Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development

English - Or. English

Sustainable Development

ROUND TABLE ON SUSTAINABLE DEVELOPMENT

MEASURING WHAT?

This document is a background paper for the OECD Round Table on Sustainable Development which has as its theme "Measuring Sustainability". The meeting will take place at OECD Headquarters, 2, rue André Pascal, 75016 Paris on 6th December 2001, starting at 9.30.

The views expressed do not necessarily represent those of the OECD or any of its Member countries.

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Introduction

Ever since the Rio Conference, the search has been on for indicators of sustainable development. While the *Rio Principles* never define sustainable development in so many words, Principle 3 talks of the right to development "so as to equitably meet developmental and environmental needs of present and future generations."

For such a high-level goal to be more than just words, signatories appreciated that they had to be able say something about whether they were moving towards that goal. Thus, in *Agenda 21*, they noted that "methods for assessing interactions between different sectoral environmental, demographic, social and developmental parameters are not sufficiently developed or applied." Nevertheless, they urged countries to "develop the concept of indicators of sustainable development"[i] in a way that would "contribute to a self-regulating sustainability of integrated environment and development systems."

Nearly ten years later, and despite a great deal of work, there is still no definitive set of agreed indicators. This paper asks what it is that people want to measure when they talk about indicators of sustainability and whether current attempts will take us very far.

The most commonly cited justification for indicators is presentational. The United Nation's Department of Economic and Social Affairs has identified calls for "simple, elegant and effective measures that do not compromise the underlying complexity [of sustainable development]. High-level decision-makers (government ministers, foundation executives, and heads of corporations) routinely ask for a small number of indices that are easy to understand and use in decision-making." Ministers attending the UN Commission on Sustainable Development, for instance, have consistently expressed the desire for some concrete measures. They have been motivated in no small part by a concern that, without hard evidence of progress towards sustainable development (or a lack of it), they will be unable to sustain momentum for their policies.

In a similar vein, the European Union has described indicators as tools to "simplify complex information so that is it quantifiable [and] can be understood and communicated".[ii] Clearly, policies that defy any clear outcome measures are going to be viewed askance.

But even accepting that, there is still the question of *what* it is that decision-makers want to be able to measure and communicate. The Rio Principles are declarations of intent that do not lend themselves easily to direct measurement. And, while some elements of Agenda 21 might lend themselves to more specific measures, most are couched in such disappointingly general, narrative terms as to be worthless in terms of measuring sustainability. In the absence of agreement on a more specific and tractable list of goals, assessing progress on sustainable development risks degenerating into lists of measures, arbitrarily chosen to suit the interests of the measuring entity.

Some Recent Attempts

The need to generate a simpler, more focussed approach to measuring progress towards sustainable development led Ministers to mandate two developed country inter-governmental agencies – the European Commission and the OECD – to propose short lists of indicators. In the context of its Strategy for Sustainable Development, the European Commission refers to the need to bridge high-level ambitious visions with practical political action by focussing on "a small number of problems which pose severe or irreversible threats to the future well-being of European society".[iii] More recently, on 30 October, the Commission identified a set of 36 structural indicators to monitor progress on the political commitments

made by Heads of State along the themes of: general economic background; employment; innovation and research; economic reform; social cohesion and the environment. Indicators proposed under these themes include:

- Unemployment rate (economic background)
- Life-long learning (employment)
- Level of internet access (innovation and research)
- Prices in the network industries (economic reform)
- Early school leavers not in further education or training (social cohesion)
- Energy intensity of the economy (environment)

In the course of tackling the wide array of specific structural themes, the Commission envisages generating up to twenty-one more indicators, including, for instance:

- Potential output (economic background)
- Childcare facilities (employment)
- E-government (innovation and research)
- Business demography (economic reform)
- Biodiversity (environment)

In short, the Commission envisages some 57 different indicators thereby allowing it to chart members' progress across a broad, but by no means exhaustive, front. Not surprisingly, many of the indicators (childcare facilities, employment rates of older workers) being proposed have a uniquely developed country feel to them.

The OECD has taken a somewhat different route than the Commission, though its concerns, as befits a developed country 'club' are similar. In its report *Sustainable Development – Critical Issues*, the OECD drew similar conclusions to the Commission. The report noted that, without integrated information on long-term sustainability problems, "public awareness of these problems will be limited and the formulation and monitoring of policy responses will be difficult". Identifying the desire of governments to introduce a concern for *future* welfare systematically throughout all policies as the distinctively *new* focus of sustainable development, the report proposed a limited set of headline indicators to measure both resources and outcomes (Table 1).

The similarity between the EU's approach and that mooted in the OECD's report on the *Critical Issues*, is that they attempt to provide definition to sustainable development by settling on a core set of substantive problems whose amelioration would, one assumes, generate more sustainable outcomes. The problem with this approach is that it is hard to defend the decision to include the tracking and measurement of some issues to the exclusion of others. However obvious many of the nominated problems are, neither initiative pretends to base its choice on any formally generated priorities. They're the priorities of the particular members.

Perhaps it is this indeterminacy at the heart of the concept of sustainable development that led OECD countries this year to decide that it is better *not* to attempt to establish a definitive – if arbitrary - set of issues to measure as proposed in the *Critical Issues Report*. Rather, they have decided to generate a 'menu' *of policy issues, which* involve trade-offs between the different dimensions of sustainable development.[iv]

Table 1. A preliminary set of sustainable development indicators (Source: OECD (2001, p. 72))

Theme	Current indicator
Resource indicators: Are we maintaining our asset base?	
Environmental assets	
Air quality	GHG emission index and CO2 emissions
	NOx emissions
Water resources	Intensity of water use (abstractions / renewable resources)
Energy resources	Consumption of energy resources
Biodiversity	Size of protected areas as a share of total area
Economic assets	
Produced assets	Volume of net capital stock
Technological change	Multi-factor productivity growth rate
Financial assets	Net foreign assets and current account balance
Human capital	
Stock of human capital	Proportion of the population with upper secondary/tertiary qualifications
Investment in human capital	Education expenditure
Depreciation of human capital	Rate and level of unemployment
Outcome indicators: Are we satisfying current needs?	
Consumption	Household final consumption expenditure
	Municipal waste generation intensities
Income distribution	Gini coefficients
Health	Life expectancy at birth
	Urban air quality
Work status / Employment	Employment to population ratio
Education	Participation rates

Such an approach is a frank acknowledgement that there is no agreement on the policy objectives to which sustainable development is directed and therefore no substantive core to which analytical work can be directed. Indicators are therefore chosen because they may illuminate the quality of policy trade-offs at the margin.

