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Greening Growth in Japan

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GREENING GROWTH IN JAPAN

By Ivana Capozza

JEL classification: H23, O33, O38, O44, Q52, Q54, Q55, Q58.

Keywords: Japan; green growth strategy; climate change; environmentally related taxes; economic instruments for environmental policy; environmentally harmful subsidies; performance targets; voluntary agreements; pollution abatement and control expenditure; eco-innovation.

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ABSTRACT

A decade of sluggish economic growth, concluding with the sharpest recession since the Second World War, has underlined the need for Japan to develop a new growth model. Such a model should restore public finances and long-term growth while preserving environmental quality and ensuring a sustainable use of natural resources. This paper assesses Japan's progress in moving towards such an environmentally friendly growth pattern. It summarises Japan's achievements and challenges in decoupling environmental pressures from economic performance. It analyses the use of market-based instruments, such as environmentally related taxes and charges and emissions trading schemes, to meet environmental and economic objectives, as well as steps taken to remove environmentally harmful subsidies. The level of integration of environmental concerns in Japan's response to the economic crisis and in its long-term growth strategy is also analysed, particularly the policy mix used to take advantage of the growth and jobs opportunities arising from eco-innovation and the environmental goods and services sector. This Working Paper relates to the 2010 *OECD Environmental Performance Review of Japan* (*www.oecd.org/env/countryreviews/japan*).

JEL classification: H23, O33, O38, O44, Q52, Q54, Q55, Q58.

Keywords: Japan; green growth strategy; climate change; environmentally related taxes; economic instruments for environmental policy; environmentally harmful subsidies; performance targets; voluntary agreements; pollution abatement and control expenditure; eco-innovation.

RÉSUMÉ

Après une décennie marquée par une croissance économique très faible, s'achevant en outre par la récession la plus brutale qui se soit produite depuis la Seconde Guerre mondiale, il apparaît nécessaire que le Japon mette en œuvre un nouveau modèle de croissance propre à restaurer les finances publiques et à revigorer la croissance à long terme, tout en préservant la qualité de l'environnement et en veillant à utiliser les ressources naturelles de manière durable. Ce rapport évalue les progrès accomplis par le Japon vers une croissance respectueuse de l'environnement de cet ordre. Il récapitule les réalisations du Japon et les défis que le pays doit relever afin de découpler les pressions exercées sur l'environnement des performances économiques. De plus, il analyse comment sont utilisés les instruments économiques, notamment les taxes ou redevances liées à l'environnement et les systèmes d'échange de permis d'émission, pour atteindre des objectifs environnementaux et économiques, ainsi que les mesures prises en vue d'éliminer les subventions dommageables pour l'environnement. Par ailleurs, le rapport examine dans quelle mesure la riposte du Japon à la crise économique et sa stratégie de croissance à long terme tiennent compte des préoccupations environnementales, en s'attachant tout particulièrement à l'étude de la panoplie de politiques et mesures appliquées pour tirer parti des possibilités de croissance et d'emploi dont l'éco-innovation et le secteur des biens et services environnementaux sont porteurs. Ce document de travail se rapporte à l'*Examen environnemental de l'OCDE du Japon, 2010* (*www.oecd.org/env/examenspays/japon*).

Classification JEL : H23, O33, O38, O44, Q52, Q54, Q55, Q58.

Mots clés : Japon ; stratégie pour une croissance verte ; changement climatique ; taxes liées à l'environnement ; instruments économiques au service de la politique d'environnement ; subventions dommageables pour l'environnement ; objectifs de performance ; accords volontaires ; dépenses de lutte contre la pollution ; éco-innovation.

FOREWORD

This paper has been authored by Ivana Capozza of the OECD Environment Directorate. The paper is an updated and extended version of Chapter 2 of the *OECD Environmental Performance Review of Japan* published in November 2010. The author would like to thank Gérard Bonnis, Nils-Axel Braathen, Jane Ellis, Brendan Gillespie, Ivan Hascic, Hiroshi Kobayashi, Tomoo Machiba, Krzysztof Michalak, Stephen Perkins, Bent Arne Saether, Tappei Tsutsumi, and Frédérique Zegel for valuable comments on and inputs to earlier drafts. Special thanks go to Carla Bertuzzi and Sarah Sentier for statistical assistance, and to Beatrix De Koster and Shayne MacLachlan for editorial support. This paper also benefitted from discussions with officials of the Japanese government and with delegates to the OECD Working Party on Environmental Performance. The views expressed in this paper do not necessarily reflect those of the OECD and its member countries.

TABLE OF CONTENTS

ABSTRACT 3
RÉSUMÉ 3
FOREWORD 4
GREENING GROWTH IN JAPAN 7
Introduction 7
1. Is Japan's economy going green? 7
2. How green was Japan's response to the economic crisis? 10
3. Japan's New Growth Strategy: towards green growth? 13
4. Modifying market incentives 16
4.1. Greening the tax system 16
4.2. Using market-based incentives in the energy, transport and manufacturing sectors 23
4.3. Subsidies 25
5. Financing environmental expenditure 29
6. Promoting eco-innovation 30
6.1. Policy framework 30
6.2. Research and development in environmental technologies 31
6.3. Performance targets 34
6.4. Promoting green products 36
7. Japan's environmental goods and services sector 37
Conclusions 39
REFERENCES 40

Boxes

Box 1. Japan's social and economic structure 8
Box 2. The Voluntary Action Plan on the Environment 23
Box 3. The Tokyo Metropolitan Emissions Trading Scheme 24

Tables

Table 1. Key objectives and priorities in the New Growth Strategy 14
Table 2. Actions taken on the 2002 OECD Review's recommendations for economy-environment integration 15
Table 3. Energy-related taxes, 2001 and 2009 17
Table 4. Energy prices in selected OECD countries, 2009 18
Table 5. Tax incentives for fuel-efficient and low-emission vehicles 21
Table 6. Energy subsidies, 2007 27
Table 7. Market size and employment potential of the environmental goods and services sector 38

Figures

Figure 1. Economic growth and environmental pressures 10
Figure 2. Environment-related investment in stimulus packages, 2001-02 and 2008-09 12
Figure 3. Environmentally related taxes..... 16
Figure 4. Road fuel prices and taxes 19
Figure 5. Pollution abatement and control expenditure..... 29
Figure 6. Public R&D budget on "green energy" 32
Figure 7. Environmental patents 33
Figure 8. Targets and performance of the Top Runner Programme, 1997-2005 35
Figure 9. Sales of selected eco-products, 2000-07 37

GREENING GROWTH IN JAPAN

Introduction

A decade of sluggish economic growth, concluding with the sharpest recession since the Second World War, has underlined the need for Japan to develop a new growth model. Such a model should restore public finances and long-term growth while preserving environmental quality and ensuring a sustainable use of natural resources. Japan's response to the economic crisis and new growth strategy have taken up this challenge by identifying the environment, and in particular innovation aimed at addressing environmental concerns, as a source of economic recovery and long-term growth. This is in line with the work underway in the OECD to develop a Green Growth Strategy. The Japanese experience can represent a contribution to the ongoing debate on how to put in practice the "green growth" concept, the instruments that could be used, and the obstacles that are likely to emerge.

This paper assesses Japan's progress in moving towards such an environmentally friendly growth pattern. First, it summarises Japan's achievements and challenges in decoupling environmental pressures from economic performance. Section 2 discusses the environmental dimension of Japan's response to the economic crisis, also in comparison with the policy reaction to the economic recession in the early 2000s. Section 3 gives an overview of Japan's New Growth Strategy, with a focus on its environmental pillar. The following sections analyse progress made in four key policy areas underpinning the transition to green growth. Section 4 discusses Japan's use of environmentally related taxes, other market-based instruments and subsidies to create market signals that could encourage more environmentally friendly decisions. Section 5 presents the evolution of public and private expenditure to control and abate pollution. Section 6 presents the trends on environment- and climate-related innovation activity through patent counts, and assesses the role of public policy in determining such trends. Section 7 presents the current and expected evolution of the environmental goods and services sector in Japan, in terms of both market size and employment. Finally, a concluding section ties the findings together.

1. Is Japan's economy going green?[1]

Japan is one of *OECD largest economies* and a major player in world trade (Box 1). However, it has lost relative ground in the last two decades, and Japan's GDP per capita was slightly below the OECD average in 2009.[2] Most of the last decade was characterised by sluggish economic growth. Between 2000 and 2008, Japan's economy grew by about 1.3% annually, a rate below the OECD average (about 2% per year). As a result of the global economic slowdown of 2008, the Japanese economy contracted sharply, and was dragged into the deepest recession since the Second World War (Section 2).

1. For technical reasons, the OECD country aggregate does not include the countries that joined the OECD in 2010 (Chile, Estonia, Israel and Slovenia). Similarly, the OECD Europe aggregate does not include Estonia and Slovenia.

2. In 2009, Japan's GDP per capita in purchasing power parity was USD 29 800 and the OECD average was USD 30 500.

Box 1. Japan's social and economic structure

Manufacturing industry makes up a larger part of the economy than in many other OECD countries, despite the growth of the service sector. Before the 2008-09 global economic downturn, Japan's industrial activity amounted to nearly 30% of GDP, in line with the OECD average, while the manufacturing sector alone accounted for 21.6% (compared to an estimated OECD average of about 17.5%). Overall, industrial production grew between 2000 and 2008, although it shrunk considerably in 2009. Japan is one of the largest merchandise exporters. High- and medium-high-technology industries, such as transport equipment, electronics and chemicals, make up the largest share of manufactured goods and exports.[3] More traditional sectors, such as steel and metals, also play a key role. Japan is among the largest exporters of technology-intensive goods, although its share in OECD technology exports has considerably decreased (OECD, 2009a).

Agricultural production continued to decrease in the 2000s, as did its share of the economy, going from 1.8% of GDP in 2000 to 1.5% in 2009. Japan's agricultural production comprises mainly rice, fruit and vegetables. Arable land constitutes only 13% of the land area and is intensively cultivated. Agriculture is a highly protected sector in Japan. Support to agriculture has decreased, although this support remains among the highest among OECD countries (Section 4.3).

While the economy and industrial production grew between 2000 and 2007, Japan's total final consumption (TFC) of energy and total primary energy supply (TPES) decreased by 1%. Energy use drastically fell in 2008 as a consequence of the economic crisis. Industry accounts for the largest part of TFC in Japan, with a share of about 27%. However, growing electricity consumption in the residential and commercial sectors is of concern. Fossil fuels account for most of TPES. The contribution of renewables to energy supply, mostly from hydroelectric power, is relatively modest. Almost 90% of Japan's energy supply (fossil fuels and uranium) is imported. Overall, Japan is relatively poor in natural resources and has to import a wide variety of minerals.

Japan has well-developed transport networks. The increasing commercial integration of Japan into the East Asia region has led to intensive air and maritime traffic. Nonetheless, road remains the dominant freight transport mode and its volume (in tonne-kilometres) has increased at the same rate as the economy. However, improved logistics has led to a decline in distance travelled and freight traffic volumes (in vehicle-kilometres). Moreover, contrary to most OECD countries, passenger transport by car has decreased since the early 2000s. Several factors explain this trend, including rising fuel prices. Compared to other OECD countries, passenger car ownership in Japan has increased at a lower rate and remains below the average.

Japan is one of the most densely populated countries in the world, with a population of over 128 million and a population density of 338 inhabitants per square kilometre (km^2), far exceeding the OECD average. Most industries, agricultural activities and people are concentrated in the coastal plains and basins, resulting in large variations of population density across regions. The low fertility rate and immigration levels have led to a slow population decline, especially in rural areas. On the other hand, the number of households has grown, with consequences for energy and resource use.[4] Japan's population is also rapidly ageing. Life expectancy at birth exceeds the OECD average by a fair margin and has continued to rise. Overall, health indicators for the Japanese population are excellent.

3. With high- and medium-high-technology industries accounting for some 80% of its exports in 2007, Japan was second only to Ireland (OECD, 2009a).
4. The number of households was 49.1 million in 2005, with 2.55 persons per household, down from 2.67 in 2000.

In the last decade, Japan made steady progress in reducing environmental pressures. The economy was characterised by a reduction in both energy and resource intensities (Figure 1). Japan's energy intensity – as measured by energy supply per unit of GDP – has decreased, albeit at a lower rate than in many countries. At 0.12 tonnes per oil equivalent per USD 1000 of GDP in 2009, it is among the lowest in OECD. Similarly, Japan's domestic material consumption (DMC) decreased by 14% between 2000 and 2007.[5] Material intensity (as measured by DMC per unit of GDP) decreased faster than in the other OECD countries and has remained well below the OECD average since 1980 (OECD, 2010a).

Emissions of traditional air pollutants, such as sulphur (SO_x) and nitrogen oxides (NO_x) continued to decrease during the economic recovery period (2002-07), showing a strong decoupling from GDP growth and fossil fuel use (Figure 1). Emission intensities decreased further during the last decade: with 0.2 kg of SO_x and 0.5 kg of NO_x per unit of GDP (USD 1 000) in 2008, Japan is one of the least pollution-intensive OECD countries. Notable progress was made in reducing emissions of dioxins, especially from waste incineration, as well as transport-related emissions (*e.g.* volatile organic compounds, carbon monoxide and particulate matter), owing to technological improvements of the vehicle fleet. Nonetheless, air quality in urban areas remains a problem. High levels of photochemical oxidants occur, due to emissions from stationary and mobile sources, as well as from sources outside the country (OECD, 2010a).

