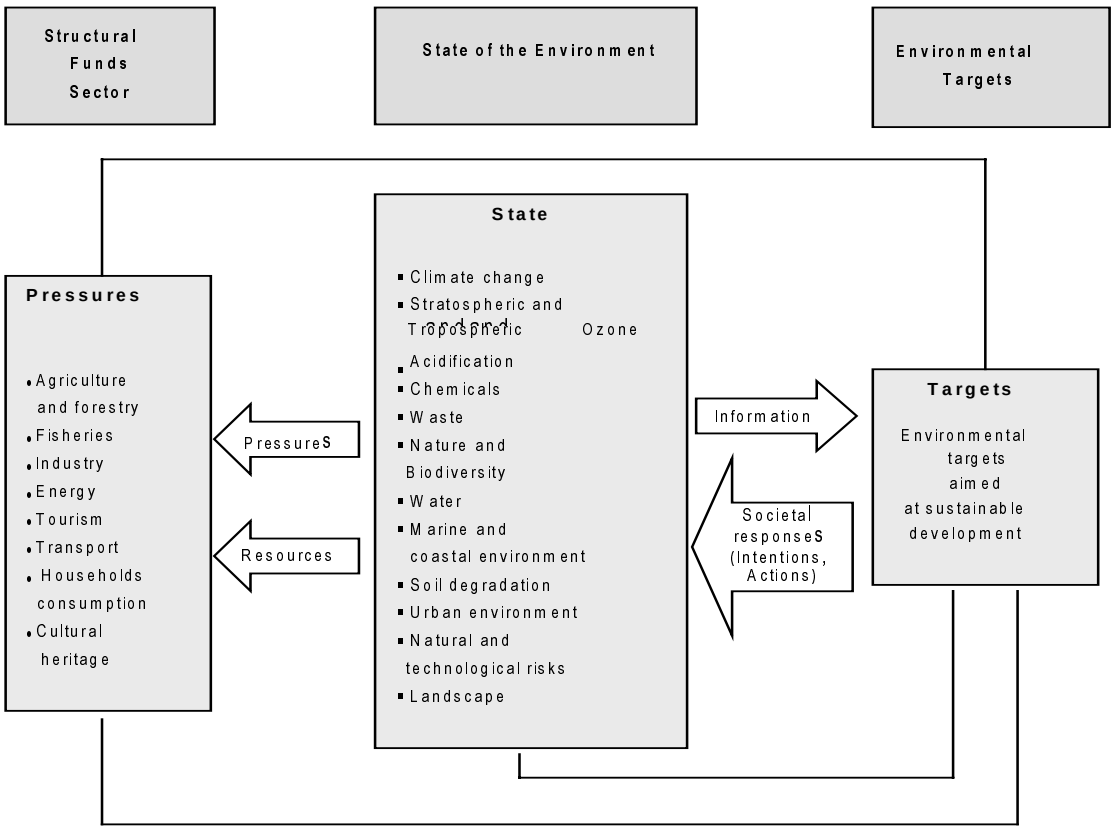
As stated earlier, examining the environmental situation and turning the pressures that are most significant for environmental quality, the emergencies (where existing) and the critical factor areas, into a readily "readable" form, can be useful in guiding the definition of targets, aims and priorities. This guidance serves environmental purposes, as well as the integration of such aspects into sector planning.

The definition of the targets must, however, satisfy the conditions of sustainability of access to environmental resources. These conditions are usually linked to the following principles:

- the rate of use of renewable resources should not be above their rate of regeneration;
- the emission of pollutants and wastes into the environment should not exceed its load capacity;
- the stock of non-renewable resources should remain constant in time.

Observing these principles, the European Commission Manual identifies ten sustainability criteria for the definition of programme targets. This document shows how environmental issues cut across all sectoral policies.

Figure 2. **Pressures, State of the Environment and Targets**



It also highlights the main community environmental directives with reference to both the identification of the environmental infrastructure shortfall and the procedures for integrating the environment into the authorisation processes.

With reference to environmental themes, there are possible sustainable development targets that explain in further detail the criteria listed by the Manual. These concern action programmes aimed at decreasing, in the course of the implementation of sector policies, the pressure on the environment (partly by analysing the different action options). They also concern programmes having a direct effect on environmental quality, with environmental infra-structuring measures that can also contribute to bridging the gap to action needed to ensure that community regulations are observed. The targets identified refer for the sustainability criteria and for the individual sectors. They group together the indicators to be found in official documents on environmental policies, international agreements, and in the implementation of community and national regulations. These are useful guidelines for the Regions (together with the analysis of the environmental situation) to help define their own targets and priorities to meet the needs of sustainable development.

3. Draft development proposal (plan/programme) and identification of alternatives

The environmental authorities will have to make sure that, right from the early phases of the drafting of the plan and programme in the elaboration of the OP, environmental priorities are adequately considered. A series of possible strategic actions is presented for insertion into the elaboration of regional plans. They are identified on the basis of, and consistent with, the set of indicators listed, and related to the state and pressure indicators.

4. Environmental assessment of the draft proposal

In the case of the environmental assessment a distinction must be made between actions related to environmental infrastructures (e.g. water treatment, waste disposal) and those related to economic activity sectors (e.g. transport, agriculture). In the case of the latter, the effects on the environment derive mostly from changes in pressure factors, whereas in the former, environmental infrastructures, they often take the form of responses to requests for intervention deriving from community, national and regional regulations which have an effect on the state of the environment.

In both cases, the references for assessment can be summarised on special forms. The forms must be organised with reference to the sectors of action, with the strategic options that summarise the targets and aims of the plan under assessment.

Environmental policy targets, a qualitative indication of the impact of the plan on the targets and a summary of the reasons for assigning the different impacts on the scale:

- P: slightly positive impact
- PP: average positive impact
- PPP: very positive impact
- N: slightly negative impact
- NN: average negative impact
- NNN: very negative impact

The assessment forms must not be regarded as part of the assessment of an already defined programme of actions. They are a tool which, from the very early stages of programme definition, could be useful (also from the point of view of quality) in defining the actions themselves and highlighting priorities among the possible solutions, particularly when considering the different components of sustainability (economic, social, environmental). In some cases, they may be actions

directly aimed at modifying the quality conditions of the environment and, therefore, at directly pursuing environmental quality targets.

It follows, then, that such a tool is wholly unsuitable for the calculation of an "algebraic sum of positive or negative impacts".

The assessment must therefore make proper reference to the environmental targets, in terms of reduced or increased pressure factors or the direct effect on the quality state of the environment. They must be useful already in the initial stages of programme definition, not just as a final assessment phase, and accompanying the programming procedure throughout in order to ensure its sustainability.

5. Indicators in the environmental field

The identification of indicators made during the elaboration of data to describe the current state of the environment, may also be useful when selecting indicators that render the relation between action strategy and sustainable development targets readily comprehensible. These indicators will have to be able to describe the environment, to identify, measure and contribute to the assessment of the impact of strategic action during subsequent checking and programming phases. In all cases, and in particular to ascertain the appropriateness of actions, these indicators must be:

- representative;
- scientifically valid;
- straightforward and easy to interpret;
- able to indicate trends over time;
- where possible, able to provide an early indication of irreversible trends;
- sensitive to the changes taking place in the environment or in the economy which they must help to reveal;
- based on data that is readily available or available at a low cost;
- based on adequately documented data of a given quality;
- periodically updateable.

The pressure and state indicators have already been discussed in reference to the DPSIR model. A summary outline of the performance indicators is given here, since it will only be possible to identify accurately them and examine their adequacy and relevance once the measures devised under the action programme have been put in place.

These indicators may be different from those of a general nature which refer to the contribution to the achievement sustainability targets. For instance, in the case of an action programme focused on urban mobility, which envisages the transfer of part of public urban transport from road to rail, one indicator could be the contribution to the reduction of CO_2. This indicator is of such a generic nature and could probably only be appreciated qualitatively. A performance indicator, on the other hand, could allow precise quantification of how much traffic has actually been diverted from one mode of transport to the other. Several examples of performance indicators are shown that can provide useful information for monitoring programme effectiveness.

6. Integration of the results of the assessment into the final decision on plans and programmes

The final version of the plans and programmes to be presented for community funding must describe how the environmental assessment has been taken into account. The role of the environmental authorities, in co-operation with the programming authorities, is to ensure that this happens in line with the indications offered under the foregoing points.

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D. GREEN ACCOUNTING: FROM THE LABORATORY TO THE INSTITUTIONS*

* By Senator Fausto Giovanelli, President, Commission for Land and Environment, Senate of the Italian Republic, Italy.

I. INTRODUCTION

Italy is ready to make a positive and creative contribution to the commitment undertaken by the international community at the Rio conference in 1992 to develop green accounting methods and procedures and bring them into practice as soon as possible.

Efforts are being made to achieve this goal not only by major state institutions, such as ISTAT (the Statistics Institute) and ANPA (the National Environmental Protection Agency), but also by Government and Parliament directly.

Already for some years now, ISTAT has been designing and developing studies in Italy to produce statistics and formats for green accounting, keeping itself abreast of the knowledge gradually being acquired and consolidated by agencies of the European Union and the United Nations.