Whether one adopts the European Commission's approach or that now being taken by the OECD, the likelihood is that we will be confronting a large – and potentially bewildering – set of indicators straddling the 'three pillars' which are purported to lie at the heart of sustainability. The policy conclusions that can be drawn from such an array will not necessarily be clear. For instance, it is difficult to say anything much about the overall sustainability of development by looking at such a mixed bag of indicators unless they are all moving in the same direction. As it happens, this is not an implausible result for developed economies. One has only to look at the extensive (and impressive) work on indicators undertaken in the UK or Denmark to see that the trend of their indicator sets is overwhelmingly positive. There is the nagging doubt, however, that positive overall trends may simply reflect the choice of indicators.

Interestingly, however obvious the nominated problems for which indicators have been proposed may appear, neither the OECD nor the Commission's initiatives pretend to base their selection of indicators on any formally generated set of priorities. In effect, the approaches and likely indicators reflect the priorities of the particular members.

It might also be objected that such a nationally based set of indicators is useful because it might show a need for policy actions within specific sectoral ecosystems. But if this data was being collected in any case, then one must question the substantive net benefit arising from incorporating this information into a collection of sustainability indicators (unless it is assumed there are benefits from bringing information to a wider public (as opposed to policy makers).

And finally, a point to which this paper returns at greater length, the utility of any nationally collected information is limited if the focus of concern is sustainability at a global level.

Is there no core?

The OECD's latest position is therefore a tacit admission that there is something seriously lacking in the conceptual underpinnings of sustainable development. This is a radical challenge to the expectations of those who believed that the singular authority of measures such as gross domestic product would be in some way modified by the addition of similarly authoritative measures of sustainability. How has this come about?

It is significant that, in recent times, sustainable development has come to be thought of in terms of *three pillars*, all of which should be mutually supporting. The goal is to set them in such a relationship that policy settings in any one field will not undermine future outcomes in any other and will, hopefully, enhance them. This approach has been taken up outside the public policy setting by companies that have started to engage in so-called *triple bottom line* accounting.

The European Commission has artfully described the relationship between the pillars as "economic growth [that] supports social progress and respects the environment, social policy [that] underpins economic performance, and environmental policy [that] is cost-effective." The notion is of a virtuous triangle of reinforcing policies that advance "a society that is more prosperous and more just, and which promises a cleaner, safer, healthier environment" not just in the near term but the long term.[v]

Elegant though this formulation is, it cannot provide any definitive boundaries for the trade-offs that inevitably occur between, for instance, seeking improvement in material living standards and maintaining ecosystems in their natural states or between high levels of investment in businesses and redistribution through taxes and the regulated delivery of social benefits. At the end of the day there are only policy trade-offs with which we have been familiar long before sustainable development entered the lexicon. This is the explicit thrust of the OECD's analysis and the implicit thrust of the European Commission's pragmatic decision to come up with a limited list of objectives.

If this conclusion is correct, does sustainable development evaporate or become, at most, a bland agenda for policy integration without any real content? That has been the conclusion of some commentators. Daniel Esty from Yale, for instance, argues that "for all its laudable goals and initial fanfare, sustainable development has become a buzzword largely devoid of content."[vi] Whatever the justice of this verdict in light of the serious and substantive work commenced by the European Commission and the OECD among others, Esty's analysis draws attention to the difficulties caused by trying to assemble such widely differing parameters for measurement and policy integration.

Esty asserts that fostering development and protecting the environment are 'linked but separate' imperatives, thereby flatly contradicting the Brundtland Commission's insistence that they were "impossible to separate". Furthermore, he asserts that in the absence of strong synergies between environmental and social issues, the inclusion of the latter agenda tends to swamp the former. In other words, having an infinite tradability between the three pillars suggests there are no environmental bottom lines that cannot be crossed.

Distinguishing the pillars

This sort of conclusion only holds if all three 'pillars' are regarded as being similar in substance, elements of which are capable of being substituted one for another without any real limits. Interestingly, that is not the flavour of the Rio Declaration itself. That was the product of a conference on e*nvironment* and *development*. And the conference didn't suddenly generate three pillars. Rather, it was focussed on meeting the developmental and environmental needs of present and future generations. Significantly, Agenda 21 is laid out in two sections: the social and economic dimensions; and the conservation and management of resources for development. In other words, there is the human sphere, which encompasses economic *and* social questions, and the biophysical sphere.

The very first Rio principle affirms the anthropocentric nature of our interest in sustainability. "Human beings," it states, "are at the centre of concerns for sustainable development." As such, any use we make of resources will involve trade-offs that have as their object the enhancement of human welfare. But there is no suggestion that welfare can be raised infinitely at the expense of those biophysical systems that make life on earth possible.

A division of labour, for analytical purposes, between the human sphere and the biophysical sphere is a sensible one. To the extent that the former is constrained by the latter, it is not unreasonable to contend that the so-called 'environmental pillar' is materially different from the social and economic ones. There are no limits to the ingenuity and efficiency with which natural resources can be transformed. However, there is a widely held intuition, and now some scientific evidence, that there are boundary conditions for the stability of the linked biological, chemical and physical systems that form the global life-support system on which human life ultimately depends. Many social outcomes, on the other hand, depend on ethical choices made concerning the *distribution* of income. There is, therefore, a substantive difference between the social and environmental dimensions of sustainable development.

