Country Scenarios toward Low-Carbon Society(LCS)

Countermeasures and Scenarios for each Country/Region

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Country Scenarios toward Low-Carbon Society (LCS)

Many countries and regions in the world have already made considerable efforts to develop scenarios toward a Low-Carbon Society. Thanks to cooperation of experts, we have compiled this brochure to summarise these LCS scenarios. The following experts submitted reports describing detailed information of their countries. Based on their reports and other information, this summary was compiled by “2050 Japan Low-Carbon Society” scenario team, who bears responsible for any errors.

We express our deepest appreciation to all who helped us to complete this work. And we do wish this summary brochure would help create awareness of LCS.

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This report is available on the Japan LCS website at “http://2050.nies.go.jp/3rdLCSWS/”.

Preface

Possible options towards a Low Carbon Society are expected to be sufficiently discussed among policy-makers before the coming G8 Summit to be held in July 2008 at Lake-Toya in Hokkaido, Japan. Hence, it will be essential for all policy-makers to confirm current situation and possible future scenarios concerning GHG reduction for each country/region.

With a hope to make the 3rd Japan-UK LCS Research Project Workshop more fruitful, participants of the workshop have cooperated to contribute information describing the current situation, policies and measures and future scenarios about each country/regions to realize a Low Carbon Society. This brochure is prepared by compiling the results of such efforts. This will help to look over emission status, countermeasures which are currently conducted and mid/long term scenarios in comparable.

In the process of creating this brochure, with an aim to complement the information, the secretariat of the workshop referred other materials such as National Communications submitted to the UNFCCC. If there is any inconsistency or inappropriate description in this brochure, the secretariat is fully responsible for it.

Contents

Australia

1. Current Status of Emission

GHG emissions in 1990: 418.3 Mt-CO_2eq*

Current (2005): 525.4 Mt-CO_2eq*

Kyoto Target: 8%

*Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

Though Australia has been placing a distance from Kyoto Protocol, the Australian Government has implemented a series of programmes in an effort to ensure reliable access to affordable energy while optimising the value of energy resources and managing environmental issues. These are outlined in the energy white paper, *Securing Australia's Energy Future*, released by the Government in 2004. A number of policies to contribute to global emission reductions while maintaining the strength of Australia's economy have also been implemented. Some of the measures are outlined below.

a) Government

Emissions trading scheme

Australia will implement a national emissions trading scheme commencing around 2010. The details of the scheme, including the emissions targets, are yet to be finalized. It is intended that all sectors of the economy be included. However agriculture and land use may be excluded from the scheme initially until monitoring issues have been resolved. While the emissions trading scheme will be a significant part of Australia's response to climate change, it will be complemented with other measures that address market failures not corrected by the emissions trading scheme.

Greenhouse Gas Abatement Programme

The Greenhouse Gas Abatement Programme (GGAP) supports private sector projects that will reduce or offset greenhouse gas emissions, particularly between 2008 and 2012 in sectors including industrial processes, mining, power generation and transport. It is projected that GGAP in 2010 will achieve annual abatement of 5 Mt CO_2-eq.

Renewable energy

A mandatory renewable energy target is in place for electricity retailers and wholesale buyers. These parties must contribute to the generation of renewable energy, or trade in renewable energy certificates, to reach the target of 9,500 GWh of new renewable energy generation by 2010. A new renewable energy target of 20 per cent by 2020 (approximately 60,000GWh) is expected to be set by the Government. This is estimated to reduce emissions by 342 Mt CO_2-eq between 2010 and 2030.

Australia

Energy Efficiency Opportunity assessment program

A mandatory Energy Efficiency Opportunity assessment program, introduced in 2006, requires firms using more than 0.5 PJ of energy to complete an assessment of energy efficiency opportunities every five years and release the assessment publicly. The program aims to improve the identification and up-take of commercial energy efficiency opportunities. Currently the program includes approximately 250 businesses.

Greenhouse Challenge Plus

Greenhouse Challenge Plus – Industry Partnerships is a cooperative partnership between government and industry that commenced in 2005. It aims to reduce greenhouse gas emissions, accelerate the up-take of energy efficiency practices, integrate greenhouse issues into business decision making and provide more consistent reporting of emissions levels. The partnership encourages the demonstration of corporate greenhouse performance through emissions inventory reporting and the development and implementation of action plans to achieve cost-effective abatement. The partnership certifies products and services with zero net greenhouse gas emissions and provides for collaboration between government and industry to identify technical best practice for reducing greenhouse gas emissions in key sectors. Currently there are over 700 members participating in the voluntary program.

National Appliance and Equipment Energy Efficiency Program

The National Appliance and Equipment Energy Efficiency Program (NAEEEP), is a collection of programs that regulates household appliances and commercial and industrial equipment. Policies include minimum energy performance standards, mandatory energy efficiency labeling and some voluntary measures including endorsement labeling and training. NAEEEP is projected to reduce greenhouse gas emissions by more than 204 Mt CO_2-eq between 2005 and 2020, whereby in 2020 the annual reduction is estimated to be around 20.9 Mt CO_2-eq. Net energy savings are projected to amount to $16.6 billion (undiscounted) from 2005 to 2020 .

b) State

Queensland 13 per cent gas scheme

Queensland introduced a requirement in 2005 that 13 per cent of all electricity generated in the state must be sourced from gas fired generation. The scheme serves dual purposes of reducing greenhouse gases and boosting the Queensland gas industry.

Greenhouse Gas Reduction Scheme

The Greenhouse Gas Reduction Scheme (GGAS) is a greenhouse gas emission trading scheme

Australia

for electricity retailers operating in New South Wales and the Australian Capital Territory (ACT). This scheme aims to reduce emissions in electricity generation to 5 per cent below 1990 levels by 2007.

State based policies for energy efficiency

In addition to supporting national energy efficiency initiatives, each state in Australia develops and implements their own energy efficiency policies.

- New South Wales has introduced a number of measures including imposing a requirement on high energy users to develop energy saving action plans and establishing a fund to support energy saving projects.
- The Victorian Government requires 250 large energy using businesses to prepare and implement Environment and Resource Efficiency Plans. By 2008 the Victorian Department of Primary Industries will establish an energy efficiency target scheme to help households reduce greenhouse gas emissions by up to 60 per cent of the 2000 level by 2050.
- The Queensland Government has initiatives to support the commercialization of sustainable and efficient energy technologies as well as to provide a rebate for households installing solar hot water heaters.
- The Western Australian Government aims to reduce energy use by 12 per cent from 2001-02 to 2006-07 in government agencies and to assist industries using sustainable energy technologies or undertaking research and development of sustainable energy technologies.

3. Mid and Long Term Scenario

C.Tulloh, M.Ford, D.Gunasekera, "Australia; Energy, Emissions and Technology", 2008

In the study, an enhanced technology scenario is developed and compared with the reference case using ABARE's general equilibrium model of the world economy, GTEM (global trade and environment model). Results of this analysis are presented over the projection period 2004–50.

a) Reference case

The GTEM reference case is a set of projections of economic growth, population levels, industry growth, productivity improvements, energy consumption and greenhouse gas emissions between 2004 and 2050. The key drivers of energy consumption and greenhouse gas emissions in the reference case are economic growth, population growth and the uptake of energy efficient and lower emission technologies and energy sources.

In the reference case, Australian population levels are projected to increase from 20.1 million in 2004 to 28.1 million in 2050. Growth in economic output is determined by growth in labour productivity and labour supply. In Australia labour productivity growth is projected to average 1.8 per cent a year over the projection period and labour supply growth is projected to average 0.6 per cent a

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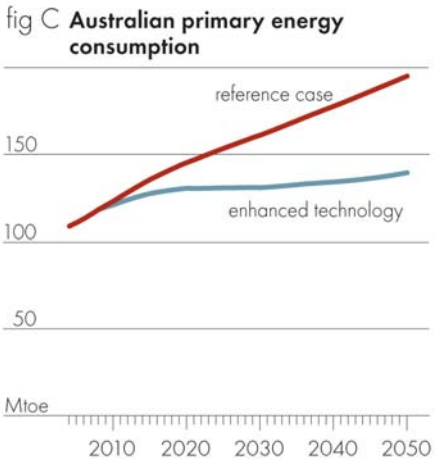
year. As a result, the Australian economy is expected to expand on average by about 2.4 per cent a year over the period 2004-50.

In Australia, fossil fuels are projected to remain the dominant source of energy, however, there is projected to be some growth in the share of non hydro renewables in energy consumption. A moderate level of technological development and uptake of energy efficient and low emission technologies and energy sources is assumed in the reference case, consistent with forecasts by the International Energy Agency, the US Energy Information Administration, various government sources and peer reviewed literature and expert opinion.

b) Enhanced technology scenario

In the enhanced technology scenario a concerted and collaborative global effort is assumed to occur from 2009 across all sectors to accelerate the development, uptake and transfer of energy efficient and low emission technologies and energy sources. This is assumed to occur while simultaneously addressing other concerns such as energy security, environmental amenity and economic and social development needs. This scenario is not intended to be policy prescriptive, but rather it provides an illustration of the potential energy consumption and emission impacts that can be achieved from the widespread uptake of currently available and plausible future technologies across various sectors and regions.

In the short term, the majority of reductions in energy consumption and emissions in the enhanced technology scenario, relative to the reference case, are assumed to be achieved through government efforts to reduce barriers to the uptake of currently available energy efficient technologies. In the longer term, the development and widespread deployment of advanced future energy efficient



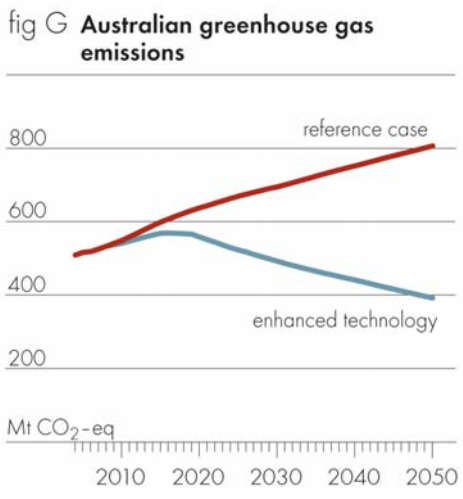


Figure: Estimated energy consumption and GHG emissions

Source: C.Tulloh et al., "Australia: Energy, Emissions and Technology" (2008)

Australia

and low emission technologies and energy services will be critical in achieving significant reductions in energy use and greenhouse gas emissions..

*This chapter is prepared based on the study "Australia: Energy, emissions and Technology" by C. Tulloh, M.Ford, D.Gunasekera for which 2050 Japan LCS scenario study team summarized while adding relevant information.

Brazil

1. Current Status of Emission

GHG emissions in 1990: 593.0 Mt-CO_2eq*

1994: 658.6 Mt-CO_2eq*

Kyoto Target: None

*Source: UNFCCC Greenhouse Gas Inventory Data

2. Countermeasures Currently Conducted

Brazil's energy supply is quite balanced. Although 40% of total primary energy supply (TPES) comes from oil, the remaining 60% are quite well shared among sugar cane products (14%), biomass (13%), hydropower (13%), natural gas (9%), coal (6%), nuclear (3%) and other renewables (3%). Fossil energy accounts thus for 55% of TPES and renewables for 42%. As a consequence, carbon intensity of TPES is low (30 tCO_2/ TJ) of TPES, in despite of the medium-high energy intensity of the Brazilian economy (7.1 MJ/USD). Medium-high energy intensity in Brazil is explained by an industrial sector which accounts for 36% of the GDP and which is strongly based in energy intensive industries.

Therefore, concerning CO_2 emissions, Brazil presents a favorable picture due to its energy structure in which the renewable sources prevail. This causes Brazil to have one of the lowest rates of emission from the energy sector in relation to the world's GDP.

a) Transport Sector

Brazil is historically committed with renewable sources of energy for transport sector – the National Ethanol Program (PROALCOOL) is a good example – and still has a great potential to explore.

Under the National Alcohol Program, around 5.6 million vehicles running on hydrated alcohol were produced from 1975 to 2000. In addition, in this period, ten million gasoline-fuelled vehicles were substituted with 25% of alcohol. In 2004, ethanol corresponded to 37% in volume of the total fuel consumption of light vehicles in Brazil. The program also prompted indigenous technological progress, such as the development of an ethanol fired engine, and more recently, the development of the flex-fuel motors.

Other biofuels tends to be fostered, especially biodiesel obtained from vegetable oils. Besides its use for transport, biodiesel can also be used to generate electricity in remote communities, which represents a key opportunity for biomass use. With the implementation of the National Biodiesel Production and Use Program, launched by the Federal Government in 2004, the Government intends to makes use of a great amount of raw materials for the production of biodiesel (such as palm and castor bean, as well as soybean). The addition of biofuels to diesel, together with the ethanol program, is the main sustainable program for the transport sector.

Brazil

b) Electric sector

In the Brazilian electric sector, more than 90% of all energy generated comes from hydroelectric power plants. However, the best hydroelectric opportunities in Brazil have probably already been exploited, especially in the Center-West, Southeast and South regions, close to the large urban centers. Therefore, emissions of greenhouse gases from the energy sector tend to grow in the next years.

The Federal Government is making all the efforts to stimulate more renewable sources of energy. Brazil has invested in projects of renewable alternative energy, distributed by the Program of Incentive to Alternative Sources of Electric Energy (Programa de Incentivo às Fontes Alternativas de Energia Elétrica - Proinfa) in 63 small hydroelectric power plants, 54 wind parks and 20 thermal units (for investments in energy through biomass).

3. Mid and Long Term Scenario

E.L.La Rovere, et al., "Development First: Linking Energy and Emission Policies with Sustainable Development", CentroClima/COPPE/UFRJ, report for the Development and Climate Project, 2007.

In this study, a reference scenario (RS) and an alternative policy scenario (AS) were analyzed for future energy and emissions future till 2030 for Brazil. MAED and MESSAGE models were used for this analysis. The major hypotheses to build future scenarios concern renewable programs, fuel replacements and energy efficiency.

The RS is similar to the IPCC B2 scenario. In AS, alternative policies for the mitigation of GHG emission in various sectors is considered. For example, the AS expects more diesel exports of up to 20% biodiesel blends.

The figure shows sectoral CO_2 emission projections under RS and AS. Under the AS, CO_2 emission is about 100Mt-CO_2 smaller in 2030 compared to the RS. Especially, the reduction potential of the transport sector is larger than that of the other sectors. It accounts for about 75% of all reduction potential. This is due to the contribution of the energy efficiency improvement of heavy duty vehicles and increase of biodiesel fuel use.

Brazil

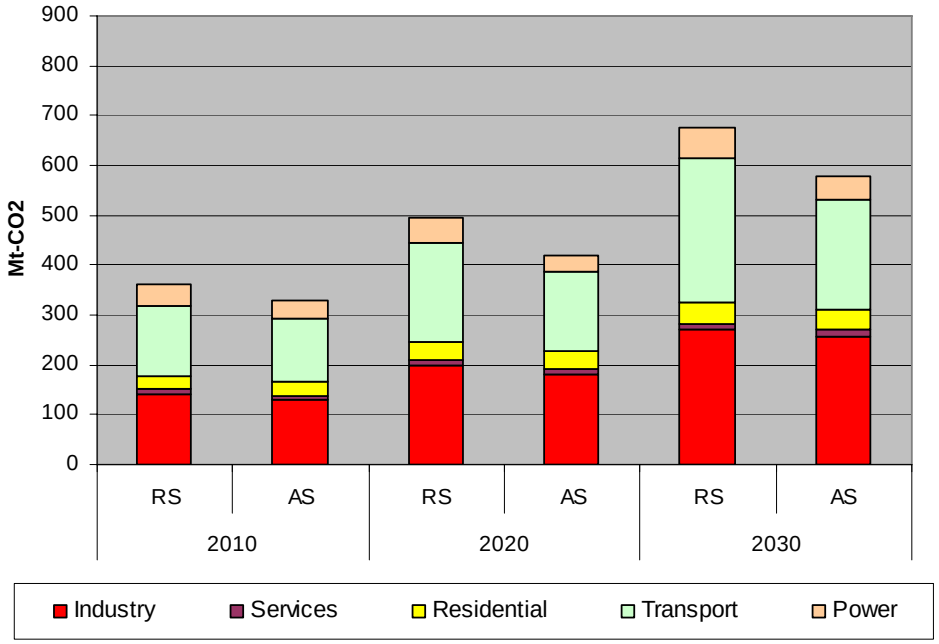


Figure: Brazil's sectoral CO_2 emission projections under a reference scenario (RS) and an alternative policy scenario (AS)

Source: La Rovere et al., "Development First: Linking Energy and Emission Policies with Sustainable Development" (2008)

*This chapter is prepared based on the study "Brazil LCS(Low-Carbon Society) Scenarios Report"(2008) by E.L. La Rovere for which 2050 Japan LCS scenario study team summarized while adding relevant information.