In addition, the CONTARE project is now under way in Italy: several regional administrations, led by Tuscany, have begun testing accounting tools, in co-operation with the appropriate Ministry, to measure the effectiveness of their environmental policies.

Considerable state resources have already been channelled into the implementation of this project. So far, it has yielded the first action programmes designed to set up a database system that will provide the required information. It utilises and develops the knowledge and practical experience of the pressure-state-response indicator system. However, it takes into account "defensive" environmental outlay only, and not all the sustainable development issues which have a bearing on the overall management of the area under consideration. Furthermore, it is addressed to users in the institutions, but does not cater for any formal link with expenditure plan approval procedures or, more generally, the accounting documents and budgets of local public administrations.

It is known that the law which established the Ministry of the Environment in 1986 also required the production of an Annual Report on the State of the Environment, and this in fact provides a wealth of data and information. But this too, has no direct bearing at all on decision formalisation procedures. For instance, it is not referred to in the course of the preparation and discussion of the Economic and Financial Planning Document.

For these reasons, Parliament has formally set itself the objective of building an information system which takes into consideration all the problems of sustainability and is intended to become an essential back-up to decision-making as a budget procedure in its own right. It is intended as a system which is to have a more authoritative place in public decision-making, thereby creating a role for Green Accounting within the formal budget approval procedures conducted by elected bodies.

In July 1999 the Senate of the Italian Republic passed a bill to integrate Green Accounting elements into the budgets of all local public administrations - the State, the regional, provincial and municipal administrations.

Discussion of this bill is now in progress at the Chamber of Deputies. It is likely, although not certain, that it will be finally approved in the first half of 2000.

The bill was drafted by the XIII Environment Commission of the Senate, with the formal co-operation of the National Council for Economy and Labour (CNEL), a constitutional body for senior consultations on legislative matters. It was signed by many of the members of parliament on the Environment Committee and by almost all the majority and opposition political parties. It was later joined by a very similar bill, tabled by a minority group. After being examined by the joint Budget and Environment Committees, it was signed by the Senate Assembly.

The text makes express, formal and substantial reference to the "European Commission guidelines on environmental indicators and national green accounting" (21 December 1994) and to the European Parliament Resolution on the same communication issued the following year.

The essential purpose of the law, and the reason it became necessary, is not simply the technical and scientific development of the ways and means of Green Accounting, but rather its "mandatory, although not binding" application in the preparation, formation and approval of the accounting and budget documents of local administrations and the State.

A recent seminar on the substance of the law, held at the Chamber of Deputies, was entitled "Green Accounting: from the laboratory to the institutions". This title clearly indicates the uppermost intention of lawmakers in Italy: to develop methods, means and tools for Green Accounting which take into account the fact that the political system is going to need to use them.

Green Accounting, then, must be developed in relation to what is required by those who are going to be using it. It has to take the lead from the basic demand it is going to have to meet, which is to provide a bank of environmental information that is reliable and at the same time usable. It does not necessarily have to be exhaustive, but should be able to generate progress towards sustainability in the decisions taken by politicians.

In other words, the approach outlined in the bill also promotes the technological and scientific development of all action programmes grouped under the title "Green Accounting" but it uproots the laboratory approach that has prevailed so far (which at this point is actually a useful effect). Or better, it grafts onto the approach taken by the professionals and agencies working in the field the political point of view; namely, the point of view of whoever is going to have to use the system, whoever represents the beneficiaries of Green Accounting, whoever represents the general interest in and entitlement to the environment.

In this instance, “whoever” denotes the institutions: the elected assemblies at the various local levels of political representation in Italy.

It is known that no procedure can become mature or reliable, or even be adequately developed, without practical application. The various green accounting modules and models, the environmental indicators and the statistics themselves, elaborated by various offices, can and must be further developed and implemented. But this further development cannot be guided, the validity thoroughly measured, the value of one model or the other appreciated, until they are being implemented. That means arriving at the stage where green accounting can be applied to the work of the public administrations.

II. STRUCTURE OF THE LAW

The purpose of the law is stated in art.1: "to integrate the economic-financial planning and budget documents of the State, the regions, the provinces and the municipalities, into the information and targets related to the environmental sustainability of development, in order to define an adequate cognitive support for the political decision-making bodies".

According to the text passed by the Senate, from the year 2004 onwards, the State, regions, provinces and municipalities with more than one hundred thousand inhabitants "are to approve" documents on environmental sustainability (satellite-budgets) "alongside and in the same context as" the regular economic planning budgets (art.2). For municipalities with fewer than one hundred thousand inhabitants, this will become mandatory in 2008.

A special commission established by the law is to draw up the outlines of these documents on the environmental sustainability of development (satellite budgets, in practice), and has twenty-four months to do so. The law itself also states several criteria for their formulation and organisation: they must be such that they are comparable and can be read in parallel with the budget documents; they must contain information selected in relation to the most significant accountabilities of each level of local government concerned; at different stages, they must specify documents according to the state of progress in the reference information system, documents which the law defines as "green accounts".

In essence, these "satellite budgets" (defined by article 2) must include an "intelligent" section aimed at supporting the decisions to be taken, together with statistical data and real data taken from the "green accounts" which are clearly described by the law as distinct from the documents on sustainability mentioned earlier.

Green accounts are defined by article 3 as "the set of information" which, as part of the national statistical system, describes:

- the extent of and variations in the natural heritage;
- interactions between economy and environment;
- expenditure for prevention, protection and reclamation in environmental matters.

A system of green accounts must be adopted separately by the State, the regions, the provinces and the municipalities before the end of 2003, on the basis of a legislative decree which is to be formulated according to the indications given in the annex. The annex makes reference to the NAMEA and SERIEE systems, as well as to the pressure-state-response indicators system for the State and the regions, and only to the sector pressure indicators system for the provinces and municipalities.

The green accounts system which is described by the law and handed over to a subsequent decree for the regulation of the classifications, structure and content "for each institutional level", is a system that must respond to a demand linked essentially to public decision-making processes at all levels. It is represented at the "macro" level (strategic decisions for the social and economic system), the "meso" level (decision-making processes concerning the different public policies), and the "micro" level (decisions concerning the managerial aspects of administrative action).

A trial period is expected to begin in the year 2002 for the "satellite budget" plans of several regions, provinces and municipalities identified with a decree from the Ministries of the Environment and Treasury (art.5). Already in the year 2000, the green accounts described in art.3 are to be adopted on an experimental basis.

Furthermore, in a number of municipalities and provinces, including Naples and Trieste, interest has already been expressed in taking part in trials. And in several areas (province of Bologna) a programme has already been set in motion.

Having illustrated the overall structure of the law, the following highlights several of the more significant and complex procedures, and look at some of the keywords used in the text to define them: namely "Green Accounts and sustainability documents" and "approval in the same context".

III. SUSTAINABILITY DOCUMENTS OR “PURE AND APPLIED” GREEN ACCOUNTING

What the law aims to put in place is a system of "satellite budgets" in municipalities, provinces, regions and State. These "satellite budgets", which are defined as "sustainability documents" in the law, may include both statistical data and real data and may use the results of green accounts which,

as pointed out earlier, are a different and separate item. In fact, "Green Accounts", as defined by the law, are the set of results generated by the statistical systems and environmental information systems. This is what is meant by "pure" green accounting. Sustainability documents (as defined by the law) are, instead, institutional deeds, "satellite-budgets": “applied” green accounting, in other words.

The first are to be implemented according to the responsibilities of the "technical" agencies (ISTAT, ANPA, ENEA), while the second are based on the responsibilities of the bodies approving them. And they are, therefore, political and institutional deeds.

This distinction is important, and must be stressed, because perhaps better than any other, it highlights one of the more unusual steps in the proposed system which can be difficult to grasp. It emphasises both the distinction and the link between green accounting as statistics and as an information system pure, and green accounting as a proper support system for policy decision-making.

Policy and budget decisions do not need all the information imaginable and possible. Too much data, too many numbers, too much information, and there is a risk that this is tantamount to no information. If is to be useful, green accounting must be such that, at any point in the decision-making process, it can provide the essential information that is most needed.

Sustainability documents are, therefore, expected to be an intelligent and organised selection of the body of information (indicators and indexes in units of measurement) that "green accounts" are able to supply. Under this law, the decision-maker will have not so much the general and fairly useful support of as much environmental information as possible, but rather a mandatory input of the minimum indispensable environmental information.

IV. THE INTERCONNECTION BETWEEN SATELLITE ACCOUNTS AND THE BUDGET

This is another concept that should be emphasised. It puts the spotlight on several other keywords in the text of the law: "approve in the same context". Approve in the same context is perhaps too condensed an expression to convey the real political significance. In other words, it conveys neither the broad scope nor the interest that should be elicited at regional, provincial and municipal assembly meetings, as well as in Parliament, by the discussion of the environmental sustainability programmes in progress which should be appropriately scheduled into the budget document approval procedure. This is what is meant by “in the same context”.

The word “approve”, on the other hand, means making a detailed identification of the individual environmental issues to be considered in the area covered by each administration; the approval stage is part of the budget sessions. The principles of transparency and accuracy are also applied when addressing environmental issues, alongside those of controllability and responsibility, which are an essential component of any budget document.