Protecting the ozone layer from degradation caused by pollutants is susceptible to a wholly different range of policy responses and measurement from those applying, for instance, to ensuring the incomes of retired people. Not only is access to income within an economic and taxpaying community an ethical judgement that defies any definitive 'answer'; it's relative importance is highly variable depending on the economic development and level of wealth in each country. By contrast, the maintenance of natural systems on which people rely, like the ozone layer, is universal in its significance and amenable to quantitative monitoring and analysis without recourse to ethical theories.

It is worth underlining that social and environmental pathologies are not always even accurately assigned under the familiar tripartite division of labour. Antibiotic resistance, for example, is a biological issue that involves the susceptibility of micro-organisms to a protective mechanism that can be de-graded through inappropriate or excessive use. The negative externality – widespread resistance – is as much an 'environmental issue' as the destruction of habitat and loss of biodiversity or threats to air or water quality. Road congestion, on the other hand, is much more an issue about failures of pricing, regulation and institutions whose roots lie in largely social and political choices (leaving aside the environmental externalities of air and water pollution which lend themselves, plausibly, to technical solutions).

There may be perfectly rational reasons why societies decide to put up with certain levels of traffic congestion, and why to do so may be perfectly sustainable. It is more difficult, however, to see how the permanent disappearance of effective defences against disease would be treated as something that would be willingly traded off or assumed to be 'sustainable'.

Defending a definitive list of indicators – the challenges

A good case can be made, then, to approach environmental and social indicators in quite different ways. Social indicators are validly chosen on the basis of the political and ethical preferences of particular communities. Their comparability across communities will always be limited by the nature of those choices. Environmental indicators, on the other hand –at least to the extent that they shed light on globally significant problems– will be grounded in the quantification of trends or trajectories that, if not mitigated or even reversed, will spell trouble; is our development path one that can be sustained without being overwhelmed by negative feedbacks of our own making?

In short, can we identify which human claims on some key elements of the bio-physical environment place us at risk of crossing thresholds beyond which lie very significant environmental perturbations with high economic, social and environmental costs?

This question of *uncertaint*y is typically ignored in most discussions on indicators. Given the different communities involved in such work, this may be unsurprising, but it is worrying. OECD Ministers were conscious of the problem when they urged the Secretariat at this year's Ministerial Council Meeting to 'fill the scientific gaps,' (an unfair request incidentally, which the OECD is singularly poorly equipped to undertake given that it is staffed primarily by economists).

Scientific *uncertainty* is, nevertheless, one of the most important components in any discussion of indicators of sustainability. It is after all a dominant feature of many important environmental problems. There is, for instance, very real *scientific* uncertainty about: the concentration of greenhouse gases at which the danger of significant climatic instability increases markedly; vulnerabilities in atmospheric chemistry in addition to those already exposed by CFCs; the quantum of deep sea fish stocks and their rate of depletion; and the cumulative impacts of persistent pollutants.

Indeed, quite apart from the basic scientific lack of knowledge on such matters, there is also fundamental *uncertainty* over both the *size and value* of resource stocks and flows in our economies. An economy dependent on exporting natural resources, while consuming at a sustainable level vis-à-vis its economy and environment, for instance, may encounter difficulties in the future when resource prices negatively effect rents, yet such price movements contain stochastic elements.[vii]

Fundamentally, the basic scientific question on indicators of environmental sustainability comes down to this: are there thresholds beyond which natural systems, on which everyone relies, will cease to deliver the so-called 'ecological services' needed to sustain life? Formulating the question in this way does not imply some absolutist definition. Nor does it deny the possibility of very significant on-going use and transformation of natural resources. These will be made on the basis of the trade-offs that have always been made. But indicators of sustainability designed with some grasp of the science would be in a position to warn of the accumulation of externalities that could impose heavy or unpredictable future costs, or both.

Filling some of the Science Gaps[viii]

Notwithstanding the international treaties that have been signed in a number of fields, a coherent account of just what thresholds we should be worrying about simply does not exist. For example, it has been established that atmospheric carbon dioxide concentration, for the last half-million years at least, has oscillated between tightly bound limits of 180 and 280/290 ppm. We also know that human activities have broken these bounds, with current carbon dioxide concentration approaching 370 ppm and that these have risen to that level at a rate at least 10 and possibly 100 times faster than at any other time during the last half-million years. But we do not yet know the full implications of this change for the stability of the

climate. Nor do we actually know whether we have crossed or are poised to cross a threshold that will lead to rapid climate change.

Having said this, scientists have, particularly in the past decade learned much more about the nature of the services provided to human society by the Earth's environment, and the ways in which human activities are affecting these. It has been established, for instance, that: (i) biological processes and structures, including biodiversity, play a far more important role than previously thought in stabilising the global environment; (ii) the ocean circulation pattern in the North Atlantic can change suddenly, switching the climate of Northern Europe from warm to very cold in a decade or less; and (iii) the chemistry of the atmosphere is potentially one of the 'Achilles heels' of Earth's life support system.

A sobering and instructive lesson about how close humanity actually came to crossing a dangerous threshold in the global environment can be drawn from the international experience in dealing with the hole in the ozone. The development of the 'ozone hole' was an unforeseen and unintended consequence of the widespread use of chloroflurohydrocarbons as aerosols in spray cans, solvents, refrigerants and as foaming agents. If the industries involved had used bromofluorocarbons instead, the result could have been catastrophic. In terms of function as a refrigerant or insulator, bromofluorocarbons are just as effective as chlorofluorocarbons. On an atom-for-atom basis, however, bromine is about 40 times more effective at destroying ozone than is chlorine.[ix]

As Nobel Laureate Paul Crutzen has written "This brings up the nightmarish thought that if the chemical industry had developed organobromine compounds instead of the CFCs – or, alternatively, if chlorine chemistry would have run more like that of bromine – then without any preparedness, we would have been faced with a catastrophic ozone hole everywhere and at all seasons during the 1970s, probably before the atmospheric chemists had developed the necessary knowledge to identify the problem and the appropriate techniques for the necessary critical measurements. Noting that nobody had given any thought to the atmospheric consequences of the release of Cl or Br before 1974, I can only conclude that mankind has been extremely lucky."[x]

The measurement of the ozone concentration in the stratosphere over Antarctica was, in effect, the "indicator" that helped societies recognise that they were approaching a potentially dangerous situation. Without a detailed understanding of the chemistry of ozone in the upper atmosphere, however, such an indicator would have been worthless. It could not have been interpreted and appropriate policy action could not have been taken. Ironically, in this case, the appropriate scientific work had been undertaken, but for quite a different reason - the fear that a fleet of supersonic aircraft then under development would alter the chemistry of the stratosphere. Fortunately and coincidentally, that chemistry was also applicable to the ozone hole issue.