Canada

1. Current Status of Emission

GHG emissions in 1990: 596.0 $MtCO_2eq$*

Current (2005): 746.9 $MtCO_2eq$*

Kyoto Target: -6%

*Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

Greenhouse gas emissions in Canada are currently about 750 $MtCO_2eq$, of which 82% or about 600 $MtCO_2eq$ originates with the production and consumption of fossil fuels, and the remaining 150 $MtCO_2eq$ is from agricultural, industrial and waste management sources, broken down as shown in the Figure below. With a population of 33 million, per capita emissions are therefore in the range of 23 tonnes, among the highest in the world. There are many reasons for this relatively high per capita emission level, chief among them being the role of production and export of energy intensive commodities, including fossil fuel itself, in the Canadian economy.

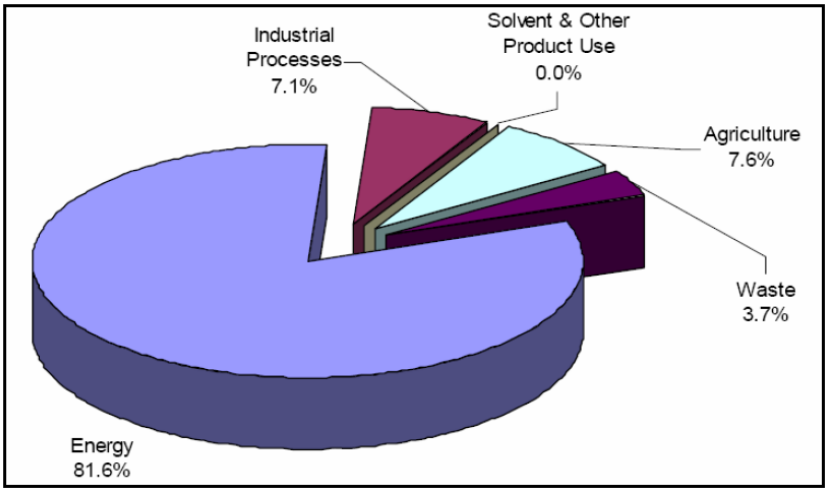


Figure: GHG Sources in Canada, 2005

Source: R. Torrie, "Prospects for a Low Carbon Society: The Case of Canada" (2008)

The next figure illustrates two alternatives for allocating the energy-related emissions. In the Source Allocation, emissions are attributed to their sources, so there is a segment called Power Generation which reflects the greenhouse gas emissions that take place at fossil-fired power plants. The emissions of the Oil and Gas production industry are partitioned into two segments, one representing the portion of this industry's emissions that result from producing and supplying the domestic market for oil and gas fuels, and one representing the portion that corresponds to the emissions related to the production of oil and gas fuels for export. In the Source Allocation frame, the emissions for the final demand sectors (i.e. residential, commercial, manufacturing, transportation)

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reflect only the emissions from the end use consumption of oil and gas fuels.

In contrast, in the End Use Allocation frame, there is no Power Generation sector as these emissions have been prorated to the final demand sectors, as have the domestic portion of the oil and gas industry emissions. The portion of the oil and gas emissions attributed to production for export is the same in both the Source Allocation and End Use Allocation frameworks.

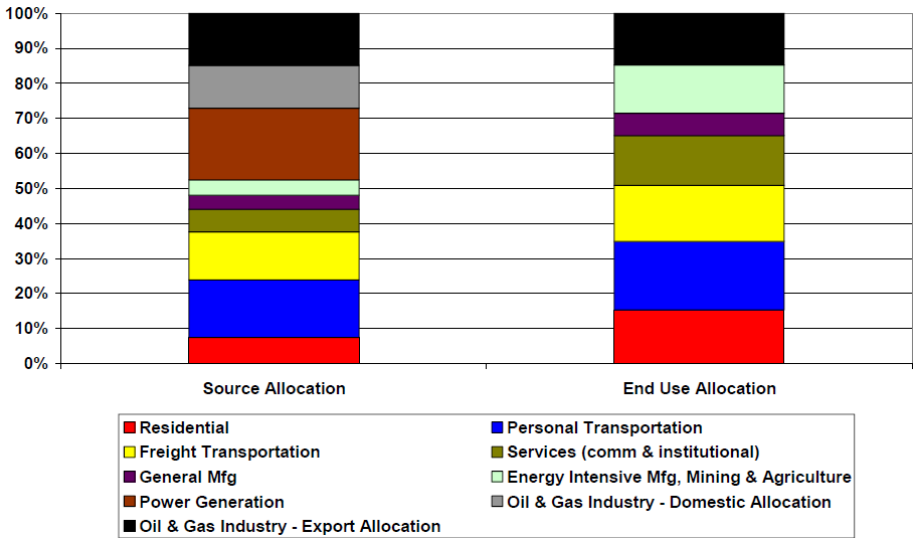

Figure: Energy-related GHG emissions in Canada in 2003

Source: R. Torrie, "Prospects for a Low Carbon Society: The Case of Canada" (2008)

Energy-related greenhouse gas emissions have tracked the growth in fossil fuel consumption, as shown in the Figure, which also shows the relative growth of population and GDP over the same period.

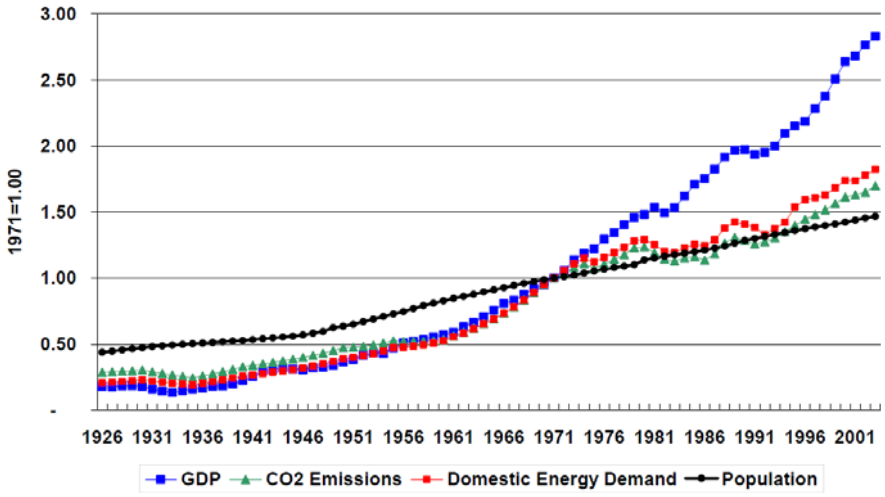

Figure: Relative growth of GDP, domestic energy demand, CO_2 emissions, and population

Source: R. Torrie, "Prospects for a Low Carbon Society: The Case of Canada" (2008)

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The challenge represented by the goal of a low carbon society is evident; it represents a dramatic reversal in a 100 year pattern of increasing fossil fuel consumption and related emissions. Growth in population and economic activity has driven energy consumption and greenhouse gas emissions up for decades, although there are moderating factors at work. There has been a gradual but longstanding reduction in the greenhouse gas intensity of Canadian energy use, reflecting the progressive shift from coal to oil to natural gas. In addition, the development of hydropower resources (and to a lesser extent nuclear power) has allowed several Canadian provinces to produce electricity with lower levels of greenhouse gas emissions than in jurisdictions dependent on fossil fuel-fired power plants.

The second and more important moderating influence on greenhouse gas emissions growth has been the ongoing improvement in the energy productivity of the economy, as measured by the value of economic output generated per unit of energy consumption. Particularly during the past 30-40 years, growth in energy consumption has been moderated by shifts in the output of the Canadian economy from primary to secondary manufacturing and from manufacturing to services, from a move to higher value added production in the primary processing industries, and from increased technological efficiency of fuel and electricity consumption. As is the case with all the OECD economies, for the past thirty years the decoupling of energy commodity and economic growth - in other words energy productivity improvement - has been far and away the largest source of energy security and moderated emissions and environmental stress from the energy system, outweighing the impact of fuel switching and commodity supply growth.

Canadian policy efforts at both the national and provincial level to reduce greenhouse gas emissions have been ineffectual to date. Under the Kyoto Protocol, the Canadian government committed to reducing emissions to six percent below 1990 level by the 2008-2012, currently, emissions are 25% above 1990 levels, or fully a third above the Kyoto target of 564 $MtCO_2eq$. Given the capital stock turnover rates of energy-using technologies, there is no prospect for Canada meeting its Kyoto target, and this is now widely acknowledged. In fact, in the absence of effective federal and/or provincial mitigation policies, Canadian GHG emissions are on a course that will see them raise to 950 $MtCO_2eq$ or more by 2020, at which point they will be 58% above 1990 levels and 68% above the original Kyoto target of 565 $MtCO_2eq$.

The current federal government has committed to reducing emissions to 20% below 2006 levels, or to about 600 Mt (i.e. 1990 levels) by 2020, and to much deeper reductions, on the order of 50% or more, by 2050. Some provinces have declared similar targets, but to date neither the federal nor the provincial governments have implemented or announced policies the would come close to achieving the espoused targets, targets which themselves fall short of what would be required to put Canada on a path to a low carbon society by mid-century.

The most significant policy announced to date (but not yet implemented) is the federal

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government's Regulatory Framework, a scheme that would cap the emissions intensity of the most emissions-intensive industries. There are still many details yet to be determined, but in broad terms the policy would require the regulated industries (power plants, oil and gas producers, industrial chemicals, cement, refining, steel, primary metals, etc.) to reduce the intensity of their greenhouse gas emissions by 18% by 2010 (relative to 2006), and then by an additional two percent per year after that for at least another four years. The policy allows for trading among the regulated industries, as well as for a limited role for domestic and international offsets. If successfully implemented, it is estimated that the Regulatory Framework would reduce emissions in 2020 by about 100-120 $MtCO_2eq$.

Another significant policy initiative, this one taken at the provincial level, is the commitment by the Province of Ontario to phase out all coal-fired electricity generation by 2014. If successfully implemented, this will constitute perhaps the single most effective GHG reduction policy measure taken to date by any North American government. Power plant emissions drop by 85% from 46 $MtCO_2eq$ in 2003 to less than 7 $MtCO_2eq$ by 2014 when the last of the coal plants is retired.

There is without doubt a growing priority being given to greenhouse gas mitigation policy development at both the federal and provincial levels in Canada. Like the federal government, several provinces have targeted bringing emissions down to 1990 levels or lower by 2020, but in general the policies and programs for achieving these targets are still under development, or have yet to be specified at a level of detail that would support assessment of their likely effectiveness. Meanwhile, high oil prices have increased already intensive development activities in the oil and gas production sector, and in particular in the emissions-intensive oil sands. Finally, Canada has been and will be deeply affected by U.S. government policy with respect to greenhouse gas mitigation, policy which seems poised for a reversal.

3. Mid and Long Term Scenario

R. D. Torrie, “Prospects for a Low Carbon Society: The Case of Canada” (2008)

The first low emission scenario for Canada was developed for the David Suzuki Foundation and focused on what it would take to cut Canada's greenhouse gas emissions by 50% by 2030, as illustrated in the following Figure. Utilizing a standard, bottom-up, end use focused methodology; the analysis systematically evaluated the technological potential for reducing emissions in Canada with existing and economically feasible technologies. By far the most important conclusion from the study was that the key to achieving deep and sustainable reductions in greenhouse gas emissions is on the demand side of the energy economy, and it also introduced to the policy debate in Canada the idea the low emission future could bring with it significant economic benefits.

Canada

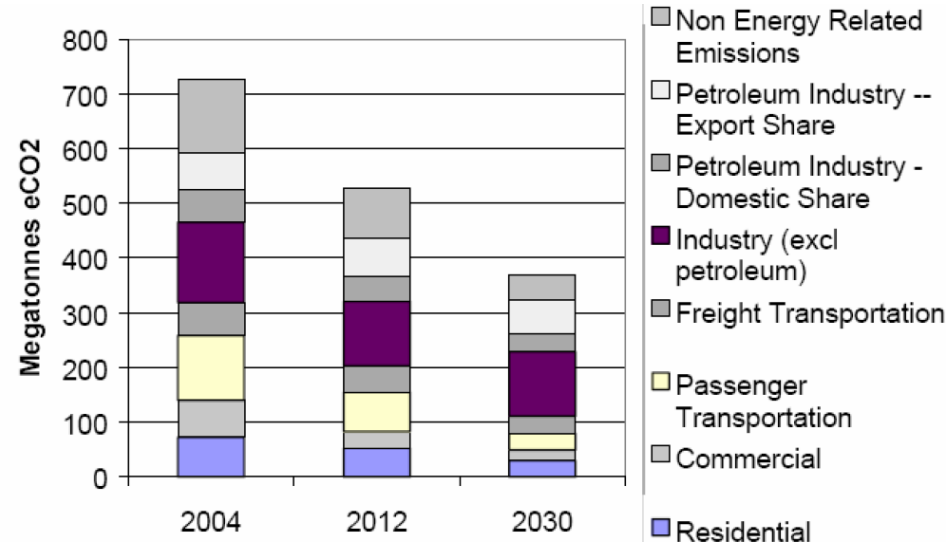


Figure: A low emission scenario for Canada

Source: R. Torrie et al., "Kyoto and Beyond: The Low Emission Path to Innovation and Efficiency" (2002)

The National Round Table on the Environment and the Economy (NRTEE) subsequently sponsored a more detailed "bottom-up" analysis of the technological potential for a deep emission reduction in Canada, this time for a 60% reduction from current levels by 2050. The results were published in the form of a modified Socolow wedge, as shown in the next Figure. Based on this work, the National Round Table developed an advisory note for the government that began to set out the road map to a low emission future for Canada. The key findings of the NRTEE Advisory began to shape the emerging policy for a low carbon society for Canada:

- A low emission future for Canada is possible with domestic solutions, but can be achieved only if energy is used more efficiently and if energy is emitted while emitting less carbon. Improvement in energy efficiency is key to the low emission future.
- Canada's growing oil and gas production sector could be compatible with a low emission future, but only if carbon capture and sequestration can be perfected.
- Increased deployment of cogeneration and renewable electricity will be needed to transform the power sector to a low emission regime, along with clean coal technology incorporating CCS.
- There is an urgent need for a long term policy signal to give the private sector the confidence it needs to bring GHG considerations into investment decisions.
- Air pollution and other co-benefits of GHG emission reduction measures are important to both the implementation and the acceptance of the low emission future.

Canada

Work is continuing on refining our understanding of what a low emission future would like for Canada, and the policies and programs that would get us there. Recent work has coupled macroeconomic models with multi-sector energy and emissions models in order to evaluate the economic impacts of greenhouse gas reduction policies. While the policies typically subjected to such analysis fall short of those that would be required to achieve deep emission reductions, they do indicate that the net economic impacts of the portfolio of GHG reduction policies currently in vogue in North America (e.g. carbon cap-and-trade; efficiency standards for buildings, cars and appliances; renewable portfolio standards, etc) will have modest and possible net positive impacts on employment, net output and per capita disposable income, even without, even without valuing the environmental damage avoided by the lower emissions.

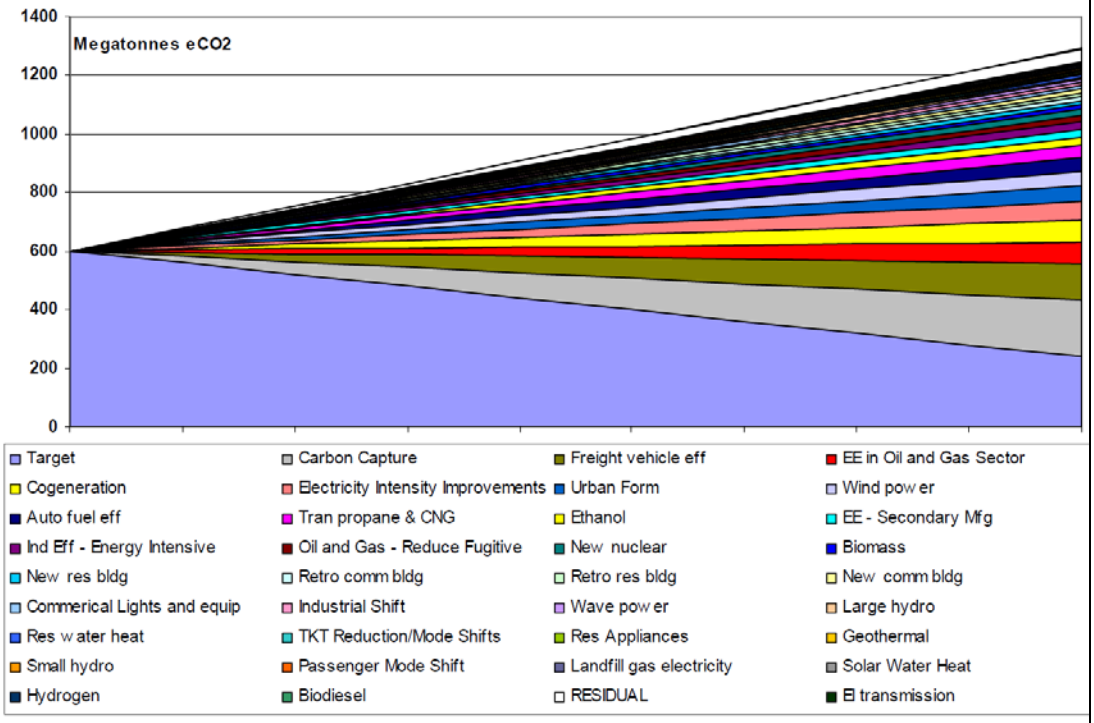


Figure: GHG Reduction wedges for Canada – All wedges

Source: R. Torrie et. al, "Energy Related Greenhouse Gas Emissions in Canada in 2050 - A Low Emission Scenario", prepared for the National Round Table on Environment and the Economy, Ottawa (2006)

*This chapter is prepared based on the study "Prospects for a Low Carbon Society: The Case of Canada" by R. Torrie for which 2050 Japan LCS scenario study team summarized while adding relevant information.