The word “approve” also encompasses the taking on of responsibility for the individual data and the overall results of “satellite-budgets” (sustainability documents). “In the same context as”, on the other hand, embraces the time relationship and the inevitable connection between environmental satellite accounts and financial accounts. This connection is a “free” connection, mediated by the democratic process, a political and non-mechanical connection; a connection mediated by the intelligence and the will of decision-makers who have been elected as representatives. This, of course, presumes that some kind of critical screening has taken place, as well as a public confrontation between majority and opposition, an assumption of responsibility and commitment to transparency in decisions, all which should definitely raise the level of joint consultation in matters of politics and the environment.

It is important to note that the law proposes no mechanical relationship between the environmental satellite budget and the regular budget, because this would be based on assumptions about something that does not exist, and at least for the time being, we do not have: namely, a single code and common unit of measurement for all environmental, local and financial variables (the famous Green GDP).

The adoption of green accounting at all levels of public administration, according to the bill, will not automatically result in their being more environmentally focused, as though they were under some sort of "eco-dictatorship". The same can be said of economic statistics and budget procedures which do not automatically lead to good government of the economy and healthy financial management.

However, it is hard to imagine that the introduction of this practice, the circulation of the critical knowledge it assumes and requires, the streamlining of the process itself in time, would not bring about the development of an environmental culture in the public decision-maker that is increasingly alert and refined, regardless of his or her political leanings. In short, if not quite a cultural revolution, this is an ongoing input of information and research for the environment. The "political decision support" described in article 1 is thus provided and is focused on sustainability.

V. CONCLUSIONS

Heading for the sustainability of manufacturing, consumption and land management systems requires a compass, propelling engines, orientation instruments. Green accounting is all this. Not only is it the compass, the engine, the rudder. It is a tool that cannot be left aside if we are not to be left sailing in a boundless ocean.

In fact, the dimensions of the change required by sustainable development are gigantic. This change will not take place from one day to the next and, if it does take place, it will not be following an already known pathway or a predetermined route. It will not take place because of the decision of one single political authority nor because of any spontaneous development of the market. There will be no modules, models, theories or plans which will generate sustainable development as though it were magic or easily commanded. There will be no Green GDP to replace the accustoming GDP. Nor a global sustainability plan that is able to keep a tight rein on the world market.

There will be, and there are instead, defensive action programmes and prohibition of the most virulent manifestations of environmental destruction. There will be thousands of action programmes to reduce the damage. There will be scientific research and technological innovation, political struggles and positive action or a better man-environment relationship in every field, from population to food, from habitat to industry and trade, international politics.

There will be no sustainable development code, if not at some later stage, after years of experience in accounting. This is why green accounting is needed. For a long time, economic policy has been searching for a theory which is entirely capable of explaining all. Instead, what economic policy has received from economists is mainly a series of part theories, a "tool box" that is not able to explain or to understand the whole of the situation, but is useful in governing some of its important aspects.

While the environmentalist culture continues its search for codes for the sustainable management of the biosphere, environmental policy must provide itself with operational and effective tools. Here and now it must seek out, construct and use its "tool box" to make development more sustainable and to bring down the wall which still separates economy and environment. This is why a law is needed to transfer the knowledge which can be generated by green accounting to the everyday policy decision-making procedures, within a definite time-span or at least as quickly as possible.

E. ENVIRONMENTAL AND SUSTAINABLE DEVELOPMENT AT LOCAL AND URBAN LEVEL*

* Document drawn up for the Ministry of the Environment and ENEA by the Italian Institute for Environmental Research. Authors: Maria Berrini, Duccio Bianchi, Mario Zambrini (ambiente.italia@galactica.it).

EXECUTIVE SUMMARY

The document shows the need to have available and develop "local and urban" indicators. These should be expressed at sub-regional level to investigate the regional differences within the various states and regions. They should also be targeted at the specific conditions of the "urban environment" as an emerging problem in international and European policies (and therefore of interest for national policies). The urban environment is an object of only recent intervention, given local jurisdictions and sensitivities which are becoming stronger and stronger (In Italy and elsewhere, also through the spreading of local Agenda 21).

Part I introduces the subject, showing the most recent efforts to develop integrated indicators of local sustainability.

Part II offers a detailed review of experiments and studies in progress developed in Italy concerning local indicators and reports on the urban environment.

Initiatives developed at a national level are considered that aim to provide support of national policies, a full picture of regional differences and of the critical state of urban environments. A consolidated experiment at environmental ranking among more than 100 Italian towns is described. As the approach used, main results, and opportunities for further development.

The general approaches to reports on the state of the environment are analysed with specific examples. These reports were drawn up in local contexts, mindful of local sensitivities and specific conditions and supportive of local policies and the shared processes of defining objectives and priorities (Plans and local Agenda 21).

A recent attempt to study and apply at a local level a set of highly integrated and multidimensional indicators is presented. From this is shown the methodological formulation, the content and problems of application.

Finally, in part III, conclusions and recommendations are presented[1].

1. The contribution reported in this text constituted an updating and reworking of previous reports or applications developed by Ambiente Italia for various bodies and we therefore thank them. The main ones are: Eurostat – Environmental Pressure Index, 1st phase, 1997-98 (for the Urban Indicator part only); EEA – Europe's Environment, the second assessment, 1998 (for the Urban Environment chapter only); Municipality of Bologna – Report on the state of the Environment, 1997-98; ENEA – Shaping an integrated system of urban environmental indicators and projection of a national centre of monitoring, 1998; Municipality of Turin – Report on the state of the Environment, 1997-98; ANPA – Guidelines for local Agenda 21 in Italy, 1998-99; Legambiente/Panorama – Urban Ecosystem (annual report 1994-99 ed.); ASNM – Guidelines for environmental sustainability in the North Milan area, 1999; ENEA/Ministry of the Environment – Sector report on urban environment for the National Plan for Sustainable Development, 1999 In the bibliography are provided other references. Some of the considerations contained in this text are the result of the participation of Ambiente Italia in the working group on sustainable indicators (DGXI) and to the Local Agenda 21 National Coordination (Italy). Finally, we thank Alessandra Salvati and Teresa Santos (Ambiente Italia) for their collaboration.

I. PREMISE: LOCAL AND URBAN SUSTAINABILITY INDICATORS IN THE WORLD

1. Significance and role

In the wake of the undertakings signed at Rio in 1992, in particular chapters 28[2] and 40[3] of Agenda 21, many local administrations, organised in "The European Sustainable Cities & Towns Campaign[4], have recognised the value of indicators and underlined the urgency of research and testing in the field: "…Towns are conscious of having to base their own decisions, particularly concerning environmental monitoring systems, impact evaluations as well as costing, budgets, revision and information, on various kinds of indicators including those relating to the quality of the urban environment, to urban traffic, and urban models and, even more importantly on indicators of urban sustainability …". " …We shall direct the local organisation in support of sustainability through the application of a large range of methods and management tools for the environment, the economy, the society and health. In order to describe current conditions and measure developments, we shall rely on sustainability indicators …"

The same attention to the instrument of indicators was confirmed in the Report "European Sustainable Cities", published by the European Commission in 1996. The report promotes the use of indicators, emphasising the need to concentrate attention not only on indicators of environmental sustainability but also working on indicators relating to "lifestyles" and to reconcile physical sustainability with social well-being.

Finally, the recent European Commission report (Sustainable Urban Development in the European Union: A Framework for Action, 1998) has again underlined the need to: "monitor policies of local sustainability, and in particular local Agenda 21, researching and testing appropriate methods and indicators". The report has also identified the reduction of the ecological imprint of urban activities as a global policy objective which implies the need to find methods adapted to measuring the ecological imprint and to relate the ecological impacts to the local Agenda 21 processes.

Even from the beginning of the 90s various initiatives regarding environmental and sustainability policies and indicators were launched at a local and urban level by international organisations (OECD, World Bank, UN, European Commission). In the same way, some national institutions (both governmental and non-governmental) have made efforts at research and experimentation in this area.

Three fundamental themes for the development of systems of indicators of local and, specifically, urban, sustainability emerge from the progress of these studies and experiments:

- multidimensionality,
- a Pressure-State-Response approach,
- the development of integrated indicators.

Obviously some of the most innovative models and indicators require a phase of experimentation and the prospect of some of them being applied at the local level causes no small difficulty: in some contexts the difficulties are not great, in other cases they risk being excessively aggregated and as a result "lose' informational content, in other cases they are not applicable because of the unavailability of separate data at the local level.

2. "By 1996, most local authorities in each country should have undertaken a consultative process with their population and achieved a consensus on a local Agenda 21 for their communities".
3. "Indicators of sustainable development need to be developed to provide a solid basis for decision making at all levels and to contribute to a self-regarding sustainability of integrated environment and development systems."
4. The European Sustainable Cities and Towns Campaign www.sustainablecities.org

With reference to these opportunities and problems, the next section covers specific experiments already carried out in Italy, and possibilities of using local and urban indicators of sustainability.