Another potentially catastrophic perturbation is the apparent slowing or shutting-down of the North Atlantic thermohaline circulation and an accompanying shift in the Gulf Stream. A great deal of heat is transported globally by the movement of ocean water. The eastern North Atlantic region, for example, is a recipient of heat in this process that makes life at 60^{o} N a much more pleasant experience in Scandinavia than it is in northern Canada or Siberia. The circulation that delivers heat to the North Atlantic is driven by the formation of ice in the Greenland and Arctic Seas and consequent release of heat to the atmosphere by the water as it cools and forms ice. Were this circulation to weaken or reverse, the effect on climates, especially those of northern Europe would be pronounced. Such abrupt shifts are known to have occurred naturally in the past.

Can the current pressure placed on this by human consumption patterns and behaviour trigger a similar change in the coming decades? Model simulations suggest that, at the present rate of human activity and consumption patterns, this circulation could indeed weaken or reverse towards the end of the century.

Furthermore, very recent work by Norwegian oceanographers has shown that the rate of formation of cold, sinking water that drives the Gulf Stream has slowed by 20% over the last 50 years.[xi] This was a one-off measurement, however, not the result of a systemic set of measurements or indicators that would monitor this critical issue. Clearly, if we are to understand this international environmental problem, more effort needs to be devoted to understanding the science. Any evidence needs to be related to policy making both at the national and at the international level.

Even more speculative is our knowledge about the part played by biodiversity - the biological fabric of the planet - in stabilising Earth's life support system. We know from over 15 years of global change research that biology is much more important than had been previously thought for the functioning of the global environment. Experiments have shown that species diversity is important for critical ecosystem functioning, such as nutrient cycling and primary production; thus, the terrestrial biosphere can not be considered simply as 'one big leaf' or as 'green slime', as portrayed in earlier climate and Earth System models. But there is a growing feeling amongst scientists that, even up to the scale of the Earth itself, the complex webs of life on land and in the sea are not only aesthetic, but they also are crucially important in maintaining the habitability of the planet.

These examples point to the urgent need for an incisive and focussed set of global environmental indicators. An absolutely basic requirement in the development of such indicators must be the filling of some of the science gaps on which the indicators are based; particularly those concerning biophysical thresholds at the global scale that humanity should not cross. In short, we must know how much biodiversity we can lose or destroy before the stability of the Earth's environment is seriously affected, and we must have 'early warning indicators' that will tell us in time if the Gulf Stream is likely to weaken or shift southwards.

For any global set of indicators to be meaningful, they would need to possess the following characteristics:

- They must be backed by solid scientific understanding. That is, we must be able to measure them at regular intervals, and we must have sufficient scientific understanding to interpret them, particularly when they change.

- They must be able to distinguish human interference from natural variability. This is absolutely crucial, as it would be counterproductive to ask societies to make major changes in response to a natural variation in an indicator. This suggests that the palaeo-sciences must play a stronger role in the development of indicators and their interpretation.

- They must be timely; that is, they must be able to give societies enough time to act to avoid crossing a critical threshold. Indicators which only show change after a critical threshold is passed would be of much less use. This criterion is actually very difficult in practise, as there is likely considerable momentum built into much Earth System functioning and it may be very difficult to detect a significant change before it is too late. This suggests that decision-making on the basis of the precautionary principle and risk analysis may still be required, *even if a set of indicators* is in place.

- Finally, the set of indicators must be flexible. Science is never static, and it is always improving our understanding of the Earth System. There must be an ongoing dialogue between science and the policy sector so that we can improve the indicator set and their interpretation as scientific understanding advances.

Clearly, we need to devote more thinking and resources to these kinds of science-related issues. Its worth noting that most of the science-related work on threshold questions is well underway internationally. The problem is the absence of international co-ordination. A modest expenditure of between 20-25 million Euros tailored to improve the co-operation between the suite of global change programmes would make all the difference.

Against this background, we can see that with sufficient information about the environmental science we can determine, for instance, the maximum level of a certain pollutant or other pressure, which an aquatic system might be able to absorb under particular conditions. Science by itself, however, is not enough for an elaboration of efficient and effective policy on sustainability. While a knowledge of the science may assist us in understanding the environmentally preferred level of pressure, it cannot tell us whether the *economic* costs to human society of achieving a certain level do not exceed the benefit of doing so.

Conversely, economics by itself is also insufficient to understand sustainable development. The economics of biodiversity, for instance, can mislead policy makers. To devise schemes to manage a resource without understanding its function within the ecosystem of which it is a part may be a recipe for disaster because the ecosystem's biodiversity can be a source of its productivity, including for instance, its stability.

This tension between environmental science and economics is also present in divergent interpretations of sustainability. Most indicator sets generated to date may be categorised as falling into one of two broad approaches to sustainability. These are frequently referred to as "weak" and "strong" sustainability.[xii]

'*Weak sustainability*' may be defined as an economic value principle. It requires that some suitably defined value of aggregate capital – including human-made capital and the initial endowment of natural resources – must be maintained intact over time. This is somewhat unclear, however and various applications of the concept have different consequences. What we might, in very narrow terms, call '*very weak sustainability*,'[xiii] for instance, requires that the generalised production capacity of the economy be maintained, thereby allowing a constant consumption per capita over time. In more general terms, 'weak sustainability'[xiv] requires that the welfare potential of the overall capital base remain intact.

