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PART II

Chapter 5

Climate Change

The current trends in greenhouse gas emissions represent a major challenge for Japan. A wide range of voluntary, regulatory and economic measures has been put in place to reduce these emissions. Technological progress and negotiated agreements are distinctive features of this policy mix. Local authorities and the private sector play an important, often innovative, role in designing and implementing climate policy. Energy, transport and climate policies are generally mutually supportive, with a focus on energy efficiency, renewable energy sources, infrastructure development and R&D. Japan is a world leader in climate-related R&D. Co-operation with developing countries and adaptation to climate change are receiving growing attention.

Assessment and recommendations*

Japan has shown *strong commitment to the global effort against climate change*. Within the framework of the 2009 Copenhagen Accord, Japan submitted its target of reducing greenhouse gas (GHG) emissions by 25% by 2020 compared to the 1990 level. 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". *Co-operation with developing countries* is given strong emphasis; in 2009 Japan launched the Hatoyama Initiative, which builds on the 2008 Cool Earth Partnership Financial Mechanism, to provide funding for climate change mitigation and adaptation in developing countries. When the Kyoto Protocol entered into force, Japan launched the *Kyoto Protocol Target Achievement Plan*, which consists of a wide range of regulatory, voluntary and economic measures. The government is implementing the Plan in close co-operation with the business sector. Local authorities are also very active and have sometimes taken the lead in introducing innovative policy measures. Japan has established a research programme to guide its climate adaptation policy.

Under the Kyoto Protocol, Japan committed to a 6% reduction in its GHG emissions on average over the 2008-12 period compared with the 1990 level. However, *national net emissions increased*, and in 2007 they were 9% above the base-year level. This was largely driven by rising emissions from electricity generation, due to the increased share of fossil fuels, especially coal, in the energy mix. Consumption of coal has increased in part to compensate for an unexpected fall in nuclear power. Consequently, progress in reducing *CO_2 intensities* has been slow compared to other OECD countries. The economic recession had a downward effect on energy demand and GHG emissions in 2008, which were 6.4% below the 2007 emissions. However, this effect is likely to be temporary and achieving the ambitious 2020 targets will require the use of significantly more cost-effective policy instruments.

Unlike many OECD countries, Japan made remarkable *progress in the transport sector;* CO_2 emissions have decreased by nearly 12% since 2000. Technological advancement and favourable tax treatment have helped to considerably improve the average fuel efficiency of the road vehicle fleet. Efficiency of freight transport has also improved. Distance travelled by car has decreased since 2003 with the rise in oil prices; passengers have increasingly used the well developed public transport system. However, passenger transport in minor cities and rural areas largely relies on private vehicles. Tackling traffic congestion remains a challenge, especially in major metropolitan areas and on motorways.

Japan has effectively *integrated energy and climate policies*, with a strong focus on energy efficiency, R&D and, more recently, renewable energy sources. Japan is a world leader in *climate-related R&D*, which benefits from growing public spending. The Renewable Portfolio Standard has created a market for renewable electricity and has contributed to developing wind, solar

* Assessment and recommendations reviewed and approved by the OECD Working Party on Environmental Performance at its meeting on 4 May 2010.

and biomass capacities. Japan has one of the largest solar photovoltaic installed capacities in the world, although the contribution of solar power to energy supply is negligible. Overall, the share of renewables in energy supply has remained fairly stable at a much lower level than in many other OECD countries. The current *policy approach to renewables* is based on technology-specific support and short-term targets, which limit investor flexibility, thus potentially increasing overall costs. A fragmented electricity grid is also an obstacle to a more extensive use of some renewable energy sources, such as wind and solar photovoltaic. Further diversifying the energy mix, including by developing renewable energy sources, would contribute to improving Japan's energy security and reducing its GHG emissions.

Energy intensity has been steadily declining, although not as much as in other countries. Energy efficiency of manufacturing has further improved; Japan's major industrial sectors are among the most energy efficient in OECD. However, *electricity consumption in the residential and commercial sectors has been steadily growing,* largely due to the increased use of electric appliances, which has more than offset their efficiency improvements promoted by initiatives such as the *Top Runner Programme*. Energy performance standards apply to a wide range of buildings and factories, although they remain mostly voluntary. Overall, Japan's energy conservation policy is largely based on promoting technological progress and pays insufficient attention to demand-side management. There is further scope to reduce domestic and commercial energy consumption and GHG emissions.

Tax rates on energy products, including transport fuels, are among the lowest in OECD and do not convey a strong price signal. *Putting a consistent price on carbon, e.g.* through emissions trading in combination with a carbon tax, would drive investment in renewables and energy conservation more cost-effectively than current policies. The government has postponed the introduction of a carbon tax for several years. The trial *emissions trading system (ETS*) is a novel initiative, but it remains voluntary and marginal. Participants benefit from governmental subsidies. In March 2010 the Cabinet approved and submitted to the Diet the bill of the Basic Act on Global Warming Countermeasures, which foresees the introduction of emissions trading and taxation measures. Japan has made extensive use of the *Kyoto market mechanisms* to reduce the costs of achieving its target.

Negotiated agreements, such as the Voluntary Action Plan in the manufacturing sector, dominate Japan's policy mix to achieve its climate objectives. Negotiated and voluntary targets should be made more transparent and take into account what would be achieved by business-as-usual technological progress. Japan should consider complementing the voluntary approach with mandatory measures, including standards (*e.g.* for buildings) and market-based instruments. The systems in place to evaluate the effectiveness of policy measures seldom include quantitative analyses of their economic efficiency compared to possible alternative options.

Recommendations

- Examine the *cost-effectiveness of the climate policy mix*, particularly of negotiated agreements, looking across a range of alternative measures.
- Put a *consistent price on carbon* through emissions trading in combination with climate-related taxes; transform the trial *emissions trading system* (ETS) into a mandatory cap-and-trade scheme that is compatible as far as possible with trading schemes in other countries; gradually introduce auctioning of permits.
- Establish a consistent and long-term framework to develop *renewable energy sources* and reduce reliance on fossil fuels, avoiding technology-specific targets.
- Further expand integrated *public transport* systems in smaller cities and rural areas, and improve *traffic demand management* to tackle congestion in large metropolitan areas and on motorways.
- Develop a comprehensive *climate change adaptation strategy*; mainstream adaptation into land-use and sectoral plans; as part of broader international efforts, provide additional finance to further integrate climate change mitigation and adaptation into development co-operation.

1. Greenhouse gas emissions profile

By ratifying the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) in 2002, *Japan committed to a 6% reduction in its greenhouse gas (GHG) emissions* on average over the 2008-12 period compared with the 1990 levels.[1] However, in 2007 Japan's total GHG emissions reached nearly 1 370 million tonnes of CO_2 equivalent ($MtCO_2eq$), 1.8% above the 2000 levels and about 9% above the 1990 baseline (Table 5.1). Japan is the world's third largest economy in terms of GDP and the seventh largest emitter of GHGs,

Table 5.1. **GHG emissions by sector and by gas,[a] 1990, 2000, 2007 and 2008**

Sector/greenhouse gas	Base year[b]	2000	2007	2008	Share in 2008 emissions	Change base year-2007	Change 2000-07	Change 2007-08
	($MtCO_2eq$)				(%)			
Total	**1 261**	**1 344**	**1 369**	**1 282**	***100.0***	***8.6***	***1.8***	***–6.4***
Carbon dioxide CO_2, *of which:*	1 143	1 254	1 301	1 214	*94.7*	*13.7*	*3.7*	*–6.6*
Energy originated, *of which:*	1 068	1 180	1 233	1 152	*89.9*	*15.4*	*4.5*	*–6.6*
Energy conversion	324	358	447	420	*32.7*	*37.8*	*25.0*	*–6.1*
Industrial sector	371	377	370	336	*26.2*	*–0.3*	*–1.7*	*–9.1*
Transport	211	259	238	228	*17.8*	*12.7*	*–8.2*	*–4.1*
Service	84	101	*103*	98	7.6	*22.9*	*1.3*	*–4.6*
Residential	57	69	63	59	*4.6*	*10.5*	*–9.2*	*–5.7*
Agriculture, forestry, fisheries	21	16	13	11	*0.9*	*–40.5*	*–21.5*	*–13.3*
Non-energy originated[c]	75	74	68	62	*4.9*	*–10.0*	*–8.9*	*–7.7*
Methane (CH_4)	32	26	22	21	*1.7*	*–31.8*	*–15.7*	*–2.1*
Nitrous oxide (N_2O)	31	29	23	22	*1.8*	*–28.3*	*–21.3*	*–0.5*
Three fluorinated gases (PFC, HFC, SF_6)	51	36	24	24	*1.8*	*–53.2*	*–32.1*	*–1.9*

a) Total CO_2 equivalent emissions excluding CO_2 from land use, land use change and forestry (LULUCF).
b) CO_2, CH_4, N_20: 1990; f-gases: 1995.
c) Includes industrial processes and waste.
Source: Japan's inventory submission to the UNFCCC, 2010.

StatLink http://dx.doi.org/10.1787/888932319022

accounting for about 3% of the GHC global total emissions in 2005. The Japanese economy was hit hard by the global economic crisis, and this had a downward effect on energy demand in 2008 (Section 3). As a result, GHG emissions dropped by 6.4% in 2008, the first year of the Kyoto commitment period (Table 5.1). This effect will only be temporary, as economic growth is expected to pick up in 2010 and 2011, and it will not be large enough to fill the gap between the commitment and current emissions.