China

1. Current Status of Emission

GHG emissions in 1994: 4,057.6 Mt-CO_2eq*

Kyoto Target: None

*Source: UNFCCC Greenhouse Gas Inventory Data

2. Countermeasures Currently Conducted

Recent rapid growth of energy use in China exerts great pressure on energy supply and environment. Total primary energy consumption increased from 400 Mtoe in 1978 to nearly 1520 Mtoe in 2005, with an annual average rate of increase of 4.7%. Rapid increase of energy use in China brought large amount of CO_2 emission in China. If there is no change for the trend of energy increase, it is believed the CO_2 emission will overpass United State in near future to be the No.1 country in the world.

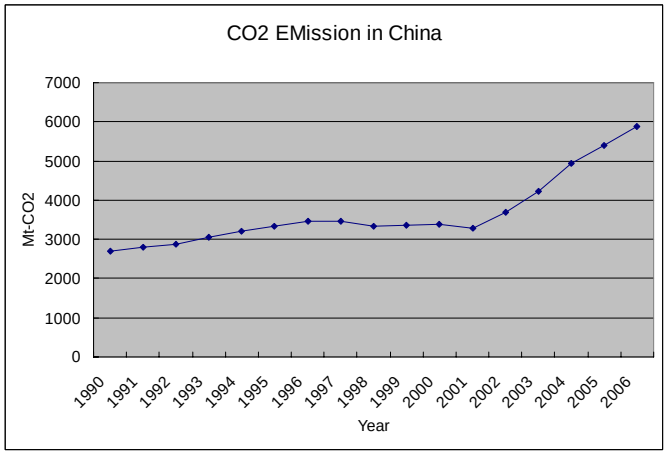


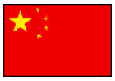
Figure: CO2 emission in China
Source: H.Xiulian et al., "Low Carbon Scenario for China: Cost and policy Options" (2008)

a) Government programs to promote energy efficiency under the 11th 5-year plan

In November 2004, China Medium and Long Term Energy Conservation Plan was announced. This plan aims to push the whole society towards energy conservation and energy intensity reduction, to remove energy bottlenecks, to build an energy saving society, and to promote a sustainable social and economic development and thus realize the grand objective of building a society that is well-off in every aspect.

The programming period is divided into the Eleventh Five Years Plan period running to 2010 and the period from 2010 to 2020. The energy conservation objectives and the focus of development by 2010 are essentially planned, whereas the objectives stated for 2020 are proposed.

- **Macro energy conservation indicators** : Energy consumption per 10,000 Yuan GDP (constant price in 1990, the same below) is expected to drop from 2.68tce in 2002 to 2.25tce in 2010 and to 1.54tce in 2020, with an annual average energy conservation rate of 3% from 2003 to 2020.
- **Energy Consumption indicators per unit of major product** : By 2010, China's products as a whole are expected to reach or approach the advanced international level of the early 1990s in terms of the indicators, of which large and medium sized enterprises are



China

expected to reach the advanced international level at the beginning of the 21st century; and by 2020 China is expected to reach or approach the international advanced level.

- **Energy efficiency indicators of major energy consuming equipment**: By 2010, energy efficiency of newly added major energy consuming equipment is expected to reach or approach international advanced level, and some automobiles, motors and household electric appliances are expected to reach the international leading level.

b) Renewable energy development and nuclear energy development plan

In 2005, China announced Renewable Energy Law, energy development target was given by raising share of renewable energy to 15% in 2020. Later the renewable energy development plan was developed, major renewable energy development target by 2020 is given as following:

- Wind: 30GW
- Solar Power PV: 1.8GW
- Solar heater: 300million m2
- Biomass Power: 30GW
- Biomass Diesel: 2Mt
- Biomass: 10Mt
- Biomass solid fuel: 50million ton
- Small Hydro: 80GW

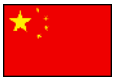
According to "National Energy Plan", published by NDRC in 2005, total nuclear power generation should be 40 GW by 2020, while new plants generating 18GW will be under construction at the same time.

c) National Program on Climate change

In June 4, 2007, the National Program on Climate Change (NPCC) was released. This is the first one in developing world and plays a milestone role. This document specified China's objectives, basic principles, key activities and projects, as well as policies and measures for the country as a response to climate change up to the year 2010. According to the National Program, China will commit to seriously complete in the same period all the tasks under the National Program, strive to construct a resource-conservative and environment-friendly society, build up national capacity to mitigate and adapt to climate change, and make further contribution to the protection and understanding of the global climate system.

3. Mid and Long Term Scenario

In the study titled "Low Carbon Scenario for China: Cost and Policy Options" by H.Xiulian and J.Kejun, four scenarios were developed for China. The baseline scenario and other scenarios were



China

formulated by defining several key driving factors such as GDP growth, population, energy efficiency improvement, etc. Four scenarios include baseline scenario, low energy future scenario, low carbon scenario, global 50% reduction scenario. They are explained as follows:

- **Baseline scenario**: This scenario gives a basic trend to describe future economic activities. Energy policies will continue with existing policies, technology progress keep moderate rate, as seen in past decades.
- **Low energy future scenario**: Various energy and emission control policies are assumed for this low energy future scenario, which reflects energy supply and environmental constraints. Further more policies on energy then existing policies will be adopted in order to get into a low energy future. Based on previous studies, there are still space to increase energy efficiency for industry, transport and building before 2030. That means by 2030 full effort will be given to reach a highest level of energy efficiency for major energy intensive industries in China.
- **Low carbon society scenario**: Based on the low energy future scenario, give climate change to be an important factor in social economic development, more effort will be given to GHG mitigation in China with domestic policies and moderate cost on the mitigation. Climate change oriented policies such as carbon tax and emission trading will be used.
- **Global 50% reduction scenario**: This is a scenario to analyze the possibility to reach global 50% emission reduction by 2050, as proposed in 2007 G8+5 Summit.

CO_2 emission keeps increasing until 2030 in each mitigation scenario. It is expected to have emission reduction after 2030 by various policy options. By 2030, CO_2 emission will increase to 2.2 billion t-C in Global 50% reduction scenario, 2.6 times of that in 2000. By 2050, it is possible to go down to 1.3 billion t-C, 60% of that in 2030, and 1.5 times of that in 2000.

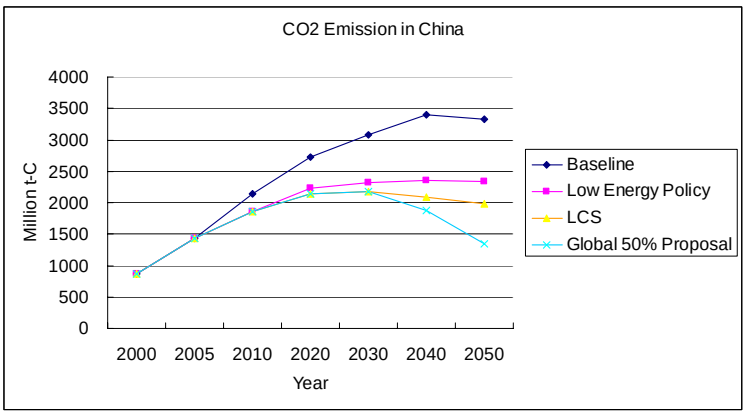


Figure: Estimated CO2 emissions

Source: H.Xiulian et al. "Low Carbon Scenario for China: Cost and policy Options"(2008)

*This chapter is prepared based on the study "Low Carbon Scenario for China: Cost and Policy Options" (2008) by H.Xiulian, J.Kejun for which 2050 Japan LCS scenario study team summarized while adding relevant information.

Denmark

1. Current Status of Emission

GHG emissions in 1990: 70.4 $MtCO_2$

Current (2005): 65.5 $MtCO_2$

Kyoto Target: -21%

*Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

The developments in Danish gross energy consumption over the last 35 yeas are shown in the Figure below. In spite of significant economic growth, it has been possible to maintain the gross energy consumption at a reasonably constant level. At the same time, the actual CO_2 emission from energy sector (excluding transport) decreased by 19% from 1990 to 2005. If foreign trade in electricity and seasonal variations in temperature are taken into account the decrease is 30%. The most important tools in achieving this have been the insulation of buildings and improved fuel efficiency, particularly through co-generation of electricity and heat. For the period 2006-2013, the energy saving agreement lays down a target according to which the annual effect of the energy savings activities must correspond to 1.7% of the energy consumption in 2003.

The share of renewable energy has also grown and now covers 16% of gross energy needs. At the same time, Denmark has succeeded in developing its energy system so that wind power covers almost 20% of the present electricity consumption.

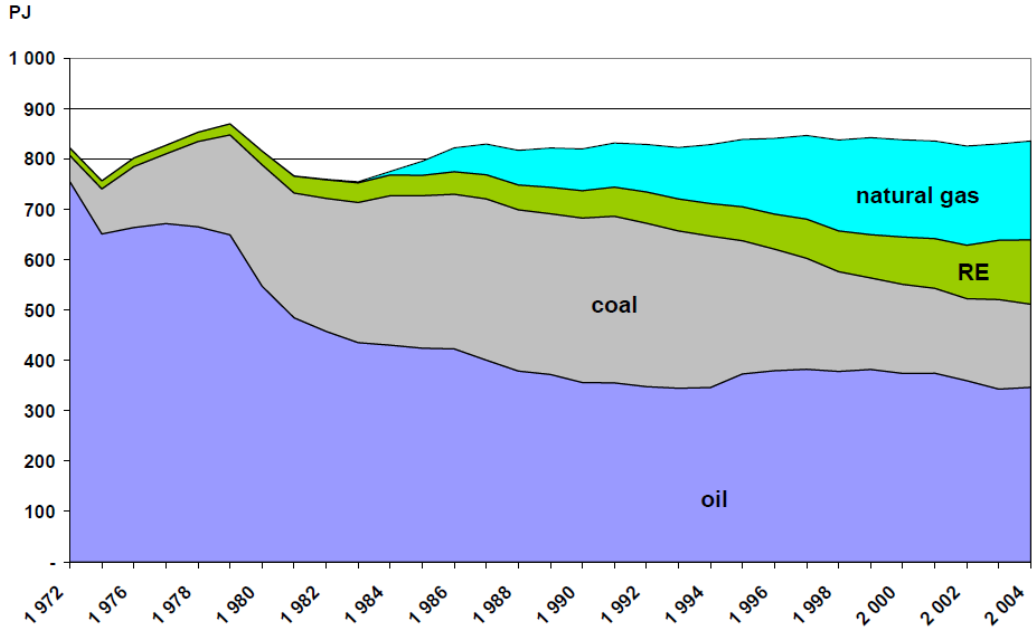


Figure: Trends in Danish gross energy consumption (Foreign air and sea carriage is not included)

Source: Ea Energy Analyses, "Danish Greenhouse Gas Reduction Scenarios for 2020 and 2050"

Denmark

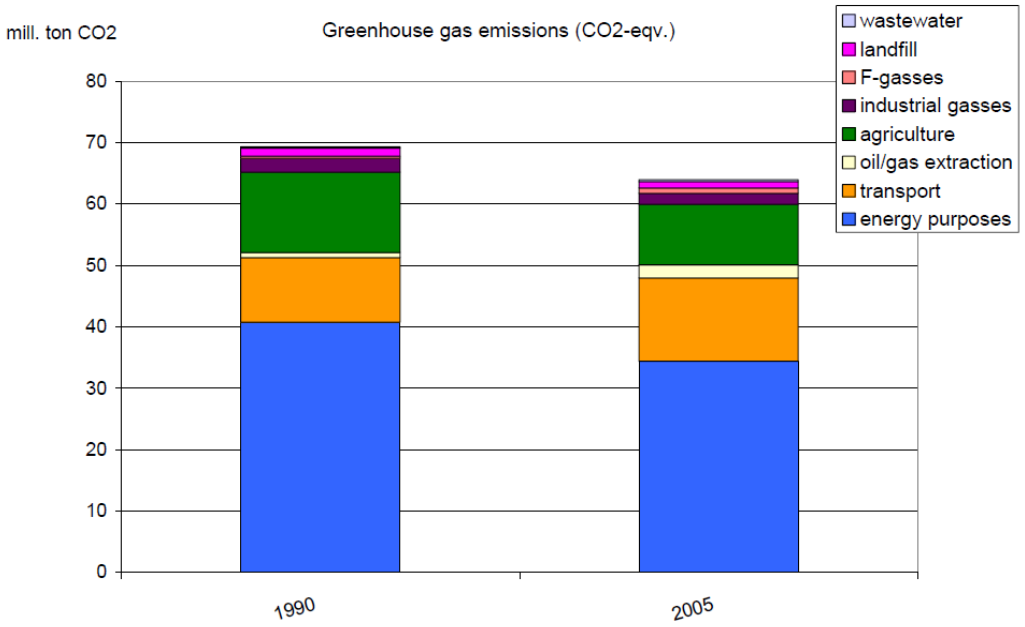


Figure: Danish greenhouse gas emissions in 1990 and 2005 distributed on sources

Source: Danish National Environmental Research Institute, "Submission to EU inventory" (2007)

3. Mid and Long Term Scenario

In the project, seven different scenarios for the future have been analysed. This includes two reference forecasts for 2020 and 2050 respectively. All scenarios assume the same economic growth rate (approx.1.9% p.a.) and the same increase in the demand for energy services.

Increased use of renewable energy, improved efficiency and energy savings are the central measures in the reference scenarios and the reduction scenarios.

The references are used as a basis of comparison for the reduction scenarios. In the references, continued active efforts as regards energy savings, improved energy efficiency and renewable energy are presumed. It is thus assumed that the energy savings initiatives set out in the Danish government's action plan from 2005 are continued. This implies that the end consumption of energy, excluding transport, declines slightly from 450 PJ in 2006 to approx. 435 PJ in 2020. The end consumption of energy reflects the energy consumption by the end consumers of the private and public sectors as well as of households.

To reach an end-use of 435 PJ in 2020, savings of approx. 1.6 % per year in the end consumption of energy (excl. the transport sector) must be implemented. Without efficiency improvements and energy saving measures, end consumption would increase to approx. 567 PJ in 2020.

Denmark

Table: Overview of the analysed scenarios

	2020			2050			
	Reference	**Combi-30%**	**Combi-40%**	**Reference**	**Red.- 60%**	**Red.- 80%-RE**	**Red.- 80%-CCS**
Energy savings**	1.6% p.a. 435 PJ	2.7% p.a. 363 PJ	2.7% p.a. 363 PJ	0.8% p.a. 609 PJ	1.5% p.a. 448 PJ	1.7% p.a. 409 PJ	1.5% p.a. 448 PJ
Transport efficiency***	+10% 150 g CO2/km	+10% 150 g CO2/km	+20-25% 125-130 g CO2/km	Approx. +15% 140 g CO2/km	+50-60% Approx. 75 g CO2/km	+50-60% Approx. 75 g CO2/km	+50-60% Approx. 75g CO2/km
Transport fuels/techs.****	8 % bio.	10% bio 5% el	15% bio 10% el	10% bio 5% el	45% el 20% h^2 10% bio	55% el 35% h^2 10% bio	45% el 35% h^2 10% bio
Renewable energy share of gross energy	21%	30%	39%	20%	75%	100%	58%
Electricity supply	Continuation of present system 18% wind 15% bio/waste	More RE 35% wind 22% bio/waste	Considerably more RE 40% wind 31% bio/waste	Continuation of present system 20% wind 11% bio/waste	Considerably more RE 60% wind, 22% bio/waste 2% solar 2% wave	Pure RE 70% wind 27% bio/waste 2% solar 1% wave	RE+CCS******* 50% wind 16% bio/waste 1% solar 1 % wave 37% CCS
Need for biomass import	0 PJ	0 PJ	42 PJ	0 PJ	137 PJ	211 PJ	99 PJ
Agriculture	NERI forecast to 2020	NERI forecast to 2020	NERI forecast to 2020	NERI forecast to 2030*	NERI forecast to 2030*	NERI forecast to 2030*	NERI forecast to 2030*

* NERI (National Environmental Research Institute) projections are only available up till 2030. Emissions from agriculture are assumed to remain unchanged in the remaining period 2030-2050. ** End consumption of energy excluding transport. *** average efficiency of the car fleet. **** Share of transport work by cars. Bioethanol is assumed to be produced by means of second generation technology. ***** CCS technologies are used on coal fired plants as well as on biomass fired plants. The latter therefore lead to a net reduction of CO2.