By way of contrast, the idea of '*strong sustainability*' emerged from the perception in ecological economics that the economy is an open subsystem of a finite global eco-system. This essentially biophysical principle is drawn from the laws of thermodynamics, and requires that certain properties of the environment must be sustained. It has been variously interpreted in the literature. In the most restrictive version, '*very strong sustainability*'[xv] calls for a set of stationary-state constraints that must be imposed on the scale of the macro-economy.

This is an overly restrictive approach and thus the concept of 'strong sustainability' is frequently preferred for indicators utilising this framework. Strong sustainability may be defined as an eco-system principle and better corresponds to our general understanding of the concept of sustainable development as outlined by the WCED.[xvi] This imperative can either be translated as maintaining ecological capital intact over time, or restricting environmental degradation above some critical level of resilience beyond which the eco-system could not recover from shocks or stress. Interestingly, the question of thresholds becomes critically important under such an approach.

The biophysical and monetary perspectives on sustainable development indicators both have their advantages and disadvantages. Nevertheless, it is clear that for any indicator set to enjoy a measure of credibility, it would need to be able to provide insights into the relationship between the two perspectives, which might otherwise be ignored. The World Bank's recent collaboration with Redefining Progress on this subject may offer a way forward. It welds these two distinct understandings of the idea together in a manner that seeks to offer insights into sustainability policies at the national *and* international level.[xvii]

The Concept of Decoupling

Against the background of the economic versus ecological perceptions of sustainability, decoupling can be seen as an attempt to help policy makers improve their understanding of the policy interface between developments in the two spheres. The concept refers to the causal link between relative growth rates of environmental variables and economic variables. There are a range of approaches in vogue on this subject, including the use of the so-called environmental Kuznets curve which posits a relationship between levels of income and certain measures of environmental quality.[xviii] Other approaches are even more ambitious and take an economy-wide perspective on the problem. One perspective which the OECD is interested in pursuing is to show that a decoupling of damage to the environment from economic growth is indicated when the growth rate of environmental degradation is smaller than the expansion of GDP over a given time period. The terms weak and strong decoupling are used to offer policy makers a feel for the extent of progress achieved over time. *Weak decoupling*, for instance, is present when the expansion of environmental pressures is positive, but less than the growth of GDP. *Strong decoupling* on the other hand occurs when the growth rate of environmental degradation is zero or negative.[xix]

Proponents of decoupling indicators argue that they can assist in enriching our understanding of sustainability. Certainly, such indicators may assist by complementing standard national accounting, thereby allowing policy makers to assess the prospects for those long-term developments that are essential for progressing sustainable development. It is not surprising therefore that OECD Ministers at the 2001 Ministerial Council Meeting gave a strong mandate to the Secretariat for the inclusion of decoupling indicators in its wider work on sustainability, including the peer review process.

Notwithstanding the Ministerial endorsement for decoupling analysis, there are numerous difficulties inherent in such indicators. Not least of course, is the point that there are numerous environmental variables where the externalities are simply not linear. Thus, continual pressure on a resource (or species) can be applied with no apparent effect for a considerable time until suddenly a threshold is crossed and the negative effects begin to rise sharply. Indicators that fail to take these essentially scientific relationships into account risk concealing potential future problems. One of the other difficulties with decoupling is the use of inappropriate data sets. There are cases where attempts to use particular data may send misleading signals, unless they are carefully explained and set in specific contexts.[xx] Decoupling data sets therefore, if they are going to be at all meaningful, run the risk of being drowned by the explanations and caveats required for substantive interpretation purposes. Worse, there is a risk that apparent decoupling may mask inherent problems and encourage national policy makers to conclude that there is not a substantive difficulty with their policy settings.[xxi]

Complementing Nationally-based Indicators with Global Ones

The OECD and the European Commission's approach to the development of agreed sets of indicators of sustainability are focussed at the national level. It is, for instance, the sustainable development of individual developed country economies that will be examined in the OECD's prestigious EDRC review

process. Similarly, the Commission's structural indicators are aimed at measuring progress in individual member states.

Such an approach can certainly help decision-makers. It would shed light on potential trade-offs at the national level between policy choices at the intersection of the three pillars of sustainable development. This can facilitate the design and identification of policy instruments to improve national-level outcomes in sustainability terms. Furthermore, a comprehensive analysis of national progress in moving onto a more sustainable development path is critically important for national regulatory and legislative purposes and the OECD and the Commission certainly offer a useful way forward in this regard.

This is all very well as far as it goes. It is important to emphasise, however, that such approaches treat members as if they were stand-alone closed economies for the purpose of measuring sustainable development. Such a point of departure contains a significant flaw. It does not recognise that there are aspects of the three pillars of sustainability, which are global in nature. To paraphrase John Donne, 'no economy is an island in and of itself.'

Many policies on sustainable development may have trans-boundary effects. Indicators along the lines proposed by the Commission, or the perspective adopted by the OECD; will find it difficult to offer any meaningful *policy* insights into the impact (positive or negative) that member economies are having on global sustainability. Such measures cannot, for instance, provide policy makers with an assessment of the environmental and social externalities generated by economic growth that are imposed beyond national borders. Nor can they provide a persuasive framework for understanding situations on the sustainability interface where policy shifts occur as a consequence of changed production processes as opposed to decoupling.[xxii]

In this era of globalisation and cross-border flows, it is not just investment, but pollutants and environmental externalities generally that require a global frame. After all, biophysical processes do not respect national boundaries. What may be required therefore is to *complement* the national-level picture with indicators which *inform* us about the pressure of human claims on the global bio-physical environment and concomitantly *indicate* whether such pressures place us at risk of crossing thresholds beyond which lie very significant environmental perturbations with high economic, social and environmental costs. Ideally, an indicator set should be able to provide information about the impact of resource use regardless of the location of recorded economic activity.