II. STUDIES AND EXPERIMENTS AT THE LOCAL LEVEL AND IN URBAN AREAS IN ITALY

1. The national system of reporting on, and ranking, the urban environment

1.1 Delay in the 90s, increasing attention in recent years

Indicators used in Italy to evaluate urban quality and structure were, up to the mid-nineties, essentially socio-economic[5].

Among the reasons for this scarcity of research into local environmental problems (which on the other hand have assumed increasing importance for town-dwellers) is certainly the fact that systematic monitoring of the environmental quality of Italian cities and studies of local indicators were not developed until recently. In the first editions (published in 1995, 1998 with data from previous years) of the European Report of the European Agency for the Environment, Italian towns are rarely present. Previous editions of the Report on the state of the Environment (Environmental Ministry, 1989, 1992, 1997) tackle the theme of the Urban Environment, not from an integrated aspect, but with separate chapters (noise, air …).

In more recent years, on the other hand, a more decisive initiative on this topic has been developed (of which the partnership with the OECD in this Conference is in its way an important "indicator"):

- The Ministry of the Environment, in the middle of 1999, granted to the National Energy and Environment Board (ENEA) an eagerly anticipated three year project on urban environmental indicators with the title "Devising an integrated system of indicators for the urban environment and planning a national monitoring centre", presented at the interministerial Energy and Environment Conference, Nov, 98 by ENEA.
- The Ministry of the Environment has recently defined common working hypotheses with the National Institute of Statistics (ISTAT), which in the past two years has developed its own periodic research activity on some aspects of the environmental quality of the largest Italian towns.
- The new National Plan of Sustainable Development (PNSS), demanded by parliament, promoted by the Ministry of the Environment and in the process of preparation in recent months, contains within it a specific chapter on the urban environment (different from the previous edition of PNSS, dated 1993, which did not consider it). The related "Sector Report", planned as a contribution to the PNSS, provides the most important environmental indicators in a representative group of medium-sized Italian towns (the data was taken principally from the Urban Ecosystem Report - description given below).
- The National Agency for the Protection of the Environment (ANPA) began in 1998 its own line of activity in support of the local administrations engaged in the processes of local Agenda 21 with attention to the theme of local indicators.
- The National Association of Italian Municipalities (ANCI) collects and makes available statistical data on municipalities, and the Italian Confederation of Local Public Services

5. An extensive survey can be found in "The quality of life in towns, methods and results of comparative research", Gianpaolo Nuvolati, Franco Angeli, 1998

Boards (CISPEL) periodically produces a report on the performance of local environmental services which represents an indispensable source for all those working in the field of local indicators.

- The National Council of Research (CNR) – IRP has developed in recent years some early studies on local demographic dynamics, using local social indicators, but also with attention to their environmental implications.
- The Ministry of Public Works has begun observing and reporting on regional dynamics with reference also to the local level.
- Parliament is in the process of approving a draft bill on Environmental Accountability[6] which provides for the adoption of a system of "environmental accounts" from 2004 for state, regions, provinces and municipalities with more than 100,000 inhabitants (for those with smaller populations the deadline is postponed until 2007).

1.2 Urban ecosystem: a detailed attempt at environmental reporting with a ranking of 103 Italian towns (1994-1999)

The partnership

One of the most consolidated activities in the field of urban environmental indicators is that organised annually by Legambiente, the environmental association which, since 1994, has carried out, in collaboration with the Italian Institute of Environmental Research, the "Urban Ecosystem" report. The report is based on a system of about twenty indicators consistent with the principal international and European models cited in this text, structured according to the Pressure-State-Response model and applied for five years now to 103 Italian municipal provincial capitals.[7]

Information collected and methodology used

The methodological experimentation developed and the data produced in these 5 years provide above all important indications relating to:

- the strategic importance in particular in Italy of having available data and indicators on a local scale capable of showing delays and successes, dynamics and evolutions in time, geographic differences, correlations between environmental performance and various urban "forms and models" (metropolises, small to medium-sized towns …).
- the opportunities offered by this system of urban environmental indicators as an instrument in support of national policies, with the prospect of developing a system of indicators of local sustainability that are increasingly multidimensional, reliable and available to share.
- the difficulties still existing for its effective implementation due largely to the lack of informational systems at a local level.

To produce the Urban Ecosystem Report, information and data were gathered on 42 separate environmental parameters with reference to the 103 Italian municipal provincial capitals, using both questionnaires and direct interviews in the municipalities, and national and other statistical sources. The 42 parameters were used to develop the 18 environmental indicators shown in Annex I, Table I.

The procedure used to compare the towns studied and therefore to determine their ranking was later modified in 1999 on the basis of the results of previous years and the municipalities were involved. In this decision the three fundamental elements used to develop the methodology are:

- Firstly[8] an "objective" was determined for each indicator, in the majority of cases with reference to national and European laws or agreements, in some cases with reference to

6. This initiative is described in Giovanelli's paper in volume III of these proceedings.
7. The research for 1999 is accessible via www.legambiente.com and on ***www.mondadori.com/panorama***
8. Developing the model formulated by IUCN in 1997

the average or better performance of some Italian towns. On the scale of performances a "minimum" and "maximum" value was introduced and, with this, a number of quality bands were defined (excellent, good, fair, average, insufficient). With this method, according to the indicator, cases in which many towns are at the top (reaching the 'objective', equal to 100) and cases in which on the other hand no town reaches the objective, can be seen. This method has allowed, in comparison with previous versions, a reduction in the distortions inevitable in methods which are based on the comparison of the sole available data. The result from each town (in total or according to separate indicators) was gathered therefore with an "objective" town as reference (rating equal to 100) which did not claim to be an "utopian" town but simply "an ideal town in current conditions in Italy". If a town gained the highest rating of the 103 towns in each of the indicators gathered in 1999, this would mean a rating of 96.3.

- Secondly, the various indicators do not all have the same weighting. The weighting of the indicators varied between 1 and 1.6 (therefore none of the 18 indicators is in reality decisive and all count for less than 10% of the final result). The weighting of the indicators has been defined using an evaluation panel comprising 20 municipalities and Legambiente experts. Their suggestions prompted a higher weighting to be assigned to water purification, differentiated collection, public transport and urban parks and gardens.
- Thirdly, a differentiated evaluation was introduced between small and large towns. Both the objectives for air monitoring (this is consistent with Italian regulations of 1991, differentiating for small towns) and the objectives for public transport are differentiated according to the number of inhabitants. In this way, even small towns (of which there are many among the 103 Italian towns examined) can receive maximum points in air monitoring (even though they do not have Milan's network) or in public transport (without having the number of passengers transported in Florence).

Importance of the data collected

The amount of data collected and studied is highly significant and the informational content offered by Urban Ecosystem is useful both for studying sectors of separate areas (air, water, waste …) and because, with reference to an extended and representative sample of Italian towns it shows the areas where there are deficiencies and delays, it gives an indication of the trends which have characterised recent years and underlines the geographic differences or the differences resulting from varying sizes or urban models. Annex I provides more detail on the 18 indicators considered important to the system and examples of two inter-urban ranking of the indicators. It also includes the final synthesis table, with the classification of the towns.

Urban Ecosystem's data can be studied later. The interface between the environmental data (also as collected in the aggregated indices) and other socio-economic variables (from per capita income, to industrial concentration, to consumption of culture) seems in fact to show interesting correlations and suggests the existence of differentiated aggregations and paths to sustainable (or perhaps unsustainable) development.

2. Local reports on the state of the environment

2.1 Instruments for a common approach in various local contexts

In parallel with the development of "national observational" activities on urban environmental quality various experiments are being developed, which, in the main, are consistent with the models described.

With the aim of guaranteeing this "common approach" of local experiments, the National Agency for the Protection of the Environment (ANPA) is about to publish a text[9] addressed to public administrations starting local Agenda 21. This includes much experience and practical information about the Italian context. With the same objective to offer common approaches even though local choices are autonomous, local Italian Agenda 21 Co-ordination[10] instituted a working group, circulated documents and web sites to review the main experiments, and defined a package of "guiding criteria" for the selection and use of indicators at a local level. The Co-ordination is proposing itself as direct interlocutor with the bodies which on a national and European level are devising systems of indicators. Some of the towns which use them have participated in the consultation developed by Legambiente and Ambiente Italia for Urban Ecosystem and by DGXI for the European Sustainability Indicators.

2.2 Increase in local initiatives and the methodological approach used

In this outline some towns, provinces or regions have organised their own selection of indicators, partly following the international models cited above and partly adapting them to specific local contexts. Some of the most recent experiments have been explicitly structured with the aim of guiding the local processes of Agenda 21.

Among the municipal provincial capitals which have recently carried out a Report on the State of the Environment are Genoa (1996), Rome (1997), Bologna (1998), Modena (1999), Turin (1999), and Arezzo (1999). Other municipalities have produced reports or preliminary documents (Venice 1998) and, among these, many "minor" municipalities have begun to get involved (Carpi, Sassuolo, Cattolica, Lecco). Among the Provinces which have produced their own reports or have got involved in recent years are Turin, Modena, Bologna, Vicenza, Viterbo, Trento, Bolzano, Biella, Rimini, Lucca. Among the Regions Tuscany (which is already on its 5th edition), Friuli Venice Giulia (3rd edition), Umbria, Piedmont and Luguria must not be forgotten.