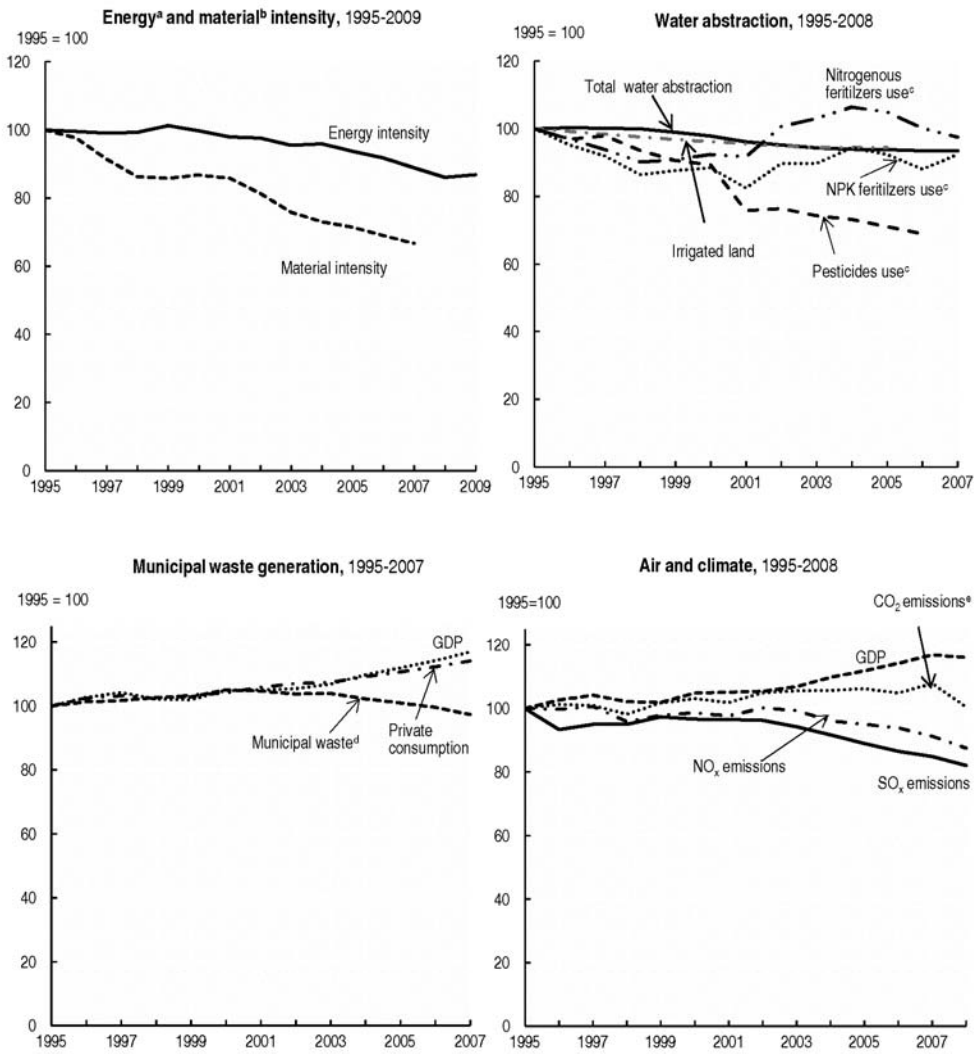
Greenhouse gas (GHG) emissions further increased; in 2007, they were 9% above the 1990 level, far exceeding the Kyoto Protocol target of reducing emissions by 6% on average over the 2008-12 period compared with the 1990 level. While the economic recession brought emissions of GHGs and of carbon dioxide (CO_2) from energy use down in 2008, this effect is likely to be temporary. CO_2 emissions from energy use had increased by nearly 5% between 2000 and 2007, a rate lower than GDP (Figure 1). As a result, the carbon intensity of the Japanese economy has decreased and is now below the OECD average. However, progress has been slower than in other major OECD economies, mainly due to an increasingly high share of fossil fuels in the energy and electricity mix (Box 1). Efficiency improvements have helped to moderate the increase of industrial emissions, and higher fuel efficiency of vehicles has largely contributed to the decline in CO_2 emissions from transport (OECD, 2010a).

While GDP and private final consumption increased during the 2000s, the generation of municipal waste decreased by 7% (Figure 1). The generation of waste per capita (400 kg in 2007) is among the lowest in OECD countries. Recycling of selected waste streams has improved, and final disposal amounts of waste have been reduced by more than half. However, waste generation by manufacturing industries has grown faster than GDP (OECD, 2010a).

Water abstraction decreased during the last decade, following the decreasing trends in population, agricultural production, and irrigated areas (Box 1 and Figure 1). With 650 cubic metres per inhabitant, Japan's water abstraction per capita is below the OECD average, but remains above a large number of OECD countries, notably European. Gross freshwater abstraction represents about 20% of available water resources, indicating a moderate water stress. The overall quality of Japanese rivers has improved, owing to the extension of wastewater systems. However, lakes and coastal waters continue to suffer from frequent algae blooms, due to the still high nutrient load from agriculture, discharges from small wastewater treatment plants and small factories (OECD, 2010a). While pesticides consumption has decreased since 2000 and the use of nitrogenous fertilisers declined in the second half of the decade (Figure 1), Japan's use of fertilisers and pesticides per km^2 of agricultural land remains well above the OECD averages.

5. DMC is the total amount of materials directly used by the economy in a given year. DMC equals domestic extraction of resources plus imports minus exports, including processed products for imports and exports. Domestic extraction is the flow of raw materials extracted or harvested from the environment and used by the economy as material factor inputs.

Figure 1. Economic growth and environmental pressures



a) Total primary energy supply per unit of GDP (at 2005 constant prices).
b) Domestic material consumption (DMC) per unit of GDP (at 2005 constant prices), where DMC is the sum of domestic (raw materials) extraction (DE) used by an economy and its physical trade balance (imports minus exports of raw materials and manufactured products). A decline in material intensity is equivalent to a rise in material productivity, i.e. GDP/DMI in Japanese indicators, where DMI=DE+IMP.
c) Apparent consumption. For pesticides, sales are often used as a proxy.
d) Waste collected by or for municipalities, waste directly delivered and separate collection for recycling by the private sector. It includes household, bulky and commercial waste and similar waste handled at the same facilities.
e) Emissions from energy use only; excludes international marine and aviation bunkers; sectoral approach.
Source: OECD, Environment Directorate; OECD-IEA (2010), *CO_2 Emissions from Fuel Combustion*; OECD (2010), *OECD Economic Outlook No. 88*.

Pressures on biodiversity are rising. Relatively high shares of fauna and flora species are threatened by deteriorating and fragmented habitats, and by invasive alien species. Protected areas registered by the International Union for Conservation of Nature (IUCN) cover less than 6% of the territory, which is low by OECD standards. Despite decreased fish production, Japan accounts for the second highest share of the world's fish catches. Agriculture is also a major source of pressure on biodiversity (OECD, 2010a).

2. How green was Japan's response to the economic crisis?

After the so-called "Lost Decade" of the 1990s, a prolonged period of economic stagnation and deflationary pressures, Japan's economy started to recover in 2002. The recovery was mainly the result of

a surge in exports caused by the low value of the Japanese currency, increased US demand, and stronger integration with other Asian countries. However, domestic demand was weak: average nominal wages decreased as the number of lower paid, non-regular workers increased, household income remained stagnant and public expenditure contracted as part of the fiscal consolidation plan. The growing number of non-regular workers has been aggravating income inequalities and poverty.[6] General price levels slowly declined, a phenomenon not seen in any other OECD country during that period. Hence, the economic expansion primarily benefited the export-oriented manufacturing sectors and large firms, whereas the rest of the economy, which depends more on domestic demand, lagged behind.

The 2008 global economic slowdown and the simultaneous rise in the value of the yen sharply reduced the volume of Japan's exports. Consequently, the Japanese economy contracted by 1.2% in 2008 and declined by 5.2% in 2009, the sharpest fall in economic activity in over half a century. The crisis had a severe impact on unemployment, and the unemployment rate was above 5% in 2009 (although Japanese unemployment rate remains low by OECD standards). Japan also faces greater deflationary risks than other OECD countries. The budget deficit (excluding one-off factors) is projected to climb from 3% of GDP in 2007 to about 9% in 2010. Japan shoulders a very large debt-to-GDP ratio. At 167% in 2007, it was the highest gross government debt among OECD countries, and it could rise to over 200% of GDP in 2011 (OECD, 2010b).

During the economic downturn, Japanese authorities acted quickly to stabilise the financial markets, stimulate the economy, increase social security and prepare for future growth. Between August 2008 and April 2009, the government launched four stimulus packages. The stimulus totalled JPY 132 trillion (about USD 1.3 trillion) for 2008-09, or 4.7% of 2008 GDP. It was the second largest stimulus effort in G7 countries and was based on additional public spending (4.2% of GDP) (OECD, 2009b). The additional spending consisted mainly of: transfers to firms and households; investment in social infrastructure, education and technology; and active labour market policies.

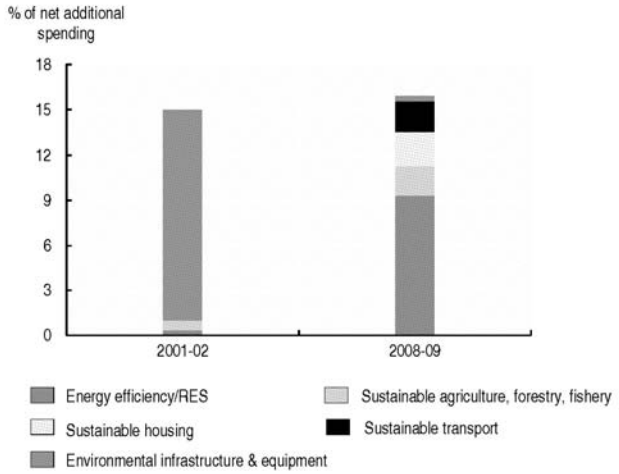
The fiscal stimulus and large public investment partially offset the negative impacts of lower employment and wages on domestic demand. This, together with a rebound in exports, helped Japan to arrest the economic recession in the second half of 2009 and slowly recover (OECD, 2010b). Fiscal stimulus cannot continue for long, however, considering Japan's large budget deficit and government debt. Once a recovery is in place, Japan should reduce the stimulus and move towards fiscal consolidation, implementing spending reductions and a broad tax reform (OECD, 2009b). The upturn will need to rely primarily on private domestic demand, given the uncertainty of export markets. The New Growth Strategy appears to be moving along these lines, as well as incorporating green growth features (Section 3).

The environmental dimension of Japan's fiscal stimulus packages

A considerable part of the additional fiscal stimulus in the 2008-09 was environment-related, in an attempt to link the anti-crisis measures to the long-term goal of promoting green growth and a transition to a low-carbon society (Figure 2). In early 2010, the Diet approved another supplementary budget, which explicitly acknowledged the environment as one of the three pillars of Japan's response to the crisis, together with employment and economic growth.

6. Non-regular workers do not have lifetime employment and have lower salaries than regular workers; they represented 34% of the labour force in 2007.

Figure 2. Environment-related investment in stimulus packages,[a] 2001-02 and 2008-09



a) Data cover three stimulus packages in 2001-02, and four stimulus packages in 2008-09.
Source: Ministry of Finance and OECD calculations.

The 2008-09 fiscal stimulus package is much larger than the one implemented to tackle the crisis in the early 2000s. It consists of higher net additional spending and lower tax cuts. The composition of net spending is also different, with a lower share devoted to public investment (OECD, 2009b).

Direct environment-related investment and fiscal incentives are estimated at nearly JPY 2.9 trillion (USD 28 billion), equivalent to 0.57% of 2008 GDP and to 16% of the 2008-09 fiscal stimulus (considering the four packages approved between August 2008 and April 2009). While this share is only slightly higher than in 2001-02, the composition of the "green" stimulus differs greatly (Figure 2). The bulk of the 2001-02 environment-related stimulus consisted of public investment in environmental infrastructure and equipment, mainly waste and wastewater infrastructure development. This kind of investment accounted for only 2% of green investments in 2008-09. The promotion of energy efficiency, renewable energy sources and related R&D represents the core (some 60%) of the 2008-09 "green" anti-crisis measures, reflecting the emphasis Japan is putting on the transition to a "low-carbon society". The remaining green component is almost evenly shared among support to sustainable housing (*i.e.* improvement of quality and energy efficiency of residential buildings), sustainable transport infrastructure (*i.e.* railways and local public transport), and rural development.

The green measures in the 2008-09 stimulus packages include: i) tax reductions for fuel-efficient and cleaner vehicles (Section 4.1); ii) "eco-point" system to reward purchases of energy-saving home appliances (Section 4.3); iii) tax incentives for investments in energy-saving and renewable energy facilities, including the possibility to claim immediate depreciation of their costs; iv) tax incentives for R&D, especially for small and medium-sized enterprises; v) capital grants and tax incentives for businesses and households that install photovoltaic panels and energy-efficient appliances; vi) a feed-in tariff to support photovoltaic energy (Section 4.3); vii) tax incentives and capital grants for energy efficient renovation of residential and public buildings (including schools); viii) support for energy efficiency and biomass reuse in agriculture; ix) forest maintenance, such as thinning, to enhance greenhouse gas absorption capacity; and x) support for green investments at local level, through "Local Green New Deal Funds".

This kind of investment is likely to have a more immediate impact on economic activity than traditional infrastructure projects (OECD, 2009b). However, some measures included in the stimulus

packages can have negative environmental impacts, as well as distort competition, and should be carefully assessed for consistency with environmental objectives. These measures include:

- transfers to highway companies to compensate them for the temporary reduction in highway tolls until the end of 2010, which are intended to reduce travel and logistics costs and to stimulate domestic demand (Section 4.2);
- subsidies for the automobile industry in the form of car-scrapping incentives (Section 4.3);
- investments in road construction, airports and fishery infrastructure (*e.g.* ports);
- additional support to farmers to expand production of rice, barley and beans, as well as measures to stimulate domestic demand for agricultural, forestry and fishery products, *e.g.* requiring schools to serve such products more frequently (Section 4.3).