CO_2 emission intensities

Carbon dioxide (CO_2) emissions account for the vast majority of Japan's GHG emissions and are almost all energy related (Table 5.1). Japan's *carbon intensity* and *CO_2 emissions per capita* are below the OECD average (Figure 5.1), reflecting the relatively low energy intensity of the Japanese economy. On the other hand, *CO_2 emissions per unit of total primary energy supply* (TPES) are slightly above the OECD average. The carbon intensity of the economy has decreased at a lower rate than on average in OECD countries and, contrary to many other countries, CO_2 emissions per capita and per unit of TPES have increased since 2000 (Figure 5.1). Factors explaining these trends include the increase of fossil fuels, especially coal, in energy supply, and the relatively high energy efficiency in some manufacturing sectors (*e.g.* iron and steel, chemicals and cement), which makes further progress more costly and difficult (Section 3).

CO_2 emission trends by sector

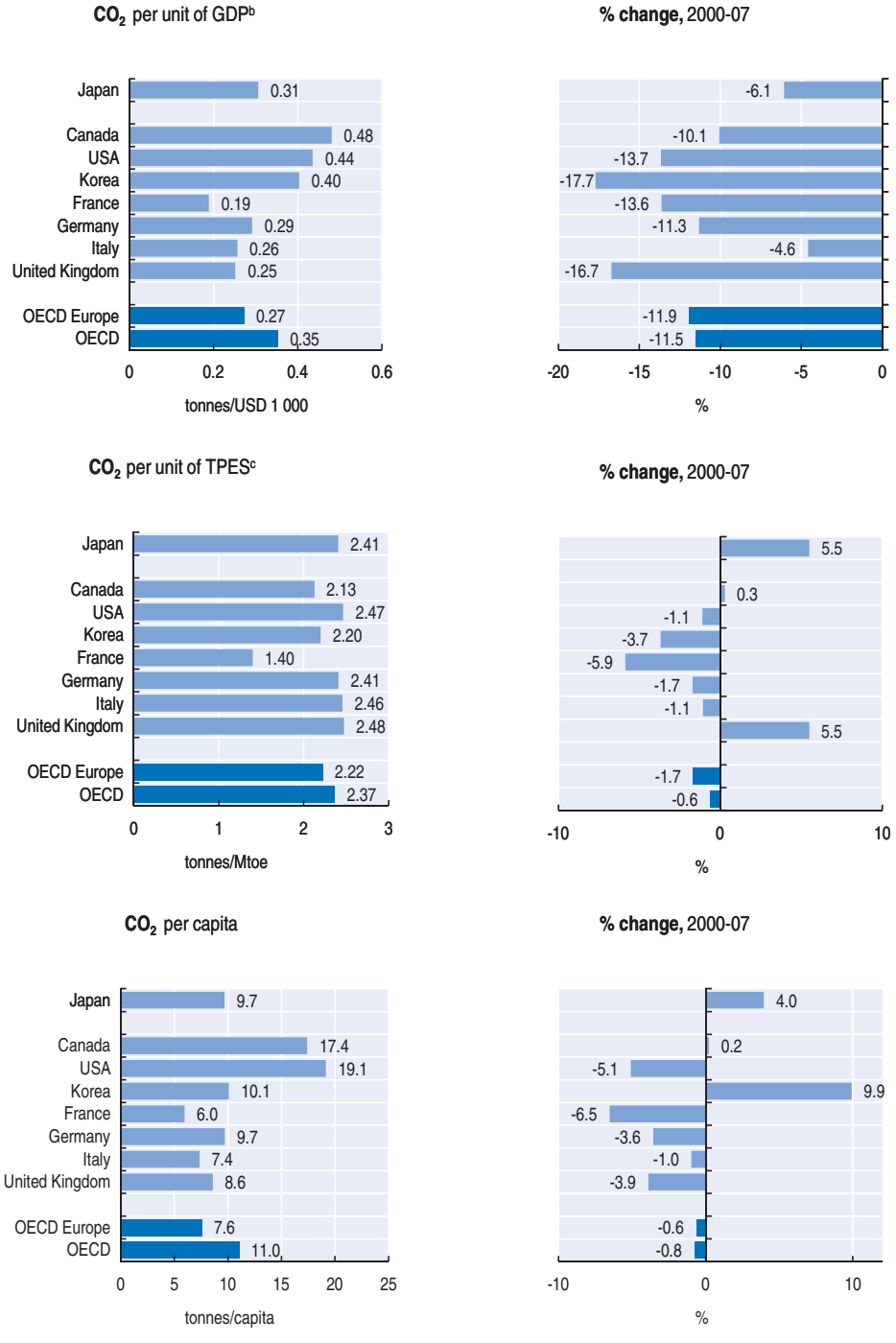
Energy-related CO_2 emissions grew relatively faster in Japan than on average in OECD countries despite relatively weak economic growth and a stable population. Energy conversion, industry and transport accounted for nearly 77% of GHG emissions and 81% of CO_2 emissions in Japan in 2008. *Emissions from the energy industry* increased more rapidly between 2000 and 2007 than in the previous decade and have driven overall emission growth (Table 5.1). Because of the increased share of fossils in the fuel mix for electricity generation to compensate for an unexpected fall in nuclear power, carbon intensity of electric generation rose by nearly 20% since 2000. The economic recession resulted in a drastic decrease in both energy demand and GHG emissions from energy conversion in 2008 (Table 5.1).

Industry accounts for about 28% of CO_2 emissions (Table 5.1). The steel industry represents 42% of emissions from industrial combustion, followed by chemicals (15%). Owing to further improvements in the energy efficiency of manufacturing processes, emissions slightly decreased between 2000 and 2007, before dropping by 9% in 2008 with the fall of industrial production. Non-energy emissions from industrial processes have also decreased.

After having increased during the 1990s, *CO_2 emissions from transport* have decreased since 2000 (Table 5.1). However, the recent drop has not yet offset the rise of the 1990s, and transport has been among the major drivers of the overall growth of GHG emissions above the Kyoto base-year level. As in many OECD countries, road transport is responsible for most transport-related emissions (90% in 2008). However, contrary to most OECD countries, emissions from road transport dropped during the review period (by nearly 12%). Emissions from both freight and passenger road transport have decreased, after having peaked in the early 2000s, paralleling the trends in energy consumption (Section 4).

Emissions from combustion of fossil fuels in the residential, commercial and public sectors have dropped since 2000, but remain above the 1990 levels (Table 5.1). The decline in the second half of the 2000s is mainly due to a change in the fuel mix used in these sectors (*e.g.* for

Figure 5.1. **CO_2 emission intensities,[a] 2007**

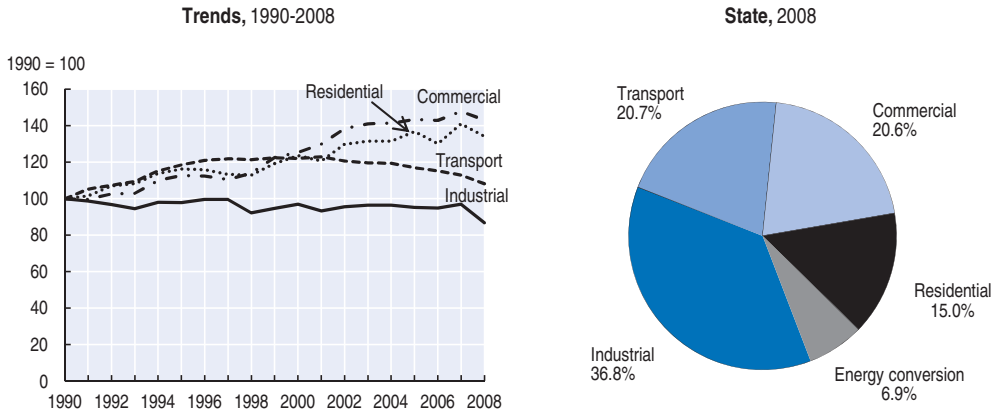


a) Includes CO_2 emissions from energy use only; excludes international marine and aviation bunkers; sectoral approach.
b) At 2005 prices and purchasing power parities.
c) Total primary energy supply.

Source: OECD-IEA (2009), *CO_2 Emissions from Fuel Combustion*; OECD (2009), *OECD Economic Outlook*, No. 86; OECD-IEA (2009), *Energy Balances of OECD Countries*.

water and space heating, cooking), with decreased use of coal and oil, and a larger use of natural gas and electricity.[2] In order to take into account the growing share of electricity in total energy supply of services and households, CO_2 emissions associated with electricity generation could be allocated pro rata to these sectors when analysing emission trends (Figure 5.2). According to this estimate, between 2000 and 2007, emission from the commercial and residential sectors increased by about 16% and largely contributed to overall emission growth, before dropping in 2008 due to the economic recession (Section 3).

Figure 5.2. **CO_2 emissions from energy use by end-use sector,[a] 1990-2008**



a) Emissions from electricity production and combustion of fossil fuels are allocated to end-users.

Source: Institute for Environmental Studies and GHG Inventory Office of Japan.

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Emissions of non-CO_2 greenhouse gases

Emissions of non-CO_2 greenhouse gases accounted for 5% of total emissions in 2008. These emissions have decreased significantly in the last two decades (Table 5.1). Emissions of *methane* (CH_4) are mainly generated by waste management and agriculture; these emissions have declined because waste disposal has decreased and incineration facilities and farming practices have improved. The decline in *nitrous oxide* (N_2O) emissions is linked mainly to the use of abatement equipment in adipic acid production.