Source: Ea Energy Analyses, "Danish Greenhouse Gas Reduction Scenarios for 2020 and 2050"

After 2020, the end consumption of energy in the reference scenario rises and in 2050 it is 608 PJ. However, this development implies continued savings, because the end consumption of energy on the demand side would have risen to nearly 900 PJ in 2050 if no savings measures had been implemented.

In the reduction scenarios, further savings measures are implemented on the basis of the technical savings potentials stated in the background material for the Danish Energy Authority's energy savings plan from 2005. In all reduction scenarios, the savings efforts are greater than in the reference scenarios.

In the transport sector, it is assumed that more fuel-efficient means of transport are used in 2020 in all the scenarios. In the reference, it is assumed that the fuel efficiency of the fleet of cars is improved by 10% compared to the present level due to more rigorous international requirements. In the most ambitious reduction scenario, an improvement of 20-25% is assumed thanks to a combination of national and international measures. This corresponds to CO_2 emission of 125-130g/km for an average car in 2020 compared to approx. 170g-CO_2/km today. By way of comparison, the EU Commission has suggested a binding agreement with the European motor industry on a maximum average emission

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from new cars of 130g CO_2/km in 2012. Furthermore, biofuels and electric/hybrid cars are introduced in the scenarios at various levels of ambition.

In 2050, hydrogen and electric car technologies are expected to be fully commercialised, playing an important role in all the reduction scenarios. In the 80% reduction scenario focusing particularly on the use of renewable energy, all conventional oil-based fuels have been phased out of the transport sector. Moreover, the fuel efficiency in conventional cars equipped with combustion engines is assumed to have improved noticeably in the reduction scenarios (50-60% compared to the present level, corresponding to 75g CO_2/km).

Although electricity consumption is expected to increase from well over 36 TWh today to just under 40 TWh in 2020, fuel consumption for electricity and district heating production decreases from 369 PJ in 2006 to 339 PJ in the reference for 2020. The reason is that the small-scale gas-fired power plants are assumed to be replaced by new, more efficient plants (Best Available Technology). Moreover, three large coal-fired power plant units are assumed to be refurbished. In this connection is assumed that their electric efficiency increases and that the plants are prepared for up to 50 % co-firing with biomass.

Generally, it is assumed that investors in the electricity sector make their investments expecting that fuel prices will not get any lower than today and that CO_2 has a market value. If investors act on the basis of a short timeframe, there is a risk that the above-mentioned fuel savings potential will not be realised. The assumption that the "Best Available Technology" is used means that the average electricity efficiency will increase from just below 35 % today to almost 40 % in the reference for 2020.

It should be stressed, that the scenarios focus on domestic electricity supply only and therefore it is assumed in the calculations that there is no exchange of electricity with neighbouring countries apart from export of surplus wind power in some of the scenarios. In the real world Danish power producers compete against producers in neighbouring countries and therefore their generation will depend on their competitiveness. Yearly variations in production from the Nordic hydro power plants does among other things determine the need for production at Danish power plants. In dry years Danish power plants will generate more to compensate for the lacking hydro power and vice versa. Sector specific models such as Balmorel are capable of modelling this relationship with a high level of detail. On average, Denmark experienced a net export of 3 TWh per annum during the last 10 years (1997-2006).

The actual exchange of electricity with neighbouring countries will affect the CO_2-emissions from the sector in the scenarios, but not the chance of complying with international reduction targets since the power sector is covered by the present EU emissions trading scheme. This implies that the generators each year are obliged to deliver quotas to the Danish state corresponding to their emissions.

In the reduction scenarios, wind power and biomass become central measures on the supply

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side. In 2020, 40% of electricity consumption is covered by wind power in the most ambitious scenario, and in 2050 wind power accounts for as much as 70% of total electricity production in the 80% reduction scenario focusing on renewable energy. In this respect the transport sector will have a central role as storage for wind power – either in the batteries of the cars or in caverns as a part of the overall hydrogen infrastructure in 2050.

In one of the scenarios for 2050 CCS (carbon capture and storage) technologies are incorporated as a possibility, including depositing CO_2 in geological layers after it has been captured at central power plants. However, a number of important barriers related to CO_2 storage need to be clarified before this technology can be used full-scale in the future. For example CCS technologies have high investment costs and large energy consumption for capturing CO_2, which is expected to result in a loss of 8-10 percentage points of electric efficiency. In addition, even if the risk of seepage from carefully selected storage sites is considered to be negligible, the risk of leakage in connection with extraction, transport and storage processes is considerable. Furthermore, it is generally difficult to carry out long-term monitoring of leakage from storage sites under the seabed, since current satellite technologies cannot "see through water". In the CCS scenario, CO_2 capture technologies are installed at both coal-fired and biomass-fired power plants. The latter will thus contribute to a net reduction of CO_2 emissions.

Compared to the present energy system, gross energy consumption remains more or less constant in the reference for 2020, while it increases considerably towards 2050. However, in all reduction scenarios gross energy consumption decreases significantly.

Today, renewable energy covers approx. 16% of gross energy consumption. In the reference for 2020, this share rises to 21%, in the 30% reduction scenario to 30% and in the 40% reduction scenario to 39%. In the scenarios for 2050, the share of renewable energy increases even further, so that renewable energy covers approx. 75% of total energy consumption in the 60% reduction scenario and 58% in the 80% reduction scenario applying CCS technologies. In the 80% RE scenario, fossil fuels are phased out and fully replaced by renewables.

In the 100 % RE scenario for 2050, it is necessary to import considerable amounts of biomass if it is assumed that the Danish biomass resources for energy purposes are of the same size as today. In this scenario, about 300 PJ of biomass is used (excl. waste and biogas) whereas the present total resource of wood wastes and straw for energy purposes is just under 90 PJ (including biomass from waste land). It will probably be necessary to import a large part of the missing biomass resources from countries outside Europe. Alternatively, Denmark must import a large part of its electricity consumption from neighbouring countries.

If Denmark were to cover its energy consumption with domestic resources only, it would be necessary to increase the use of wind power further or include large amounts of solar energy, wave power and geothermal energy. Photovoltaics and wave power only play a small role in the reduction

Denmark

scenarios because there is a significant degree of uncertainty as to whether these technologies will be competitive with wind power and biomass in 2050.

The larger total energy consumption in the CCS scenario, compared to the other reduction scenarios, is due to the additional energy consumption used to separate CC2 from flue gas at power plants.

The energy consumption in the scenarios has been converted into CO_2 emissions on the basis of the greenhouse gas emission factors of the fuels. Emissions from agriculture (primarily methane and N2O) and from industrial processes etc have been added to this.

The emissions from agriculture are based on a projection of emissions up to 2030, made by the Danish National Environmental Research Institute (NERI, 2007). Over the period 2030-2050, emissions from agriculture are reduced by just below 2 Mt from 10.4 Mt to 8.7 Mt. In the period 2030-2050, emissions are assumed to be unchanged.

The agricultural sector has not been subject to analyses of reduction potentials in this project. However, in parallel to this project, COWI has analysed the reduction potentials and costs in the agricultural sector. According to COWI, it is possible to reduce emissions from agriculture by a further 4.8 Mt, and emissions from industrial processes and waste/sewage can be reduced by 50% (a reduction of approx. 1.4Mt) (Danish Environmental Protection Agency/COWI, 2007).

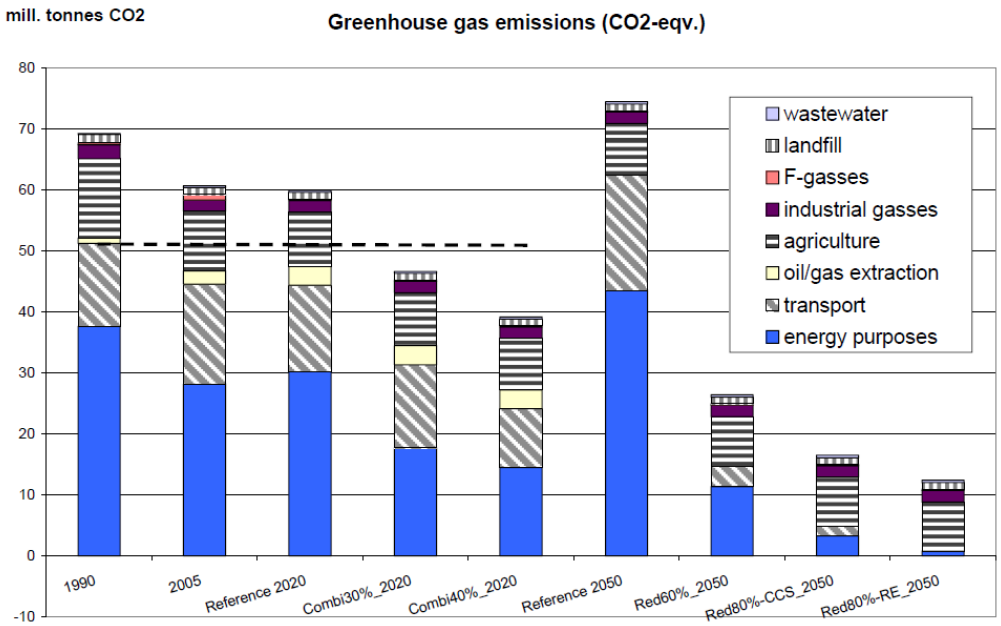

Figure: Greenhouse gas emissions in 1990 and 2005 (actual emissions) and in mercenaries for 2020 and 2050.

The Danish Kyoto objective for the period 2008-12 is indicated by a broken line.

Source: Ea Energy Analyses, "Danish Greenhouse Gas Reduction Scenarios for 2020 and 2050

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The Figure above shows the historical emissions of greenhouse gasses in 1990 and 2005 compared to the emissions in the seven scenarios of the future. It should be noted that the figures for 1990 are based on actual emissions. Today, emissions from the energy and transport sectors account for more than 70% of the total emissions – and in the scenarios, reduction measures are implemented particularly in these two sectors.

The total greenhouse gas emission in the reference for 2020 is approx. 60 Mt, which is 5 Mt more than the Danish Kyoto objective for 2008-2012. This corresponds to a reduction of just under 14% compared to 1990.

In the reduction scenarios for 2020, the emission of greenhouse gasses is reduced to 47 Mt (Combi30%) and 39 Mt (Combi40%) respectively.

In 2050, it is only in the 100% RE scenario that an 80% reduction of the emissions – corresponding to a total emission of just under 14 $MtCO_2$ equivalents – is obtained. However, the CCS scenario is close to attaining the target, and by use of further reduction measures within agriculture, for example, the 80% objective can be achieved.

*This chapter is prepared based on the study "Danish Greenhouse Gas Reduction Scenario for 2020 and 2050" (2008) by K. Karlsson for which 2050 Japan LCS scenario study team summarized while adding relevant information.

European Union

1. Current Status of Emission

The EU-**15** has a commitment under the Kyoto Protocol to reduce the collective GHG emissions by 8 per cent below base-year levels. There is no collective target for EU-**27** emissions. The EU-**15**'s GHG emissions in 2005 decreased by 11% from the base year. In the EU-**27** they decreased by 11%.

The EU-**15**'s GHG emissions in 2010 are estimated to be about 7.4 per cent below base year levels and 0.6% short of the Kyoto target. However, they are expected to be about 11.4% below them by implementing additional policies promptly.

2. Countermeasures Currently Conducted

a) EU-ETS (EU-Emission Trading Scheme)

In January 2005 the European Union Greenhouse Gas Emission Trading Scheme (EU-ETS) commenced operation. The first trading period runs from 2005 to 2007, and thereafter the new periods start every 5 years. Each Member State has to establish a national allocation plan (NAP) for each trading period. In this allocation the Member State decides total number of allowances to be created for the period and the distribution of these allowances to individual plants. This plan must be approved by the European Commission.

CO_2 was the only target in the first period, but the coverage of the scheme are extended in the second period. Those plants which could not meet the target have to pay penalty charges (40 euro/t-CO_2 in the first period, 100 euro in the second period). Each plant is allowed to use credits of CDM/JI (CER, ERU) to fill in gaps. Currently, energy conversion sector and industry sectors are affected, while the extension to transportation sector is under discussion.

b) Legislation to reduce the average CO_2 emissions of new passenger cars

In December 2007 the European Commission proposed legislation to reduce the average CO_2 emissions of new passenger cars in the EU to 120g/km by 2012. In this proposal the average CO_2 emissions of new passenger cars will be required to be less than 130g/km, and the remaining 10g/km will be achieved by complementary approaches; such as tyres, air conditioners or the use of biofuels.

The limit value curve of CO_2 emissions is defined according to the mass of the vehicle. Therefore manufacturers will still be able to make cars with emissions above the limit value curve as long as the fleet average remains at 130g. This will be the basis of the EU's strategy to reduce CO_2 emissions from passenger cars, which account for about 12% of the EU's CO_2 emissions.

European Union

3. Mid and Long Term Scenario

a) Energy Policy for Europe/ 2007

In January 2007 the European Commission proposed a comprehensive package of measures to establish a new Energy Policy for Europe. The proposals set out series of ambitious targets on greenhouse gas emissions and renewable energy to be met by 2020. They consist of 3 pillars as listed below.

- A true internal energy market

  It proposed to build a true internal energy market not only for climate change but also for sustainability and energy security.

- Accelerating the shift to low carbon energy

  It proposes a binding target to increase renewable energy sources' share to 20% (from 6.5% today), and to increase that of biofuels for transport to 10%.

- Energy efficiency

  It reiterates the objective of saving 20% of total primary energy consumption by 2020. It would be achieved by efficient vehicles, tougher standards and better labeling on appliances, energy performance of existing buildings, improvement of efficiency of heat and electricity generation, transmission and distribution.

The main targets and policies proposed here were endorsed by the European Council held in Brussels in March 2007.

b) Limiting Global Climate Change to 2ºC - The way ahead for 2020 and beyond/ 2007

In January 2007 The European Commission presented a communication entitled, "Limiting Global Climate Change to 2ºC - The way ahead for 2020 and beyond".

This is a proposal that developed countries reduce their GHG emissions by 30% by 2020 (compared to 1990 levels), which is necessary to ensure 2ºC limit. This also mentions that the EU takes on a firm independent commitment to achieve at least 20% GHG reduction by 2020, until an international agreement is concluded. As for the long-term target, it mentions that global GHG emissions must be reduced by 50% by 2050, and those from developed countries should be reduced by 60-80% by 2050. The main targets proposed in this communication were approved by the European Council held in Brussels in March 2007.

c) Action Plan for Energy Efficiency/ 2006

In October 2006 European Commission presented its action plan to realize the estimated savings potential of over 20% of the EU's annual primary energy consumption by 2020, compared

European Union

with the BaU scenario. Building on existing EU energy efficiency legislation, the plan foresees 10 particularly important priority actions covering all energy sectors. The main targets and policies proposed in this action plan were approved by the European Council held in Brussels in March 2007.