In January 2010, the Diet approved another supplementary budget, which diverts about JPY 7.4 trillion allocated in the previous budgets to new spending measures. All the environment-related measures were confirmed and partly extended, including the "eco-point" system for home appliances, subsidies for low-emission vehicles, and support for the renovation of buildings (with the introduction of a housing "eco-point" scheme). However, the 2010 regular budget includes some measures that are potentially harmful to the environment, including increased support for agricultural production, further discounts on highway tolls, and a provision for lowering motor fuel taxation in case of oil price peaks.

3. Japan's New Growth Strategy: towards green growth?

Japan's New Growth Strategy, first approved in December 2009 and revised in June 2010, outlines a model of growth based on domestic demand, innovation, and stronger economic integration of Japan in the Asia region, as well as less dependence on heavy public investment in infrastructure. The Strategy takes into account the challenges of climate change and Japan's ageing population. As a result, it identifies the environmental and health sectors, together with increased leisure time and tourism, as the main sources of demand and, hence, as the key drivers of future growth and job creation. In particular, the promotion of "green innovation", *i.e.* innovation in the environment and energy sectors to achieve a low-carbon society, is one of the "basic policies", as indicated in Table 1. Greening the tax system is one of the instruments that will be used to promote green innovation.[7]

The Strategy appears to include the main elements of the *2009 OECD Declaration on Green Growth* and of the *OECD Interim Report to the Green Growth Strategy* (OECD, 2010c): green investments, R&D, low carbon infrastructure, tax instruments, co-ordination of labour market with education policies, and international co-operation. The Strategy gives much emphasis to the linkages between environmental protection, economic growth and social change, in an attempt to move from a strictly environmental interpretation of sustainable development to a more integrated approach. The government should systematically evaluate the impact of the strategy's implementation on the environment, as well as the net contribution of environment-related sectors to growth and employment.

7. For a comprehensive analysis of Japan's growth strategy, as revised in June 2010, see the 2011 OECD Economic Survey of Japan.

Table 1. Key objectives and priorities in the New Growth Strategy[a]

Basic Policy	Objectives to 2020	Priorities
Become a leader in environment and energy through "green innovation"	Generate market value of over JPY 50 trillion and 1.4 million jobs in environment-related sectors; reduce global GHG emissions by at least 1 300 $MtCO_2$eq. by promoting Japanese technology worldwide.	– Renewable energies and innovative technologies. – Zero-emission residential and commercial buildings. – Comprehensive policy package to achieve a low-carbon society, ncluding regulatory reforms and greening the tax system.
Health leader strategy through "life innovation"	Create market value of about JPY 45 trillion and 2.8 million jobs in health-related sectors.	– R&D in pharmaceuticals, medical and nursing care technologies. – Expand the availability of accessible housing for elderly and disabled people. – Strengthen medical and nursing care services.
Economic strategy for Asia	Establish a Free Trade Area of the Asia-Pacific (FTAAP); take advantage of Asia growth opportunities.	– Roadmap for reaching the FTAAP agreement. – Promote international adoption of Japanese safety standards. – Public-private support for sustainable transport and environmental infrastructure. – Make Haneda Airport an international hub; "open skies" agreement; port infrastructure. – Revise regulations that obstruct flows of people, goods, and capital.
Promote a tourism oriented nation and local revitalisation	– Increase annual number of foreign visitors to Japan to 25 million, for JPY 10 trillion of market value and 560 000 jobs. – Revitalise urban and under-populated areas. – Increase the self-sufficiency rate for food to 50% and for timber to over 50%; increase agriculture, forestry, fisheries, and food product exports by a factor of 2.5, to JPY 1 trillion. – Double the market of existing housing; reduce the share of insufficiently earthquake-proof housing to 5%.	– Ease tourist visa requirements for citizens of Asian countries. – Increase use of paid vacation time. – Use private finance initiatives and public-private partnerships to provide infrastructure in urban areas. – Introduce an individual household income support system for farming households; promote partnerships among agriculture, commerce and industry. – Revitalise forests and forestry, *e.g.* through biomass use. – Improve the market of existing housing. – Earthquake-proof renovation of buildings.
Strategy for a science and technology oriented nation	Increase public and private investment in R&D to over 4% of GDP; increase the number of Japanese world leading universities and research institutions; expand ICTs.	– Reform universities and public research institutions; ensure full employment for those who complete doctoral courses. – Reform systems and rules to foster innovation. – Provide "one-stop" government services; reform regulations to encourage ICT use.
Employment and human resources	– Halve the number of "freeters"[b]; rectify M-shaped female employment; increase the number of job-card holders to 3 million[c]; increase the minimum wage; shorten working hours and increase utilisation of paid vacation time. – Achieve a sustainable increase in the birth rate; attain the world's top level of academic achievement.	– Increase the employment rate of young people, women, the elderly, and the disabled. – Improve assistance to job seekers and the unemployment insurance system; expand the job-card system to include vocational qualification. – Expand childcare services; make childcare leave more flexible. – Improve the quality of education. – Improve the social environment to ensure the safety of children.

a) This table presents objectives and priorities of Japan's growth strategy as approved in December 2009. The 2010 version of the strategy added the financial sector to the "basic policies" and confirmed most of the priorities.
b) "Freeter" is a Japanese expression for people between the age of 15 and 34 who lack full time employment or are unemployed (excluding students), live with their parents and earn some money with low skilled and low paid jobs.
c) Under the job-card system, businesses provide training to part-time and low-skilled workers and issue them with job cards that contain a record of their training, evaluation and employment.

Source: Government of Japan (2009).

The "New Growth Strategy Realisation Promotion Council" was established in September 2010 to oversee the implementation of the Strategy. It is chaired by the Prime Minister, with the participation of relevant ministers and leaders of government agencies, the governor of the Bank of Japan, business and labour representatives, and private experts (OECD, forthcoming). This Council fills a longstanding institutional gap, since previously there had not been any specific institution that co-ordinated governmental policy on sustainable development and green growth. While mechanisms have been in place to ensure policy co-ordination, the integration of environmental and economic policies has usually

remained difficult, with ministries and local authorities focussing on the implementation of their respective sectoral and local plans. Japan also reinforced its policy evaluation procedures. Progress reviews are conducted annually and their results are disclosed to the public. However, there is no evidence that these reviews influence the annual planning and budgeting processes. Further, they do not sufficiently assess the cost-effectiveness of the policy mix and, in many cases, considerations other than effectiveness and efficiency guide policy making.

Overall, Japan has made important strides to green its economy and to implement the recommendations of the 2002 *OECD Environmental Performance Review* on economy-environment integration (Table 2). However, important challenges still remain, and Japan would benefit from enhancing the cost-effectiveness of its environmental policy mix, notably by making greater use of market-based instruments.

Table 2. Actions taken on the 2002 OECD Review's recommendations for economy-environment integration

Recommendations	Actions taken
Continue to restructure environment-related taxes in a more environmentally friendly way.	The Ministry of the Environment established an Expert Committee to discuss potential effects of the carbon tax. Japan introduced tax incentives to favour more environment-friendly vehicles (see below).
Review and further develop the system of road fuel and motor vehicle taxes, with a view to promoting more sustainable modes of transport, to internalising environmental costs, while paying attention to the demand for transport infrastructure and to introducing more flexibility in the allocation of the revenue.	Taxation of road fuels has remained unchanged. Japan has introduced tax breaks for motor vehicle taxes to link them to fuel efficiency and exhaust gas emissions of vehicles, including heavy-duty vehicles. The earmarking of vehicle and road fuel taxes to road construction and maintenance was phased out in 2009.
Continue to reduce sectoral subsidies that have negative environmental implications.	Japan phased out subsidies for domestic coal production in the early 2000s. Support to farmers has decreased.
Strengthen efforts to buy and use "greener goods" (*e.g.* via green procurement policies and the green consumer movement) so as to promote more sustainable production and consumption patterns.	Green public procurement requirements have been mandatory for central government institutions since 2001. The Eco-Mark certification programme has been extended and several other eco-labels apply. Several incentive schemes are in place to favour the purchase of cleaner products, including vehicles and electric appliances.
Review distributional implications of proposed market-based instruments for environmental management and sustainable development.	No actions taken.
Assess the impact of changes in technology and lifestyle (*e.g.* the impact of information/communications technology, increased recreation time, retirement) on environment and nature, taking into account related changes in patterns of settlement, transport, production and consumption.	Some reports (including the White Papers issued by the Ministry of the Environment and the Ministry of Land, Transport, Infrastructure and Tourism) describe the interactions between the environment, on the one hand, and social, demographic and settlement changes, on the other.

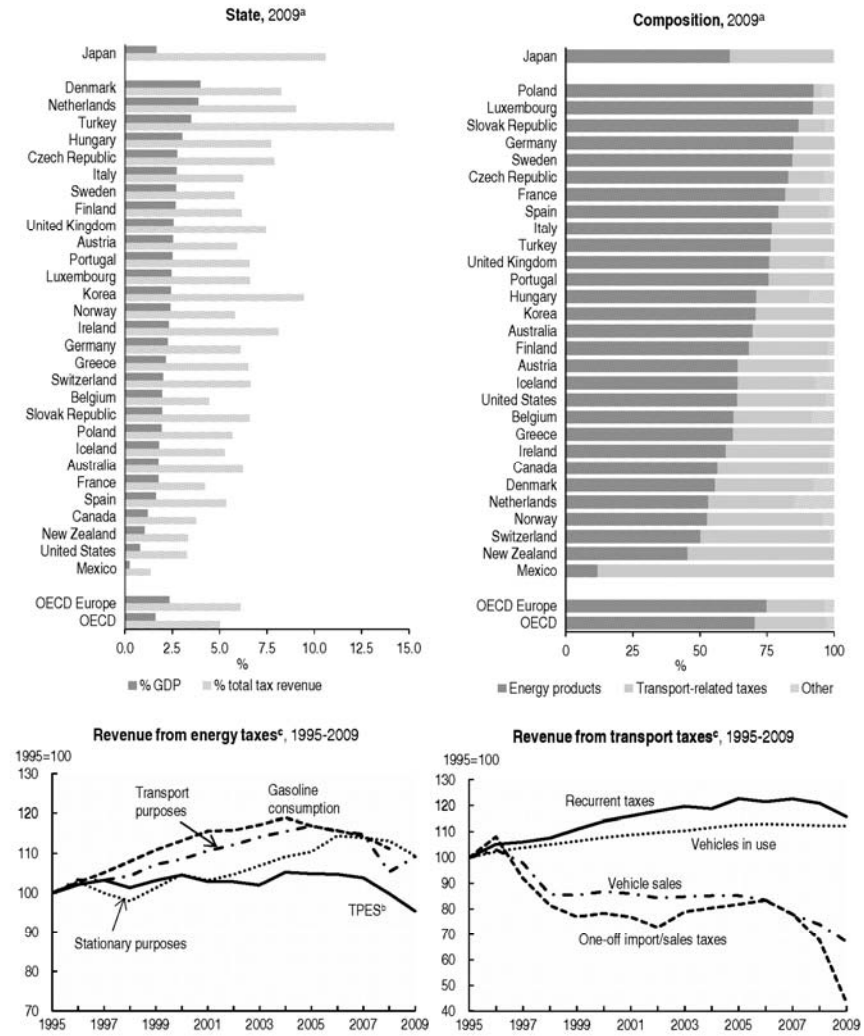
Source: OECD, Environment Directorate.

4. Modifying market incentives

4.1. Greening the tax system

Japan's tax system differs from that of many OECD countries in several respects. In particular, the tax revenue to GDP ratio is one of the lowest in the OECD area (28.1% in 2008, compared to the OECD average of 34.8%). Revenues from indirect taxes on goods and services, including those on energy and transport, account for a much lower share of tax receipts than the average for the other OECD countries (18% of tax receipts in 2008, compared to 31.7%).[8]

Figure 3. Environmentally related taxes



a) 2008: Greece, Poland, OECD Europe, OECD.
b) Total primary energy supply.
c) At 2005 constant prices.
Source: OECD-EEA Database on economic instruments for environmental policy; OECD-IEA (2010), *Energy Balances of OECD Countries*; OECD (2010), *OECD Economic Outlook No. 88*; MLIT, Japanese Automobile Manufacturers Association.

8. The consumption tax rate is the lowest among OECD countries at 5%. In 2009, the economic recession caused a decrease in overall tax revenues, notably in revenues from corporate taxation. As a result, revenues from taxes on goods and services exceptionally accounted for nearly a third of total tax receipts in that year.

As in all OECD countries, environmentally related tax revenues largely consist of revenues from taxes on energy use and vehicles. Japan imposes a multiplicity of such taxes, some of which are collected at local level. Revenues from environmentally related taxes (in real terms) increased by about 6% between 2000 and 2007, before sharply decreasing as a consequence of the economic crisis. They accounted for 1.7% of GDP in 2009. This share is in line with the OECD weighted average, although well below the OECD Europe average (Figure 3), and it has slightly decreased since the late 1990s. Revenues from environmentally related taxes fluctuated around 6% of total tax receipts for most of the 2000s, a share above the OECD weighted average, though in the lower half of OECD countries. However, this share soared to over 10% in 2009, the second highest in OECD, as a result of the negative impact of the economic recession on overall tax receipts (Figure 3). Energy taxes play a relatively minor role in Japan compared with other major economies, accounting for about 60% of environmentally related tax revenues (Figure 3).

Taxes on energy products

Tax rates on energy products are lower in Japan than in a number of other OECD countries, notably European countries, and have remained virtually unchanged (in nominal terms) since the early 2000s (Table 3). Exceptions include the extension of the petroleum tax to coal in 2003 and the increase of the tax rate on natural gas and liquefied petroleum gas (LPG), which partly corrected for the uneven tax burden on various fossil fuels (IEA, 2003). This, combined with the growing share of coal and natural gas in total primary energy supply (TPES), has led to an increase in revenues from energy taxes for stationary purposes (Figure 3), despite a rather stable TPES.