The methodological base of the local reports is at present, heterogeneous and varies according to the basis of the time period in which the document was drawn up, on the different reasons which led to it and on the different technical competencies involved.

In the beginning stage, which included the first experiments undertaken in the period (the '80s) in which the Report on the State of the Environment played a general informational and awakening role, a new phase was actually replacing it. In this new phase the Report presented the diagnostic and monitoring instruments to be used in the context of local processes of sustainable planning. In effect, this meant abandoning the "encyclopaedic" style (didactic and/or descriptive treatment) and using formulations aimed more at syntheses where the indicators play a more important role.

For the above-mentioned text (ANPA, 1999) an arrangement was produced of the indicators used in 6 reports on the state of the urban environment. There were chosen from those recently published in as many medium and large towns. From this comparative reading and from the analysis of other local Reports cited at the head of this paragraph emerges in the most recent experiments the consolidation of a common approach. A set of indicators is used which varies between 80 and 50 parameters but only in some cases have these parameters been reduced to a more limited selection of indicators. The themes tackled cover, on the whole, the main environmental areas (Air, Water etc) and the various sectors of activity (Mobility, Industry) and many reports use the State-Pressure-Response approach in the selection of indicators.

From a comparative reading there also appear specific differences relating to the selection or definition of indicators. The differences are due obviously to choices which each situation made separately and, in the majority of cases, result from lack of homogeneity in the availability of databases and reflect also the variety of geographic contexts and therefore the local importance of

9. *Guidelines for local Agenda 21in Italy* by Ambiente Italia for ANPA, in the process of being published, 1999
10. The Italian local Agenda 21 coordination was founded in April '99 and, at the beginning of December had more than 75 local administrations as members.

different factors (tourism in Rome, industry in Turin, the sea and tidal waves in Venice etc). In other cases the report was influenced by the technical orientation of whoever drew it up or varying importance was attached to some or other aspect, relative to the administrations and communities concerned. For example, there is a lack of homogeneity in areas such as urban structure, quality of life, health, energy.

2.3 Concrete examples of the use of urban environmental indicators according to the Pressure-State-Response approach

The list of indicators selected in two of the various local experiments analysed is provided (the cities of Turin and Venice) in Annex II. These are two very different situations, but which have used partially complementary methodologies (with attention paid in differing degrees to environmental and socio-economic factors).

Some of the most recent experiments have finally sought to evaluate the great amount of data collected, drawing attention to the main informative content. Annex II includes a syntheses of the information collected for the Turin Report[11].

Another example of some interest for its structure and finality is the set of indicators of "quality of life" (in the sense attributed to it by the method itself) developed by Meglio Milano[12] to monitor the situation in Milan. The system of indicators (a total of 100 in the 1999 ed.) is divided into 15 thematic areas which include social, economic and environmental dimensions (see the list of thematic areas in Annex II).

The cases cited initiated research activities on the state of the environment with a clear aim of guiding (and later monitoring) the processes of local Agenda 21. In a different way, but in all the situations analysed, this activity has helped the local administration and community to highlight trends, critical situations, opportunities and therefore define priorities for intervention.

3. In search of highly integrated and multidimensional local sustainable indicators: the proposal for North Milan

3.1 A typical urbanised area of post-industrial development

The geographical area defined as "North Milan" is composed of four municipalities in the province of Milan: Bresso, Cinisello Balsamo, Cologno Monzese and Sesto San Giovanni. With 235,000 inhabitants (1997), the North Milan area concentrates 10% of the population of the 187 municipalities of the province of Milan (excluding Milan) and is one of the most densely populated areas in Europe (6,500 hab/km²).

The whole of this region is a typically old industrialised area: vast abandoned industrial sites, high, long-term unemployment, an identity and collective image crisis. But this process has also produced new opportunities and has changed the area into a region of "local variety", because it is composed of areas and centres with characteristics differentiated by diversified economies where the decline of large industries does not mean de-industrialisation.

3.2 Indicators in support of local strategic planning

In this context, in the North Milan region, a process of strategic planning for the regional and local economic system has been started, promoted by the North Milan Development Agency (ASNM) and co-ordinated with the administrations of the four municipalities. In this phase, in fact, the

11. Report on the State of the Environment and on the sustainability of the municipality of Turin (1999) , by Ambiente Italia
12. An association promoted by the Automobile Club of Milan, the Chamber of Commerce, the universities of Milan and a number of firms. The monitoring system reached its 9th edition in 1999

municipality of North Milan is confronted with many different options in the economic, regional and environmental, social and institutional spheres.

In support of this process of strategic planning a system of "local indicators of sustainability" has been developed.[13] The realisation of a system of indicators of urban sustainability is placed not only in a region and on an unusual scale (which does not correspond with an administrative entity), but also in a region "in the process of changing" and at the beginning of a well-constructed process of participatory planning.

3.3 Aims and architecture of the system

The system of indicators of the North Milan region has the aim of constructing a functional instrument for the orienting and monitoring of the strategic programming activities and the policies of urban sustainability understood in their multidimensionality.

In relation to this objective a system of indicators based on three essential elements has been proposed:

- The proposed system of indicators is structured "with objectives" and as "multidimensional": it concerns therefore four dimensions of sustainability (environmental, social, economic, educational).
- The system of indicators is directed to measuring the performance of the community towards its own objectives (and not to create a description of the situation). Consequently, they seek to develop "performance" and "multi-objective" indicators.
- Some "key-indicators" have been extracted from an "extended list" of indicators, with the aim of having available a useful instrument to communicate and select a group of indicators that can be used to benchmark the region (with the outside world, or within the region, between municipalities and between homogenous sub- regions). Among the identified key indicators are included some highly integrated and innovative indicators and truly synthetic indices for which it would be necessary to verify and test the possibilities of local application.

3.4 Path used

The path used to define the system of indicators could therefore be described schematically thus:

- preliminary check of the informational base;
- identification of objectives of sustainability;
- definition of the structure of the system of indicators;
- selection of potential indicators;
- technical and socio-political verification of the system of indicators (and participation);
- Preparation of the definitive list (extended list, key indicators).

3.5 Identified objectives for sustainable strategic planning

The 6 global objectives (of a strongly multidimensional character) identified[14] for the sustainability of North Milan are:

13. ASNM – *Guidelines for sustainability in the North Milan region,* by Ambiente Italia, in the process of being published, 1999
14. The objectives represent an adaptation of the established objectives of the Strategic Agenda for North Milan (dic 99, by A Balducci et al), which constitutes the first anchor of a participatory path for a local Agenda 21.

- limit the consumption of resources, revitalise and upgrade the environmental and regional system;
- programme for infrastructure and sustainable mobility;
- promote a competitive, innovative and environmentally compatible economy;
- improve urban quality of life and showcase the region;
- ensure equitable social well-being and the growth of human capital;
- reinforce participatory government and institutional co-operation.

3.6 Objective/dimension matrix, extended list of indicators

From the objectives identified above there has been a progression towards defining a first "extended list" of indicators, using a matrix comparing the dimensions of sustainability with the global objectives of sustainability. Annex III shows some of the indicators selected, how they are organised in the "objective/dimension" matrix. All the indicators have been assigned to their principal reference objective, but in the case of multi-dimensional indicators (occurring in large numbers), the indicators have been shown with reference to all the objectives involved. The greater part of the 6 objectives are already intrinsically multidimensional.

The proposed indicators are, on the whole, "integrated": the improvement of the performance in these indicators tend to identify a convergence between the various dimensions of sustainability.

The number of indicators (79 in total) is differentiated between the various dimensions (39- environmental, 23 – social, 10 - economic, 7 – institutional). This does not imply that a weighting different to the 4 dimensions is intended to be attributed, but the choice depends in reality on the varying availability of data at a local level.

3.7 Multidimensional and integrated key-indicators: opportunities and problems of application

The "key-indicators" identified for North Milan are those indicators which concern environmental or socio-economic priorities of the region and, in a certain way, those which depend more directly on specific actions of public and private operators (and on the behaviour of town-dwellers) in the region.

Considering the essential themes for sustainable development of the North Milan region, attention has been focalised on 2 specific aspects (economic conversion and regional re-equilibrium), identifying the indicators useful in monitoring and evaluating the evolution of phenomena and the efficiency of the policies. Among the key indicators selected are some synthetic indices, partially innovative (and which therefore require some experimentation and perfecting) and some highly integrated and multidimensional.

The key indicators will be expressed as performance indicators in such a way that they can monitor not only the progress of a certain phenomenon, but also how much and with what intensity this is oriented in the desired direction with respect to the objectives.

Two aspects are tackled:

Work, well-being and environment

The identified strategy is to halt and reverse the decline (employment and conditions for well-being) that is linked to the end of an industrial cycle, transforming the region into an economic area specialised in new industrial and service activities with a low environmental impact and with a strong orientation towards the whole information technology sector and multimedia.