- Appliance and equipment labeling and minimum energy performance standards
- Building performance requirements and very low energy buildings ("passive houses")
- Making power generation and distribution more efficient
- Achieving fuel efficiency of cars
- Facilitating appropriate financing of energy efficiency investments for small and medium enterprises and Energy Service Companies
- Spurring energy efficiency in the new Member States
- A coherent use of taxation
- Raising energy efficiency awareness
- Energy efficiency in built-up areas
- Foster energy efficiency worldwide

France

1. Current Status of Emission

GHG emissions in 1990: 564 Mt-CO_2eq*

Current (2005): 558.4 Mt-CO_2eq*

Kyoto Target: 0%

* Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

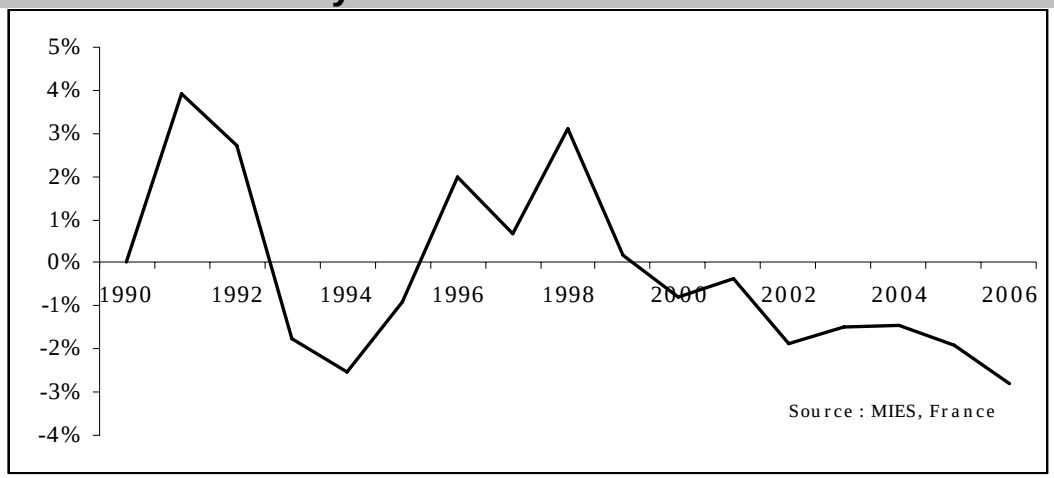


Figure: GHG Emissions from France

Source: MIES,"La division par 4 des émissions de dioxyde de carbone en France d'ici 2050" (2004)

Intend to meet the Kyoto Target, in 2004 a new measure named "Climate Plan" has been introduced to complement "National Program against Climate Change" which was delivered in 2000. In "Climate Plan", BaU emissions are projected to increase 620 $MtCO_2$-eq in 2020 (10% above the Kyoto Target). As a countermeasure against this increase, some programs are set up, which are:

- 5.75% biofuel target in 2010
- A larger tax credit for thermic renovation in building
- New taxes and subsidies on new cars in function of their emissions

In 2005, Parliament adopted a law which sets national targets as a 3% per year reduction of GHG and a division by 4 to 5 of national emission in 2050. And in 2007, new domestic tool named "Domestic Project" has started, where a domestic Joint Implementation has been introduced. The tool is expected to foster reduction from 10-15 $MtCO_2$-eq per year.

"Grenelle of Environment" was launched by the newly-appointed President Nicolas Sarkozy in May 2007 to open broad negotiations with various actors. The working group on climate change and

France

energy is set as one of the 6 WGs with an objective to define a path to reach the Factor 4 in 2050, which later created a quite ambitious list of proposed measures in parallel with EU decision including:

- An ambitious renovation plan for existing building, aimed at reducing energy consumption by 12% (resp. 20%) in tertiary (resp. residential) buildings in five years
- For new buildings, a breakthrough towards 30% zero-energy buildings in five years and 100% in 2020
- An increase the share of rail and water freight from 14% to 25% of total domestic freight in fifteen years
- No new road infrastructures, except projects already in the pipe, and systematic priority of investment in railways and waterways

3. Mid and Long Term Scenario

According to the IPCC, 2007, global emissions must fall from 41.2 $GtCO_2$-eq emitted in 2000 down to 20.6 $GtCO_2$-eq in 2050. Assuming an ultimate convergence of per capita emissions in 2050, for equity reasons, and a world population reaching 9.2 billions at the same horizon (which corresponds to the median UN population scenario), per capita emissions should converge to 2.24 tons of CO_2-eq in 2050. Since French per capita emissions were 9.2 tons of CO_2-eq in 2000, the national effort would be a division by 4.1 of per capita emissions.

On the other hand, the factor 4 has been flagged for its simplicity so that it is no use of adhering to the precise value. For example, a recent report from a French advisory council raised a debate by arguing that the right target is a factor 2.6 instead of 4. Although 2.24 tons of CO_2-eq in 2050 is shown above, the factor value of 2.6 tons of CO_2 per capita is introduced in 2050, up from 2.2.

3.1 Government

a) MIES, Mission Interministérielle sur l'Effet de Serre, 2004,

In order to satisfy the Factor 4 target in 2050, 8 alternative energy systems were examined. It concludes that the target is feasible with upcoming technologies and that sufficient flexibility remains for collective choices between the various options, provided that a large use of fossil fuels is avoided in transportation, electric supply and residential heating.

URL : http://www.ecologie.gouv.fr/IMG/pdf/Facteur4-franc_BAT.pdf

b) OE-DGEMP, Observatoire de l'Energie, Direction Générale de l'Energie et des Matières Premières, 2005

It describes a world scenario built from the MEDEE energy demand model and the POLES partial equilibrium energy model. The scenario is based on a global 450 ppm CO_2 target, with a division by 4 of OECD emissions.

France

URL: http://www.industrie.gouv.fr/energie/prospect/pdf/oe-facteur-quatre.pdf

3.2 Others

a) De Boissieu: Division par quatre des émissions de gaz à effet de serre de la France à l'horizon 2050, 2006

It does not develop new scenarios but build a policy-relevant roadmap to reach the target in France. To date, no macroeconomic simulations have been done on the feasibility and the costs of a 'Factor 4' scenario in France because of the lack of ready-to-use energy-economy model for France.

URL: http://www.effet-de-serre.gouv.fr/images/documents/Rapportf4docfse.pdf

*This chapter is prepared based on the study "France LCS(Low-Carbon Society) scenario report" (2008) by R.Crassous-Doerfler, M.Colombier, S.Mathy which 2050 Japan LCS scenario study team summarized while adding relevant information.

Germany

1. Current Status of Emission

GHG emissions in 1990: 1,227.9 Mt-CO_2eq*

Current (2005): 1,001.5 Mt-CO_2eq*

Kyoto Target: -21%

* Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

Germany is making good progress in climate protection. With a greenhouse gas reduction currently at 18 percent, Germany has largely met its Kyoto target for 2008-2012 of a 21 percent reduction compared to 1990. These considerable emissions reductions were achieved for instance by modernizing the energy supply in eastern Germany between 1990 and 1998. Between 1998 and 2005 the government introduced the Ecological Tax Reform (1999), the Renewable Energy Sources Act (2000), the Combined Heat and Power Act (2002) and launched emissions trading (2005). All are important milestones in climate policy.

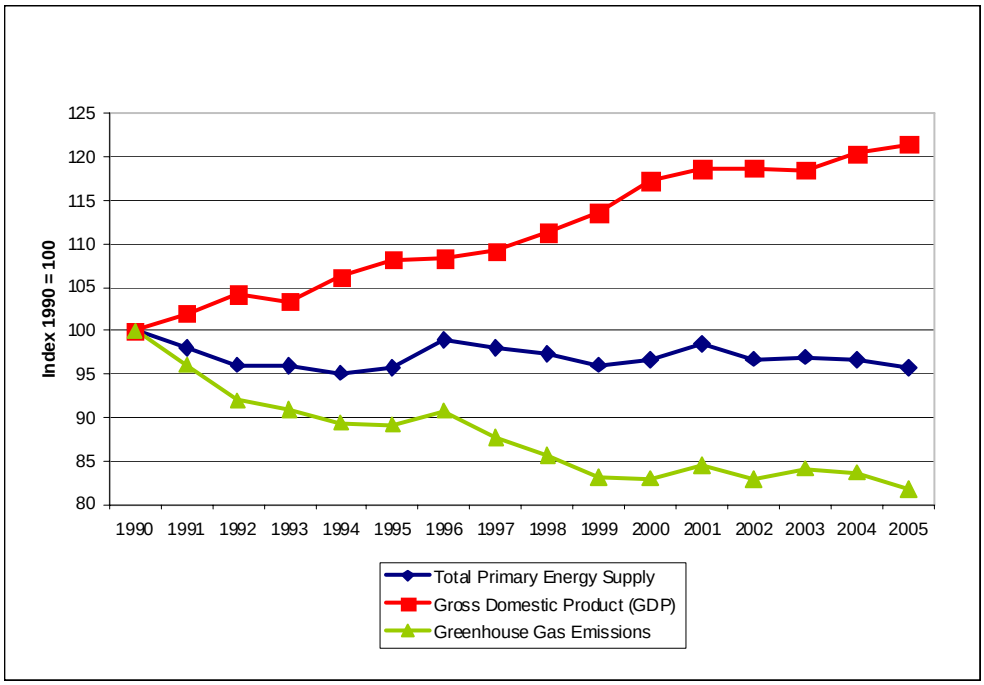


Figure: Decoupling Growth, Energy Consumption and Emissions in Germany between 1990 and 2005

Source: Anna Schreyogg"What is the vision and pathway toward LCS in Germany? "(2007)

Now the 2020 target is coming into view. The present government supports greater emission reduction targets in all industrialized countries and ambitious contributions by newly industrialising

Germany

countries. Due to Germany's pioneering role, we are already introducing measures aimed at reducing Germany's emissions by 40 percent by 2020 compared to 1990.

For this reason, in August 2007 the German government adopted a comprehensive 29 point, package of measures on energy and climate policy. Never before has Germany had such an extensive programme for climate and environmental protection. The new package of measures will provide impetus for all the key CO_2-relevant areas - from electricity and heat production to transport, building modernization and energy efficiency - and promote climate protection. The package contains 21 acts and ordinances and 10 support programs, all aimed at significantly reducing CO_2 emissions.

Funding for climate protection

It has been increased continuously by the German government. For the financial year 2008, a total of 2.6 billion euro is available from the federal budget for climate protection. This is 1.8 billion euro more than in 2005.

Renewable Energy Sources Act

This act guarantees the feed-in of electricity from renewables at a fair and fixed fee. Under the act, fixed fee is laid down for each kilowatt hour of electricity generated from renewables. The additional costs compared with conventional energy production are apportioned among all electricity consumers.

This act has served as a model for more than 30 countries. The expansion of renewables shows how our country profits from its role as a driving force for climate protection: within just two years, from 2004 to 2006, employment in the renewables sector rose by 50 percent. The dynamic employment development in the field of renewable energies will create more than 400,000 jobs by 2020. This generates demand in other industries too and gives the industry sustainable growth in lead markets. Stock prices of companies offering these future-oriented technologies show that the financial world is now also convinced that this road is a viable one. And this positive development looks set to continue.

Germany will restructure its energy supply up to 2020. Electricity from solar, wind, biomass and other renewable energies will then have a share of 25-30 percent. In comparison: in 2000, this share was 6.3 percent and in 2006 around 12 percent. Within the same period, the renewables' share in heat supply will rise to 14 percent, more than twice the current share of 6.3 percent. The relevant technologies are available. They only need to penetrate the market. Corresponding laws are currently being developed.

Germany

3. Mid and Long Term Scenario

"Long term scenarios for sustainable energy future in Germany"(2002): The Wuppertal Institute for Climate, Environment and Energy (WI)

The scenarios were using a GHG reduction target for Germany of 80 percent by 2050, relative to 1990. In order to reach the target, the main measures implemented in the scenarios are efficient energy use, fuel switch from coal to gas in electricity generation and a high share of renewable energies. The scenario includes the phasing out of nuclear power until 2023 and excludes the use of CCS.

The following actions which are derived from the scenario analyses are suggested by WI for Germany:

- Increase in the average energy productivity by 3–3.5 percent for at least two to three decades (compared with approximately 1.7 percent/year in the last decade). This leads to a lower primary energy consumption of 25 percent to 30 percent by the year 2030 compared to status quo conditions.
- Increase of renewable energies in primary energy consumption by 12–15 percent by 2030 and in the generation of electricity by 25 percent, compared to the status quo (4 to 5 percent for primary energy and under 15 percent for electricity).
- Increase the contribution of CHP to energy production by doubling or trebling in comparison to now.

The analyses show that an 80 percent reduction of GHG emissions of Germany until 2050 compared to the 1990 level is possible and economically feasible. However, to reach this target until the middle of the century substantial modifications of our energy system and use as outlined above are needed. The German government's 2007 program for climate and environmental protection is the starting point in a dynamic process of further developments towards the emission reduction targets for 2050 and beyond.

*This chapter is prepared based on the study "Country Low Carbon Society scenario report" (2008) by A.Schreyogg for which 2050 Japan LCS scenario study team summarized while adding relevant information.

India

1. Current Status of Emission

GHG emissions in 1994: 1,214.2 Mt-CO_2eq*

Kyoto Target: None

* Source: UNFCCC Greenhouse Gas Inventory Data

2. Countermeasures Currently Conducted

India's development pathway over the years has been centered on economic and social development with sustainability goals resulting in lower mitigation cost besides creating co-benefits. Sequel to this paradigm, India acceded to the Kyoto Protocol in 2002 without any binding commitment to reduce GHG. For the institutional setting concerning CDM approval, Indian National CDM Authority was established with Ministry of Environment & Forests in December 2003.

In terms of registered CDM projects, India continues a lead in number, accounting for over 35 percent of 771 projects registered by the CDM Executive Board. Expected reduction from 295 registered projects amounts to 200Mt of CO_2 per year during 2008-12.

Besides CDM, India also initiated various measures of energy efficiency, technology interventions, fuel policy, etc.

a) Policy in the Tenth Five-Year Plan (2002)

- Increase in the production of coal and electricity
- Enhancement of domestic exploration and development of oil and gas (including CBM)
- Acquisition of overseas assets and resources
- Promotion of structural reform and deregulation of the energy sector
- Improving energy efficiency by DSM
- Improvement of environment contamination measures

b) Draft for the Eleventh Five-Year Plan (2005)

- Placing a panel of experts for setting comprehensive energy policies
- In particular, focus on improving the efficiency of energy usage

c) Energy Conservation Law (enforced 2002)

Bureau of Energy Efficiency (BEE) enforced Energy Conservation Law under Ministry of Power (MoP) etc.

- Enforcement of Energy Conservation Law
- Establishment of BEE
- Specifying energy-intensive industries, and impose the duty of evaluation reports
- Establish energy funds within the state governments and conduct support measures

India

d) New and Renewable Energy Policy (2005), Ministry of Non-Conventional Energy Sources

The policy is an integral component of national energy policy. Recognizing the changes that are likely to occur in the global energy fuel-mix, production, transmission, distribution, applications and consumption levels apart from the requirement to meet future energy needs, the core drivers of development and deployment of new and renewable energy technologies products and services are as under :

- Lesser dependence on energy imports through a diverse and sustainable fuel-mix in furtherance of National Energy Security;
- Sustaining accelerated deployment of renewable energy systems/devices through indigenous design, development and manufacture apart from creating new sources of energy in furtherance of aim of Energy Independence;
- Expand cost-effective energy supply for achieving per capita energy consumption level at par with global average through increasing share of new and renewable energy in the fuel mix in furtherance of aim of Equity
- Augment energy supply to remote and deficient areas to provide normative consumption levels to all sections of the population across the county through new and renewable energy sources in furtherance of aim of Accessibility;
- Fuel Switching through new and renewable energy system/devices deployment in furtherance of the aim of conventional Energy Conservation.

3. Mid and Long Term Scenario

P. R. Shukla, Subash Dhar and Diptiranjan Mahapatra (2007), Indian Institute of Management, Ahmedabad

In order to assess the Low carbon society scenario, both of AIM and MARCAL has been introduced. At first, as a reference case, Base Case Scenario assumes the future economic development along the conventional path. The annual GDP growth rate 8%/year for the 27 years, and the value matches with the moderate economic growth projections for India (Gov. of India, 2006). Another two alternative scenarios are considered and each of them describes the future to 2050.

a) Carbon Tax Scenario (CT)

This scenario presumes stringent carbon tax (or permit price) trajectory compared to milder carbon regime assumed under the base case. Besides the difference in carbon tax, the underlying

India

structure of this scenario is identical to the Base Case. The scenario assumes stabilization target of 550 ppmv CO_2e. The 550 ppmv CO_2e Stabilization scenario translates to CO_2 concentration stabilization at 480 ppmv, assuming the contribution of Non-CO_2 gases and land-use change to be contributing to the 70 ppmv CO_2 equivalent concentration level. The carbon price trajectory corresponding to Stabilization at 550 ppmv CO_2e concentration target is same as what would for the 480 ppmv CO_2 concentration stabilization target for the CCSP SAP 2.1a equivalent scenario. The carbon price trajectory for 480ppmv CO_2 concentration stabilization, interpolated from CCSP SAP 2.1a stabilization scenarios (Clarke et. al., 2007), is \$10/ CO_2 during the Kyoto protocol period and rises to \$100/ CO_2 in 2050. The scenario assumes greater improvements in the energy intensity and higher target for the share of commercial renewable energy compared to the Base Case scenario.