Table 3. Energy-related taxes, 2001 and 2009

		2001	2009	Exemptions
Gasoline tax	On unleaded gasoline			Aviation, diplomats, heating, gasoline used as solvent for rubber and as raw material for petrochemicals
	- gasoline tax	48.6 JPY/l	48.6 JPY/l	
	- local gasoline tax	5.2 JPY/l	5.2 JPY/l	
Delivery tax	On delivery of:			Agriculture, forestry, fishing, mining
	- light oil	32.1 JPY/l	32.1 JPY/l	
	- diesel fuel	32.1 JPY/l	32.1 JPY/l	
LPG tax	On LPG used for transport purposes	17.5 JPY/kg	17.5 JPY/kg	Exports; LPG used as heating fuel or in manufacturing
Petroleum and coal tax	On natural gas, imported LPG	0.72 JPY/kg	1.08 JPY/kg	Exports; fuel oil used in agriculture, forestry or fishing; naphtha and gaseous hydrocarbons used as raw materials for production of petrochemicals and ammonia
	On crude oil, imported petroleum products	2.04[b] JPY/l	2.04 JPY/l	
	On coal	-	0.70 JPY/kg	
Aviation fuel tax	On aviation fuels	26 JPY/l	26 JPY/l	Central and local governments, international air transport
Power-resource development tax	On sale of electricity	0.445 JPY/kWh	0.375 JPY/kWh	

Source: Government of Japan.

Nonetheless, prices of energy products for stationary uses are relatively high in Japan (Table 4). The prices of natural gas and oil are higher than in other major industrialised countries. This is partly due to the high cost of shipping. Households pay a disproportionally higher price of electricity and natural gas than industrial customers. Electricity retail prices decreased between 2000 and 2007, owing to improvements in the efficiency and competitiveness of the electricity sector (IEA, 2008). Although electricity prices remain higher in Japan than in many OECD countries, their decline did not help moderate the use of electric appliances in the residential sector.

Table 4. Energy prices in selected OECD countries, 2009

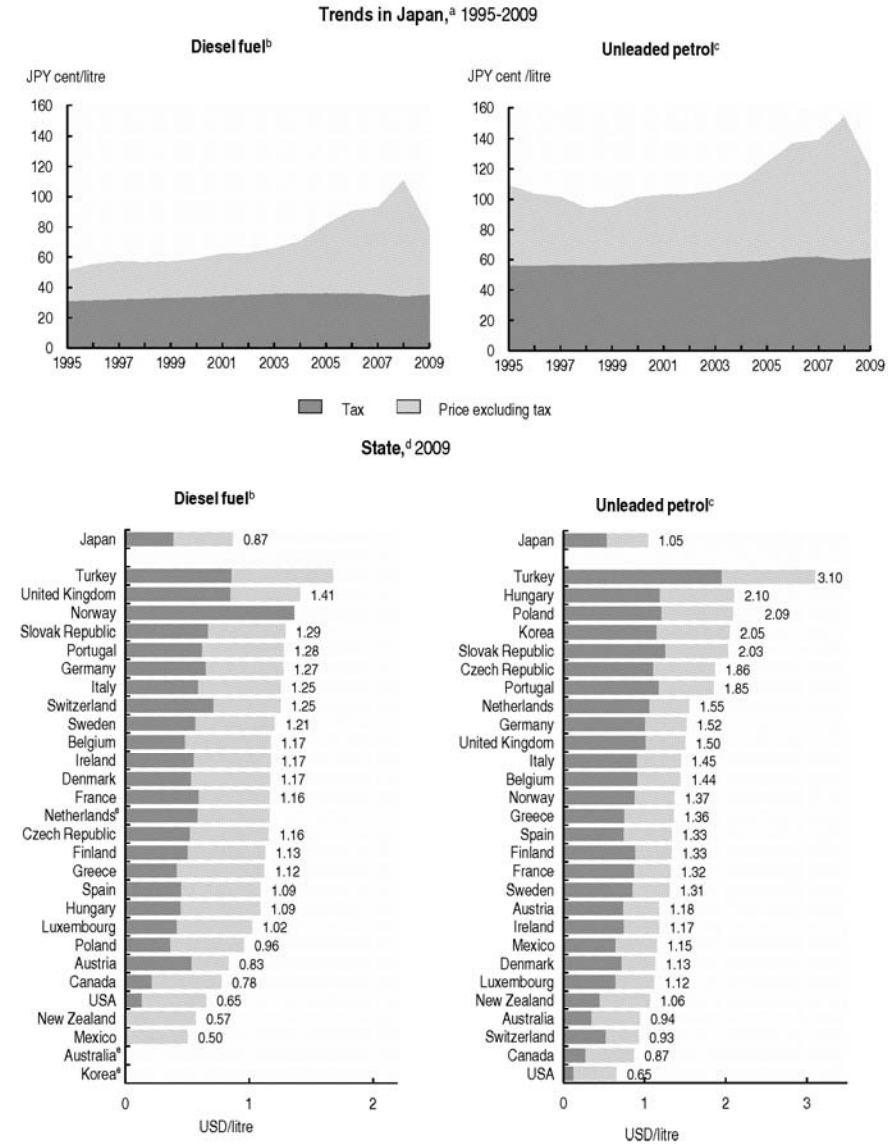
	Electricity		Oil			Natural gas	
	Industry (USD[b]/kWh)	Households (USD[c]/kWh)	Industry (USD[c]/t)		Households[a] (USD[d]/1 000 l)	Industry (USD[b]/10^7 kcal)	Households (USD[c]/10^7 kcal)
			high sulphur	low sulphur			
Japan	0.158	0.185	776.5[f]	584.6	579.9	454.0[e]	1 213.5[e]
Canada	0.064[e]	0.079[e]	432.1	..	649.9	357.0[f]	444.8[f]
USA	0.068	0.115	372.3	..	661.3	202.8	459.5
Korea	0.058	0.127	480.3	525.9	1,250.0	479.5	954.0
France	0.107	0.125	429.3	541.5	626.9	438.9	665.7
Germany[e]	0.109	0.272	..	437.0	613.0	..	..
Italy	0.276	0.241	..	474.7	1,223.8	557.7	897.4
United Kingdom	0.135	0.200	x	576.0[e]	665.2	323.7	775.4
OECD Europe	0.139	0.191[f]	..	481.7	677.6	459.9	841.1
OECD	0.106	0.151	349.0[d]	..	676.6	304.1	643.6
JPN price/OECD Europe (%)	*113*	*97*	..	*121*	*86*	..	..
JPN price/OECD (%)	*148*	*123*	*223*	..	*86*	*149*	*189*

.. not available x not applicable.
a) Light fuel oil.
b) At current exchange rates.
c) At current PPPs.
d) 2005 data.
e) 2007 data.
f) 2008 data.
Source: OECD-IEA, Energy prices and taxes, 4th quarter 2010.

Taxes on fuels for transport purposes account for some 83% of the revenue from energy-related taxes. Japan's taxation of transport fuels stands out among OECD countries in a number of ways. Japan is one of the few OECD countries taxing aviation fuel used on domestic flights. Gasoline and diesel taxes – and prices – are well below those of most OECD countries (Figure 4). In 2009, taxes accounted for 45% of the diesel price and 51% of the gasoline price, compared to a range of 50-60% of the diesel price and 62-68% of the gasoline price in the G7 European countries.[9] This gives drivers a relatively weak incentive to drive energy efficiently even if they choose low-emission cars.

9. The tax rate on diesel includes the petroleum tax and the diesel oil delivery tax; the tax rate on gasoline includes the petroleum tax and the gasoline tax.

Figure 4. Road fuel prices and taxes



a) At constant 2005 prices.
b) Automotive diesel for commercial use.
c) Unleaded premium (RON 95); Japan and Korea: unleaded regular.
d) Diesel fuel: at current prices and exchange rates; unleaded petrol: at current prices and purchasing power parities.
e) Data not available.
Source: OECD-IEA (2010), *Database of end-use prices*.

While fuel prices increased in 2000-08, in line with world oil prices, nominal tax rates have remained unchanged and their impact on transport decisions has thus been negligible (Figure 4). Yet, passenger demand appears to be sensitive to fuel prices: passenger traffic by car continued to grow in the early 2000s and started to progressively decrease, as did gasoline consumption, when fuel prices rose (OECD, 2010a). The gasoline tax represents over 65% of the revenue from transport fuel taxes, due to the dominance of gasoline vehicles in the fleet. Consequently, revenues from fuel taxes largely follow the trend in gasoline consumption (Figure 3). The response of Japanese consumers to the rise in fuel prices, exacerbated by the 2008 oil price peaks, shows that a higher and better targeted fuel taxation, *e.g.* on the basis of fuel carbon content, would offer an incentive for buying smaller and more fuel-efficient cars, driving shorter distances and shifting to public transport. However, in its 2010 budget, the government announced that fuel taxation would be reduced in case of new oil price spikes. In a scenario with lower oil prices and economic

recovery, the recent positive trends in GHG emissions from road transport may well turn negative. Fuel taxation more in line with the OECD average would counteract this and help fiscal consolidation.

The government has been discussing the introduction of a carbon tax for several years. In 2009, the Ministry of the Environment (MOE) proposed a tax of JPY 1 064 (USD 10) per tonne of CO_2 on fossil fuels, including transport fuels. This is a relatively low level compared to similar taxes applied in other countries (*e.g.* Finland and Sweden) and to the average price of a CO_2 allowance in the EU emissions trading system. Under the proposed carbon tax scheme, the gasoline tax would be simultaneously reduced, so that the final tax rate, including the carbon tax, would be comparable to the minimum rate applied in the EU. Moreover, relief measures for specific industries would be considered, such as exempting coal for steel manufacturing and compensating large emitters. While such exemption would help moderate the potential impacts of the carbon tax on the international competitiveness of Japanese industries, they would create uneven abatement incentives across sectors and a loss of efficiency. They should therefore be transitional and targeted to the most exposed sectors. A carbon tax could complement a new mandatory emissions trading system, thereby extending carbon pricing to households, offices and transport (Section 4.2). The government signalled its intention to introduce such a tax as part of a comprehensive tax reform scheduled for 2011. This would provide opportunities to raise additional revenues that can help fiscal consolidation, or partially or fully shift the tax burden from more distortionary taxes on businesses and labour.

The revenue from most energy-related taxes is earmarked for several purposes.[10] Earmarking revenue from transport fuel and vehicle taxes for road construction and maintenance was removed in 2009. For several years, the rates of these taxes had been based on the financial requirement for road work. The removal of earmarking is thus a positive step that allows these taxes to be better designed to meet environmental goals, primarily climate change goals. In general, earmarking tax revenue reduces the flexibility of fiscal decisions and, therefore, overall efficiency, and should be limited to the extent possible.

Vehicle taxes

Japan imposes taxes on the purchase and ownership of motor vehicles at prefectural and national levels. None of these taxes is directly based on the environmental performance or fuel efficiency of vehicles.[11] Nonetheless, during the last decade, tax breaks were introduced to favour the purchase of more environment-friendly vehicles (Table 5). As from 2001, the automobile tax was reduced by 25-50% depending on a vehicle's fuel efficiency and exhaust emission levels, and it was increased by 10% for old vehicles.[12] The tax break was extended in 2009 to the acquisition tax and the motor vehicle tonnage tax. The so-called "next generation vehicles", including hybrid and plug-in hybrid, electric, clean diesel and compressed natural gas cars, are fully exempted. These tax breaks are set to be phased out in 2012. Technological advancement and tax incentives have helped to considerably improve average fuel efficiency of the road vehicle fleet, with a shift to smaller and more fuel-efficient cars (OECD, 2010a).

10. Revenue from the petroleum and coal tax is used to finance oil development and stockpiling, energy conservation and renewable energy source development; proceeds from the power-resource development tax are earmarked for promoting power source locations and R&D; and those from the aviation fuel tax are used to finance airport construction.

11. The prefectural acquisition tax is charged on retail price at the time of purchase; the prefectural annual automobile tax is based on engine size; and the national tonnage tax is imposed at the time of the mandatory periodical vehicle inspection on the basis of the weight and age of the vehicle, with reduced rates for "next generation vehicles".

12. Diesel cars older than 11 years and gasoline cars older than 13 years.

Revenues from the acquisition tax decreased sharply in the second half of the 1990s, with both the decline of vehicle sales and the shift to small and mini cars. Revenues rebounded in 2002 with the introduction of the automobile tax break, which boosted sales of more expensive standard-size, albeit more fuel-efficient, cars. Revenues from recurrent taxes (automobile and motor vehicle tonnage taxes) have slightly decreased in nominal, though not in real, terms between 2002 and 2007, with the growing number of small and fuel-efficient vehicles in the fleet, as well as with the overall expansion of the vehicle stock. The economic recession severely hit vehicle sales and, in turn, revenues from vehicle-related taxes (Figure 3).

Table 5. Tax incentives for fuel-efficient and low-emission vehicles

Type of vehicle	Fuel efficiency	Emissions performance	Incentives		
			Automobile tax	Acquisition tax[a]	Motor Vehicle Tonnage tax[b]
Alternative-energy next generation vehicles	Electric (including fuel cell), plug-in hybrid, clean diesel, hybrid and natural gas vehicles that meet certain performance requirements		50% reduction	exempted	exempted
Passenger cars	Compliant with 2010 standards +25%	Emissions down by 75% from 2005 standards	50% reduction	75% reduction	75% reduction
	Compliant with 2010 standards +15%	Emissions down by 75% from 2005 standards	25% reduction[c]	50% reduction	50% reduction
Heavy-duty vehicles	Compliant with 2015 standards	Compliant with 2009 standards	--	75% reduction	75% reduction
		NO_x or PM emissions down by 10% from 2005 standards	--	50% reduction	50% reduction

a) From 1 April 2009 to 31 March 2012.
b) From 1 April 2009 to 30 April 2012, with reductions applicable once only, at the time of the mandatory vehicle inspection.
c) Discontinued in April 2010.
Source: MLIT.

Other environment-related taxes

Several local authorities have introduced a landfill tax for disposal of industrial waste.[13] Tax receipts mainly used for waste generation control, recycling, waste reduction, and other appropriate waste treatment measures (OECD, 2010a).