For this strategic region the following are picked out as key indicators:

- Indicators of work eco-efficiency: emissions of CO2 per employee, use of water per employee, industrial waste per employee, % of people employed in firms with environmental certificates. As the data relating to municipal GDP is unavailable, the identified indicator, representative of the environmental efficiency of the economy is based on the number of employees, emphasising at the same time the objective of employee development. The working population constitutes in fact in its turn an indicator of the value of economic activity. These indicators show how much pollution and how much consumption of resources is generated by each job offered.
- Indicators of competitiveness: number of patents, % of high tech workers. The index of competitiveness developed by World Economic Forum is too complex to be reproduced at a local level and is significant not in absolute terms, but in terms of ranking. A synthetic indicator of the development of factors of local competitiveness is however theoretically possible even if it requires a period of study and testing.
- Indicators of economic well-being: growth rate of turnover of firms, unemployment rate.
- Indicators of social equity: index of social justice. The index of human development elaborated by the UNDP seems of little importance when applied to a local level. A re-working of the idea was supplied however by the Dublin Foundation (*European Foundation for the Improvement of Living and Working Conditions)* with the proposal of an "index of social justice", expressed as a "percentage of the population exposed to poverty, unemployment, lack of access to education, information and recreation". In the area being examined the indicator is proposed in a more synthetic form but is nevertheless necessary to refine the methodology of weighting and effectuate a more thorough check of the availability, representativity and reliability of the necessary data.
- Indicators of gender equality: index of gender development. The index of gender equality developed by the UNDP is of little importance at a local level. This index could however be adapted, joining it with the measure of gender empowerment (MEG). The variables to be considered could be: education rate, employment rate, % of owners of companies, rate of political representation. For this index also it is necessary to refine the methodology of weighting and effectuate a more thorough check of the availability, representativity and reliability of the necessary data.

Urban quality:

The chosen strategy is to reorganise the area (from the urban, geographic and environmental point of view) through reclamation of abandoned industrial sites, freeing disused areas, bridging gulfs and removing barriers, inventing a new landscape with a re-balancing of functions, initiating an improvement in the quality of urban life and improving the availability and the state of environmental resources.

For this strategic area the following have been identified as key indicators:

- Indicators of environmental quality: number of days with atmospheric pollution, % of the population exposed to noise above the threshold (as % cases of excessive noise).
- Indicators of availability of services: index of accessibility (population which lives within … metres of public parks and gardens, within … metres of public transport, within … metres of food stores, within … metres of primary schools) or index of availability of services compared to the standard level.
- Indicator of urban security: % of victims of personal acts of violence and of traffic accidents (with death rates).
- Indicators of restoration of industrial sites: hectares of industrial sites reused.

A later combined index of eco-efficiency and ecological sufficiency, identified by region is the Ecological Imprint. The concept and method of calculation of the ecological imprint has been sufficiently defined and the indicator has been already applied even at the urban level (London, the Hague, Barcelona). However, as the scale of representation descends from national to local, more assumptions become necessary. This can be based on average values of larger areas (provincial, regional or national level) more of the variables that determine the indicator escape the intervention powers of local government. The first applications of the indicator are being tested in Italy (for example by the city of Turin) and its application is expected in the North Milan region from 2000.

III. CONCLUSIONS AND RECOMMENDATIONS

From analyses of international activities and from specific experiments carried out in Italy it emerges that:

- It is necessary to develop and have available indicators adapted to a local level (regional and sub-regional) to be able to study differences in various phenomena, differences that are present in the various states.
- It is necessary to develop and have available indicators adapted to study the specifics of the "urban environment", in which environmental, social and economic aspects are highly integrated, in which responses have specific characteristics due to their closeness to the problems, and to the effects and influence of various agents.
- A common reference system (criteria, standards, core sets of indicators) is required which orients and is integrated in a complementary way into the list of indicators (possibly a more extensive list) autonomously studied and locally adapted, resulting from specific objectives, from local perceptions of priorities regarding collective and democratic processes of defining objectives.
- There is a requirement for research, adaptation and experimentation on systems of local and urban integrated and multidimensional indicators.
- Indicators of sustainability should constitute one of the fundamental components of the process of constructing local Agenda 21 as well as an autonomous instrument of reporting (the system of indicators support the drawing up of a "diagnostic table" and the monitoring and verification of the objectives of local Agenda 21).
- All the research and experimental activity should be developed openly, evaluating experiments and possible partnerships between governmental, non-governmental, local, national and supranational organisations, with feedback from, and involvement of, local communities.

ANNEXES

A. URBAN ENVIRONMENT REPORTING EXAMPLES

Table 1. **Indicators used by Ecosistema Urbano (1999 edition)**

Indicator	Measurement Unit	Source
Air monitoring	number and types of monitoring stations compared to legal obligations and differentiated by size of city (according to DM 20/5/91, adapted)	Municipalities, 1998 data
NO^2	annual average (daily averages) from all stations	Municipalities, 1998 data
CO	average in excess of the 10 mg level, weighted for the number of stations	Municipalities, 1998 data
Nitrates	average content (mg/l NO3) in drinking water	Municipalities, 1998 data
Water consumption	per capita consumption (l/inhabitants/daily range)	Municipalities, 1998 data
Purification	% of elimination of civil load, calculated as: % of inhabitants linked up (by daily range Functioning) * purification efficiency (CODusc/CODingr)	Municipalities, 1998 data
Urban solid waste production	Per capita production of urban waste (kg/ inhab/year)	Municipalities, 1998 data
Differentiated collection	% differentiated collection (excluding bulk) in total solid waste	Municipalities, 1998 data
Cars driven	cars/100 inhabitants in the municipality	Municipalities, 1998 data
Public transport	Journeys/inhabitants year (differentiated by resident population)	Municipalities, 1998 data
Pedestrian precincts	m^2/inhabitant	Municipalities, 1998 data
Cycling paths	m/inhabitant	Municipalities, 1998 data
Fuels	per capita consumption (petrol and diesel) in kep/ inhabitants/year on a provincial basis	Petroleum bulletin (1997 data)
Household GWh	per capita household electrical consumption (kWh/inhabitant) on a provincial basis	Enel, 1998 data
Urban parks and gardens	m^2/inhabitant of usable parks and gardens excluding parks and protected areas	Municipalities, 1998 data
ISO 14000 certified industries	n. of provincial certifications (1999)/per 1000 billion provincial value added	Sincert (October 1999); for value added: Istituto Tagliacarne (1997 data)
Commitment to local Agenda 21	Municipalities registered for Italian local Ag 21 Co-ordination	Local Ag 21 Coord. Nat. (October 1999)
Tumour and respiratory system deaths	Deaths by tumour and illnesses of the respiratory system of the provincial population (n. every 10,000 inhabitants)	Istat 1995 data

Table 2. **Examples of urban environmental ranking: Urban Ecosystem** ('99 ed.)

A. Purification[15]

Town	% purif.	Town	% purif.	Town	% purif.
Agrigento	Na	Como	86%	Lodi	58%
Enna	Na	Matera	85%	Caserta	57%
Nuoro	Na	Modena	85%	Campobasso	56%
Oristano	Na	Verona	85%	Genoa	56%
Cagliari	100%	Perugia	82%	Aosta	53%
Caltanissetta	100%	Alessandria	81%	Avellino	53%
Cosenza	100%	Brescia	80%	Gorizia	52%
Massa	100%	Lecce	80%	Potenza	52%
Pavia	100%	L'Aquila	79%	Venice	52%
Ragusa	100%	Syracuse	79%	La Spezia	51%
Salerno	100%	Biella	78%	Lucca	51%
Savona	100%	Rome	78%	Forlì	48%
Trento	100%	Reggio Emilia	77%	Isernia	48%
Bologna	99%	Rovigo	76%	Bari	46%
Piacenza	99%	Udine	76%	Pisa	46%
Bolzano	97%	Ferrara	74%	Viterbo	45%
Brindisi	96%	Rieti	74%	Macerata	43%
Siena	96%	Ancona	73%	Vicenza	41%
Terni	96%	Ravenna	72%	Messina	40%
Turin	96%	Chieti	70%	Naples	38%
Bergamo	95%	Grosseto	70%	Rimini	38%
Cremona	95%	Pesaro	70%	Ascoli Piceno	36%
Pescara	94%	Varese	70%	Vibo Valentia	36%
Sondrio	91%	Parma	69%	Padua	27%
Verbania	91%	Asti	68%	Treviso	24%
Cuneo	89%	Frosinone	66%	Palermo	19%
Foggia	89%	Mantua	66%	Pordenone	18%
Lecco	89%	Latina	65%	Florence	12%
Livorno	89%	Vercelli	65%	Benevento	10%
Prato	89%	Pistoia	64%	Taranto	7%
Trieste	89%	Teramo	63%	Catania	3%
Catanzaro	88%	Arezzo	62%	Imperia	0%
Crotone	88%	Novara	62%	Milan	0%
Sassari	87%	Belluno	61%	Trapani	0%

15. % of inhabitants connected to purification plants *functioning days *efficiency of purification system (CODoutflow/CODinflow); source: Urban Ecosystem 99.
Even though it is improving, the purification system situation requires further development. In 6% of municipalities the number of inhabitants connected to the sewage system is shown to be even less than 50%. The number of municipalities without any system of purification has declined from 8 in 1995 to 3 in 1998. Among them the city of Milan stands out, while purification plants have been introduced in Palermo and Catania before Milan. A purification level of less than 50% of the population is still indicated in 17 municipalities (25 in 1995). A purification level above 80%, however, is indicated in only 56 main towns as yet. The purification plants report generally normal outflowing effluent (only Taranto reaches 186mg COD) and only in 5 cases exceeding the level of 125 mg COD.