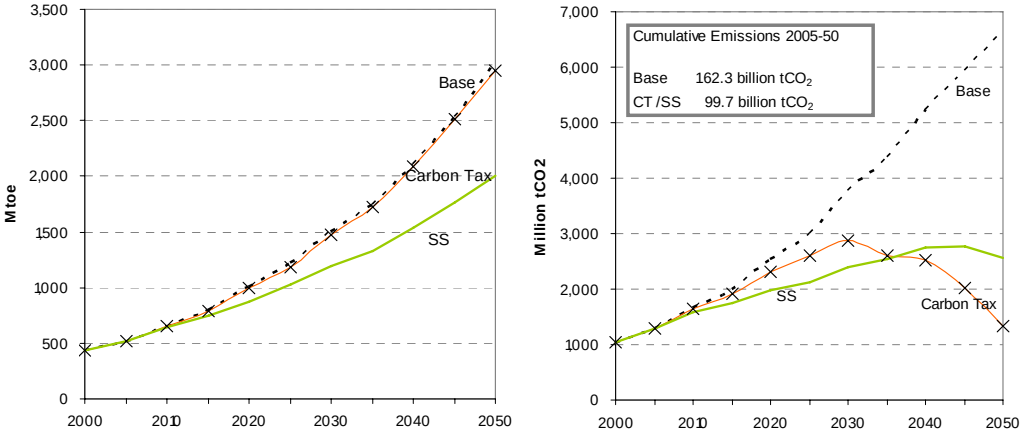
b) Sustainable Society Scenario (SS)

This scenario assumes the underlying socio-economic dynamics like IPCC SRES B1. In addition, the scenario assumes a society which is responding to a globally agreed long-term carbon dioxide concentration stabilization target of 550ppmv. India's Low Carbon Society scenario then aims to generate carbon mitigation and adaptation responses to match the needs of cost-effective 550 ppmv CO_2e global concentration stabilization regime. In comparison with the mild carbon tax assumed in the sustainability scenario, the carbon price trajectory corresponding to the stabilization target is likely to be higher (IPCC AR4 Chapter 3, 2007) since it is explicitly responding to a carbon budget. Hence, India's cumulative CO_2 emissions (from 2005 to 2050) in LCS scenario should be lower than the sustainability scenario. Instead of carbon tax trajectory, the SS scenario assumes a cumulative carbon budget for the post-Kyoto period from 2013 to 2050. The SS scenario will have higher penetration of decarbonisation options like carbon capture and storage (CCS) and new and renewable energy sources.

c) Scenario Comparison

The table below shows the differences between the two scenarios, CT and SS. In SS scenario, mitigation choices are more diverse and include measures that are designed to influence several development indicators simultaneously. SS scenario pays greater attention to public investment decisions, e.g. in infrastructure which lead to modal shifts in the transport sector; and institutional interventions that alter the quality of development. In case of CT scenario, the mitigation measures are more direct and have greater influence on private investments. In developing countries undergoing rapid transitions, aligning the development and carbon mitigation measure have significant advantages.

India



Source: P. R. Shukla et al.,"Indian Institute of Management, Ahmedabad" (2008)

Figure: Energy & CO_2 Emission Trajectories across LCS Scenarios

Table: Contributions to Cumulative Mitigations over Base Case: 2005-50

In Billion Ton CO_2

Mitigation Choice	SS	CT
Electricity (Fuel Switch)	13.4	30.5
Building (Material Design)	4.6	-
Renewable Energy	6.2	2.8
Device Efficiency	6.7	5.9
Material Substitutions	4.9	-
Recycling	1.0	-
Reduced Consumption	8.0	-
Urban Planning	4.7	-
Transport (Modal Shift)	8.6	-
Others	3.8	4.3
CCS	0.5	19.1
Total Mitigation	**62.6**	**62.6**

Source: P. R. Shukla et al.,"Indian Institute of Management, Ahmedabad" (2008)

*This chapter is prepared based on the study "Low-Carbon Society: India Country Report"(2008) by P.R.Shukla, S.Dhar, D.R.Mahapatra for which 2050 Japan LCS scenario study team summarized while adding relevant information.

Indonesia

1. Current Status of Emission

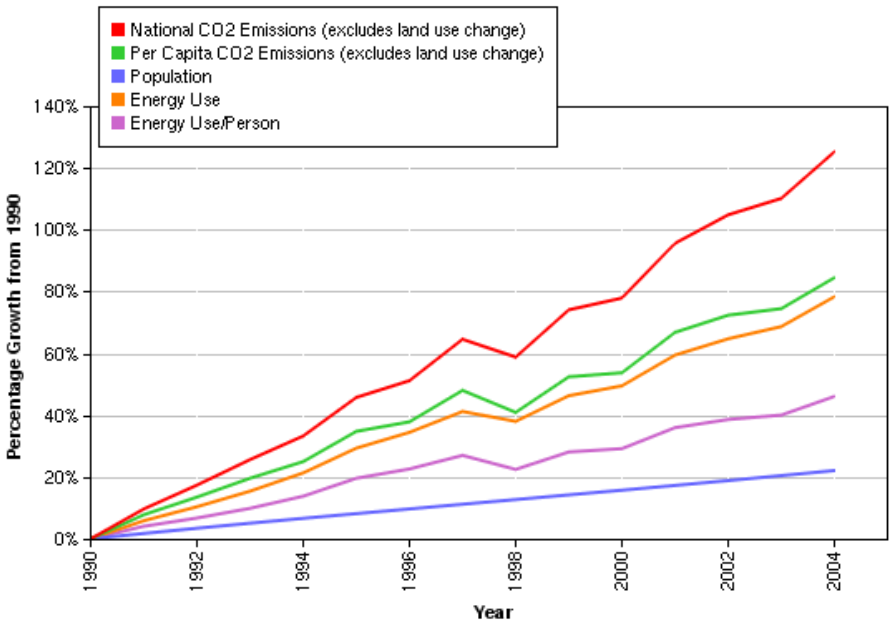
GHG emissions in 1994: 502Mt-CO_2eq*

Kyoto Target: None

* Source: R.Boer, "Indonesia's Plan Towards Low Carbon Society" (2008)

2. Countermeasures Currently Conducted

GHG emission from Indonesia in 1994 was about 1,070 Mt CO_2e with land use change and forestry (LUCF) and 502 Mt CO_2e without LUCF. The largest contribution to the Indonesian GHG emissions was forestry sector and followed by energy. It was estimated that in the period of 1990-2004, the GHG emissions from Indonesia (excluding LUCF) increased quite rapidly, and the percent change of emission within this period compare to 1990's emission was more than 120%.



Source: R.Boer: "Indonesia's Plan Towards Low Carbon Society" (2008)

Figure: Historical trend of population, energy use and emission in the period of 1990-2004 in Indonesia (WRI, 2008)

a)Energy

The total emission from energy sector was 259Mt-CO_2e (in 2003). Due to energy crisis occurred in 2005, government of Indonesia has issued Presidential Regulation (PERPRES) Number 5/2005 on National Energy Policy. Under this regulation the reliance on fossil fuel is reduced by increasing the use of coal and renewable energy from 14 to 33% and from 5 to 17% respectively. It is expected that the emission reduction resulted from implementing this regulation is about 17% from the

Indonesia

BAU emissions.

b)Forestry

This sector is a major contributor to the national GHG emissions. Ministry of Forestry has set up progressive target to reduce emissions from this sector by enhancing carbon sequestration (rehabilitation of degraded land), avoiding deforestation and forest degradation and combating illegal logging and forest fires.

Current law and policy supports a range of measures that can reduce emission from deforestation and degradation that include:

(i) improvement of natural forest and plantation forest management systems through practicing *Reduced Impact Logging* (RIL), to which Indonesia is signatory;

(ii) reduction of reliance on native forest as the source of land for wood chip plantations and estate crops by using already cleared or highly degraded land for these purposes;

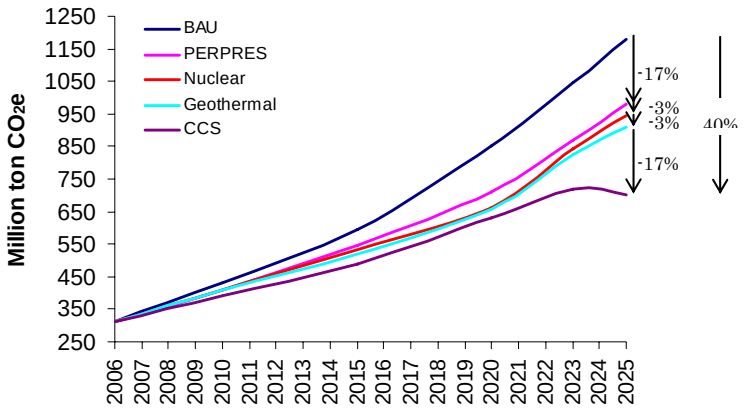
(iii) re-direction of extractive timber operations and conversions for plantations and estate crops away from peat lands and engage in restoration of already cleared peat areas by restoring original hydraulic conditions and encouraging re-afforestation or natural regeneration; and engagement of local communities in conservation and sustainable management of Conservation Forests, Protected Areas and Production Forests.

3. Mid and Long Term Scenario

a)Energy

Further emission reduction can be achieved up to 40% from the BAU emission by increasing the use of geothermal energy, nuclear and carbon capture and storage. A number of policy instruments to support the implementation of mitigation activities have also been issued such as President Instruction (INPRES) on Energy efficiency and Regulation of Energy and Mineral Resources Minister (PERMEN) on guideline for implementing energy efficiency. Cost for the implementation of mitigations activities under PERPRESS (Energy conservation and energy efficiency) will be cost effective but not for the development of nuclear energy, geothermal and Carbon Capture and Storage.

Indonesia

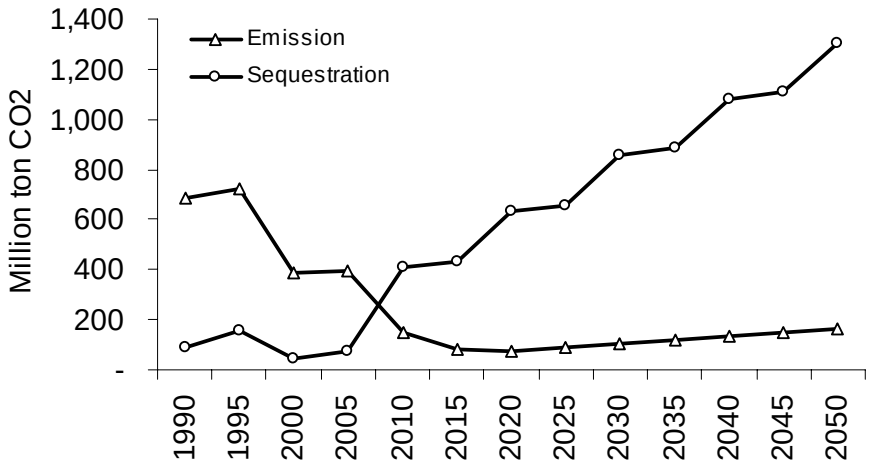


Source: Boer, "Indonesia's Plan Towards Low Carbon Society" (2008)

Figure: GHG emission reduction from BAU under four mitigation scenarios

b)Forestry

Successful implimentation of the mitigation programs, as described in the previous section, will lead to higher carbon sequestraton and lower emissions. In 2025, it is expected that Indonesia will have capacity to sequester 571 $MtCO_2e$.



Source: Boer, "Indonesia's Plan Towards Low Carbon Society" (2008)

Figure: Potential carbon sequestration and emission reduction from LUCF (SME,2007)

*This chapter is prepared based on the study "Indonesia's plan towards Low Carbon Society(LCS)"(2008) by R.Boer for which 2050 Japan LCS scenario study team summarized while adding relevant information.

Italy

1. Current Status of Emission

GHG emissions in 1990: 516.9 Mt-CO_2eq*

Current (2005): 579.5 Mt-CO_2eq*

Kyoto Target: -6.5 %

*Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

The revised Guidelines for national policies and measures for the reduction of greenhouse gas emissions were approved in 2002 by the Interministerial Committee for Economic Planning (CIPE) together with the related National Action Plan (2003-2010). These documents identify the policies and measures already decided, even if not fully implemented, and some other additional measures envisaged to enable Italy to meet its commitment under the Kyoto Protocol.

The competent ministries are currently working on the reviews of the Guidelines to update the national GHG emissions projections and identify additional domestic policies and measures to reach the national target.

Interministerial Technical Committee for GHG (CTE)

The National Action Plan 2003-2010 set up the committee chaired by the Ministry of Environment, Land and Sea. The committee has the responsibility to regularly monitor progress in the implementation of policies and measures, on the basis of indicators and sectoral-level emissions. It also has the task to carry our cost-effectiveness analysis to identify additional measures needed to meet the Kyoto target. The Technical Committee includes representative of the Regions and of the Ministries for Economic Development, Agricultural and Forestry Policies, Infrastructures, Transport, University and Research, Foreign Affairs.

The White Certificates system

The White Certificates system represents a cross cutting policy aimed at promoting energy efficiency and delivering emissions reductions in all the energy end use sectors. Its impacts on GHG emissions reduction have been calculated and reported for each of the relevant sectors – namely the cogeneration, industry and civil sectors – in the pertinent subparagraphs.

Table: National target for primary energy savings

	Target (Mtoe/year)	
Year	Electricity distributors	Gas distributors
2005	0,1	0,1
2006	0,2	0,2
2007	0,4	0,4
2008	0,8	0,7
2009	1,6	1,3

Source: ”Fourth National Communication” (2007)

Italy

The system was firstly introduced in July 2001 by means of two ministerial decrees, later repealed and substituted by two new decrees approved in April 2004. The new decrees set the obligation on electricity and gas distributors with more than 100,000 customers as of 31 December 2001, to achieve the primary energy saving target of 2.9 Mt of oil equivalent per year by 2009. The overall national target was then scheduled annually according to the table in the previous page.

The distributor's quota of national savings is determined according to the ratio of own electricity/gas distributed to the national total in the previous year. The annual energy saving targets can be achieved through the implementation of energy saving projects in all energy end-use sectors. Projects contribute to the achievement of targets for 5 years; only for specific projects the time limit is raised up to 8 years. Compliance with the target is verified through the surrender to the competent authority of the corresponding amount of White Certificates by May 1st of every year, starting with 2006. Each Certificate testifies the saving of 1 Mt of oil equivalent. Only additional savings over legislative requirements can be taken into consideration: projects implemented to abide the law cannot be awarded White Certificates. Projects can be implemented either by distributors – directly or through controlled companies – or by energy saving companies. Target-bound distributors can therefore gain their own certificates, or buy them on the market from other parties. Certificates can be traded bilaterally or else through organized market.

The Green Certificates system

Legislative decree 79/99 introduced the obligation on electricity providers (generators and importers) to feed the grid with a minimum share of electricity produced from renewable energy sources. The obligation started in 2002. The initial share was set at 2% of the overall electricity produced or imported (exceeding 100 GWh), but the increase of this quota over time was already planned in the decree. The law provides for an indirect bonus for cogeneration: in order to calculate the required quantity of renewable electricity, the electricity produced by cogeneration plants is subtracted from the total.

Providers are allowed to fulfill their obligation by different means:

- They can generate the required share of renewable electricity setting up new renewable capacity;
- They can import the required share of renewable electricity from foreign counties where a similar mechanism is in force; or
- They can purchase the relative quota, represented by the so called Green Certificates, on the market.

Green Certificates are tradable rights issued for the first twelve years of incremental generation of renewable electricity (originally 8 years): in order to qualify for the issuance of Green Certificates the plant generating it must have started operation after April 1st, 1999. Each certificate represents 50 MWh and its price is determined by market forces.

Italy

Feed-in tariff for photovoltaic electricity

Decree 28 July 2005 (amended by decree 6 in February 2006) introduced a feed-in tariff system for electricity produced by the photovoltaic conversion of solar energy fed into the grid. The decree provided for a specific twenty-year incentive tariff varying between 0.445 and 0.490 euro/kWh depending on the plant size and on the date of commissioning. The tariff declines 2% per year for the systems installed after December 2006. The declining compensation rate creates an incentive to reduce costs and to implement projects as early as possible. In addition to the twenty year feed-in tariff, system owners also retain the benefits of net metering or on-site consumption of the electricity generated.

The decrees established a target for the rated power to be installed of 1,000 MW by the year 2015 and a maximum limit of the cumulative electric power of all the plants that may benefit from the supporting measures of 500 MW.

The huge number of applications received and the potential for success of this policy paved the way for changes to the existing system. The previous decrees will still apply only to those plants which have already been granted the right to the incentive tariffs by the end of 2006. The decree 19 February 2007 applies to all the applications received after that date.

The new scheme applies to all PV plants connected to the grid with a nominal capacity higher than 1 KWp. The tariffs are still guaranteed for 20 years but they have been slightly changed to further incentive installations integrated in buildings. They vary in relation to the nominal power and the type of the installation, as shown in the table.