Some 0.5% of environmentally related tax revenue is generated by a levy on SO_x emissions linked to the 1973 Law Concerning Compensation for Pollution-Related Health Damage. The purpose of the levy is to secure funding for compensating victims of air pollution certified by 1987 (OECD, 2002). The levy rate is set *ex post*: the financial requirement for health damage compensation (*i.e.* the revenue requirement) is shared among emitters proportionally to their 1982-86 emissions (60% of the revenue) and current annual emissions (40% of the revenue). Only installations that were active as of 1987 are deemed responsible for air pollution and are charged. The levy is thus more an instrument to enforce environmental liability than an economic incentive. Its burden on emitters is fading, as is the revenue. While it contributed to the uptake of SO_x abatement equipment in the 1980s, it is doubtful that it has played a role in curbing emissions in recent years (OECD, 2010d).

13. Twenty-seven prefectures out of 47 and one ordinance-designated city out of 60, as of January 2009.

Other tax incentives

Japan provides fiscal support to both households and businesses. Households can claim tax credits for the purchase of new houses meeting energy efficiency standards and for the installation of energy efficient equipment, such as heat insulation materials and solar panels. Similarly, businesses can benefit from tax credits or special depreciation rates on investment costs for improving energy performance and controlling pollution. Owners of highly efficient buildings have access to low-interest loans. Preferential tax treatment or low interest rates are provided by governmental financial institutions to promote the use of equipment for high-temperature incineration, or for treating smoke and soot, PCBs or other types of waste (OECD, 2010a). Tax credits are also given for investment in R&D (Section 6.).

Assessment

Japan plans to carry out a comprehensive review of the tax system by 2011, which will include a review of environmentally related taxes and consider the reinforcement of such taxes. A number of fiscal incentives have been introduced to make the tax system more environment-friendly, notably in the case of vehicle taxes, as recommended by the 2002 *OECD Environmental Performance Review* (Table 2). However, tax breaks to subsidise environment-friendly vehicles are generally less efficient than charging the polluting dimension of road transport. Such tax breaks represent expenditure for the government, in terms of foregone fiscal revenues, as was the case with the automobile tax. Moreover, they can contribute to increasing vehicle use, which can potentially offset the technical efficiency gains. Hence, the environmental effectiveness of these measures is questionable, *e.g.* in terms of reducing emissions of greenhouse gases or air pollutants. Higher oil prices have largely helped to moderate passenger traffic by car since 2003, and might have well been the primary incentive to shift to cleaner vehicles. Overall, Japan needs to redirect taxation from purchase and ownership of vehicles to their use and associated pollution load, *i.e.* through better targeted fuel taxes and road pricing (Section 4.2). Any remaining taxes on vehicles should be directly linked to their fuel efficiency and environmental performance.

Japan needs to reform its tax system to come to grips with urgent, and potentially conflicting, objectives: raising tax revenues to cope with high public debt and growing social spending resulting from an ageing population, while promoting economic growth and addressing widening income inequality (Jones and Tsutsumi, 2008). The OECD recommended raising the consumption tax rate and broadening the base of direct taxes by reducing allowances and deductions (OECD, 2009b).[14] Broadening the use of indirect taxes on the consumption of goods and services that are potentially harmful to the environment, *e.g.* through a carbon tax, can also contribute to reaching these goals. Such taxes would generate revenues that can help the government with fiscal consolidation and/or be used to partly reduce taxes on households and businesses, thereby promoting economic growth. The regressive nature of such taxes should be addressed through *ad hoc* social benefit schemes. The introduction of other taxes, such as on air and water pollutants, could also be considered. Japan needs to streamline its current environmentally related taxes, with a view to reducing overlapping tax bases and administrative burden, as well as improving the fiscal autonomy of local governments. The current municipal tax on immovable property could also be redesigned to offer incentive towards energy efficient housing.

14. Japan applies exceptionally high corporate tax rates. The share of direct taxes (personal and corporate income taxes and social security contributions) in total tax revenue is relatively high compared to other OECD countries. Several studies show that for a given level of taxes, a higher incidence of direct taxes (especially on business activity) relative to indirect taxes is detrimental to economic growth (Jones and Tsutsumi, 2008).

4.2. Using market-based incentives in the energy, transport and manufacturing sectors

Emissions trading

Japan has taken its first steps to implement a CO_2 emissions trading system. In 2005, Japan's voluntary emissions trading scheme (JVETS) was launched to gain experience in emissions trading. As of 2009, 303 companies participated in the programme, although they accounted for less than 1% of industrial CO_2 emissions. Participants in the JVETS voluntarily pledge to reduce emissions relative to their average in the previous three years. One-third of the abatement costs are borne by the government; this subsidy is returned if the target is not achieved, although no other penalty applies. To meet their targets, firms can either cut their emissions or purchase allowances from firms that have exceeded their targets, as well as credits from the Kyoto mechanisms. Targets have always been exceeded so far and the number of transactions has been modest. In 2008, companies achieved a 23% reduction in emissions from baseline levels, which was much higher than the committed 8%. Allowances were traded at around JPY 800/tCO_2 (less than USD 8), a low price compared to the price of an allowance in the EU ETS and lower than the average price of JPY 1 200/tCO_2 in the JVETS in the previous two years. The budget to operate the JVETS and subsidise participants has been between JPY 1.8 and 3 billion per year.

A voluntary domestic credit scheme was introduced in 2008, with the aim of reducing GHG emissions from small and medium-sized enterprises (SMEs). Under this scheme, large companies that finance emission reduction projects in SMEs can acquire credits certified as emission reductions in their joint project. These credits can then be used to meet the large companies' targets under the Voluntary Action Plan on the Environment (VAP) (Box 2).

Box 2. The Voluntary Action Plan on the Environment

The Voluntary Action Plan (VAP) on the Environment was launched in 1997 by Keidanren (the federation of Japanese industries). Industries in the Keidanren VAP committed themselves to bringing their GHG emissions below the 1990 levels by 2010. Also businesses not affiliated to Keidanren in the transport, commercial and service sectors have set up GHG emissions reduction plans. Overall, the VAPs cover about 80% of 2007 CO_2 emissions from the industrial and energy conversion sectors, and about 45% of national emissions. Each sector stipulates its own target and emission reduction measures in the VAP in consultation with the government. Many industries set their targets in terms of energy or emission intensities. This means they can achieve their targets even if emissions increase, as happened during the economic expansion phase in 2002-07.

The Keidanren's Evaluation Committee was established in 2002 to carry out independent reviews of the VAP. According to the review of the 2007 results, decreased use of nuclear power and increased production resulted in emissions above the target. In 2007, about half of the assessed industries did not meet their targets. Nonetheless, between 2000 and 2006, overall emissions of participating industries remained below the 1990 levels. The review recommended improving the VAP analysis at industry level and ensuring information disclosure.

In October 2008, the government launched a trial emissions trading system (ETS), involving 715 firms and covering more than two-thirds of industrial CO_2 emissions. Many ETS participants also take part in the VAP and set their reduction targets accordingly.[15] However, as in the previous programme, the trial ETS does not require participants to set a cap on emissions and no fine is issued in case of non-compliance. Participants receive for free an allocation of permits, equal to their baseline emissions net of their own reduction commitment. They can use emission credits acquired through the Kyoto mechanisms and the voluntary domestic credit scheme. It is too early to assess the effectiveness of the system.

15. Businesses that do not participate in the VAP use the JVETS target-setting method.

Box 3. The Tokyo Metropolitan Emissions Trading Scheme

Tokyo is one of the biggest cities in the world with 13 million population and USD 815 billion of GDP in 2006. It functions as Japan's political, economical and cultural centre, attracting people, companies and government institutions. This has resulted in large CO_2 emissions (56 Mt), which are comparable to those of a country like Norway, for example. The top contributor to CO_2 emissions is the commercial sector (21 Mt), followed by transport (15 Mt) and households (14 Mt). Emissions from transport decreased by 16.5% in the 2000-07 period, whereas those from the commercial sector increased by 9%. The Tokyo Metropolitan Government (TMG) is committed to reducing GHG emissions in the Tokyo area by 25% from the 2000 levels by 2020. This target is shared among sectors, with larger cuts required in the transport (-40%) and residential (-20%) sectors, and a 10% cut in the business sector.

To tackle emissions from the public sector, TMG has implemented a reporting system. The system is based on the approval of five-year emission reduction plans at the government agency or institution level, mid-term reporting and final reporting. Successful government institutions receive an award. The system can be implemented relatively easily since fewer than 1% of these institutions in the metropolitan area emit approximately 40% of the total CO_2.

TMG launched its metropolitan cap-and-trade system in April 2010. This set emission caps on some 1 400 buildings and commercial activities, with the aim of decreasing emissions by 6% in 2010-14 and 17% in 2015-19 from the base level (average of continuous three years in 2002-07 period). This is quite unique compared to other emissions trading systems (ETSs), which usually target the industrial sector. Participants in the system have several options to achieve their targets; for example, they can offset their emissions by reducing emissions from large sources outside of the Tokyo metropolitan area. Trading is set to begin in 2011.

According to the opinion poll conducted by the Tokyo Chamber of Commerce and Industry in May 2008, around 90% of firms acknowledged the importance of measures to combat climate change. About 60% declared that they expected an increase in economic costs from the implementation of the emissions trading, although only 4% opposed its introduction and some requested relief measures to be included in the system.

TMG became a member of the International Carbon Action Partnership (ICAP) in May 2009, and presented its system as a model for low carbon metropolitan areas. In an effort to reinforce co-operation with neighbouring prefectures, TMG has launched a number of initiatives (*e.g.* workshops) in which 80% of prefectures and large cities have participated.

These emissions trading experiences are a positive step forward, since they imply a price signal for GHG emissions, although the signal is still relatively weak. This voluntary approach reflects concerns of the business community about the potential negative impacts of mandatory emission caps on competitiveness. Japan needs to follow up on its plan to introduce a mandatory ETS at the earliest opportunity, with a view to achieving the announced mid- and long- term targets.[16] A mandatory cap-and-trade system, which sets the overall desired level of emissions, would minimise abatement costs, create a clear and credible price signal for investment decisions and promote innovation. The possibility of banking permits (*i.e.* carrying over permits that are not used in the trading period in which they are issued) would help limit uncertainty and price volatility. Auctioning would provide revenues to help fiscal consolidation (OECD, 2009b). To take account of acceptability issues, auctioning could be gradually introduced, aiming at full auctioning in the mid-term. The ETS should ideally cover the entire economy, including transport, or be complemented by a carbon tax applied to non-trading sectors. A mandatory ETS could also be linked to such systems implemented in other countries, namely in the EU, thus reducing the overall cost of

16. Within the framework of the Copenhagen Accord, Japan confirmed its mid-term target of cutting its GHG emissions by 25% from the 1990 levels by 2020. This target is "premised on the establishment of a fair and effective international framework in which all major economies participate and on agreement by those economies on ambitious targets". Previously, Japan had launched the Action Plan for Achieving a Low-carbon Society, setting the goal of a 60% to 80% reduction in GHG emissions by 2050.

meeting the targets and lowering carbon prices (OECD, 2009c).[17] However, the 2010 bill of the Basic Act on Global Warming Countermeasures, foreseeing the implementation of a mandatory ETS and taxation measures, has not been approved yet. A mandatory cap-and-trade system is set to become operational in Tokyo in 2011, covering around 40% of total emissions from the commercial and industrial sectors in the metropolitan area (Box 3).

Renewables Portfolio Standard

Under the Renewables Portfolio Standard (RPS), introduced in 2003, each electric utility has to sale a target rate of electricity generated from "new energy".[18] These utility-specific targets add up to national annual targets. The goal is to produce 17 billion kWh of electricity from new energy sources by 2014, a nearly five-fold increase of current production levels. The annual targets have been easily achieved so far. The RPS appropriately does not specify which renewable sources are to be increased, thus allowing a choice of cost-effective investments to meet the goal. Utilities can meet their obligations by either producing the required volume of electricity from renewables or trading with other generators; banking excess generation and borrowing from the following year are also allowed. The RPS has contributed to the development of renewable electricity in recent years, especially of wind, solar and biomass technologies (OECD, 2010a).

Road pricing

In addition to fuel and vehicle taxes, Japan applies a flexible and rather complex system of road pricing for its nearly 9 000 kilometres of motorways. The network is self-financed through the "toll-pool" system, which allows cross-subsidisation between profitable and unprofitable motorways, and prices are very high (OECD, 2005). Lower rates apply to light vehicles and motorcycles. Discounts of 30 to 50% apply to motorway tolls at off-peak times, for long-distance use and on weekends. To divert traffic from congested roads running through residential areas, a discounted toll applies on some urban stretches of motorways (so-called "environmental road pricing"). The 2008-09 anti-crisis package introduced further discounts on road tolls during weekdays and a flat rate of JPY 1 000 on weekends, aiming to stimulate travel and tourism. Furthermore, in its 2010 budget, the government approved the expansion of toll discounts on a pilot basis, with a view to progressively eliminating all road tolls.[19] Overall, despite high prices, the toll system encourages long-distance driving, including over routes that are very well served by fast trains. The measures recently approved would strengthen this incentive, whereas an appropriate implementation of the polluter-pays-principle would require road pricing to reflect both the distance travelled and the environmental performance of vehicles. Japan should carefully review its road toll system and assess the potential environmental impacts of reducing or eliminating tolls, with a view to making road pricing consistent with its climate-related goals.

4.3. Subsidies

The government provides various types of financial assistance to businesses and households. Subsidies to businesses included in the 2008-09 stimulus packages amounted to some 0.5% of GDP, the fourth highest GDP share for such subsidies among OECD countries (OECD, 2009d). Businesses often benefit from government financial assistance to meet environmental targets, also under negotiated agreements (OECD, 2010a), thereby undermining a consistent application of the polluter-pays-principle.