It is worth noting that the European Commission acknowledges this point. Its outline of a European Union-wide strategy for sustainable development includes a reference to the effect that "many of the challenges to sustainability require global action to solve them." It goes on to observe that, "as EU production and consumption have impacts beyond our borders, we must also ensure that our policies help prospects for sustainable development at a global level."[xxiii]

It is precisely this international dimension which is of concern to many people. The citizens of developed countries are conscious that they have managed to make real progress in restoring the quality of air and water that had been compromised in the developmental trade-offs of the industrial revolution and its aftermath. Indicators showing positive trajectories in both the EU and the OECD frameworks confirm this. There is, however, unease about the negative impact their consumption decisions may be having at the global level – something that cannot be ascertained from nationally derived data sets.

It is also worth highlighting the point that it is the *international* dimension of sustainability, particularly on the environmental pillar, where countries spend inordinate bureaucratic resources to negotiate multilateral agreements to control, restrict and otherwise reduce behaviour which may negatively impact the global

commons. National trajectories of sustainable development in developed economies may be progressing in the right direction, but the impact of those countries on the global environment may not be quite so benign.

The Effects of Trade

Against this background, and assuming that we will soon have sufficiently meaningful scientific knowledge about critical global environmental thresholds, how can we complement nationally based indicator sets in a way which gives meaning to the concept of sustainable development in a truly international sense?

Clearly, we need to combine nationally based approaches with indicators that offer insights into global trends. This is not so vast a topic as might be imagined. It is possible, for instance, to suggest a short list of pressure points, on which human activity has an impact and which, by their very nature, cannot be addressed or measured at the national level. Such a list would, at a minimum, include items like changes in the chemistry of the atmosphere; ocean circulation; and biodiversity.

Human impact on these pressure points can be charted through consumption patterns, which are reflected in trade flows. Trade generally improves the allocative efficiency of the countries involved. A failure to take trade into account in consumption patterns therefore distorts the picture of a particular country's sustainability.

One area where we do have some reasonably sound scientific knowledge about the impact of human consumption on a significant pressure point is in respect CO2 emissions. It is perhaps no coincidence that almost every indicator project currently underway internationally considers a country's carbon emissions (measured by production output) as comprising a part of the sustainability indicator set. And it is precisely the global nature of the issue that has prompted many countries to participate in a multilateral arrangement to address the impact of carbon emissions on climate change.

Country emission levels alone, however, may tell us only part of the story. The role of international trade in, for instance, carbon-intensive products like steel or chemicals becomes particularly important when talking about sustainable development because it can distort an economy's estimate of its quantity of emissions and thus the level of its contribution to the problem. Thus, a country's emission levels may appear to be set artificially low because it imports significant quantities of carbon embedded in non-energy products. A national-level indicator, which fails to take into account trade flows, can easily mask this kind of 'carbon leakage'. In this context, global emissions might not be reduced as much as expected or might even increase.[xxiv] The magnitude of this problem is underlined by the rapid expansion of international trade.

This problem has already been the subject of considerable analysis, as have ways of measuring it. One set of estimates (based on six of the G7 economies (excluding Italy)) indicates that the embodiment of carbon in imported goods is rather significant.[xxv] The weighted average for these six was 13% of the total carbon generated by these countries - a figure, which varied considerably from one country to another. Thus, the figure for France exceeded 40%, while both Canada and the UK exceeded 20%. Other analysts have reported similar results.[xxvi] Not surprisingly, the carbon embodied in a country's imports of manufactured products tended to reflect patterns of trade.

The considerable amount of carbon embedded in imports by developed economies suggests that measuring only domestic carbon production will be misleading. This highlights the challenges created by trade flows, particularly between developed and developing countries, which need to be addressed in the design of indicators. Indeed, many fossil fuel rich developing countries would have surplus emissions generated

during the production of goods for export over the emissions generated overseas during the production of goods for import. The reverse is true for many fossil-fuel poor countries (many of whom are OECD members). The extent of this trade underlines the essential meaninglessness and singular unfairness of an indicator designed to measure only carbon emitted during in-country production processes. [xxvii]

Calculating the carbon embodied in every single imported product is complicated and difficult.[xxviii] Having said that, the difficulties are not insurmountable. Nor are they beyond the ability of an organisation like the OECD. It is worth noting, for instance, that the number of sectors that impact on carbon embodiment in imported goods is actually remarkably small. These are: chemicals, electricity, natural gas, mining services and ferrous and non-ferrous metals. Together, they account for the greater part of carbon emissions embodied in imported products. Reasonably sophisticated modelling work is already extant.[xxix]

There are two distinct advantages inherent in an approach designed to complement national-level indicators with measurements of the impact of an economy on certain global issues. First, it would result in an improved picture of global sustainability. Second, and just as importantly perhaps, such a perspective may help place the global debate about the purpose and use of indicators on a more constructive footing.

This latter point is all the more important in view of the ambition of both the OECD and the Commission to present their work on indicators as a contribution to the World Summit on Sustainable Development. Many developing countries are understandably nervous about any proposal for indicators which is likely to shed a rather grim light on the developing world's levels of sustainability as measured by developed-country criteria. Many would not relish, for instance, measurement against many of the social indicators under discussion in the Commission or the OECD. Nor would many enjoy the application of the proposed indicators of air or water quality which are unable to account for the reasons for such changes (i.e. as the consequences of rapid economic development, not least through the production of goods for export to the developed world.)

Furthermore, there is considerable resistance in both developed and developing countries to any 'beauty contest' approach to indicator sets. Developed-country Ministers have gone to great lengths to explain that is not the intention of either the Commission or the OECD's approach, yet it is clear that residual suspicions remain. A particular anxiety is that a nationally based indicator set may lead to critical comparisons being made among developing countries with the logical extension perceived to be some form of conditionality in which the future delivery of development assistance might be linked to positive progress on sustainability.

One way to encourage a greater interest in indicators of sustainability internationally therefore might be to complement national indicator sets being developed at the OECD and in the Commission with indicators which measure what we might describe as 'trade or spill over effects.' Such a complementary approach would result in a more meaningful perspective on sustainability. It would illuminate the point that the consumption patterns of the developed world have a significant impact on global sustainability. Further, such an indicator set would provide a useful balance to the generally positive progress on sustainability being made by most developed countries at the national level. At the same time, this would underline the essentially integrated and global nature of economic activity that is making inter-country comparisons in this sphere less and less meaningful.