The total emissions of the three *fluorinated gases* (HFCs, PFCs and SF_6), comprising less than 2% of total GHG emissions, have decreased by over 30% since 2000 as a result of reduced emissions from solvent use and electric appliances. The implementation of the legislation on the recovery of fluorocarbons from electric appliances has contributed to this progress (Chapters 4 and 6). However, emissions of HFCs have been increasing again since 2004-05 and are expected to further rise in the future, due to the growing use of refrigerating and air conditioning equipment.

Emission removals

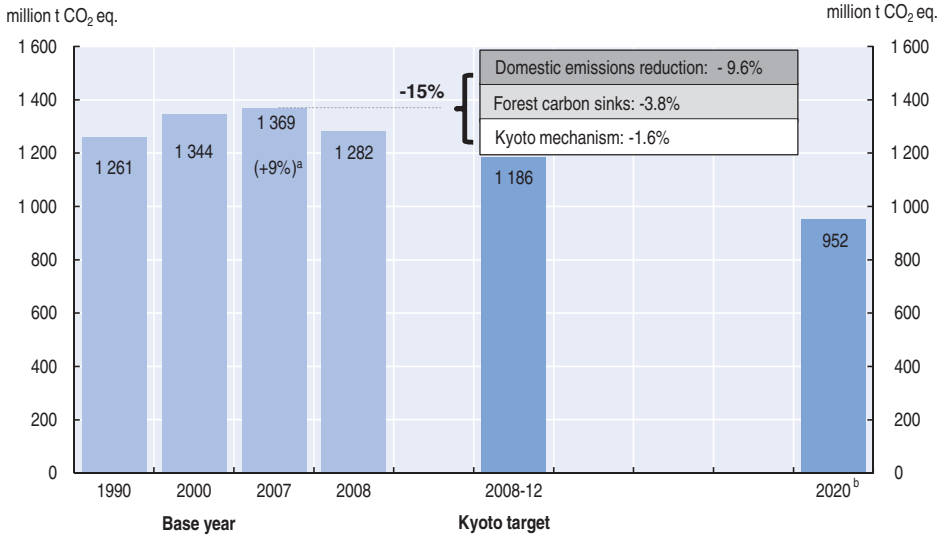
Japan has projected that emission removals from *land-use change and forestry* would contribute 3.8% to the overall GHG emission reductions needed to meet the Kyoto target. This means absorbing 47.7 $MtCO_2$ per year during the 2008-12 period. Emission removals have increased and, in 2007, they accounted for 3.2% of base year emissions, indicating that Japan needs to slightly increase absorption capacity to meet its target.

2. Policy and institutional framework

The *1998 Law Concerning the Promotion of Measures to Cope with Global Warming* remains the legislative basis of Japan's climate policy. The Global Warming Prevention Headquarters, established in 1997 and chaired by the prime minister, continues to co-ordinate climate change policy at national level and regularly reviews progress. The Ministry of the Environment (MOE) retains major implementation responsibilities at the central level. Many other ministries are involved, including the Ministry of Economy, Trade and Industry (METI), the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) and the Ministry of Agriculture, Forestry and Fisheries (MAFF) (OECD, 2002). Local authorities have become more involved in designing and implementing climate policy. As required by the legislation, most prefectures and large cities have developed their emission reduction plans. In 2008, the requirement for local plans was extended to middle-sized cities.

When the Kyoto Protocol took effect in February 2005, the Global Warming Prevention Headquarters launched the *Kyoto Protocol Target Achievement Plan*. The Plan was last revised in 2008 to take account of the increase in GHG emissions and of the need to cut emissions by 15% from the 2007 levels in order to meet the Kyoto target. This cut is to be achieved mainly through reductions in domestic emissions (9.6%), carbon sinks (forests) and the Kyoto mechanisms, which are expected to make additional reductions possible (Figure 5.3).[3] The Plan consists of a mix of regulation, governmental spending, voluntary measures, and economic incentives addressing key economic sectors. The greatest emission reductions are expected from the implementation of energy efficiency standards (*e.g.* Top Runner Programme) for electric appliances and vehicles, the Voluntary Action Plan in the industrial sector, the development of renewable energy sources, and the improvement of building energy performance (Table 5.2). The government implements these policy measures in close co-operation with the private and business sectors.

Figure 5.3. **Overview of the Kyoto and mid-term emission targets in Japan**



a) Percentage change relative to the base year.
b) -25% relative to the base year, "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".

Source: Japan's Inventory submission to the UNFCCC, 2010; Ministry of the Environment.

Table 5.2. **Key measures in the Kyoto Target Achievement Plan**

Measures	Reduction in 2007 ($MtCO_2$)	Expected average reduction in 2008-12 ($MtCO_2$)	Government budget in 2007 (JPY million)	Implementing measures
Industry				
Voluntary Action Plan	. .	65 300	13	
Energy management in factories and workplaces	4 500	8 200-9 800	26 500[a]	● Law Concerning the Rational Use of Energy.
Commercial sector				
Improvement in the energy efficiency of buildings	13 300[b]	28 700	1 000 (incl. R&D)	● Law Concerning the Rational Use of Energy. ● Tax reduction. ● CASBEE.
Energy management systems	3 700	5 200-7 300	2 270	
Improvement in the efficiency of appliances under Top Runner standards	14 350	26 000		● Law Concerning the Rational Use of Energy.
Dissemination of highly energy efficient equipment	1 440	6 400-7 200	12 500 + 5 800[a]	
Residential sector				
Improvement in the energy efficiency of buildings	6 600	9 300	187 000[a] + 40 (incl. R&D)	● Law Concerning the Rational Use of Energy. ● CASBEE.[b]
Transport				
Improvements in the fuel efficiency of automobiles and appliances under Top Runner standards	15 280	24 700-25 500	6 000 (+ R&D)	● Law Concerning the Rational Use of Energy. ● Tax exemption on vehicle taxes. ● Advantageous interest rate.
Improvement in freight transport efficiency	13 090	13 890	26 930[a]	● Law Concerning the Rational Use of Energy.
Energy conversion sector				
Reduction of CO_2 emissions intensity in the electric power sector through promotion of nuclear energy	. .	14 000-15 000	303 449 (+ R&D)	● Tax reduction. ● Advantageous interest rate.
Promotion of measures for renewable energy (greater use of biomass heat, photovoltaic generation, etc.)	33 150	38 000-47 300	87 125 (incl. R&D)[a]	● Act on special measures concerning new energy use by electric utilities. ● Tax reduction.
Promotion of introduction of cogeneration and fuel cells	12 460	14 000-14 300	58 500[a]	● RPS[c] Act.
Non-energy related CO_2				
Reduction of CO_2 from waste incineration	10 750[d]	5 800	34 821[a]	● Basic Act for Establishing a Sound Material Cycle Society.
Installation of N_2O decomposers in the production process of adipic acid	. .	9 850	None	● Voluntary action by private companies.
F-gases				
Promotion of substitute materials and products	45 600	64 000	2 160 (+ R&D)	● Guidelines. ● Tax reduction.
Sinks				
Promotion of forest and forestry measures	39 970	47 670	76 500	

a) Includes other measures.
b) Comprehensive Assessment System for Built Environment Efficiency.
c) Renewables Portfolio Standard.
d) 2006.
Source: Review of the Kyoto Target Achievement Plan, 2008.

The *2007 central government budget for the Plan* was about JPY 1 trillion (USD 8.5 billion), representing around 2% of overall public expenditure at the central level.[4] However, the methods used for selecting policy measures, allocating the budget to them, and determining the expected emissions reductions take little or no account of cost-effectiveness and do not consider possible alternative options. In many cases, quantitative data of economical and social costs are not available.

In July 2008, Japan launched the *Action Plan for Achieving a Low-carbon Society*, setting the goal of a 60% to 80% reduction in GHG emissions by 2050. This action plan puts great emphasis on the development and dissemination of climate-friendly technologies, use of economic instruments, and regional and citizen's initiatives (Box 5.1). It also sets a number

Box 5.1. **Action Plan for Achieving a Low Carbon Society**

1. Development and dissemination of new and existing advanced technologies:
   - *Carbon capture and storage (CCS) technology:* verification tests on a large scale from 2009 onward, aiming at implementation by 2020.
   - *Clean combustion technology for coal:* increase the generation efficiency of integrated gasification combined cycle (IGCC) power generation to 48% by 2015.
   - *Innovative solar power generation:* increase the efficiency of solar electric power generation to over 40% by 2030; reduce power generation cost to JPY 7/kWh.
   - *Fuel cells*: reduce costs to JPY 400 000/kW, improve durability to 90 000 hours, and ensure the wide use of fuel cells by 2020-30.
   - *Super efficient heat pump* (air conditioning and hot water supply in residential buildings): reduce costs by 25% and increase efficiency by 50% by 2030; halve costs and double efficiency by 2050.
   - *Zero-emissions energy sources* (renewables and nuclear power): increase their share in electricity supply to over 50% by around 2020.
   - *Solar power generation:* achieve world leadership; set targets for increasing generation 10-fold by 2020, and 40-fold by 2030.
   - *Next generation vehicles:* increase the share of next generation vehicles (hybrid, electric, plug-in hybrid, fuel cell, clean diesel vehicles, CNG vehicles, etc.) from about 2% of new car sales to 50% by 2020.
   - *Energy efficient lighting:* replace incandescent light bulbs with bulb-shaped fluorescent lamps by 2012.
   - *Energy-efficient housing and buildings:* implement energy efficiency measures in all new houses and buildings; promote "200-year Housing", *i.e.* building a stock of high-quality housing that can be used for many years.
   - *Promotion of nuclear power:* improve utilisation capacity to the level of major nuclear-using countries, establish a nuclear fuel cycle, while securing safety as top priority.
   - *Implement initiatives in the government sector:* cut GHG emissions by 8% compared to the 2001 level by 2010-12.
2. Framework for moving the whole country towards reduced carbon intensity:
   - *Emission trading:* experimental implementation of an integrated domestic market from fall 2008.
   - *Make the tax system greener:* extend environmentally related taxes as part of a comprehensive review of the tax system.
   - *"Visualisation" of emissions:* disclose information about GHG emissions linked to the production and consumption of many goods and services.
   - *Guide flow of capital to environmental businesses:* promote community funds, etc. and guide financial institutions in implementing the Principles of Responsible Investment (PRI).
3. Support for regional and citizens' initiatives:
   - *Cut GHG emissions in agriculture, forestry and fisheries:* establish 300 "Biomass Towns" by 2010.
   - *Create low-carbon cities and regions:* select about ten cities as environmental models by 2008.
   - *Environmental education:* increase the number of Education for Sustainable Development (ESD) Centres (UNESCO Associated Schools) to 500.
   - *National energy-saving campaigns:* promotion of Team Minus 6%, Eco Action Point, Green IT; consider daylight-saving time.

of technology- and sector-specific targets. 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". In March 2010, the Cabinet approved and submitted to the Diet the bill of the Basic Act on Global Warming Countermeasures, which confirms the 2020 target and sets the 2050 target of 80% less emissions compared to 1990 levels. The bill also foresees the introduction of emissions trading and taxation measures.