Table: Feed in tariffs for photovoltaic plants

	Feed-in tariff (euro cent/kWh)		
System size	not integrated	partially integrated	integrated
from 1 to 3 kWp	40	44	49
from 3 to 20 kWp	38	42	46
over 20 kWp	36	40	44

Source: ”Fourth National Communication” (2007)

Speed up of circulating fleet update, subsidy to change older cars with new ones with average emission of 145 gCO_2/km

With a fleet simulation model it has been estimated the effects of reducing the average CO_2 emissions of all new cars to 140 g CO_2/km. The measure is starting from 1 January 2007, the actual circulating fleet will continue to be renewed at the same path of the more recent years (higher than the average of the last 10 years). The share of diesel and petrol car will be constant at 50-50 with a slight reversal of more recent trends. It is also hypothesized an increase of sales of new vehicles using LPG / natural gas, that contributes to the target emission value.

The results of the simulation are shown in the table below. This type of measure has a limited effect

Italy

in the first years but it continues to deliver in the following years, up to 2020, with sizeable reductions. Actual average emissions are about 150 g CO_2 km (2004). The emission reduction in the years after 2012 are not so high because also in the b.a.u. scenario it is expected an increase of efficiency of vehicles. So tighter standards are certainly needed after 2012

Table: Emissions reduction with new cars at 140 gCO_2/km from 2007, Mton

CO_2 savings	2010	2012	2015	2020
Total	2.96	3.55	4.38	4.40

Source: "Fourth National Communication" (2007)

The case of new fleet at a much lower emission rate, 120 gCO_2/km, from 2010, with additional reductions has been simulated too. The next table shows the additional reductions possible with this tighter standard from 2010.

Table: Additional emissions reduction with new cars at 120 gCO_2/km from 2010, Mton

CO_2 savings	2010	2012	2015	2020
Total	0.0	1.47	2.7	4.7

Source: "Fourth National Communication" (2007)

Use of biofuels

The estimate of the impact of this measure at 2010 is of 2.39 Mt CO_2 per year. In Italy there is the industrial structure to produce this amount of fuel, with row material produced in Italy or imported. The impact is lower than the total potential of the measure because the trend scenario for 2010 already includes a small quantity of biodiesel. The impact of this measure at 2020 is assessed taking into account a share of biofuels of about 10% to replace diesel or petrol for transport purposes.

Table: Summary of policies and measures in the transport sector

Name of policies or measure	Objective and/or activity affected	GHG affected	Type of instrument	Status	Implementing entity or entities	Estimate of mitigation impact, by gas Mt CO_2eq		
						2010	2015	2020
TRANSPORT								
Implemented								
Biofuels	Promoting the use of biofuels	CO_2	regulatory	implemented	Government	2,39	2,41	2,17
Adopted/Planned								
Use of biofuels	Promoting the use of biofuels	CO_2	regulatory	planned	Government	0,00	6,03	8,69
Fleet update	Subsidy to change older cars with new ones with average emissions of 140 g CO_2/km	CO_2	regulatory	planned	Government	2,96	4,38	4,40
Fleet update	Further subsidy to change older cars with new ones with average emissions of 120 g CO_2/km	CO_2	regulatory	planned	Government	0,00	2,70	4,70
New infrastructure in public transport	Reducing private car use and traffic congestion	CO_2	regulatory	planned	Government	0,00	1,35	4,50

Source: "Fourth National Communication" (2007)

*This chapter is based on the materials contributed by F.Bosello with summarization and addition made by 2050 Japan LCS scenario study team.

Japan

1. Current Status of Emission

GHG emissions in 1999: 1,261 Mt-CO_2eq

Current (2005): 1,360 Mt-CO_2eq

Kyoto Target: -6%

* Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

In order to achieve 6% reduction of GHG emission which is Japan's commitment under the Kyoto Protocol, the Government of Japan formulated "Kyoto Protocol Target Achievement Plan" in May 2005. The table shows the target for each origin. Based on the evaluation for the progress, the plan will be revised in March 2008.

Table: Estimated GHG Emissions in FY2010, introduce by "Kyoto Protocol Target Achievement Plan"

	Base year	FY2002		Existing measures scenario	
	Million t-CO2	Million t-CO2	Ratio to base year total emissions	Million t-CO2	Ratio to base year total emissions
Energy-originated CO2	1,048	1,174	+10.2%	1,115	+5.4%
Commercial sector	476	468	-0.7%	450	-2.1%
Non-commercial sector	273	363	+7.3%	333	+4.9%
(Other sectors including offices and other business facilities)	144	197	+4.3%	178	+2.8%
(Residencial sector)	129	166	+3.0%	155	+2.1%
Transport sector	217	261	+3.6%	259	+3.4%
Energy conversion sector	82	82	-0.0%	73	-0.8%
Non-energy originated CO2, CH4, N2O	139	128	-0.9%	130	-0.8%
CO2 not generated from energy	74	73	-0.1%	74	+0.0%
CH4	25	20	-0.4%	20	-0.3%
N2O	40	35	-0.4%	35	-0.4%
Three fluorinated gases	50	28	-1.7%	67	+1.4%
HFC	20	13	-0.6%	46	+2.1%
PFC	13	10	-0.2%	9	-0.3%
SF6	17	5	-0.9%	12	-0.4%
Greenhouse gas emissions	1,237	1,331	+7.6%	1,311	+6.0%

* Due to rounding, the totals in the table above may not match the sum of the columns.

Source: http://www.kantei.go.jp/foreign/policy/kyoto/050428plan_e.pdf

"Keidanren Voluntary Action Plan on the Environment," formulated in 1997 with the target of limiting carbon dioxide emissions in FY2010 to under FY1990 levels, occupies a central role in countermeasures in industrial and energy conversion sectors. 35 industries involve, which cover approx. 80% of total emissions of the sector. The Government of Japan conducts regular follow-ups to improve the transparency, reliability and probability of achieving the targets.

"Top-runner Standards" was introduced in FY1998 based on the Energy Conservation Law. To date, 21 types of equipment have been designated. As for gasoline vehicles, in FY2003 approx. 80% (shipment basis) had already achieved the top-runner standards of FY2010. Regarding residential and service sectors, 19 types of equipment have been designated under the Top-runner Program.

The government collaborates with the business circle, NPOs, the labor circle and researchers to disseminate knowledge and develop national campaigns, such as "Team Minus 6%". Businesses that emit a certain volume of GHG are obliged to report their emissions to the central government since

Japan

April 2006. Penalties will be imposed on those who fail to report their emissions.

The environment tax has been discussed as a price incentive and as a source of funds to implement climate change countermeasures. However, with strong oppositions by industries, the tax system was excluded from the next revision of Kyoto Protocol Target Achievement Plan, along with a cap & trade scheme.

3. Mid and Long Term Scenario

3.1 Government

a) "Cool Earth 50" (2007)

In May 2007, the then Prime Minister Shinzo Abe proposed a long-term strategy named "Invitation to Cool Earth 50" which sets a long-term target of cutting global GHG emissions by half from the current level by 2050 as a common goal for the entire world by developing innovative technologies and building a low carbon society.

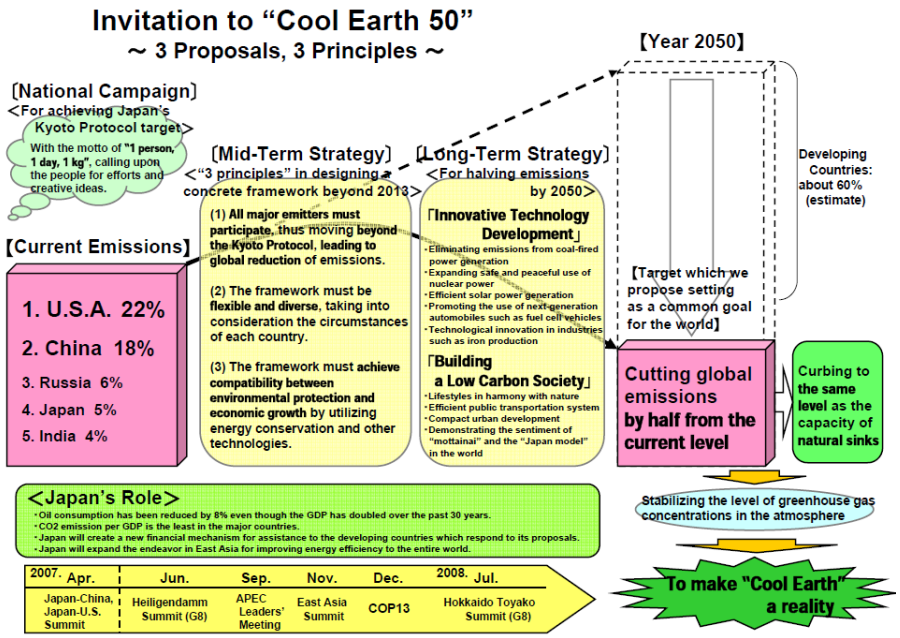


Figure: Overview of "Cool Earth 50"

Source: http//kantei.go.jp/foreign/abespeech/2007/05/24speech_e.html

Japan

b)METI (Ministry of Economy, Trade and Industry): "Energy Supply and Demand Outlook" (2005)

The latest version of the "Long-Term Energy Supply and Demand Outlook", published in 2005, shows that the energy demand in Japan would slow down and then decline in the early 2020s. It also shows that another 50 billion liter of energy could be saved by technology improvements and change of people's awareness.

c)METI (Ministry of Economy, Trade and Industry):"Energy Technology Vision" (2005)

The strategic technology road map of energy sector by back-casting was published to establish strategic energy R&D plans by identifying technology portfolio to prepare for resource and environmental constraints. Three extreme cases were set, and technological specifications in sectors of residential/commercial, transport, industry, transformation were identified under those conditions.

3.2 Others

a) National Institute for Environmental Studies :"Japan Low Carbon Society Scenarios towards 2050" (2004-2008)

A research project on long term climate change policies to achieve low carbon society in 2050 launched in 2004. The narrative storylines, their quantitative scenarios and environmental options which achieve GHG reduction by 70% from 2000 level was developed. The scenarios toward 2050 with back-casting method are being investigated.

URL: http://2050.nies.go.jp/project_e.html

b)RITE (Research Institute of Innovative Technology for the Earth) :"Phoenix Project":(2002-2006)

The purpose this project is to make integrated assessments on the impact and mitigation of global warming. They distinguished the impact of global warming into two types (continuous event and catastrophic irreversible event), and assessed how to set long-term target from a viewpoints of costs, equity and how to avoid catastrophic events.

URL:http://img.jp.fujitsu.com/downloads/jp/jeco/events/ff2006-tokyo1-3.pdf

c)KIKO Network: "Creating a Vision -- Cutting Emissions 30% by 2020"(2006)

KIKO Network has been carrying out a project aimed at achieving by 2020 carbon dioxide emissions from Japan's residential and commercial sectors that are 30% lower than 1990 levels. A report on the results of this project was published in September 2006.

URL: http://www.kikonet.org/english/publication/Sep2006.pdf

Japan

d) Tokyo Metropolitan Government :"10-Year Project for a Carbon-Minus Tokyo" (2007)

Tokyo Metropolitan Government presented its mid-term strategy on climate change to shift CO_2 emissions to a downward trend promptly in June 2007.

e) "Citizens': Open Model Projects for Alternative and Sustainable Scenarios": Citizens' Open Model Projects for Alternative and Sustainable Scenarios (2004)

Two scenarios, "Revival Scenario" and "Switchover Scenario," are proposed by environmental NGO members and experts in the fields of energy and global warming as alternatives of the Government's "Long-Term Energy Supply and Demand Outlook", which is what they call as the "Boiled Frog Scenario."

URL: http://www.isep.or.jp/shimin-enecho/presen_pdf/COMPASS_finalreport_en050428.pdf

Shiga Prefecture

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1. Current Status of Emission

GHG emissions in 1990: 13,423 ktCO_2eq*

Current (2002): 13,470 ktCO_2eq*

* Source: Annual report on the Environment in Shiga Prefecture (2007)
http://www.pref.shiga.jp/biwako/koai/hakusyo19/02hakusyo/02honbun/02-01-03.pdf

2. Countermeasures Currently Conducted

The "Shiga Global Warming Countermeasures Area Promotion Plan" was revised in December 2006, based on the national "Kyoto Protocol Target Achievement Plan" and other more recent factors such as industrial developments in the prefecture.

Table: Shiga GHG Emissions (kt-CO_2eq)

	1990	2002	2010			
			BaU	Reduction	Policy	Reduction rate
CO2 generated from energy	11,803	12,514	14,149	1,912	12,237	13.5
Industry	6,564	5,926	6,130	633	5,497	10.3
Transport	2,897	3,683	4,290	409	3,881	9.5
Domestic	2,341	2,905	3,727	687	3,040	18.4
Residential	1,259	1,587	1,821	251	1,569	13.8
Commercial	1,083	1,318	1,906	435	1,471	22.8
Energy Conversion	0.2	0.5	1.2	183	-182	-
CO2 generated from other	1,251	575	269	105	164	38.9
Waste	101	240	269	105	164	39.0
Other (Industrial process)	1,149	335	0.6	0	0.6	0.0
Subtotal (CO2)	**13,054**	**13,089**	**14,418**	**2,017**	**12,401**	**14.0**
CH4	209	197	204	9	195	4.2
N2O	105	124	144	9	135	6.6
Three fluorinated gases	55	60	60	4	56	6.6
HFC	25	57	57	4	53	7.1
PHC	0.1	0	0	0	0	0.0
SF6	30	4	4	0	4	0.0
Subtotal (Others)	**368**	**381**	**408**	**22**	**386**	**5.4**
Total emissions	**13,423**	**13,470**	**14,826**	**2,039**	**12,787**	**13.8**
CO2 absorption	-	-	-	583	-583	-
Net emissions	**13,423**	**13,470**	**14,826**	**2,622**	**12,204**	**17.7**

In this plan, Shiga prefecture set an original target to reduce GHG emissions to 9% below 1990 levels (by 17.7%, 2.6Mt-CO_2eq below BaU) by 2010 through the steady promotion of existing countermeasures, such as the air environment improvement plan, and by promoting cooperative efforts among all actors, including citizens, businesses and local governments. The substantial contribution of secondary industry to GDP and the high growth rate in the number of automobiles are cited as characteristics of the Shiga prefecture. Countermeasures in the industrial sector and transportation sector are therefore very important.

The population growth rate of this decade in Shiga prefecture is the highest in the country, and the rate of usage of all major electric appliances is higher than the national average. For this reason, urgent action in the residential sector is also required.

The following are measures that can be taken by the actors towards achieving the targets:

Firstly, citizens need to maximize their efforts towards energy and resources savings in all activities, use environmentally-friendly vehicles, save energy in their homes, introduce new energy sources, and so forth. The total expected GHG reductions are 230kt-CO_2 eq.

Secondly, businesses need to promote the air environment improvement plan, maximize energy and resources savings in their business activities, introduce new energy sources, and so forth. The total

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expected GHG reductions are 1,434kt-CO_2eq. Finally, the local government needs to continue to undertake the promotion of climate change measures by citizens and businesses, the promotion of environmental education, the promotion of infrastructure improvement, and so forth. The total expected GHG reductions are 959kt-CO_2eq. The following are specific examples of the projects Shiga prefecture is currently undertaking:

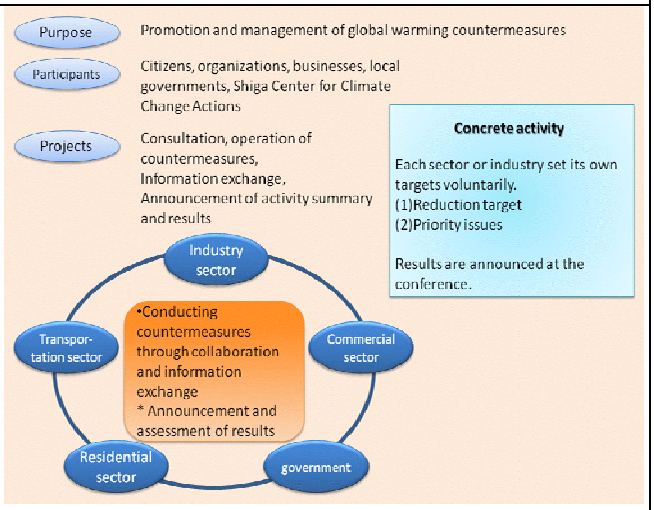

Figure: Shiga Global Warming Countermeasures Promotion Conference

The Shiga Global Warming Countermeasures Promotion Conference (tentative) is an event which helps various actors such as citizens, businesses, local governments and NPOs to conduct their own countermeasures independently. The actors will be urged at the conference to act collaboratively and effectively by sharing information.