What are the implications for social indicators?

The above discussion has to some extent steered away from the social dimension of sustainability. As pointed out earlier, this third pillar has grown out of the human development sphere/biosphere division

designated by the Brundtland Commission and Agenda 21. Nevertheless, there is no question that social issues are critically important to both OECD and non-OECD members and alike and for very good reasons.

In a sense there are two ways to use the term 'social' for sustainable development purposes. The use of the concept can be a label for restating that societal objectives are broader than the achievement of economic growth and that unless attention is paid to the social dimension then weakening social conditions can arrest economic development. Alternatively, it can be a purely technical comment about the conditions necessary for the long-term pursuit of developmental objectives.

The risk inherent in adopting the first approach in preparing indicators is that social issues get treated as being of the same order of importance as the environmental issues. This is a difficult position to sustain. While there are certainly inter-generational issues, there are no real *scientific* thresholds in the social sphere in the same way there are with the environment. The message of sustainable development is thus most potent when it refers to the risks to societies of purchasing higher living standards as a way of spanning economic and social needs at the cost of a degraded environment.

This is substantively different from the message that is stressed in discussions of social policy- namely that good social policy promotes growth. The environmental message warns of trade-offs beyond certain thresholds; the social message stresses complementary effects. There is also a risk that extending the term sustainable development beyond the environment/economic interface to embrace a range of social concerns will disable its utility as a guide to policy decisions.[xxx] Developers of indicators of sustainability need to be more creative, and ambitious. They need to reconsider how the economic/social spheres could be better amalgamated rather than creating an artificial distinction between the two in a way that Rio never intended.

In this regard, it may be worth looking more closely at the UN's Human Development Index (HDI). This indicator set, which is not without controversy, uses indicators of 'health, wealth and wisdom.' Many countries, though by no means all, regard it as a useful measure of progress in terms of a country's commitment to and level of human development. Furthermore, the three indicators utilised in HDI have a wealth of sophisticated empirical data behind them. One important nuance HDI offers, for instance, is evidence of the increasing numbers of poor and an embryonic middle class within the Third World as well as pockets of poor and a growing underclass in rich Western democracies. The attraction of the index is that it is methodologically transparent and easy to understand but doesn't pretend to illuminate trade-offs at the environmental interface.[xxxi]

An emphasis on a core set of health, education and income indices via HDI may be one way to think meaningfully about how to bring social indicators into the sustainability debate. Certainly, many countries will want to go further than the OECD and the Commission have proposed. They may want to consider, for instance, investment in post-secondary education, or the sustainability of pensions, but for many developing countries their priorities in the social sphere of sustainable development are less complicated than that. In short, the one-size-fits-all approach, which is plausible in respect of genuinely global environmental challenges, may be less appropriate when developing social indicators.

Assuming that current trends are not, in a hard bio-physical sense, sustainable, there is a very real risk that, unless we start getting serious about measuring our achievement or lack of it in sustainability terms, progress at the current rate will never see us turn the corner. Certainly, a failure on this front will never see the development prospects of literally billions of people significantly improved within their lifetimes.

Perhaps then it is time to ask some hard questions about whether countries are really looking at the most useful ways of measuring the sustainability of their development paths? Don't we also need to ask how best to generate some form of consensus on what it is we think is important to measure at the global level?

At the national level, perhaps the hoary old principle of not meddling in the internal affairs of others should equally apply when discussing indicators.

Conclusion

It has been this paper's contention that we need to tackle our lack of scientific knowledge about a short list of environmental problems that have trans-boundary effects. Improving our scientific knowledge of some of the global thresholds, while simultaneously ensuring that cross-border impacts of consumption and trading patterns are reflected in measurement systems, may improve our understanding of some of the global trends that currently fill many of us with unease.

At the same time, such an approach may help encourage developing countries to see sustainability indicators as something other than yet another thinly concealed attempt by the developed world to hamper efforts by developing countries to strive for the living standards of OECD members. At the very least, by adopting a more flexible and global perspective in our indicator development programmes – one that is less prey to questionable inter-country comparisons - we might move some way towards responding to the exhortation in Agenda 21 to "contribute to a self-regulating sustainability of integrated environment and development systems".

NOTES

References

Asheim, G.B., and Nyborg J., (1995) On the Interpretation and Applicability of a 'Green National Product' *Review of Income and Wealth* 41 (1), pp. 57-71

Benedick, E., (1991) *Ozone Diplomacy*, Harvard University Press, Cambridge, MA

Crutzen, P., (1995) My life with O3, NOx and other YZOxs. *Les Prix Nobel* (The Nobel Prize) 1995. Stockholm: Almqvist & Wiksell International, pp. 123-157.

Esty, D., (2001) A Term's Limits, *Foreign Policy*, September/October, pp. 74-75.

European Commission, (2001a) *Communication from the Commission: A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development*, European Commission, Brussels, 15 May (COM (2001) 264 final).

European Commission, (2001b) *Measuring Progress Towards a More Sustainable Europe: Proposed Indicators for Sustainable Development*, European Commission, Brussels.

Hardi, P., and DeSouza-Huletey, J.M., (2000) *Issues in Analysing Data and Indicators for Sustainable Development*, Ecological Modelling, Volume 130, pp. 59-65.

Hansen, B., Turrell, W.R. and Oesterhus, S., (2001) Decreasing Overflow From The Nordic Seas Into The Atlantic Ocean Through The Faroe Bank Channel Since 1950, *Nature* 411, pp. 927-930.

OECD (2001a) *Sustainable Development: The Critical Issues*, OECD, Paris.

OECD (2001b) *The Concept of Socially-Sustainable Development: Review of Literature and Preliminary Conclusions, (SG/SD(2001)13)* Paris.

OECD (2001c) *The Concept of Socially-Sustainable Development: A Survey,* (S*G/SD(2001)13/ANN),* Paris, 22 October.

OECD (2001d) *Peer Reviews of Sustainable Development and Required Indicators, (SG/SD(2001)12)* Economics Department, Paris, 19 October.