The *2002 OECD Environmental Performance Review of Japan* (EPR) made a number of recommendations related to climate protection, which provide a useful framework for assessing Japan's present climate policy (Table 5.3).

Table 5.3. **Actions taken on the 2002 EPR recommendations for climate change**

Recommendations	Actions taken
Seek the entry into force of the *Kyoto Protocol* in 2002, with *timely ratification* processes, and with the widest possible participation.	Japan ratified the Kyoto Protocol in 2002, following the revision of the law concerning measures to combat global warming.
Further develop the national policy framework to combat climate change, with a *balanced mix of policy instruments* (including an expanded use of economic instruments such as taxes and charges), to reach domestic and international commitments; review and further develop environment-related taxes where appropriate, from the viewpoint of GHG reduction and other objectives.	Japan's Voluntary Emissions Trading Scheme (JVETS) has been operating since 2005; in October 2008, a trial domestic emissions trading was launched. MOE established an Expert Committee to discuss potential effects of the carbon tax. The bill of the Basic Act on Global Warming Countermeasures (2010) foresees the introduction of emissions trading and taxation measures.
Develop and implement *co-ordinated demand management measures* (*e.g.* road pricing, parking charges, energy service company) and energy efficiency improvement measures (energy efficiency standards and other measures) in the *transport and residential/commercial* sectors.	In the transport sector, Japan has implemented various measures for demand management and energy efficiency improvement such as introducing ITS, flexible expressway toll, Top Runner Programme and tax reduction for low-emission vehicles. In the residential/commercial sectors, the Top Runner Programme has improved energy efficiency of a wide range of electric appliances. The Law Concerning the Rational Use of Energy introduced higher energy efficiency requirements for residential and commercial buildings. A system for the assessment of energy efficiency of buildings (CASBEE) was developed.
Strengthen the management of *motor vehicle traffic* through a comprehensive package of policies including traffic demand management measures (*e.g.* land-use planning, economic instruments, information technology) and measures promoting the use of more fuel efficient vehicles and of *less polluting transport modes.*	See above.
Continue to implement policy measures to reduce emissions of *HFCs, PFCs and* SF_6 with a balanced mix of policy instruments.	Japan has implemented a mix of measures to reduce non-CO_2 GHGs, such as: *i)* voluntary initiatives; *ii)* promotion of the development of alternative substances; and *iii)* recovery of HFCs contained in appliances.
Review and revise *voluntary initiatives in industry* to improve energy efficiency and reduce GHG emissions (*e.g.* more explicit targets, expanded public access to relevant information).	Relevant ministerial councils regularly assess the voluntary initiatives in each industrial sector, and disclose information to the public. They can recommend more ambitious targets.
Take further measures to encourage the development and use of *renewable forms of energy* and to promote *fuel switching* where appropriate.	Japan has implemented a system of renewable energy quotas in the electricity sector (renewable portfolio standard), and a feed-in tariff to promote photovoltaic installations.

Source: OECD, Environment Directorate.

3. Climate change and energy policy

Japan depends on outside sources for its energy needs, and its energy mix is heavily based on fossil fuels (Box 5.2, Figure 5.4). The *2002 Basic Act on Energy Policy* sets the key priorities of Japan's energy policy: energy security, environmental "suitability" and use of market mechanisms. Measures to improve energy efficiency and to reduce reliance on fossil fuels are expected to largely contribute to meeting the Kyoto target (Table 5.2).

Box 5.2. **Energy structure and trends**

Energy mix

While the economy was recovering between 2002 and 2007, Japan's *total primary energy supply* (TPES) slightly decreased. It sharply decreased in 2008 (by over 4% compared to the previous year) as a consequence of the economic crisis, falling to the lowest level since the mid-1990s. Japan's energy supply is heavily based on *fossil fuels* (Figure 5.4). As of 2008, they represent 83% of TPES, which is in line with the OECD average, but fairly above the OECD Europe average (77%). Oil accounts for 43% of Japan's TPES, down from 49% in 2000. Nuclear power has also decreased in recent years, due to the temporary shutdown of power plants caused by earthquakes and related security concerns, and accounts for 13% of TPES. This decline has been offset by the increased use of natural gas and especially coal, which comprise 17% and 23% of TPES, respectively. Japan has very limited domestic supplies of natural resources and imports about 88% of its energy supply, mainly fossil and nuclear fuels.

Japan has diversified its *fuel mix for electricity generation*. Coal represents the main fuel, accounting for 30% of electricity output, followed by natural gas, nuclear and oil (Figure 5.5). The share of coal products and natural gas in electricity output has increased to compensate for the decrease in nuclear power and oil. About 9% of electric power is generated from renewables, compared to 16% for OECD countries and over 20% for OECD Europe. Overall, power generation from renewables has also been declining, reflecting, among other things, the fact that hydropower, which represents 85% of renewable electricity, has been approaching its full capacity.

While the contribution of *renewables* to energy supply has slightly increased in OECD countries since 2000, in Japan this share has been wavering around 3% (Figure 5.5), about half of the OECD average (6.7%) and far below the projected 7 to 8.2% in 2010. When excluding traditional renewable technologies, such as hydro and geothermal power, the share falls to less than 1.5%. Hydro power remains the main renewable source (40%), followed by biomass and renewable municipal waste (35%) and geothermal energy (17%). Energy supply from all renewable sources has substantially decreased, with the exception of that from renewable municipal waste, photovoltaic and wind. Japan has the third largest installed photovoltaic capacity among OECD countries and produces some 18% of the world's photovoltaic cells. Energy production from photovoltaic and wind has increased 6- and 27-fold, respectively, although the contributions of these renewables to energy supply and electricity generation remain negligible.

Energy use and energy efficiency

Japan's *energy intensity*, as measured by TPES per unit of GDP, was 0.12 toe per USD 1 000 (at purchasing power parity), which is well below the OECD average (Figure 5.4). Japan's total final energy consumption (TFC) has slightly declined since 2000, while real GDP has increased by around 2% per year. However, electricity consumption grew by 7%, especially in the service and residential sectors. Electricity consumption per capita is slightly below the OECD average, but remains higher than in a number of countries, namely all large European OECD economies.

The *industrial sector* is the largest final energy consumer in Japan and, with a share of about 30%, takes up a larger part of TFC than in many OECD countries (Figure 5.4). While industrial production increased between 2000 and 2007, energy consumption from industry remained largely stable. Indeed, energy consumption per unit of industrial production decreased by 7.5% in that period, owing mainly to improvements in energy efficiency. The most energy consuming industry is iron and steel, which makes up 23% of industrial consumption, followed by chemical and petrochemical (19%), machinery (10%) and paper (9%). Energy consumption in the steel and machinery sectors has risen by 15% and 17% respectively since 2000 due to an increase in production, while in other sectors it has dropped or remained unchanged.