Table 3. **Examples of urban environmental ranking: Urban Ecosystem** ('99 ed.)

B. Cycle tracks[16]

Town	M/ab	Town	M/ab	Town	M/ab
Agrigento	Na	Rimini	0.31	Pescara	0.01
Alessandria	Na	Padua	0.29	Rome	0.01
Ascoli Piceno	Na	Latina	0.23	Ancona	0
Catanzaro	Na	Pisa	0.22	Aosta	0
Lecce	Na	Novara	0.2	Asti	0
Lucca	Na	Turin	0.19	Avellino	0
Massa	Na	Udine	0.17	Benevento	0
Messina	Na	Belluno	0.15	Cagliari	0
Nuoro	Na	Parma	0.14	Caltanisetta	0
Palermo	Na	Arezzo	0.13	Campobasso	0
Pavia	Na	La Spezia	0.13	Catania	0
Pesaro	Na	Bologna	0.12	Cosenza	0
Sassari	Na	Salerno	0.12	Crotone	0
Syracuse	Na	Como	0.11	Enna	0
Venice	Na	Brindisi	0.1	Foggia	0
Sondrio	1.27	Siena	0.1	Frosinone	0
Modena	0.81	Terni	0.1	Genoa	0
Treviso	0.73	Florence	0.09	Gorizia	0
Ferrara	0.69	Bergamo	0.08	Imperia	0
Cremona	0.68	Teramo	0.08	Isernia	0
Cuneo	0.66	Matera	0.07	L'Aquila	0
Forlì	0.66	Biella	0.06	Lecco	0
Reggio Emilia	0.61	Milan	0.06	Macerata	0
Trento	0.53	Rieti	0.06	Naples	0
Pordenone	0.48	Varese	0.05	Oristano	0
Lodi	0.47	Chieti	0.04	Perugia	0
Brescia	0.42	Pistoia	0.04	Potenza	0
Bolzano	0.41	Prato	0.04	Ragusa	0
Mantua	0.41	Trieste	0.04	Savona	0
Verbania	0.4	Caserta	0.03	Taranto	0
Grosseto	0.39	Livorno	0.03	Trapani	0
Rovigo	0.39	Piacenza	0.03	Vercelli	0
Vicenza	0.38	Verona	0.03	Vibo Valentia	0
Ravenna	0.36	Bari	0.01	Viterbo	0

16. Metres/inhabitants; source: Urban Ecosystem census 1999.
56 towns report cycle paths with a total of 841 km. In comparison, note that the National Plan of Sustainable Development established an objective of 2000 km of total cycle paths in one hundred Italian towns. Turin (with 89 km), Modena (71 km), Ferrara and Reggio Emilia (with more than 40 km) have the longest total length of cycle paths.

Table 4. **Urban environmental reporting: the final classification**

EXCELLENT (between75% and 100% of the goal of sustainability)	No municipality			
GOOD (between 65% and 75% of the goal of sustainibility)	Venice	70%	Bergamo	67%
	Pavia	69%	Como	67%
FAIR (between 55% and 65% of the goal of sustainibility	Cremona	62%	Prato	57%
	Bologna	61%	Perugia	57%
	Brescia	60%	Chieti	57%
	Sondrio	60%	Udine	57%
	Bolzano	60%	Rome	56%
	Turin	60%	Avellino	56%
	Ferrara	60%	Arezzo	56%
	Lecco	59%	Pescara	56%
	Trento	58%	Reggio Emilia	56%
	Florence	58%	Livorno	56%
	Ancona	58%	Trieste	56%
	Siena	58%	Alessandria	55%
	Modena	57%	Mantua	55%
	Salerno	57%		
AVERAGE (between 45% and 55% of the goal of sustainability	Vicenza	54%	Cosenza	50%
	Verona	54%	Savona	50%
	Parma	54%	Varese	50%
	Lucca	54%	Forlì	50%
	Genoa	53%	Catanzaro	50%
	Lodi	53%	Teramo	49%
	Matera	53%	Gorizia	49%
	Rimini	53%	Syracuse	49%
	Piacenza	53%	Pordenone	49%
	Campobasso	53%	Sassari	49%
	Ravenna	53%	Brindisi	48%
	Ascoli Piceno	52%	Bari	48%
	Treviso	52%	Macerata	47%
	Isernia	52%	Benevento	47%
	Pesaro	52%	Naples	47%
	Caserta	52%	Messina	47%
	Belluno	51%	Foggia	46%
	Pisa	51%	Milan	46%
	Palermo	51%	Biella	45%
	Padua	51%	Taranto	45%
	Rovigo	51%	Asti	45%
	Terni	51%	Cagliari	45%
	Verbania	51%	Catania	45%
	Cuneo	50%	Aosta	45%
	Rieti	50%	Novara	45%
INSUFFICIENT (between 35% and 45% of the goal of sustainability)	La Spezia	44%	Crotone	41%
	L'Aquila	44%	Enna	40%
	Ragusa	44%	Viterbo	39%
	Caltanissetta	43%	Potenza	39%
	Massa	43%	Imperia	37%
	Frosinone	42%	Trapani	37%
	Pistoia	41%	Vibo Valentia	36%
	Vercelli	41%	Lecce	36%
	Grosseto	41%	Latina	36%

Table 5. **Data availability for urban environmental reporting experiments**[17]

Indicator	**Unit**	**Availability** (% municipalities)
Monit. Air	Fixed centr. Parameters	88%
NO2	98° perc	69%
NO2	Average	71%
O3	No. exceeding 200 ug/microcosms	64%
O3	No. exceeding 110 ug/mc	59%
CO	No. exceeding 30 mg/mc	70%
CO	No. exceeding 10 mg/mc	65%
Benzene	Average value	30%
Noise	Number controls	83%
Water poured into system	Mc/daily range	88%
Consumption drinking water	Microcosms/daily range supplied	86%
NO3	Mg/1 average	86%
Purification	Inhabitants connected/served	96%
COD outflow	Mg/1	83%
Urban waste products	Kg/inhab/year	96%
Differentiated collection	% of Urban solid waste	96%
Final destination waste	% dumped	90%
Public transport	Passengers transported	98%
Pedestrianized area	M^2	85%
Limited traffic zones	M^2	83%
Cycle paths	N	82%
Cycle paths	Km	86%
Public parks and gardens	Parks and gardens m^2/inhab	86%
Parks and gardens	Green spaces facilities	77%
Green spaces	Parks and nature reserves m^2	82%

17. % availability (of the total of 103 municipalities involved) of the data useful for the study of the individual indicators - Urban Ecosystem, '99 edition.

B. LOCAL URBAN ENVIRONMENT INDICATORS

Table 1. **Indicators used in 2 environmental reporting experiments in Italy**[18]

AIR	**Turin**	**Venice**
	Report on the state of the environment in the city of Turin (by Ambiente Italia, 1999)	**Project Venice 21** (set up by FEEM, 1996)
Metereology		Tidal wave (as ind. Water)
Air quality: sulphur dioxide	98° percentile on annual basis, all points of measurement	98° percentile on annual basis, all points of measurement
Air quality: nitrogen dioxide	98° percentile & average on annual basis for each point of measurement; total no. exc conc hourly average of 200 and 400 ℓg/m3	98° percentile & average on annual basis for each point of measurement
Air quality: detailed	Annual average for each point of measurement	Annual average, each point of measurement
Air quality: PM10	Annual average for each point of measurement	
Air quality: CO	Average no. exc conc 8 hr – year for each point of measurement; no. exc attention lvl.	
Air quality: Ozone	No. total exc threshold protec health 110ℓg/m3 (8 hr) and attention lvl.	
Air quality: Benzene and IPA	Annual average for each point of measurement	
Air quality: lead	Annual average for each point of measurement	
Air quality: level of attention		% daily range of exc attention lvl: O3, NO2, SO2 & CO
Adequacy of monitoring system	Active stations, location, type; % valid dates	
Atmospheric pollution emissions	Annual est. emissions Nox, Sox, CO, PTS & COV – t/year, % by sector origin	Annual est. emissions Nox, Sox, CO, PTS & COV – t/year
Emissions control: cars	No. controls – blue stamp	
Response policy: PTU, measures to reduce emissions	PTU objectives	
Response policy: temporary blocking of traffic	No. provisions	
NOISE	**Turin**	**Venice**
Sound level	Day/night – each point of measurement, Leq dB (A)	
Exposure	% pop exposed day levels > 65 dBA, night > 55 Dba	% pop exposed day levels > 65 dBA
Monitoring	No. monit. Pts., no. monitoring daily ranges	
Control of inflow:town-dwellers' recommendations	No. controls; % reason requested intervention	
Acoustic zoning of the territory	State of progress	

18. .Some information included in this table comes from "Linee guida per le Agende 21 locali in Italia" ANPA (currently being published).