OECD (2001e) *Environmental Indicators to Measure the Decoupling of Environmental Pressure from Economic Growth (SG/SD(2001)9)* Environment Directorate, Paris, 24 October.

OECD (2001f) *Presentation of Decoupling Indicators*, Environment Directorate, November.

Rutherford, T., (1992) *The Welfare Effects of Fossil Carbon Reductions: Results from a Recursively Dynamic Trade Model*, Economics Department, Working Paper No 112, Paris.

Sturgiss, R., (1995) Greenhouse Gas Emissions: The Impact of International Trade, *International Trade Papers 1995*, AGPS, Canberra.

Sturgiss., R., (1996) *Integration, Trade Liberalisation and Climate Change*, Unpublished Paper.

United Nations Development Programme (1999) *Human Development Report*, New York.

Vitalis V (forthcoming), *Modelling Embedded Flows: A New Perspective and Some Improvements to Techniques*, Econometrica.

World Bank and Redefining Progress (2001) *Accounting for Sustainable Development: Complementary Monetary and Biophysical Approaches*, Working Paper for OECD Round Table, Washington, November.

Wyckoff, A. W., and Roop, J.M., (1994) The Embodiment of Carbon in Imports of Manufactured Products: Implications for International Agreements on Greenhouse Gas Emissions. *Energy Policy*, March 1994, pp. 187-194.

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[i] Chapter 40 of Agenda 21.

[ii] European Commission (2001a)

iii See European Commission (ibid).

[iv] OECD (2001d)

[v] European Commission (ibid)

vi See Esty (2001). .

[vii] Norway illustrates the point. In some years during the period 1973-1990, it experienced changes in its petroleum wealth, due to price changes, which were greater than GDP (Asheim and Nyborg 1995). It is of course possible to argue that anticipated discoveries of new stocks would be incorporated into existing prices. On a more general level, however, unanticipated structural shifts in an economy (due, for example, to unanticipated technological changes or changes in population) may alter such 'shadow' attempts at pricing, thereby greatly reducing the value of any measure attempting to indicate such changes as a predictor of future welfare.

[viii] We are indebted to Dr Will Steffen Executive Director, IGBP for his assistance in preparing this section. Needless to say, all errors and omissions are solely the responsibility of the authors.

[ix] http://www.gtz.de/proklima/Methyl2.htm

[x] Crutzen (1995)

[xi] Hansen, B., Turrell, W.R. and Oesterhus, S. (2001).

[xii] cf Turner (1994) and Hediger (1999 and 2000

[xiii] This concept is introduced by Solow (1986)

[xiv] Pearce et al (1994) outlines the concept in greater detail.

[xv] Costanza et al (1991) expands on 'very strong sustainability.'

[xvi] WCED (1987, p. 47) notes that sustainable development "requires that the adverse impacts on the quality of air, water and other natural elements are minimised so as to sustain the eco-system's overall integrity."

[xvii] World Bank and Redefining Progress (2001)

[xviii] See Arrow et al (1995).

[xix] For a detailed exposition of this approach and potential indicators see OECD (2001e and f).

[xx] There is excellent data available, for instance, on the per capita consumption of fish stocks. On the face of it, this would present a useful source of decoupling comparison. Yet the use of such data sets in a decoupling analysis may add little of value. Norway, for instance, has a very high level of fish consumption per capita but it is also renowned for its fish stock management systems. Linking the data to consumption/GDP therefore would not be particularly revealing. To underline the point, Japan has similarly high consumption figures, yet it looks at the question of fish stock management somewhat differently to Norway. Some reference to the impact of fish subsidies on stock management and the stress this places on a resource we simply do not know enough about, for instance, would need to be woven into the analysis to make it meaningful..

[xxi] The use of water stocks, for instance might be rising at a slower rate than GDP, thereby implying decoupling, but we just do not know if that is true. Certainly, if this usage continues at the same trajectory there will come a point where the resource will be exhausted with obvious economy (and environment) wide effects. Yet, in most analyses of countries, such trajectories are characterised as being weakly decoupled.

[xxii] It is quite possible for a developed country to conclude that, at the national level, CO2 emissions are declining, but GDP continues to expand. A policy maker might conclude on this basis that decoupling is occurring. Yet such a conclusion ignores the point that other factors influence the relationship between economic growth and environmental quality. These factors include the scale of economic activity, its composition, changing techniques of production and the impact internationally of national consumption patterns expressed through trade.

[xxiii] European Commission (2001a, p.5)

[xxiv] See Rutherford (1992) and Wyckoff and Roop (1994)

[xxv] See, for instance, Wyckoff and Roop (1994). The countries examined were Canada, France, Germany, Japan, the UK and the USA.

[xxvi] See, for instance, Sturgiss (1995)

[xxvii] Sturgiss (1995 and 1996) elaborates this argument in some detail (in relation to the FCCC) and offers important insights into the implications thereof.

[xxviii] Though Benedick (1991) points out that the Montreal Protocol contains provisions (on CFCs) which are analogous to accounting for the embodiment of carbon in manufactured products.

[xxix] Calculating the carbon embodied in every single imported product is complicated and difficult, though there has been considerable progress in improving the mathematical basis for this work (see, for instance, V Vitalis, *Modelling Embedded Flows: A New Perspective and Some Improvements to Techniques*, Econometrica, forthcoming). The sophistication and detail of the OECD's trade database offers a useful starting point from which a workable approach could be constructed. This would need to be combined with input-output tables (e.g. steel in autos) as well as substantive and accurate energy data that reveals which energy types were used to create a particular product in that country (e.g. aluminium is very carbon intensive if the electricity was made from coal (e.g. USA). There is less of a problem if the process utilises natural gas, though other methodological difficulties exist in the case of nuclear or geo-thermal power. Close collaboration with the International Energy Agency would be required to ensure that the statistical data is as accurate and meaningful as possible.

[xxx] See OECD (2001b) and (2001c) for a fuller discussion of the difficulties in this regard.

[xxxi]. For more details on the index and its utility see United Nations (1999)