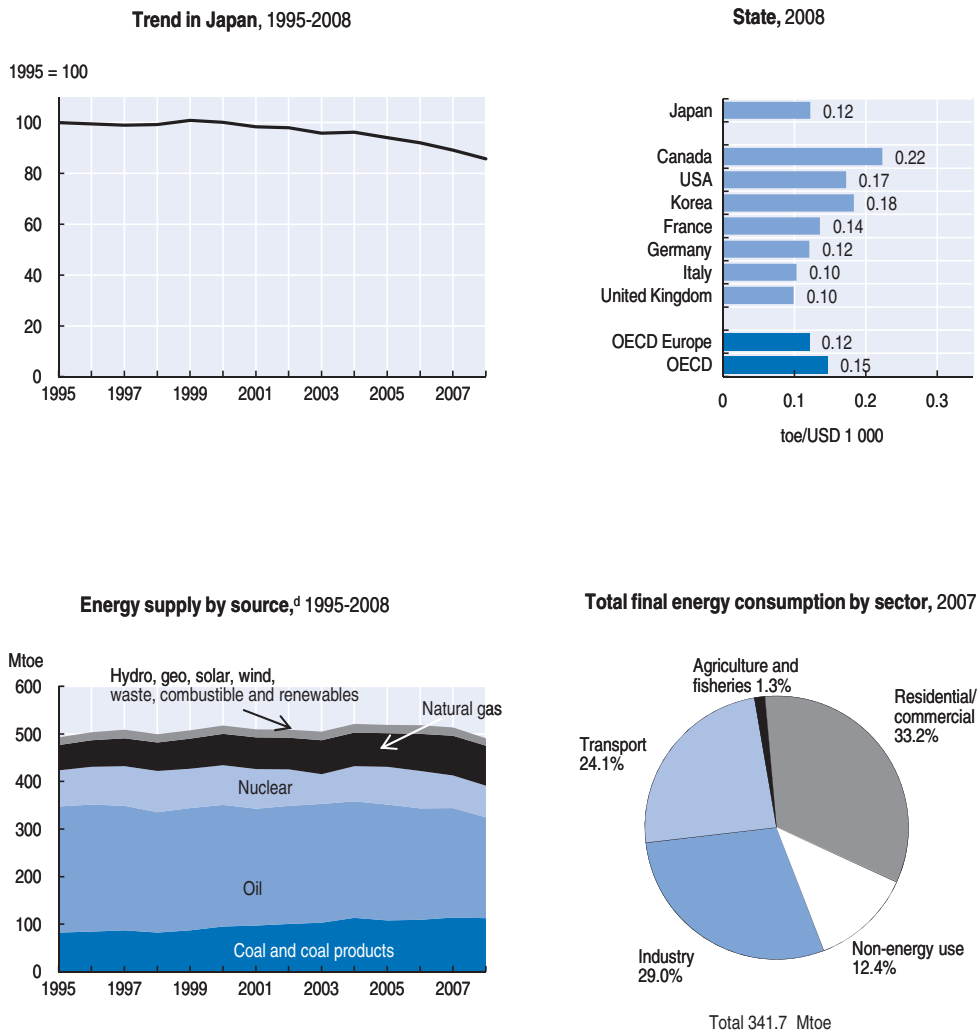
Final energy consumption from the *commercial (including service) and residential sectors* slightly increased (by 4% and 1%, respectively) between 2000 and 2007. Heating and cooling accounted for almost half of energy consumption in the tertiary sector, followed by use of electric appliances and lighting. During that period, electricity consumption from households grew by 13% and from commercial and service activities by 19%. This reflects: *i)* an 8.3% expansion of office floor space; *ii)* a 9% increase in the number of households (while the total population grew by only 0.7%); and *iii)* the demand for more and bigger electric appliances. These trends have cancelled out the improvement in energy efficiency of office equipment and home appliances. Energy consumption in these two sectors is expected to further increase in the future.

Box 5.2. **Energy structure and trends** *(cont.)*

Energy consumption from *transport* accounts for 24% of TFC (Figure 5.4). Contrary to many OECD countries, it decreased by 6% during the review period. This decline was driven by a 6% decrease in energy use from road transport (both freight and passengers). Nonetheless, road transport still accounts for 90% of total consumption in the sector (Figure 5.8). Only energy use from domestic aviation has increased during the period (by 2%).

Figure 5.4. **Energy[a] structure and intensity**

Energy[b] per unit of GDP[c]



a) Excludes international marine and aviation bunkers.
b) Total primary energy supply.
c) GDP at 2005 prices and purchasing power parities.
d) Breakdown excludes electricity trade.

Source: OECD-IEA (2009), *Energy Balances of OECD Countries*; OECD (2009), *OECD Economic Outlook*, No. 86.

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Following the requirements of the 2002 Basic Act on Energy Policy, the *2003 Basic Energy Plan* (subsequently revised) aims at promoting nuclear power, securing a stable energy supply, promoting technological progress, developing renewable energy sources, and contributing to the development of an international framework for energy conservation and climate change. The *2006 New National Energy Strategy* sets the following quantitative targets to be reached by 2030:

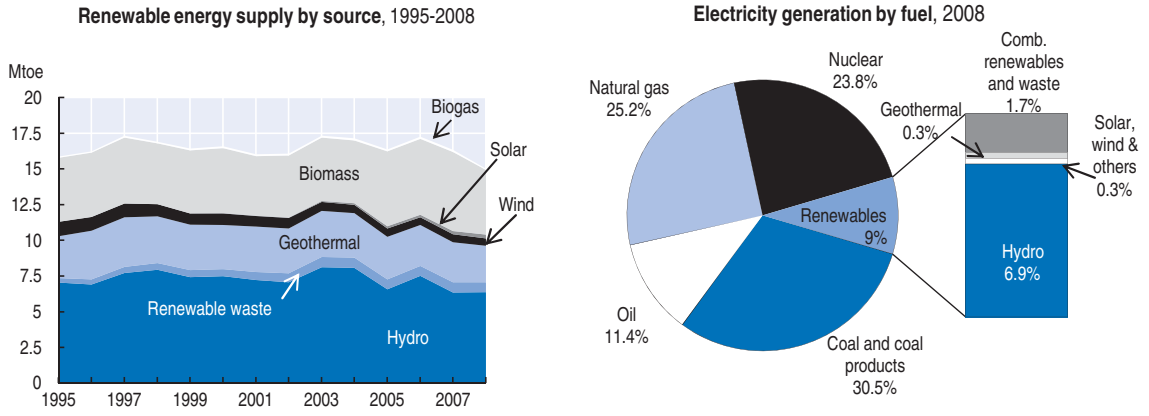
- reduce final energy consumption per unit of GDP by 30%;
- reduce the share of oil in TPES to 40%;
- reduce the oil dependence of the transport sector to 80%;
- increase the proportion of nuclear energy in total power generation to 30-40%; and
- expand the ratio of exploration and development of oil resources by Japanese companies to around 40%.

METI is the main *authority in charge of designing and implementing Japan's energy policy*, in co-operation with other authorities, such as MOE and MLIT. It systematically evaluates energy policy measures against several criteria, including their potential contribution to reducing GHG emissions. The evaluation is conducted *ex ante* as a contribution to the budget process, and *ex post* (every three to five years) to assess efficiency and effectiveness of policies and measures. However, these evaluations focus primarily on the measures that have been selected for implementation and seldom include a cost-effectiveness analysis that examines a range of alternative policies (IEA, 2008).

3.1. Promoting renewable energy sources

The *share of renewable sources*, mainly hydro power, has fluctuated around 3% of energy supply, which is relatively low compared to other OECD countries (Figure 5.5). Japan aims at increasing the share of renewables in primary energy supply to 10% by 2020. Japan has also introduced a *target for "new energy"*, which includes all renewable energy technologies whose development needs assistance, thus excluding large hydro power plants and geothermal heat. The target is a 3% share of new energies in TPES by 2010 (from some 2% in 2005), implying a considerable increase in overall renewable energy supply in a relatively short period. This global target is based on short-term technology-specific targets, which

Figure 5.5. **Renewable energy**



Source: OECD-IEA (2009), *Energy Balances of OECD Countries*.

StatLink http://dx.doi.org/10.1787/888932318832

potentially limit investor flexibility. The government provides capital grants for the installation of renewable energy plants. Global long-term targets would create a more stable scenario for investors, facilitate investment planning and, therefore, potentially bring down overall costs. Putting a price on carbon, as through a mandatory emissions trading system (Section 5.2), would drive investments in renewables in a more cost-effective way.

Under the *Renewables Portfolio Standard* (RPS), introduced in 2003, each electric utility has to sale a target rate of electricity generated from new energy. 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 (Box 5.2, Figure 5.5). Nonetheless, as many other countries, Japan needs to upgrade its electricity grid to allow for higher levels of electricity from renewables and particularly from wind, for which the highest potential is located in the northern and sparsely populated island of Hokkaido. Moreover, Japan should streamline market rules on grid interconnections to minimise barriers to entry (IEA, 2008).[5]

The "Policy Package to Address the Economic Crisis" (April 2009) includes the target of increasing *solar photovoltaic* installations 20-fold by 2020. In November 2009, Japan launched a feed-in-tariff (FIT) scheme: 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 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.

The 2002 Biomass Nippon Strategy (revised in 2006) promotes *biomass energy* as a means to address climate change, contribute to a sound material-cycle society, and support the development of agriculture and forestry. Japan foresees the establishment of 300 "Biomass Towns" by 2010, which will rely extensively on biomass energy, following the model of "Eco-Towns" (Chapter 6).[6] As of end 2009, 221 biomass towns had been created.

Japan has set a target of 500 million litres (Ml) of crude-oil equivalent for the consumption of *transport fuels derived from biomass* by 2010. This is 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 meet this goal. Biofuel production is at an early stage in Japan and 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 (kl) per year by 2011.[7] To minimise potential impacts on vehicle safety and exhaust emissions, upper limits of 3% and 5% have

been set for biofuel content in gasoline and diesel respectively. Bioethanol-blended gasoline benefits from tax exemption on its bioethanol content (up to 3%). 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).

Japanese energy policy includes a complex mix of financial and fiscal incentives to encourage particular energy technology choices. It is not clear how well this mix has been working (IEA, 2003). Japan should develop a comprehensive map of all the various measures that impact the energy sector and assess their effectiveness and cost-effectiveness, with a view to rationalising these policy options.

3.2. Promoting energy efficiency

In a context of economic recovery, energy consumption slightly declined in Japan from 2000 to 2007, but it dramatically fell in 2008 as a consequence of the economic crisis. Japan's *energy intensity* has been steadily, albeit slightly, decreasing, owing largely to heavy investments in energy efficiency in the manufacturing sector (Figure 5.4). Nevertheless, some consumption trends are still cause for concern, in particular concerning electricity in the tertiary and residential sectors (Box 5.1), and have prompted the Japanese authorities to take action.