WATER	**Turin**	**Venice**
Water consumption	Total and per capita consumption by use	Total consumption by sector
Supply	Withdrawal by source, %	
	Network losses, %	
Quality of water for human consumption: chemicals	Average conc nitrates, comp. Organohalogens – year, by each point of measurement compared with VG and CMA	
Quality of surface water: Synthetic index	Extended Biotic Index, EBI; % Distrib. Quality types principal chemical/microbiological parameters; types in relation to use	
Quality of water table: chemicals	Average conc nitrates, organohalogenic composts – year, each point of measurement	
Quality of bathing water		Compared with required quality
Coverage of collecting service	% pop served by collection network	
Coverage of purification service	% pop served by purification plants	% pop served by purification plants
Efficiency of purification service	% difference between inflow and outflow levels with respect to: BOD5, COD, NH4, P tot.	
Evaluation of pollution levels		Nutrients levels – t/year P & N in lagoon; eutrophication - % of surface covered with algae
Response policy	Projects and initiatives	
SOIL AND SUBSOIL	**Turin**	**Venice**
Landslides	Ha. by class of instability, total active, quiescent, stabilized landslides	
Risk of overflow	No. activities present in fluvial zones	
Vulnerability	Vulnerable areas – types of vulnerability	
Use of soil	% distribution destination use	
Quarries and extractive activities	Disused quarries: m², characteristics/critical states	
Contaminated areas	M² affected, characteristics and locations	
Response policy	Projects and interventions	
LANDSCAPE AND NATURE	**Turin**	**Venice**
Public parks and gardens: availability	% dist. By type; m²/inhab	M²/inhab
Public parks and gardens: accessibility	Pop 15 minutes dist on foot from green area	
Ecosystems and important sites	Humid zones, exc. Woods, parks, biotypes: characteristics, size, municipal distribution	
Vegetation	Recommendations relating to protected, rare and threatened flora; tree plantations: no and species	
Wildlife	Mammal, bird, reptile, amphibian, insect species	Acquatic bird species
Protection policy	Projects and interventions	
URBAN STRUCTURE	**Turin**	**Venice**
Expansion of buildings	Ha buildings, % on territory	
Urbanised area	M²/inhab, % on territory; % by destination of use	
Inhabited density	Inhab/km²	
Building activity	Volume – m3 – constructed and demolished buildings	
Urban renewal projects	Projects, intervention programmes	

ENERGY	**Turin**	**Venice**
Total energy consumption	Tep/year, %	
Energy consumption: share of consumption by consumer sector	Tep/year, %	Domestic electric energy consumption – kWh/inhab. & natural gas – m3
Supply	Dependency on foreign supplies and local contribution by energy supplier (% of consumption); cogeneration – electr energy, thermal energy (kWh)	
Use of renewable sources	Hydroelectric energy production, % total prod; biogas (dumping), % private consumption	
Climate-altering emissions	% dist. And t/year CO2 eq by sector (residential, transport) and by energy supplier	
Pollution emissions by energy production plants		
Sources of electromagnetic fields	Index population exposure: limited value comparison	
Response policy	Municipal initiatives	
WASTE	**Turin**	**Venice**
Urban waste	Total production – t and per capita – kg/inhab.	Total production – t and per capita – kg/inhab
Differentiated collection	% incidence of Diffr. Coll. on total production of urban waste; % Diffr. Coll. merchandise composition	% incidence Diffr. Coll of total production of urban waste
Urban waste disposed of by mode	% by type of disposal; disposal capacity	
Special waste		Total production
MOBILITY	**Turin**	**Venice**
Private motoring	Cars/100 inhab.	
Demand and supply of parking space	% payment on public property and on infrastructure	
Systematic mobility	% on total mobility; % by motive	
Total mobility: modal distribution	Incidence of private car ownership	
Total mobility: origin and destination	No. motorized movements daily range with origins in the municipality, % dist movements daily range by O & D	
Times		Average time used for systematic movements
Public transport: extent	Km of network	
Public transport: protected and/or reserved network	Km; % on whole network	
Public transport: quality of service offered	Km/h	
Public transport: demand	Journeys/inhab. (year)	
Goods transport		% maritime transport, % air transport
Passenger transport		% maritime transport, % air transport
Road infrastructure: pedestrianized area	M²	
Road infrastructure: cycle paths	Km	Km to Mestre
Accidents	Death rate (deaths/tot. accidents); and injury (injuries/tot. acc.)	
Response policy	Urban Traffic Plan (UTP): objective of short and medium term; substitution public car park	

ECONOMIC ACTIVITY	**Turin**	**Venice**
Economic structure	% dist. Workers and local units by sector activity	% variation no. add by macrosectors; no. employees in Porto Maghera
Industry: plants at risk	No. plants at risk of major incidents, classes A & B	
Industry: water withdrawal and drainage	Sources of supply (m3); recycling %	
Industry: spreading of environmental management systems	No. certified sites	
Agriculture: SAU and SAT	Ha. SAU – type of cultivation - & SAT	
Agriculture: forms of management	% by type, ha affected; % of farms with tot. area < 5 ha.	
Agriculture: biological agriculture	Ha. Affected, % used as meadows	
Services: commercial activity		No. commercial firms by type
Tourist flow		Arrivals, presence (with or w/out overnight stays)100 inhab.
Hotel structure		% hotels with good quality services (facilities for the disabled, restaurants, heating, telephone & TV in room
SOCIAL ASPECTS	**Turin**	**Venice**
Demographic structure: inhabitants	(in URB. STRUCTURE)	No. inhabitants - % variation; natural balance, migratory balance
Demographic structure: index of old age		% pop > 65 years old
Demographic structure: composition of the nuclear family		% families with < 3 people
Education		Illiteracy index, average, higher education
Labour market		Unemployment rate; creation of new jobs (open-ended, temporary)
Housing: quality		% housing without one or more basic services: bath, heating, drinking water
Housing: size		Index of overcrowding: inhab/no rooms
Property market		Average selling price/m²; average monthly rent house of 90m²
Housing: evictions		No. annual evictions
Medical services		No. inhab/available hospital beds
Health		No deaths by tumour/100,000 inhab.

Table 2. **Key used in the syntheses** (Turin 1999)

TENDENCY: Compared with the past, has the situation changed? For better or for worse compared to the environmental objectives thought desirable?

RESPECT FOR THE OBJECTIVES: Currently, are the binding standards or objectives respected?

IMPORTANCE: Currently, what are the most problematic or significant environmental situations?

STATE OF KNOWLEDGE: Can the monitoring and analytical activities be improved?

CAUSES –PRESSURE FACTORS: Which sectors or activities principally influence these resources or phenomena?

RESPONSE IN PROGRESS: What positive actions has the public administration carried out or started with the intention of improving or consolidating the trend? (NB: the actions mentioned are only those of mitigation, protection or upgrading. For actions addressing pressure factors see the other table)

LOOKING INTO THE FUTURE: Considering the situations of the principal critical states, are there good prospects of achieving the binding or desired environmental objectives? Should the responses in progress or started be reinforced in order to achieve the objectives?

Table 3. **Thematic areas of 100 "quality of life" indicators**, **MeglioMilano Association** (99 ED.)

- Population (migratory balances, birth and old age indices …)
- Environment (atmospheric pollution, waste, potable well pollution …)
- Jobs (employment and unemployment, bankruptcies …)
- Health (hospitalisation, deaths from various types of tumour to AIDS …)
- Hardship (abortion, suicides …)
- Law and order (efficiency of the judicial system, criminality …)
- Economic well-being (average income, poverty, bank deposits, car & telephone ownership …)
- Housing (availability of rooms, ownership, costs …)
- Education (schooling …)
- Mobility (public transport, street accidents …)
- Support services
- Public services
- Service industry
- Culture and entertainment (expenses, library availability and attendance, cultural facilities …)
- Sport (sport centres availability and attendance …)

C. THE OBJECTIVES/DIMENSIONS MATRIX EXTRACTS FROM THE EXTENDED LIST[19]

OBJECTIVES	Environmental quality	Sustainable mobility	Economic competitiveness	Urban quality of life	Social well-being	Participatory government
ENVIRONMENTAL DIMENSION						
NOISE	Population exposed to the various noise levels	Population exposed to the various noise levels				
GREENHOUSE EFFECT	CO^2 emissions by worker		CO^2 emissions by worker			
SOCIAL DIMENSION						
POVERTY AND HARDSHIP					% of families below the poverty line	
ECONOMIC DIMENSION						
ECONOMIC ACTIVITY	Prod. Activity ISO certificate 14000 and EMAS		Prod. Activity ISO certificate 14000 and EMAS			
LABOUR			% youth and female unemployment	% youth and female unemployment		
INSTITUTIONAL DIMENSION						
PUBLIC SECTOR BUDGET	Social and environmental expenditure % municipal budget			Social and environmental expenditure % municipal budget		
PARTICIPATION	Voluntary associations			Voluntary associations		Voluntary associations
PARTICIPATION			% of women owning a business			% women owning a business

19. The complete list with the 79 indicators is in: ASNM – Guidelines for the sustainability of the North Milan area, by Ambiente Italia, being published, 1999

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