17. Linking ETSs directly tends to lower the overall cost of meeting the countries' or regions' joint targets by allowing higher-cost emission reductions in one ETS to be replaced by lower-cost emission reductions in the other.

18. According to Japan's definition, "new energies" include all renewable energy technologies whose development needs assistance, thus excluding large hydro power plants and geothermal heat.

19. Japan plans to phase out tolls on 37 motorways, representing 18% of total motorway length, starting from June 2010.

Besides straining the public budget, some support measures can have harmful environmental effects, as they affect production and consumption decisions. Japan needs to regularly review its subsidy policies to verify that the benefits are higher than the associated costs, including environmental costs. Removing perverse subsidies should be a central part of a comprehensive environmental fiscal policy reform, with a view to increasing the cost-effectiveness of policy measures, which are particularly important during times of economic crisis. As recommended in the 2002 OECD Review, Japan has taken some steps to reduce environmentally harmful subsidies (Table 2).

Subsidies to promote environment-friendly products

Like other vehicle-producing countries, Japan introduced support measures for its car industry as part of the 2008-09 anti-crisis policy package. The so-called Green Vehicle Purchasing Promotion Programme provides subsidies for purchasing new fuel-efficient cars and heavy goods vehicles to replace old ones (13 years or older). Eligible vehicles need to comply with the 2010 fuel efficiency standards. However, purchases not associated with scrapping old vehicles can also benefit from a subsidy, albeit lower, if the new vehicle exceeds the 2010 standards by at least 15%. The government has allocated approximately JPY 370 billion (about USD 3.7 billion) to the programme, expecting an increase in sales of up to 690 000 vehicles. The programme was set to terminate in September 2010.

The Eco-Point Programme was launched in mid-2009 to encourage purchases of energy-efficient household appliances, namely TV sets, air conditioners and refrigerators. Consumers are awarded "eco-points" for the purchase of these products depending on their energy performance, with or without scrapping old appliances. The "eco-points" can be used to buy other goods and services nationwide. The government covers the costs of the programme (some JPY 232 billion), which was set to end in December 2010.

These incentive schemes have softened the impact of the economic crisis on the automotive and electric appliance sectors. However, they distort the market by discriminating among manufacturing sectors and consumers, namely low-income households who cannot afford to buy new products. From an environmental perspective, rewarding the purchase of energy-efficient goods is not a cost-efficient way to reduce environmental impacts. These incentives encourage the use of subsidised products. The Japanese experience shows that despite the improved energy efficiency of electric appliances, overall electricity consumption in the residential sector has increased (OECD, 2010a). Moreover, the environmental impacts over the whole lifecycle of a product should be considered, including the increased demand for steel.

Energy subsidies

Japan offers financial support for energy efficiency programmes, renewable energy sources, and related research and development. In 2008-09, this support averaged some JPY 465 billion (about USD 4.7 billion) per year.[20]

In November 2009, Japan launched a feed-in-tariff (FIT) scheme with the aim of increasing solar photovoltaic installations 20-fold by 2020: solar panel owners can sell excess photovoltaic electricity to utilities at JPY 48/kWh for 10 years. This tariff is around twice the electricity price and slightly above the estimated generation cost (ANRE, 2008); the level of the feed-in tariff is comparable to that applied in other countries, such as Germany and Spain, and is set to decrease over time. The government estimates that the cost to households will be between JPY 30 and 100 per month and that in the first years of implementation the FIT will cost domestic and industrial consumers JPY 80-90 billion per year. Since only

20. Including about JPY 140 billion per year of financial support for the improvement of the environmental performance of businesses.

generation exceeding household needs can be sold, individuals are also encouraged to reduce their energy consumption. Investment costs for installing solar panels in the commercial, residential and public sectors are partly subsidised. Firms also benefit from a 7% tax deduction or can claim a special depreciation rate for investment in solar panels until 2011.

In the early 2000s, Japan phased out its subsidies for domestic coal production, following a restructuring programme of the coal industry.[21] However, Japan still subsidises business activities related to other fossil fuels, with the goal of securing a stable energy supply (Table 6). Japan also exempts from excise duties fuels used in agriculture, forestry, fishery, mining, petrochemicals, manufacturing, and for heating purposes (Table 3).

Bioethanol-blended gasoline benefits from tax exemption on its bioethanol content (up to 3%). Biofuel production is at an early stage in Japan and is mostly based on waste and residue materials. In 2007, the government announced a roadmap for increasing the annual production of biofuels to 50 000 kilolitres per year by 2011.[22] Japan aimed at reaching 500 million litres of crude-oil equivalent of transport fuels derived from biomass by 2010. This was expected to reduce CO_2 emissions by 1.3 Mt. Given the high production costs of domestic biofuels, Japan would have to provide significant support to stimulate domestic supply or rely on imports to further increase biofuels use. However, emission reductions achieved using biofuels come at a much higher overall cost than those achieved using other policy measures, namely emissions trading (OECD, 2008).

Table 6. Energy subsidies, 2007

Subsidy	Purpose	Budget amount for 2007[a] (JPY million)
Natural gas exploration subsidy	Promote natural gas exploration by mining companies	907
Subsidy for oil refining technology programmes in oil-producing countries	Promote joint research with oil-producing countries on oil refining technologies	9 925
Oil prospecting subsidy	Support geological surveys abroad	1 812
Oil refining rationalisation subsidy	Assist the development of advanced oil refining technologies	12 457
Oil product quality assurance subsidy	Support analysis of petroleum products and development of analysis techniques	1 898
Subsidy for structural reform measures for petroleum product distribution	Assist business diversification and other structural reform measures by oil distributors	12 442
Large-scale oil disaster prevention subsidy	Support the construction and maintenance of oil fences and their transport in emergencies	800
Promotion of natural gas use subsidy	Help private firms convert coal-burning facilities to natural gas-burning ones	6 005

a) Financial year.
Source: IEA, 2008.

21. The main type of subsidy concerned coal consumption of electric utilities, whereby coal producers received subsidies to cover the difference between market prices and those established under domestic agreements.

22. In 2008, 200 kl of bioethanol and 10 000 kl of biodiesel were produced.

Fisheries support

Government financial transfers to fisheries have continued to decline, from about USD 2.8 billion in 2000 to USD 1.9 billion in 2007. Japan remains the second largest provider of governmental support to this sector among OECD countries, following the US. This support is linked neither to production nor to investment in new vessels, which have the greatest potential to reduce fish stocks. Japan provides direct payments for fleet reduction (for scrapping vessels and surrendering licenses), as well as interest subsidies for the renewal of small fishing vessels, mainly to improve fisheries management and work safety. Some 70% of government financial transfers to fisheries are for coastal infrastructure construction (*e.g.* fishing ports, coastal roads) (OECD, 2010e). While these subsidies do not increase fishing effort, they constitute payments to the construction industry and can provide incentives to invest in unnecessary or unprofitable infrastructure, especially at a time when the fisheries sector is declining (OECD, 2010a).

Agricultural support

Agriculture is a highly protected and low-productivity sector in Japan. Total support to agriculture, including general services such as education, marketing and infrastructure, decreased during the 2000s. It accounted for about 1% of GDP in 2006-08, which is in line with the OECD average.

Support to farmers also decreased from 58% of gross farm receipts in 2000-02 to 47% in 2007-09.[23] However, support to farmers in Japan remains twice the OECD average. Moreover, support linked to production (*i.e.* to levels of input or output) accounts for nearly 95% of support to producers, far above the OECD average (55%). This kind of support is generally distortionary and environmentally harmful, since it stimulates production and input use, with negative impacts on the use of water, land, fertilisers and pesticides. While administered prices of some agricultural products, including rice, were abolished during the last decade, market price support still accounts for 85% of agricultural support.[24] Rice continued to be the most heavily supported commodity. As a result, Japanese consumers pay almost twice the world market price for agricultural products. Japan needs to reduce its high level of support, moving away from support to production and towards direct support to farmers. Improving the composition of support could bring benefits to farmers, consumers and the environment (OECD, 2009e).

In 2007, Japan introduced an agricultural support scheme designed to promote more environmentally friendly farming. To be eligible, producers have to be certified as "eco-farmers". This involves reducing the use of chemical fertilisers and pesticides by half compared to conventional farming. The number of eco-farmers has rapidly increased, reaching 10% of commercial farms. Such rapid enrolment in the scheme would not have been possible without incentives in the form of interest concessions and direct payments. Further expanding the scheme would require additional budgetary support, which was JPY 3 billion (about USD 30 million) a year in 2007 and 2008. However, payments for environmentally friendly farming account for only 0.5% of total payments to farmers, a very low share compared with agri-environmental payments in other major OECD economies, such in the EU and the US. Further efforts are needed to make agricultural support conditional on meeting appropriate environmental standards, as recommended in the 2002 *OECD Environmental Performance Review*.

23. Support to agriculture is measured in terms of Producer Support Estimate percentage, which expresses the monetary value of public transfers to producers as a percentage of gross farm receipts.

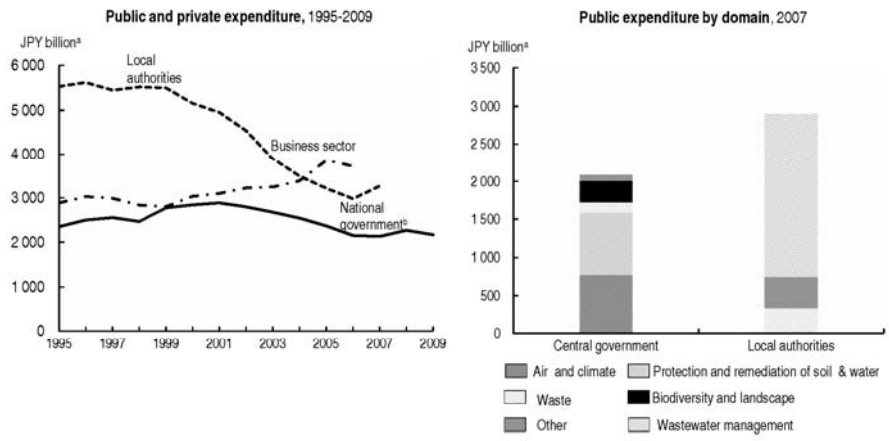
24. Market price support indicates the value of transfers resulting from any policy that leads to higher domestic market prices (*e.g.* tariffs, production quotas, administered prices).

5. Financing environmental expenditure

Public pollution abatement and control (PAC) expenditure represented about 1.2% of GDP in 2007, down from 1.7% in 2000.[25] Also the share of public expenditure devoted to environmental protection has steadily declined since 2000, reaching 3.4%. Expenditure has been scaled down in all sectors, with the exception of those related to climate change. Most of Japan's public expenditure on environmental protection is spent at local level, by prefectures and municipalities, although with substantial financial transfers from the central government. Fiscal autonomy of local authorities is indeed low. PAC expenditure by the central government has decreased by 24% in real terms since 2000, while local expenditure has decreased even more, by 37% (Figure 5). These trends partly reflect the increasing role of the private sector in financing and managing environmental infrastructure and services, particularly in the waste sector (OECD, 2010a). Indeed, private PAC expenditure has increased by 22% since 2000.

Investment represented about 38% of public PAC expenditure in 2007, down from 55% in 2000. Despite this decline, environmental investment still represents 15% of Japan's overall gross capital formation, the highest share among OECD countries. This reflects an ongoing, large-scale investment plan to fill Japan's environmental infrastructure gap, especially in sewerage and wastewater treatment facilities (OECD, 2010a). As a result, wastewater management still accounts for over 70% of public PAC expenditure at local level (Figure 5). On the other hand, the weight of the waste sector has slightly decreased, showing that progress has been made in developing waste treatment infrastructure and outsourcing municipal waste management to the private sector (OECD, 2010a). At the central level, growing attention to climate change has resulted in an increasing share of public expenditure, comparable to the share allocated to prevention and remediation of water and soil pollution, which had traditionally been higher in Japan (Figure 5).

Figure 5. Pollution abatement and control expenditure



a) At constant 2005 prices.
b) 2009: previsional budget.
Source: Ministry of the Environment and OECD calculations.

25. This estimate is based on government expenditure classified as "Environment Protection" according to the Classification of the Functions of Government (COFOG).

Involving the financial sector

Japanese financial institutions have seized the opportunity offered by the growing interest in the environment to provide targeted financial products, such as low-interest loans for environmental investments or ISO 14001 certification of enterprises. Formerly public financial institutions have taken the lead. In 2004, the Development Bank of Japan (DBJ) launched a system of environmental rating of companies' activities, which assesses the companies' efforts to reduce their environmental impact, and adjusts the terms of financing accordingly. Between 2004 and 2008, 120 companies were financed under this scheme, involving some JPY 160 billion. In 2002, a Shoko Chukin Bank investment fund was established to finance environment-related investments in small and medium-size enterprises (SMEs). Several private financial institutions are also increasingly providing this kind of service, and have broadened their target customers from large corporations to SMEs (Ito, 2006). Some local governments have co-operated with local banks to increase the availability of funds for environmental investments; the Environmental Finance Project launched by the Tokyo Metropolitan Government is an example.

The Japanese stock market has promoted some eco-funds, which invest in environmentally responsible companies, and are often combined with socially responsible investment funds (so-called Eco-SRI funds). Around 25 such funds were available as of July 2006. While in 2006, Eco-SRI funds accounted for only 0.4% of all investment funds in Japan, their net asset value had grown by more than 50% in about one year, indicating increased interest among investors (Ito, 2006).

6. Promoting eco-innovation

6.1. Policy framework

The promotion of eco-innovation is a key feature of Japan's environmental policy and the main link between economic, industrial and environmental policies. Japan's definition of eco-innovation goes beyond the development and application of environmental technologies, to embrace the social aspects of technological progress and its impacts on quality of life. This concept of eco-innovation implies broad structural changes in the economy and society (OECD, 2009f).