Japan has traditionally attached high priority to energy efficiency, aiming to both increase the security of energy supply and curb GHG emissions. The 1979 *Law Concerning the Rational Use of Energy* remains the centre-piece of Japan's energy efficiency policy; it has been revised several times during the review period since 2000 to cover small factories, buildings and transport. Among the novelties, *energy management requirements* have been extended, moving from a factory-based approach to a company-based approach. Energy management (*e.g.* energy plans, energy use reporting and energy managers) is now mandatory for a larger number of industrial and commercial companies whose overall energy consumption is above a certain threshold.[8] Industrial firms are also required to reduce their energy intensity by 1% per year. In addition, a recent amendment to the Law introduced "*sectoral benchmarking*" *for industrial energy-intensive sectors* (iron and steel, cement and electricity generation): medium- and long-term energy efficiency targets have been set at the level of the best performing companies in each sector. METI carries out on-site inspections and discloses to the public the names of the companies that fail to meet the targets. The "name-and-shame" mechanism is effective in Japan, since it puts the image of the brand at risk.

Building owners and developers are required to report on the *energy performance of buildings*. This requirement, initially applied to the construction and renovation of large non-residential buildings, has now been extended to large residential buildings and to smaller non-residential buildings. Japan has developed the *Comprehensive Assessment System for Built Environment Efficiency* (CASBEE), under which buildings are rated against several criteria, including energy and resource efficiency, and local and indoor environmental quality. Contrary to many other countries, however, energy efficiency standards for buildings remain voluntary in Japan.

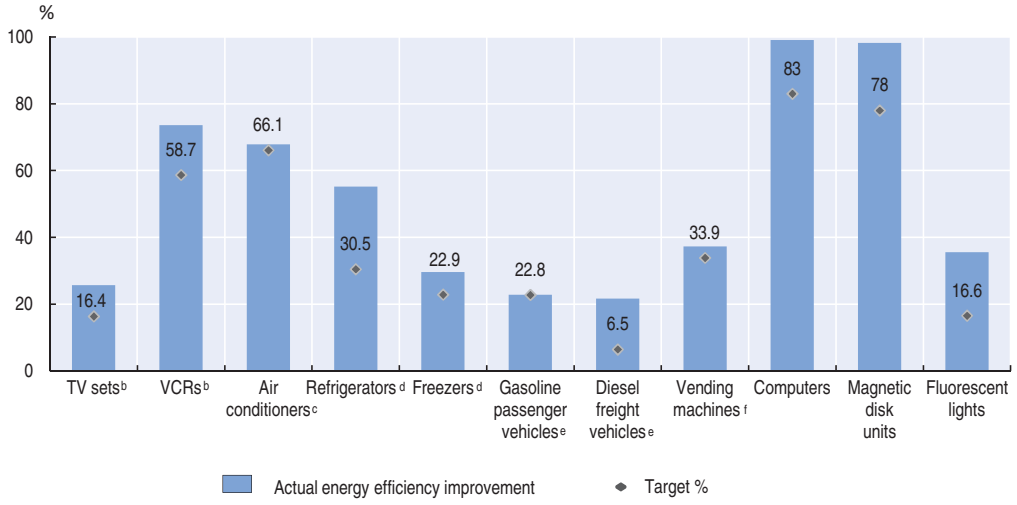
Japan provides *fiscal and financial support* to small and medium-sized enterprises (SMEs) for implementing energy efficiency measures, including the installation of efficient equipment, energy management systems and research and development. Similar subsidies apply to the building sector. Enterprises and households can claim tax credits or

special depreciation rates on investment costs for the installation of energy efficient equipment, including solar panels. Owners of highly efficient buildings have access to low-interest loans.

The Top Runner Programme

In 1998, Japan introduced the Top Runner Programme, which is *a set of energy efficiency standards* for energy intensive products, such as home appliances and motor vehicles. During the review period, 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. The target refers to the weighted average energy performance of the products sold by a company in the target year, and not to the individual product sold. 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 5.6). Manufacturers highly support the programme, since they are directly involved in setting the targets and energy efficiency is considered to be a competitive advantage.

Figure 5.6. **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.

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. 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, there is scope to improve the programme. The *financial and economic costs of the programme* have not been analysed. Other measures, including market-based instruments and other standard setting measures, might be more cost-effective and induce more rapid technological advancement (Chapter 2). Also, the constant overachievement of targets raises questions about their level of ambition (Figure 5.6).

Energy prices

Energy taxes have remained virtually unchanged since the previous *OECD Environmental Performance Review of Japan* (2002) (Table 2.1). Exceptions include the introduction of a tax on coal in 2003 and the increase of the tax rate on natural gas and liquefied petroleum gas (LPG). Overall, energy taxation is lower than in a number of other OECD countries, notably European.

Nonetheless, *energy prices are relatively high* in Japan (Table 5.4). The price of natural gas is higher than in other major industrialised countries, especially for domestic customers. This is partly due to the high cost of shipping. Households pay a disproportionally higher price than industrial customers. Electricity retail prices have decreased in recent years, 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 has not helped moderate the use of electric appliances in the residential sector.

Table 5.4. **Energy prices in selected OECD countries, 2008**

	Electricity		Oil			Natural gas	
	Industry (USD[c]/kWh)	Households (USD[d]/kWh)	Industry[a] (USD[c]/t)		Households[b] (USD[d]/1 000 l)	Industry (USD[c]/10^7 kcal)	Households (USD[d]/10^7 kcal)
			High sulphur	Low sulphur			
Japan	0.116[f]	0.173[f]	776.5	945.6	908.4	454.0[f]	1 212.4[f]
Canada	0.059[e]	0.078[e]	571.5	. .	909.2	357.0	448.7
USA	0.070	0.114	558.4	. .	892.0	368.1	525.3
Korea	0.060	0.131	692.0	722.8	1 657.5	499.5	936.1
France	0.060	0.126	555.7	587.4	914.4	607.3	688.1
Germany	0.109	0.224	. .	591.8	859.3	. .	. .
Italy	0.290	0.240	. .	643.3	1 492.6	646.5	905.9
United Kingdom	0.146	0.188	x	576.0[f]	871.8	446.0	672.7
OECD Europe	0.117	0.179	. .	660.7	963.4	. .	. .
OECD	0.102	0.134	. .	. .	953.4	428.9	648.5
JPN price/OECD Europe (%)	*99*	*97*	. .	*143*	*94*	. .	. .
JPN price/OECD (%)	*114*	*129*	. .	. .	*95*	*106*	*187*

. .: Not available.
x: Not applicable.
a) HS High-sulphur oil, LS Low-sulphur oil.
b) Light fuel oil.
c) At current exchange rates.
d) At current PPPs.
e) 2006 data.
f) 2007 data.
Source: OECD-IEA (2009), *Energy Prices and Taxes*, 3rd quarter 2009.

StatLink http://dx.doi.org/10.1787/888932319041

3.3. R&D in energy and climate change technologies

In Japan, *public research expenditures for energy*, as share of GDP, exceed those of other major economies. Nuclear power remains the dominant energy research area, accounting for 65% of total outlays in 2008. While total R&D expenditure on energy remained fairly stable during the review period, Japan's R&D on renewable, hydrogen and fuel cells technologies increased considerably, reaching some 10% of total energy R&D outlays in 2008. Japan has also increasingly promoted research on clean coal technology and carbon capture and storage. On the other hand, the public R&D budget for energy efficiency decreased by 25% between 2000 and 2008, and represents now some 12% of the total, owing to the growing role of the private sector in this research area. Japan's energy R&D funding is linked to its overall energy policy objectives.

Japan is a world leader in *climate-related technological innovation*, as indicated by the number of patents it holds in this area (Chapter 2). The 2008 Cool Earth Innovative Energy Technology Programme prioritises 21 energy- and climate-related technologies, and will provide road maps to guide the development of these technologies.

4. Climate change and transport policy

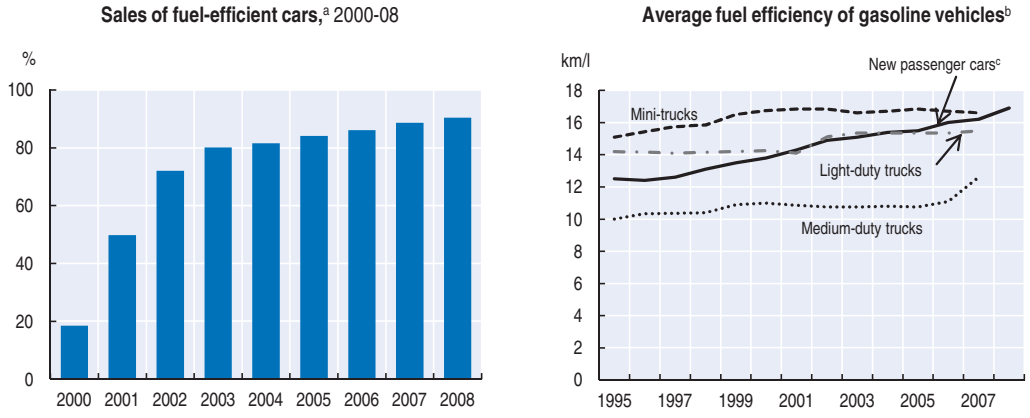
In 2002, Japan set a *specific target for the transport sector*: 250 $MtCO_2$/year by 2010, which represents a 15.1% increase from the 1990 level. The target was lowered in 2008 to 240 $MtCO_2$/year to take account of the actual reduction in GHG emissions from transport. Japan has implemented a *wide-ranging set of measures to achieve this target*, focusing on promoting vehicle fuel efficiency, vehicle taxation, public transport, efficient logistics and congestion and traffic flow management. Great attention is being given to "next-generation vehicles" in the Action Plan for Achieving a Low-carbon Society (Box 5.1). MLIT is the main authority in charge of transport policy and has explicitly integrated climate-related goals into its policy documents.

Vehicles

The *Top Runner Programme* (Section 3.2) sets targets for average fuel efficiency of new passenger and heavy-duty vehicles by 2010 and 2015. Noticeably, Japan is the only country in the world that has imposed fuel efficiency standards for heavy-duty vehicles. Progress has been rapid, and the 2010 target for passenger cars (15.1 km/l or 153.8 g-CO_2/km) was achieved well in advance (JAMA, 2009). Average fuel efficiency of new gasoline passenger cars produced in Japan was 16.5 km/l in 2008, only slightly below the 2015 target of 16.8 km/l,[9] indicating that targets could be further raised (Figure 5.7).

Diesel-fuelled cars account for a negligible share of the vehicle fleet. Consequently, Japan has one of the lowest diesel consumption rates for transport purposes among OECD countries. According to Japan's estimates, increasing the share of diesel passenger vehicles in the fleet by 10% would help to reduce GHG emissions from transport by 2 $MtCO_2$/year (IEA, 2008). The 2006 New National Energy Strategy promotes the use of clean diesel vehicles that have exhaust gas emissions comparable to those of gasoline vehicles. To this end, such vehicles have been fully or partially exempted from vehicle-related taxes (Table 2.2).

Figure 5.7. **Vehicle fuel efficiency**



a) Share of certified fuel-efficient and low-emission passenger cars in total sales.
b) Vehicles produced in Japan.
c) Average certified fuel efficiency.

Source: Japan Automobile Manufacturers Association.

Vehicle taxes

Vehicle-related taxes have been repeatedly modified to favour environmentally friendly vehicles. A reduction of up to 50% applies to the annual automobile tax depending on a vehicle's pollutant emission reductions and fuel efficiency; the tax is increased by 10% for old vehicles. Full or partial exemptions apply to the acquisition and tonnage taxes for low-emission and fuel-efficient cars and so-called "clean vehicles" until 2012 (Table 2.2). Within the framework of the 2008-09 stimulus package for economic recovery, the government introduced a *car scrapping incentive*, subsidising the replacement of old vehicles (13 years or older) with new energy-efficient ones (Chapter 2).

Fuel prices and taxes

Japan deviates from most other OECD countries in fuel taxation. Japanese *gasoline taxes and prices* are substantially lower than in most OECD countries (Figure 2.4). Tax rates have remained unchanged for more than a decade. Taxes account for a much lower share of fuel prices than in the European G8 countries. This gives drivers a weak incentive to drive energy efficiently even if they choose low-emission cars. 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 (Chapter 2).

Traffic management

Japan has implemented various measures for tackling traffic congestion. *Intelligent transport systems*, using electronic tolls, centrally controlled traffic signals and vehicle information systems, have been introduced. Investments in rail carrying capacity, ring roads and by-passes are helping to make traffic more fluid. The government has also promoted *eco-driving* (*e.g.* steady speed, reduced load) through several information campaigns. While the overall effects of eco-driving are not clear, it appears to be more promising for freight than passenger transport. Overall, *traffic congestion* remains a

problem, especially in large metropolitan areas. This suggests that stronger incentives are needed to optimise car use, such as congestion charges and peak pricing on urban stretches of motorways.

Japan applies a flexible and rather complex system of *road pricing for motorways*. Lower rates apply to light vehicles and motorcycles. Motorway tolls offer discounts of 30-50% 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 government is planning to progressively eliminate road tolls.[10] Overall, the toll system encourages long-distance driving, including over routes that are very well served by fast trains (Chapter 2). 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.

Freight transport

New measures have been implemented to improve efficiency in freight transport and to promote a modal shift from road to railways or navigation. *Large carriers and consigners* are required to decrease their energy use by 1% per year over the mid- to long- term, to introduce energy management plans and to periodically report to MLIT.

Public transport

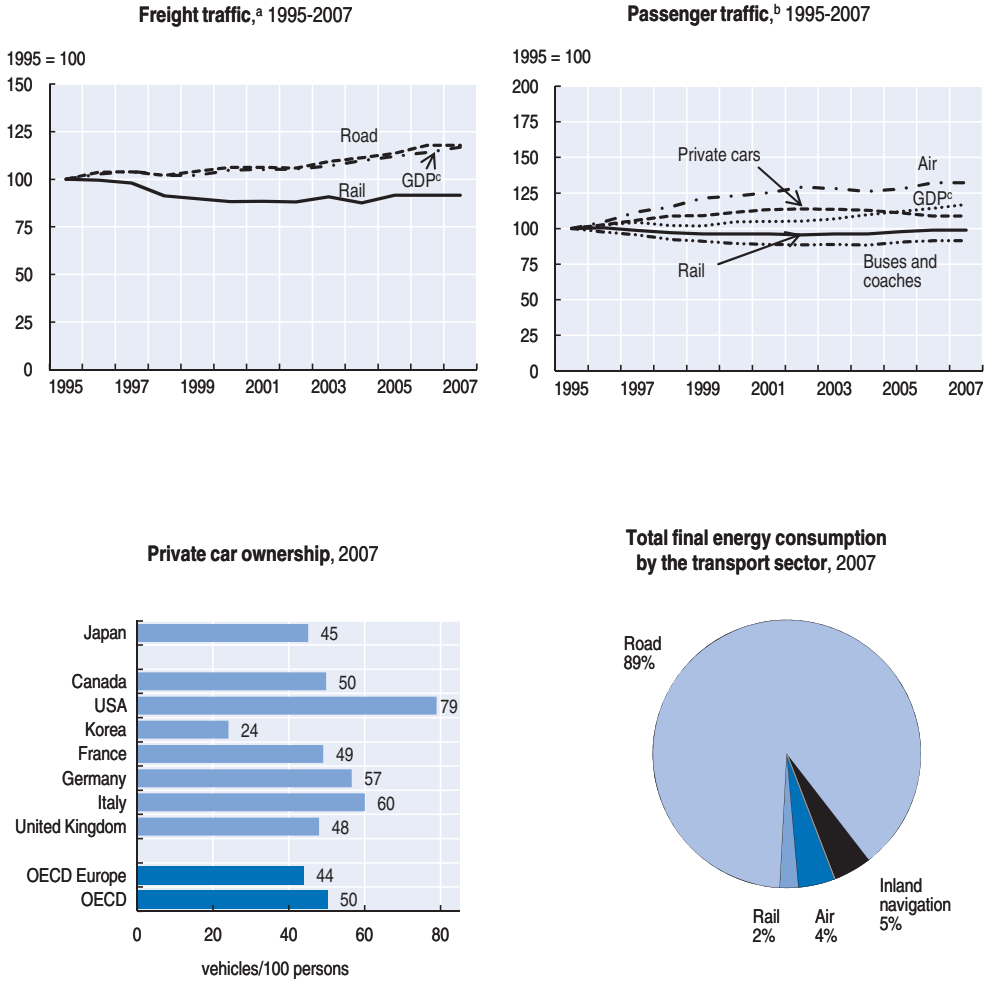
Japan has *very well-developed rail and public transport systems*. The government has continued to extend public transport networks and facilities and to improve interconnections and ticketing systems. *Model projects of environmentally sustainable transport* have been developed in 27 areas since 2005. Some municipalities have introduced the "compact city" model in their urban master plans, aiming to bring local economic and social activities closer together.

Performance

Road has remained the dominant freight transport mode and has continued to grow in line with GDP (in tonne-kilometres). Remarkably, this growth is associated with a decrease in distance travelled by heavy duty vehicles (in vehicle-kilometres), indicating an improvement in loading efficiency of road freight transport. Also distance travelled by car has decreased since 2003. The rise in oil prices might well have been a major driver for this decline and have made travelling by public transport more attractive. Air traffic has increased and dominates long-distance passenger traffic (Figure 5.8).

In the three major metropolitan areas,[11] public transport is the dominant transport mode, accounting for some 60% of passenger travel. Private car transport remains dominant at national level, and especially in minor cities and rural areas, although it accounts for a lower share of passenger travel than in most OECD countries. The decline in the number of passengers travelling by public transport, together with the need to control public spending, has led to a shutdown of some routes and services in peripheral areas (MLIT, 2008). The number of passenger cars in use increased by some 10% between 2000 and 2008, albeit at a much lower rate than in the previous decade. Private car ownership remains lower in Japan than in the other G8 OECD countries (Figure 5.8).

Figure 5.8. **Transport sector**



a) Index of relative change since 1995 based on values expressed in tonne-kilometres.
b) Index of relative change since 1995 based on values expressed in passenger-kilometres.
c) GDP at 2005 prices and purchasing power parities.

Source: OECD, Environment Directorate; OECD-IEA (2009), *Energy Balances of OECD Countries*.

These trends have resulted in a decline of *energy consumption from transport* (Box 5.1). In particular, energy use from road transport, which makes up about 90% of consumption from the sector, has declined (Figure 5.8). The policy measures described above have contributed to this achievement and, consequently, to a reduction in CO_2 emissions. Only emissions from aviation have grown. 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 (Figure 5.7). Efficiency of logistics and freight transport has also improved, mainly due to a shift from driver-owned trucks to larger freight service companies and the adoption of eco-driving by operators. Traffic flows have improved, resulting in reduced traffic congestion and travel time and improved on-road fuel intensity. However, in minor cities and rural areas, CO_2 emissions per passenger have increased, which reflects high reliance on private vehicles (MLIT, 2007). More efforts are therefore needed to improve transport management in these areas.