The key features of Japan's approach to eco-innovation are close co-operation with the private sector and active involvement of consumers to promote lifestyle changes. The manufacturing sector has heavily invested in eco-innovation, which is seen as a factor of competitiveness. At the same time, the government has put in place a number of measures to stimulate demand for environmental technologies and products, such as tax incentives for cleaner vehicles (Section 4.1), the Eco-Point Programme (Section 4.3), and the green public procurement policy (Section 6.4). Japan has also supported exports of environmental technologies through international co-operation activities. Examples include 3Rs (reduce, reuse, recycle initiatives in Asia and official development assistance (ODA), which is often provided at more concessional terms when tied to Japanese technology (OECD, 2010f).

Several strategic policy documents include eco-innovation as an objective.[26] The New Growth Strategy identified "green innovation" as one of the growth drivers to 2020 (Section 3). Several ministries are involved in promoting eco-innovation, often in co-operation. In particular, the Ministry of the Environment (MOE), the Ministry of Economy, Trade and Industry (METI) and the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and their affiliated institutions. METI has a general responsibility in industrial and R&D policies, including overseeing the New Energy and Industrial

26. For instance, the 2007 Strategy for a Sustainable Society in the 21st Century and the Third Basic Environment Plan, as well as the Third Science and Technology Basic Plan.

Technology Development Organisation (NEDO), which co-ordinates and manages R&D activities, including environment-related R&D. The Council for Science and Technology Policy (CSTP), established in 2001, is an advisory body to the Cabinet Office that ensures co-ordination among different ministries.

6.2. Research and development in environmental technologies

Financing environment-related R&D

Japan is one of the OECD leaders in R&D, with R&D expenditure well above the average. In 2008, public and private R&D expenditure accounted for 3.4% of GDP, up from 3% in 2000. The business sector funds and carries out over 78% of R&D, the highest share among OECD countries. High- and medium-high-technology industries, such as transport equipment, electronics and chemicals, accounted for some 80% of Japan's exports of manufactured goods in 2007. Japan's number of patent applications is among the highest in the world.

Central government outlays for R&D for environmental purposes have slightly increased, although remaining about 1% of the overall government R&D budget, a relatively low share by OECD standards.[27] According to the annual Survey on Research and Development conducted by Japan's Statistics Bureau, 10% of large enterprises invested in environment-related R&D in 2007, and environment accounted for nearly 6% of their R&D budget.[28] Over 70% of these enterprises were in the manufacturing sector.

Government outlays for energy R&D accounted for 13.2% of the public R&D budget in 2009, the highest share among OECD countries. Nuclear power remains the dominant energy research area, accounting for 68% of total outlays in 2009. While total R&D expenditure on energy remained fairly stable during the decade, Japan's public R&D outlays on "green energy" or on energy issues that could bring potential environmental benefits (including renewables, hydrogen and fuel cells technologies, energy efficiency, and carbon capture and storage) have tended to grow. They were the second highest among OECD countries in absolute terms in 2009. However, these expenditures represent some 25% of the energy R&D government budget, the lowest share among OECD countries, reflecting large private sector expenditure in this field. The public R&D budget for energy efficiency decreased by over 30% between 2000 and 2009, and represents now some 11% of the total, owing to the growing role of the private sector in this research area. Nonetheless, energy efficiency continues to attract the largest share of public funds targeted to research in "green energy". Japan has also increasingly promoted research on clean coal technology and carbon capture and storage (Figure 6).

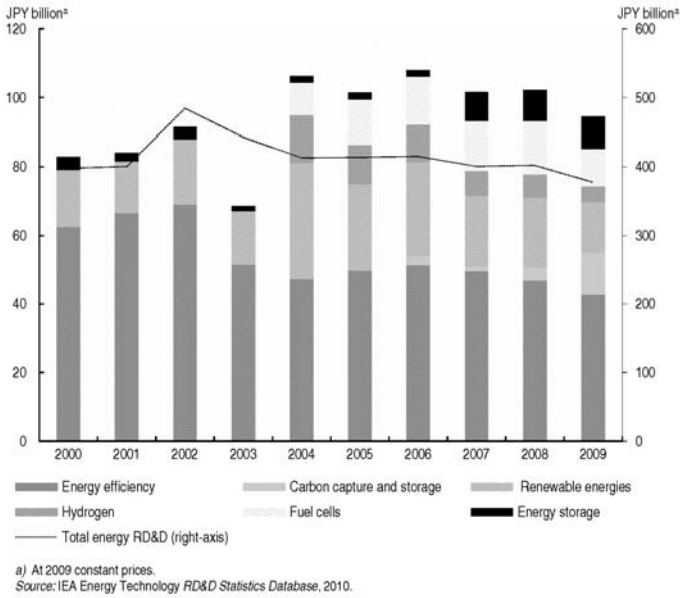
Japan's environmental R&D efforts have been moving from traditional pollution control technologies to climate-related and non-traditional "green technologies". In particular, Japan is a pioneer in "green information and communication technologies" (ICTs), acknowledging their potential contribution to higher efficiency in energy and resource use (OECD, 2009f).[29]

27. The allocation of expenditures to specific objectives is determined on the basis of managerial intentions at the time of commitment of the funds. Given the uncertainty associated with basic R&D, this may be difficult to establish with confidence.

28. Large enterprises are those with a capital above JPY 100 million.

29. In 2008, METI launched the Green IT Initiative, with a focus on infrastructures and technologies for teleworking, intelligent transport systems, and home and building energy management systems.

Figure 6. Public R&D budget on "green energy"



Japan has launched a number of initiatives to promote R&D in environmental technologies, such as the Global Environment Research Fund and the Global Environment Research Programme, managed by MOE. In the last few years, the funded research projects have focused on climate change mitigation, adaptation and carbon sinks. The 2008 Cool Earth Innovative Energy Technology Programme sets priorities for 21 energy- and climate-related technologies, for which development road maps are being established. Businesses investing in environmental R&D, as in other R&D fields, benefit from special tax treatment. Tax subsidies for R&D have increased since 2000 (OECD, 2009a). Nonetheless, direct government investment in basic R&D for environment- and climate-related technologies should increase to share the risk with the private sector of developing new technologies and to further accelerate innovation (OECD, 2009b).

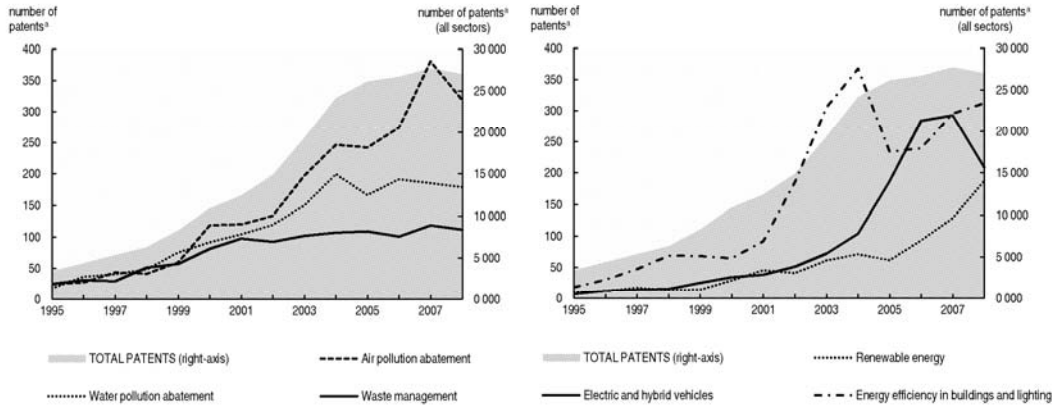
Patents in environmental technologies

Japan accounted for around 20% of world inventions in pollution abatement and waste management technologies over the 2000-08 period. Patent applications in these areas represented 2% of overall Japanese inventions, a relatively low share compared to other countries. Their number increased rapidly in line with overall patenting activity, especially for air pollution abatement technologies (Figure 7). Explanations include the tightening of environmental standards, such as on dioxins emissions from waste incineration in the late 1990s and on vehicle emissions standards in the second half of the 2000s.[30] Although not easy to track, negotiated agreements with industrial facilities may have provided some incentive to innovate (Section 6.3). Patents in air pollution control technologies represented half of environmental management innovations in 2000-08. Innovations related to solid waste management and water pollution control technologies steadily increased until 2001 and 2004, respectively, and have tended to stabilise since, in line with worldwide trends (OECD, 2009g).[31]

30. Patents in air pollution control may include innovations in the automotive industry linked to the tightening of vehicle emission standards.

31. Some technical difficulties in extracting aspects of energy recovery, material recycling and waste prevention may result in a downward bias in the data.

Figure 7. Environmental patents



a) Patents filed under the Patent Co-operation Treaty (PCT). Patent counts are based on the priority date and the inventor's country of residence.
Source: OECD (2011), *OECD Patent Statistical Database.*

The high level of investment in R&D has helped Japan become a leader in climate-related technologies (OECD, 2009b).[32] The number of patent applications for some of these technologies has been growing faster than for traditional environmental management technologies, or for technologies in other sectors (Figure 7). This development is in line with trends in other Kyoto Protocol Annex I countries (Haščič *et al.*, 2010), and can be partly explained by the increase in public expenditure for related R&D, especially for fuel cells, energy-efficient lighting, solar energy and bio-energy. Although this is difficult to assess, the Top Runner Programme targets (Section 6.3) on lighting, electric appliances and cars agreed in the late 1990s might have contributed to spur innovation in energy efficiency in buildings and lighting and in electric and hybrid vehicles. The Keidanren Voluntary Action Plan on the Environment, launched in 1997, might also have played a role (Box 2). The recent growth in the number of patents for renewable energy technologies seems to indicate that the Renewable Portfolio Standard, introduced in 2003 to promote renewable electricity, may have induced innovation in that sector (Section 4.2).

Environmental Technology Verification Programme

The Japan Environmental Technology Verification Programme (J-ETV) was launched in 2003 and, following a pilot phase, has been fully operational since 2008. It aims to make environmental technologies more attractive for investors and consumers, thereby facilitating their wider use. In order to benefit from the J-ETV, target technologies need to be at a relatively advanced stage of development and deal with environmental problems for which no regulation exists. Technology manufacturers and distributors can voluntarily apply for verification after paying a fee that partially covers the costs of the process. Verified technologies can then use the J-ETV label.

MOE co-ordinates the J-ETV Programme, approves the technology testing protocols, and maintains the database of verified technologies. The "verification organisations", which include local governments, public corporations and non-profit organisations, carry out the verification process and report to MOE. The criteria for selecting verification organisations have not been particularly strict, and the independence and technical skills of verification organisations need to be strengthened. Promoting the J-ETV label in export markets would make the verification programme more attractive for technology manufacturers.

32. Over the 2000-08 period, Japan accounted for 40% of world patents in electric cars and hybrid vehicles, 33% in efficient buildings and lighting, and 10% in renewable energy technologies.

During the pilot phase (2003-07), the J-ETV Programme's annual budget was between JPY 200 and 250 million; 157 technologies were verified in 10 technology fields, such as organic wastewater treatment at small facilities and volatile organic compound abatement for small factories. At the end of the pilot phase, some 65% of participating companies declared that they had obtained, at least partially, the benefits they expected from the programme for their business activities.

6.3. Performance targets

The Top Runner Programme

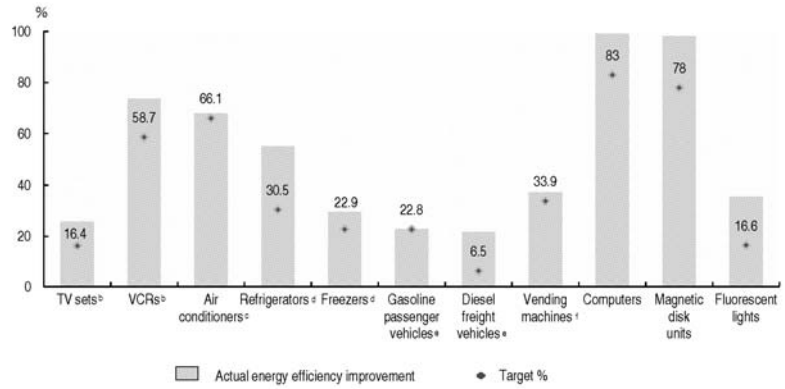
Japan has a long-standing tradition in implementing performance targets to improve the environmental performance of production processes and products. In 1998, Japan introduced the Top Runner Programme, which is a system of dynamic energy efficiency targets for a variety of products, ranging from vehicles to household electric appliances. The coverage of the programme was extended from 10 to 23 product categories. While many countries have introduced minimum efficiency performance standards, Japan has set efficiency targets for product categories to be achieved within a given number of years on the basis of the most efficient model on the market. [33] METI can disclose the names of companies that fail to meet the targets, as well as issue recommendations, orders and fines. To date, no enforcement actions have been taken, as targets have been systematically met or exceeded (Figure 8). Manufacturers highly support the programme, since they are directly involved in setting the targets and energy efficiency is considered to be a competitive advantage.

Manufacturers and importers must provide information to consumers about the energy performance of their products, either using or not using a label. Japan has recently introduced a uniform energy conservation label (for air-conditioners, TV sets and refrigerators) and a label for retailers who excel in promoting energy efficient products. While the Top Runner Programme is implemented by manufacturers, the resulting energy and CO_2 emission savings will mostly come from the sectors purchasing the products, such as the commercial, residential and government sectors.

The Top Runner Programme has been effective in promoting technological and energy efficiency improvements of several products. According to some estimates, the Top Runner Programme has reduced energy consumption by 5% in road transport and by 8% in the residential sector. However, the overall impact on energy savings and related costs remain unclear and there is scope to improve the programme. The financial and economic costs of the programme have not been analysed. While the programme does not call for public financial support, a number of measures are in place that contribute to achieving Top Runner objectives, including fiscal incentives for purchasing products that meet or exceed the programme's targets (Sections 4.1 and 4.3).