5. Cross-sectoral policy instruments

5.1. *Voluntary initiatives*

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.[12] This means they can achieve their targets even if emissions increase, as happened during the economic expansion period.

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.

The voluntary approach has triggered participation and *visible commitment of industrial organisations and companies* to reduce emissions. However, it does not secure a cost-effective and well-balanced distribution of mitigation 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 emission targets of successful industries, the level of ambition of these targets and the potential for further energy 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 VAP and, hence, whether public money could have been spent on more effective and ambitious programmes. The *cost-effectiveness of the VAP* 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 the emission reduction targets at the lowest cost.

5.2. *Market-based approach*

Emissions trading

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%, and traded allowances at around JPY 800/tCO_2, compared to an average price of JPY 1 200/tCO_2 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 VAP.

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.[13] However, 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 domestic credit scheme. It is too early to assess the effectiveness of the system.

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. 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, 2009a). 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. A mandatory ETS could also be linked to such systems implemented in other countries, namely in the EU, thus reducing the overall cost of meeting the targets and lowering carbon prices (OECD, 2009b).[14] The 2010 bill of the Basic Act on Global Warming Countermeasures foresees establishing a mandatory ETS. 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 5.3).

Carbon taxation

The government has been discussing the *introduction of a carbon tax* for several years. In 2009, MOE proposed a tax of JPY 1 064 (USD 10) per tonne of CO_2 on fossil fuels, including transport fuels. Relief measures for specific industries would be considered, such as exempting coal for steel manufacturing and compensating large emitters. Such sectoral exemptions would create uneven abatement incentives across sectors and a loss of efficiency. Therefore, they should be transitional. Japan plans to introduce the carbon tax as part of the *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 (Chapter 2).

Box 5.3. **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 transportation (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 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 ETS 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 ETS, although only 4% opposed the introduction of the ETS 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.

5.3. The Kyoto mechanisms and carbon sinks

According to the Kyoto Protocol Target Achievement Plan, the Kyoto mechanisms – *i.e.* emissions trading, Clean Development Mechanism (CDM) and Joint Implementation (JI) – could account for 1.6% of the GHG emission reductions needed to meet the Kyoto target (Figure 5.3). *Japan has been purchasing emission credits from the international market* since 2004, and JPY 30.3 billion have been allocated for credit purchases in the 2008-12 period. The New Energy and Industrial Technology Development Organisation (NEDO) is the independent agency managing these credit purchases. As of 2008, NEDO had purchased 55 $MtCO_2$. The company Japan Carbon Finance Ltd. develops GHG reduction projects, which are funded by the Japanese Greenhouse Gas Reduction Fund (JGRF), and purchases related emission credits. As of June 2008, Japan Carbon Finance had purchased credits for 18.5 $MtCO_2$ and distributed them to JGRF investors.[15]

As of end 2009, *Japan was the world's fourth largest CDM investor*, with 277 projects representing 11.6% of the total number of CDM projects worldwide. These are concentrated in a few countries, with China alone accounting for two-thirds of total credits from CDM projects, and the top five host countries (China, Brazil, Korea, India and Chile) accounting for more than 85% (OECD, 2009a). The government has issued guidelines for assessing their effectiveness. Japan has also been using part of its official development assistance (ODA) to develop CDM projects. However, in accordance with the 2004 decision of the OECD Development Assistance Committed, Japan should ensure that the use of ODA for CDM projects does not reduce funds available for aid activities.

As a relatively energy efficient economy, Japan has much scope to use the Kyoto mechanisms to *reduce the costs of achieving its targets* beyond the Kyoto commitment period. Increasing emission credit purchasing to 20% of total emission reductions would more than halve the cost of achieving a 20% cut (relative to 1990 levels) in emissions by 2020 relying on domestic measures alone (OECD, 2009b).

Japan plans to increase *forest capacity for carbon uptake* by thinning additional 0.2 million hectares (ha) per year in 2007-12, for a total of 3.3 million ha. In 2007 and 2008, Japan appropriated the necessary budget resources for these additional forest improvements.

6. Climate change policies at local level

Prefectures and municipalities play an important role in climate change policy and develop their own targets, policies and measures. The central government provides guidelines, model projects, and financial support. Some municipalities, such as the Tokyo Metropolitan Government, have led the way for the introduction of innovative policies (Box 5.3).

In 2008, the government launched the *Eco-Model City Project*. The GHG emission reduction plans of 13 cities were selected to receive governmental technical and financial support. The government also shares information with other cities and oversees the project. There is a wide variety of participants, ranging from Yokohama with 3.65 million inhabitants to Shimokawa with 3 900 inhabitants. This is a promising initiative for both technical and social innovation, although it is too early to assess results in terms of GHG reductions on the ground.

7. Climate change impacts and adaptation

Like many other OECD countries, Japan is in its *early stage of assessing climate change impacts* and mainstreaming climate change adaptation into physical planning and other long-term decisions. Some research projects have attempted to assess the nature, magnitude and costs of climate change impacts in Japan.

A *Committee on Climate Change Impacts and Adaptation Research* was established in October 2007. In October 2009, MOE, the Ministry of Education, Culture, Sports, Science and Technology, and the Japan Meteorological Agency jointly released a report on "Climate Change and Its Impacts in Japan" to provide inputs for policy-making. The report recognises the impacts that have already been observed, such as the increase in mean temperatures and frequency of heavy rains; it estimates that a rise in temperature by 2 to 3.2 degrees Celsius from pre-industrial levels would cost Japan from JPY 11 trillion/year to JPY 17 trillion/year. Only the basic elements of an adaptation strategy have been laid down, such as vulnerability assessment, constant monitoring, and early warning. Integration of

climate change adaptation into planning processes will be the responsibility of each sector authority. Adaptation is also an important part of Japan's co-operation with neighbouring and developing countries (Chapter 4).

8. Co-operation with developing countries

In 2007, Japan launched the Cool Earth 50 strategy, proposing the long-term target of halving current global emissions by 2050. Co-operation with developing countries is a key element of this strategy. In 2008, Japan introduced a *Cool Earth Partnership Financial Mechanism*, amounting to USD 10 billion over five years.[16] Based on policy consultations with developing countries, USD 2 billion would be allocated to assist with adaptation efforts and improve access to clean energy, and USD 8 billion would be used to support mitigation. The latter includes the promotion of CDM projects, improved policies (legal systems, capacity development, monitoring), private sector programmes and co-benefits initiatives. As of November 2008, eight countries were already getting assistance from Japan under the partnership (Indonesia, Tuvalu, Senegal, Madagascar, Guyana, Niger, Namibia, and Ethiopia) and 60 were at an early consultation stage.

In 2009, Japan launched the new *Hatoyama Initiative*, which absorbs the Cool Earth Partnership and the related financial commitments to support developing countries in addressing climate change. Under this initiative, Japan will provide overall USD 11 billion in ODA and other official flows and USD 4 billion of private funds by 2012. These initiatives put great emphasis on the use of Japanese technologies and expertise, which may result in tied aid to developing countries and reduce aid effectiveness (OECD, 2010).

Japan has been promoting *co-operation in the Asia-Pacific region* on the basis of a "co-benefits approach", with the aim of achieving economic gains from addressing climate change and air pollution problems, and simultaneously benefiting the development process of the partner country. Co-benefits demonstration projects have taken places in China and Indonesia, following the 2007 Joint Ministerial Statements, as well as in other countries (*e.g.* in Malaysia, Thailand) (Chapter 4).

Notes

1. The base year is 1990 for carbon dioxide, methane and nitrous oxide, and 1995 for fluorinated gases.
2. Coal has not been used in the residential sector since 1999.
3. The projected emission reduction by Kyoto mechanisms varies in accordance with actual emission levels in 2008-12.
4. This budget can be divided into four categories: *i)* measures directly contributing to the target (JPY 530 billion); *ii)* measures contributing in the mid- or long-term (JPY 149 billion); *iii)* measures indirectly contributing to the target (JPY 365 billion); and *iv)* other measures (JPY 40 billion).
5. Renewables are intermittent electricity sources that can negatively affect the stability of the electricity grid.
6. Municipalities are required to prepare and implement a programme for using more than 90% (in carbon content) of biomass derived from local waste or more than 40% (in carbon content) of locally available unused biomass.
7. In 2008, 200 kl of bioethanol and 10 000 kl of biodiesel were produced.
8. This implies that energy management is required also in small factories, offices and shops that are part of a larger company, even if their on-site energy consumption is relatively low.

9. Average fuel efficiency is measured using the JC08 test cycle. If measured using the less strict 10-15 test cycle, average fuel efficiency of new gasoline passenger cars produced in Japan was 16.9 km/l in 2008.
10. Japan plans to phase out tolls on 37 motorways, representing 18% of total motorway length, starting from June 2010.
11. Tokyo, Osaka, Kyoto and the neighbouring prefectures of Saitama, Chiba, Kanagawa, Aichi, Hyogo and Nara.
12. For instance, the Japanese Federation of Electric Power Companies has voluntarily committed to reducing CO_2 emissions intensity of electricity generation to 0.33 kg-CO_2/kWh by 2020. However, carbon intensity of power generation rose to 0.453kg-CO_2/kWh in 2007, by nearly 20% since 2000, due to the increased share of fossils in the fuel mix.
13. Businesses that do not participate in the VAP use the JVETS target-setting method.
14. 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.
15. JGRF was established in 2004 by a total of 33 entities, including private firms and two government banks.
16. In addition to the commitment of USD 1.2 billion for the Climate Investment Fund.

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