33. Compliance with the targets is assessed on the basis of the weighted average energy performance of a company's sales, and not on the individual products that are sold.

Figure 8. Targets and performance of the Top Runner Programme,[a] 1997-2005



a) The energy efficiency standard is defined in terms of kilometres per litre for vehicles and kWh/year for electronic appliances. The "energy efficiency improvement" shows the change in this indicator. For example, if energy efficiency increased from 10 kilometres per litre to 15, that would be a 50% improvement.
b) Until 2003.
c) Until 2004.
d) 1998-2004.
e) From 1995.
f) From 2000.
Source: Energy Conservation Centre (2008).

The Top Runner Programme focuses on realistic levels of energy efficiency, thereby encouraging incremental improvements rather than breakthrough innovations. The "top runners", *i.e.* firms with the most energy-efficient products at the start of a target cycle, do not need to invest further (OECD, 2009b). Moreover, since compliance is assessed by comparing performance in the base and target years, target setting does not take account of potential technological improvements that would occur in the absence of the programme, or of developments already available but commercially untapped (Nordqvist, 2006). Comparing performance in the target year with baseline projections would be more appropriate (IEA, 2008). Also, the constant overachievement of targets raises questions about their level of ambition (Figure 8). Other measures, including market-based instruments and other standard setting measures, might be more cost-effective in producing more rapid eco-innovation.

Negotiated targets

In many cases, performance targets are negotiated with the major branches of Japanese industry within the framework of voluntary action plans, such as the Keidanren Voluntary Action Plan on the Environment (Box 2). Such agreements include quantitative targets and timelines concerning, for instance, control of greenhouse gas emissions, the reduction, reuse and recycling of waste, and reduced use of hazardous chemicals in manufacturing. Businesses consider voluntary initiatives and corporate environmental management as ways to reduce further government regulation and strengthen their ability to compete on the global market. Often, as in the Top Runner Programme, these performance targets are accompanied by a "name-and-shame" mechanism: the names of under-performing companies are disclosed to the public. This mechanism puts the brand image of companies at risk, representing an incentive for eco-innovation in Japan that is probably more effective than the stringency of environmental regulations. According to an OECD survey conducted in 2003, fewer than 5% of facilities in Japan felt that environmental policies were very stringent, and more than 65%t found them to be not particularly stringent (Johnstone *et. al.*, 2007).

The voluntary approach has triggered participation and visible commitment of industrial organisations and companies to reduce their environmental impacts. However, it does not secure a cost-effective distribution of abatement efforts across industries and companies, and it does not motivate them to go beyond their voluntary commitments. While the government regularly reviews progress and raises the

targets of successful industries, the level of ambition of these targets and the potential for further improvements should be carefully considered. In particular, the target-setting process should be made more transparent. It should take into account the information advantage of the business sector (*e.g.* on emission abatement costs) and the incentive for businesses to slow down progress towards targets to avoid stricter targets in the future. It should also be determined whether progress made would have been made without the negotiated target and, hence, whether public money could have been spent on more effective and ambitious programmes. The cost-effectiveness of such voluntary agreements needs to be thoroughly assessed and compared with other possible policy instruments to make sure that the instruments used are those that allow to achieve environmental objectives (*e.g.* GHG emission reduction targets) at the lowest cost.

6.4. Promoting green products

Green public procurement

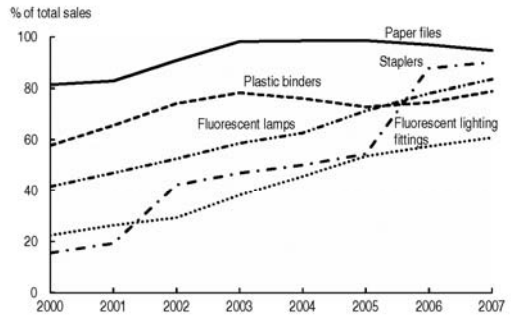
Japan had introduced a green public procurement policy before the adoption of the 2003 OECD Recommendation on "Improving the Environmental Performance of Public Procurement". All governmental institutions are required by law to develop green procurement policies, define annual targets for the purchase of selected eco-products, and annually report to MOE. The 2008 *Basic Policy for the Promotion of Procurement of Eco-Friendly Goods and Services* represents the framework for green procurement at the national government level. It defines evaluation criteria for 246 categories of products and services, up from 152 in 2002, including for materials and equipment used in public works construction. In 2007, Japan extended the green purchasing requirements also to the procurement of services.

However, green public procurement requirements do not apply to the local level. Nonetheless, many local authorities have voluntarily implemented similar measures and subscribed the Green Purchasing Network's guidelines. Further extending the green purchasing requirements to local governments would enhance the effectiveness of the policy, in particular since a large share of public expenditure is invested locally. In expanding its green purchasing policy, the government should make sure that it targets goods and services with the highest potential environmental returns. Also, tendering procedures should be transparent and competitive, and should not discriminate among potential suppliers.[34]

More than 90% of products and services procured by central government agencies meet the required environmental criteria. This outcome was achieved with minor increases in public expenditure. Since the introduction of the green public procurement policy, the market shares of eco-friendly products widely used in the public administration have substantially increased (Figure 9). According to MOE's estimates, the national government's green purchasing policy resulted in a reduction of CO_2 emissions by 89 500 tonnes in 2006, which is equivalent to the amount of CO_2 emitted by a town of 42 000 inhabitants. The financial implications of Japan's green public procurement policy and the overall costs to the Japanese economy of achieving such emission reductions should be assessed and compared with the costs of alternative policy measures.

34. OECD Council Recommendation on Improving the Environmental Performance of Public Procurement (C(2002)3).

Figure 9. Sales of selected eco-products, 2000-07



Source: Surveys of selected national associations (File and Binder; All Japan Stationary; Japan Luminaires; Japan Electric Lamp Manufactures).

Eco-labelling

The Japanese Environment Association (JEA), under MOE's aegis, manages the Japanese environmental product certification system, the Eco-Mark Programme. The label is assigned to products that have lower environmental impacts than similar products over their whole life cycle, from material extraction to disposal. Manufacturers who are awarded the Eco-Mark pay an annual fee that is proportional to product sales.

As of 2007, 4 617 products were awarded the Eco-Mark in 47 product categories. JEA aims to achieve 6 000 certified products in 51 categories by 2012. The market share of Eco-Mark products has increased. According to some estimates, the use of certified products has led to some decreases in CO_2 emissions, resource consumption and waste disposal. Obtaining the Eco-Mark has become the norm for major manufacturers, which suggests that the awarding criteria need to be constantly revised to ensure that the environmental impact of a labelled product is substantially lower than average.

Many other certification programmes exist. For instance, an energy efficiency label is associated with products that achieve Top Runner targets, and a uniform energy conservation label applies to some home appliances. Many companies have also launched their own eco-labels. However, criteria for awarding the labels may differ greatly. Japan should consider streamlining the overall eco-labelling system to improve reliability, send clear messages to consumers and reduce possibilities of falsification.[35]

7. Japan's environmental goods and services sector

The global and Japanese markets for environmental goods and services have expanded in the last decade and are expected to grow faster in the future. According to some estimates, the value of the global market for environmental goods and services, including renewable energy technologies and low carbon activities,[36] was about USD 1.6 trillion in 2007-08. Japan accounted for 6.3% of this global market, the third largest share after the US and China (Innovas Solutions, 2009).

In the second half of 2008, overall Japanese exports suffered from declining global demand, but exports of environmental products grew by over 35% compared to the same period in 2007 (Nitta, 2009). According to a survey conducted by the Japanese External Trade Organization in 2009, some 18% of Japanese manufacturing businesses were producing and exporting environmental products, especially waste treatment devices, eco-paints and adhesives, photovoltaic cells and other renewable energy

35. In 2008, a number of Eco-Mark falsification cases occurred, including falsification of the percentage of waste paper pulp in recycled paper, inappropriate use of printing inks, and falsification of recycled plastic products. In response, the Eco-Mark Office strengthened its inspection activities.

36. Alternative fuels, carbon finance and building technologies.

technologies, electric, hybrid and fuel cell vehicles, and wastewater treatment equipment (JETRO, 2009). The latter drove export growth in 2008. East Asia, particularly China, is the main export market for Japanese environmental products and technologies, followed by Europe.

In 2003, MOE estimated the market size and employment of environmental businesses.[37] According to this study, the eco-business turnover was JPY 30 trillion (USD 280 billion) in 2000 and will nearly double by 2020 (Table 7). The New Growth Strategy aims at enlarging the environment and energy-related markets by an additional JPY 50 trillion (USD 530 billion) (Section 3). Resource management, broadly defined and including housing renovation and repair, was estimated to account for two-thirds of the market in 2000; environmental protection, mainly wastewater treatment facilities and provision of waste services, accounted for the remaining third.

Table 7. Market sizes and employment potential of the environmental goods and services sector[a]

	Market size (JPY billion)			Employed		
	2000[b]	2010[c]	2020[c]	2000	2010[c]	2020[c]
Pollution management, of which:	9594	17943	23706	296570	460479	522201
air pollution control	642	3166	5169	8971	39306	53579
wastewater management	4818	5821	5831	59099	62353	54224
waste management	3614	7736	11126	211859	330006	378035
Cleaner technologies and products	174	453	609	3108	10821	13340
Resources management, of which:	20177	28830	34061	468917	648043	700898
recycled materials	7878	8744	9404	201691	211939	219061
renewable energy	163	929	929	5799	30449	28581
energy conservation and energy management	727	4883	7868	13061	160806	231701
other[d]	10794	13720	15275	218436	219059	195655
Total	29944	47227	58376	768595	1119343	1236439

a) Private sector only.
b) The figures for the market size in the year 2000 use varying fiscal year definitions.
c) Forecast.
d) Includes: repair of machinery, furniture, etc.; housing renovation and repair, and urban greening.
Source: MOE (2003).

In the MOE study, related employment was estimated at 769 000 in 2000, equivalent to 1.2% of total employment, and was expected to grow by 46% in 2010 and reach 1.2 million employed by 2020. The largest growth in employment and market value was expected in the energy sector and in the manufacturing sector for air pollution control equipment (Table 7). More recent estimates indicate that employment in private environment-related businesses had already reached 1.4 million in 2006, compared to about 76 500 employed in the public environmental administration (MOE, 2009). Initiatives such as the "Eco-Town Programme" to improve resource and waste management have positively contributed to local development and employment, supporting industrial restructuring in favour of environment-related sectors. In 2008, the government launched similar initiatives – the "Eco-Model City Projects" and the "Biomass Towns" – to stimulate a local development based on climate-related activities and biomass energy (OECD, 2010a).

37. Firms producing goods and services that measure, prevent, limit, minimise or correct environmental damage to water, air and soil, as well as problems related to waste, noise and ecosystems. This includes cleaner technologies, products and services that reduce environmental risk and minimise pollution and resource use. The estimate covers the domestic market only.

The New Growth Strategy expects to double employment in environment-related businesses by 2020 (Section 3). Overall, the transition to a green economy will require industrial restructuring and, therefore, a reallocation of labour resources across sectors. Net employment effects should be carefully assessed; labour market and education policies should take into account the new skills and competences that will be needed to adjust to greener technologies, production processes and working methods.

Conclusions

In a changing economic, social and international context, Japan has made important progress towards greening its economy. It has managed to reduce some of the pressures on the environment, notably energy and material use, air emissions, water abstractions and municipal waste generation. However, complex, long-term challenges remain: primarily, climate change and biodiversity sustainable use. Japan's New Growth Strategy gives much emphasis to the linkages between environmental protection, economic growth and social change. It identifies eco-innovation as one of the pillars of future growth and job creation. In this respect, it appears to include the main element of a "green growth" model, including environment-related investments, R&D, tax and market-based instruments, and targeted education policies.

To some extent the fiscal stimulus package that was implemented to tackle the 2008-09 economic crisis anticipated the new growth strategy, by including several environment-related measures. While these "green" measures represented a share of the fiscal stimulus comparable to that of previous anti-crisis packages, its composition differed greatly: it focused on direct investments and fiscal incentives to promote energy efficiency, renewable energy sources and related R&D. In general, this kind of investment is likely to have a more immediate impact on economic activity than traditional environmental infrastructure projects. However, some measures included in the stimulus package, such as support to agricultural production, road construction and discount on highway tolls, can have negative environmental impacts and should be carefully assessed for consistency with environmental objectives.

The government has supported the supply of environmental technologies by increasingly financing environment-related R&D – although most R&D is financed and performed by the business sector – and by deploying a range of measures that stimulate demand for green products. Overall, Japan's approach to environmental policy and eco-innovation has been characterised by a strong emphasis on performance standards and negotiated agreements with industry. These approaches have helped Japan to become a leader in a range of environment- and climate-related technologies and to improve environmental performance of manufacturing processes and products. However, they promote incremental rather than fundamental technological changes, and it is often difficult to determine the progress that would have been achieved without them. The constant overachievement of negotiated targets raises questions about their level of ambition.

More cost-effective policy instruments, particularly market-based instruments that apply to the economy as a whole and not just to particular sectors, would provide better incentives for achieving environmental objectives and for promoting eco-innovation. In particular, putting a price on carbon, *e.g.* through a cap-and-trade system in combination with a carbon tax, would be an essential step. There has been a slightly greater use of market-based policy instruments in the last decade, notably by partly linking vehicle taxation to fuel efficiency and by implementing a trial CO_2 emissions trading system. However, there is a continued strong tendency to encourage industry and consumers to purchase environmentally friendly products by providing various forms of subsidies rather than by including environmental costs in the price of goods and services. In view of their impact on the already strained public finances, such measures should be reconsidered in terms of their environmental effectiveness and economic efficiency. Reforming the tax system, expanding environmentally related taxes and removing subsidies that have perverse environmental effects or that contravene the polluter-pays-principle, could help fiscal consolidation without hampering economic recovery. The tax reform foreseen in 2011 would provide a good opportunity to establish a tax system that is more supportive of economic growth and environmental protection.

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