The Shiga Center for Climate Change Actions was originally established in 2000, with the aim of enlightening people on global warming. It has successively expanded its function as a hub of climate change actions. For example, it is conducting the Eco-Car Meister System (a project to train personnel to provide environmental information when selling automobiles) as well as providing up-to-date environmental information by e-mail magazines, and so forth.

Source: The Shiga Global Warming Countermeasures Promotion Plan (2006)
http://www.pref.shiga.jp/d/new-energy/suishinkeikaku_zenbun.pdf

3. Mid- and Long-Term Scenario

"Vision for a Sustainable Shiga Society" (2005-2008)

It is obvious that global environmental issues are becoming increasingly important and that the local Lake Biwa environment is changing. It is therefore necessary that all the actors, such as citizens, businesses and local governments, have a common future vision and act together in order to ensure the sustainable development of Shiga prefecture. In order to achieve this, Shiga prefecture decided to develop the "Vision for a sustainable Shiga society", with the target year of 2030, which provides direction for sustainable development with a long-term perspective and specifies which policies should be pursued.

This project began in FY 2005. It has taken several steps towards achieving its goal, such as publishing the "Framework for a sustainable Shiga society" (2006) and "Shiga's scenario towards the

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realization of a sustainable society" (2007), as well as facilitating discussions at the Shiga Environmental Council in 2007. The final report is planned to be completed in late March 2008.

This vision makes reference to an ideal sustainable Shiga society from the four perspectives of: "Nature and climate", "Industry", "Town development" and "Life". It then sets two main goals: the "Realization of a low carbon society" and the "Revival of the Lake Biwa environment".

More specifically, the former goal refers to the "Reduction of GHG emission in Shiga prefecture by 50% below the 1990 level by 2030"; the latter goal to a "Secure, healthy ecosystem and safe water environment around Lake Biwa" and "Revived relationships between Lake Biwa and people's lives, leisure, food and housing".

The five steps below are cited as a basic policy to undertake policies and countermeasures for target achievement:

1) Develop a comprehensive approach as opposed to an end-of-pipe approach

2) Combine various policy measures

3) Aim for the creation of new business opportunities and improvements to the quality of life

4) Create and disseminate new ideas on welfare by utilizing both the latest technologies and traditional wisdom

5) Build up a scheme which helps climate action to be beneficial and visible

Then, as for both the "Realization of a low carbon society" and the "Revival of the Lake Biwa environment", policies and countermeasures which can be conducted by the community independently are organized, based on the viewpoints above.

The policies and countermeasures for the "Realization of a low carbon society", are classified into the "Reduction of energy-oriented GHG emissions", the "Reduction of non-energy-oriented GHG emissions" and the "Increase of absorption of GHG". The "Reduction of energy-oriented GHG emissions" is further classified into the "Reduction of energy demand", the "Increase energy efficiency" and the "Conversion to low emission energy".

The effect of CO_2 reduction through the introduction of each of these policies and countermeasures is then estimated by using a CO_2 emissions estimation tool called the "Snapshot Tool" and referring to "Shiga's scenario towards the realization of a sustainable society" (2007). As a result, it is shown that halving the CO_2 emission by 2030 compared to the 1990 level is possible by conducting all the listed countermeasures and actions by various actors.

Similarly, policies and countermeasures for the "Revival of the Lake Biwa environment" are

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categorized into “Healthy ecosystem”, “Secure and safe water environment” and “Relationship with life and Lake Biwa”.

In addition, Shiga prefecture has proposed the following four projects which can contribute to the “Realization of a low carbon society”

1) A sustainable transportation system

2) Local production and local consumption of wood and agricultural products

3) Promotion of pro-environmental behavior by visualization of CO_2 emissions

4) Creation of carbon off-set scheme by collaborating with the business world

As a next step for achieving the vision, these projects are going to be examined, and then the vision of Shiga in 2030 and its policy direction should be reflected in “Shiga Comprehensive Plans” and other related plans.

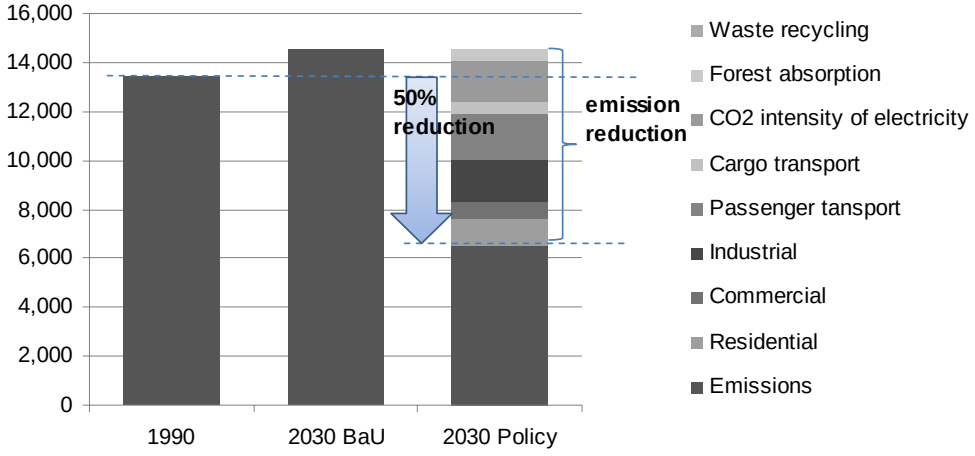


Figure: GHG emission/reduction (kt-CO_2eq)

Source: Vision for a sustainable Shiga society (2007)

*This chapter is based on materials contributed by the Environmental Policy Division, Department of Lake Biwa and the Environment, Shiga Prefectural Government, with summarization and additions made by the 2050 Japan LCS scenario study team.

Korea

1. Current Status of Emission

GHG emissions in 1990: 289.5 Mt-CO_2eq*

Current (2001): 542.9 Mt-CO_2eq*

Kyoto Target: None

*Source: UNFCCC GHG Inventory Data

2. Countermeasures Currently Conducted

Korea's GDP rose 1.7 fold to 427.3 billion dollars between 1990 and 2001 and its per capita GDP rose 1.5 fold accordingly 9,025 dollars in 2001. Korea's primary energy consumption was estimated at 198.4 million TOE (tons oil equivalent) in 2001 ranking it the 10th largest energy consuming nation in the world. Of the total energy consumed, 97.2% was imported. Oil was the major source of energy at 50.7%, followed by coal (23.0%), nuclear energy (14.1%), LNG (10.5 %), hydraulic power (0.5%) and others (1.2%). Of the total energy consumption, about 55.7% was used by industry, 21.5% by the residential and commercial sectors, 20.9% by the transportation sector and 1.92% in others including the public sector.

Rapid economic growth and increase in personal income have led to a sharp growth in the demand for transportation and the number of cars has greatly increased from 127,000 in 1970 to 12,694,000 in 2001, recording a 100-fold growth in thirty years. The number of privately owned cars showed particularly rapid growth. In the passenger transport sector, subway routes continue to expand in line with the growth of national income and the subway and domestic aviation play a greater role as important transportational modes, while maritime shipping is increasingly taking on a bigger role in the freight transport sector.

Rising energy consumption is the major cause of the increase in greenhouse gas emissions which rose 2.6% from 144.3 million tons of carbon (MtC) in 2000 to 148.0 MtC in 2001. The energy sector was a major contributor to this increase at 104.2% while industrial processes, agriculture and waste contributed -3.5 %, -3.0% and 2.2%, respectively.

The trend of total greenhouse gas emissions between 1990 and 2001 indicates an annual increase of 5.2% with per capita emissions rising by 4.3% per year since 1990, recording 3.13 tons of carbon (tC) in 2001. However, the greenhouse gas intensity indicated the increase seen during the early 1990s began to fall after 1996. In the energy sector, which consists of fuel combustion and fugitive emissions, greenhouse gas emissions increased 5.6% per year from 67.6 MtC in 1990 to 123.5 MtC in 2001. After 1990, emissions from industrial processes recorded a sharp increase of 10.2% per year.

Methane and nitrous oxide emitted from the agriculture and livestock sectors fell 0.8% per year between 1990 and 2001 due to the decline in land use for rice cultivation as well as a reduction in the use of fertilizer and in the number of livestock, among other factors. On the one hand, the amount of

Korea

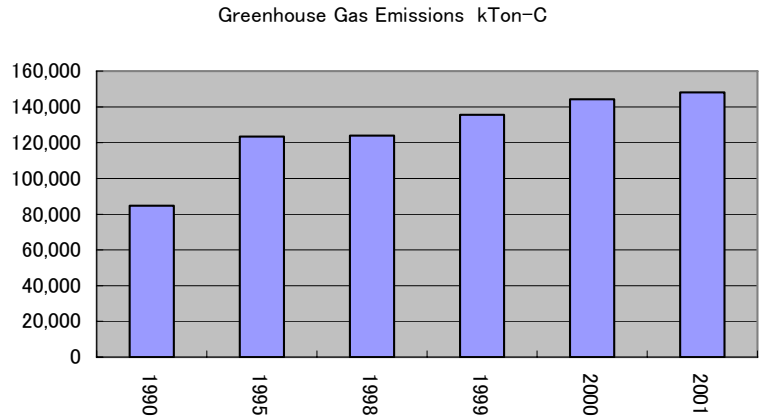


Figure: Greenhouse Gas Emissions

Source: "Second National Communication of Republic of Korea"

domestic sewage and industrial wastewater increased in line with the surging population and economic growth. However, stronger waste management policies since the mid-1990s have resulted in reducing emissions from the waste sector by an annual 4.2 % over the same period.

Although progress in urbanization led to increased carbon dioxide emissions from soil due to land-use change, the total net removal from land-use change and forestry increased by 3.5 % annually along with the steady increase of forest growth. Total carbon dioxide emissions between 1990 and 2001 rose by 5.8% per year. Fuel combustion and industrial processes were the main sources of emissions. Most carbon dioxide emissions occur from fuel combustion which increased by 5.8%

Table: Promotional Strategies of Policies & Measures for GHG Reduction in Korea

Promotion of Technology to Reduce GHG & Development of Environment-Friendly Energy	• Designate GHG-reducing technology as one of the prospective environmental technologies to promote R&D. • Create a market demand for renewable energy by reinforcing the efforts to develop cleaner environment-friendly energy.
Strengthening of Policies and Measures for GHG Reduction	• Reinforce energy conservation efforts through integrally managed energy conservation policies and improve efficiency in energy usage. • Fortify energy conservation policies for the residential and commercial sectors by reinforcing energy efficiency standards for buildings & insulation level of building envelope and expanding the Energy Efficiency Labeling Program. • Conserve transportation fuel consumption by promoting cleaner alternative fuel and compact cars. • Reinforce GHG-reduction policy in the transport sector through efficient management of major transportation networks and traffic demand, establishment of a comprehensive logistics information network and standardization of logistics equipment. • Reinforce GHG-reduction policy by improving the methods of farming and animal husbandry in the agriculture and livestock sectors as well as promoting recycling and minimizing waste. • Conserve and expand forest sinks through afforestation and reforestation projects.
Inducement of Public Participation & Cooperation	• Promote PR and strengthen partnerships with industries and NGOs. • Motivate the public to participate and cooperate in the efforts to reduce GHG emissions by promoting PR and strengthening education programs for students and workers.

Source: "Second National Communication of Republic of Korea"

Korea

annually between 1990 and 2001 mainly attributable to power generation and the transportation sector. Emissions of methane fell 4.5% per year, which was attributed to the slowing energy sector along with the ordinarily high methane-producing waste and agriculture sectors. On the other hand, emissions of nitrous oxide recorded an annual increase of 6.0% over the same period.

Policies & Measures

Recognizing that the conservation of energy and reduction of greenhouse gases not only contribute to international cooperation but are also consistent with the long-term development goals of the Korean economy, the various policies and measures related to energy conservation and reduction of greenhouse gas emissions as advocated by the UN Framework Convention on Climate Change (UNFCCC) have been established in Korea. In 2001, the agreement on the implementation plan for the Kyoto Protocol and changes in Korea's economic and industrial circumstances were reflected in the establishment of the Second Comprehensive Action Plan (2002-2004). Through the Plan, efforts are being made nationwide to accelerate the steering of business activities to low energy-consuming industries and to conserve energy for the prevention of global warming.

Accelerated development of advanced industries that are less energy-intensive such as the IT industry and other high-tech industries and active energy conservation efforts in all sectors will enable the early establishment of an economic structure that prioritizes energy conservation. This reflects Korea's basic policy direction and measures for greenhouse gas reduction in order to contribute to the global efforts to mitigate climate change.

The reduction of greenhouse gases in the energy sector is being promoted by targeting energy supply and demand, heating and cooling of buildings, and transportation fuel. As regards energy demand, greenhouse gas reduction is being achieved through an integrally managed energy conservation policy and improvements in energy efficiency. For energy supply, policies are being devised to expand the use of renewable and cleaner energy. Furthermore, various policies and measures to improve energy efficiency in buildings, expand the use of clean fuel, and broaden the market demand for compact cars are also being formulated.

In the transportation sector, various greenhouse gas reducing efforts are being made through two promotional goals:

- efficient management of the national transportation system and traffic demand
- establishment of a comprehensive logistics information network and standardization of the logistics apparatus.

Greenhouse gas reduction efforts are also being made in the agriculture & livestock sectors by improving farming and animal husbandry methods. As for the waste sector, policies and measures to establish a foundation to minimize waste, increase recycling and expand waste management processes are being implemented. Policies to increase removals and decrease emissions are also being

Korea

implemented in the forestry sector through efficient management and maintenance of forests and afforestation.

Projections of GHG Emissions

The growing trend of greenhouse gas emissions will continue if the current shift of Korea's industrial structure continue and considerable efforts to reduce emissions are not implemented. Projections indicate that Korea's greenhouse gas emissions will rise by 70% above 2000 levels by 2020. However, the carbon dioxide intensity during the forecast period is expected to gradually decrease due to improvements in demand-side energy efficiency and shifts to cleaner fuels.

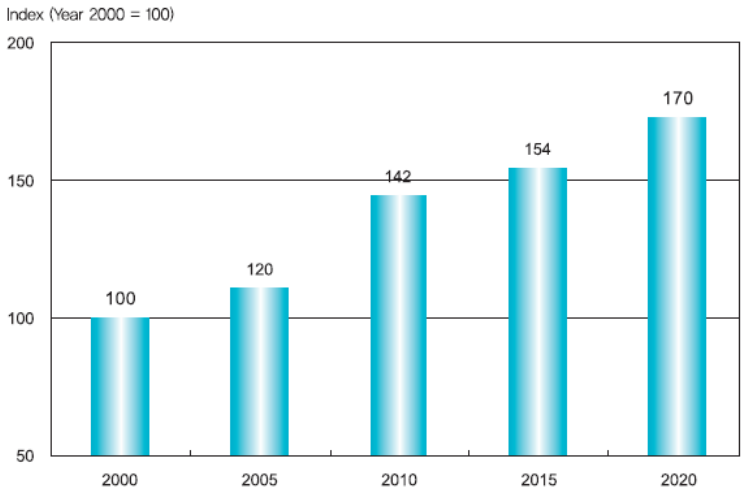


Figure: Projected GHG Emissions Trend (2000-2020)

Source: "Second National Communication of Republic of Korea"

Greenhouse gas emissions from energy, agriculture and waste which accounted for about 90% of the total emissions of greenhouse gases is expected to increase by 2.7% annually from 2000 to 2020. During the same period, emissions from fuel combustion will increase by 2.8% annually and emissions from waste by 2.4%, whereas removals from sinks and emissions from agriculture are projected to annually decrease by 1.4% and 1.1%, respectively.

Carbon dioxide, the main gas among energy related GHG, will see a relatively modest increase of 2.9% annually from 2000 and 2020 and account for 96.8% of all greenhouse gas emissions in 2020 from the 93.5% in 2000. This is largely due to the government's energy conservation efforts to comply with the UNFCCC as well as improvements in energy efficiency, increase in the consumption of low carbon energy and renewable energy and increase in waste incineration.

Although emissions of nitrous oxide and methane from waste are expected to increase, projections indicate emissions of nitrous oxide, which accounted for 1.8% of total greenhouse gas emissions in 2000, will decrease by 1.2% annually and account for 1.4% in 2020. Methane emissions

Korea

are also expected to decrease by 1.9% annually from occupying 4.6% of total greenhouse gas emissions in 2000 to 1.8% in 2020 due to the reduction in the number of livestock and land dedicated to rice cultivation.

3. Mid and Long Term Scenario

LEE, D. Kun and PARK, Chan: "Low Carbon Scenarios in 2050"(2008)

Although it is not easy to describe any long-term trends for such a dynamic country like Korea, the two scenarios are introduced. In both of them, the energy demand for the sectors such as industry, transport, residential and commercial, are defined considering some policies and measures. GDP growth and urbanization are remarkable indices.

Scenario A

Technical improvement is a result of continuous investment in Research and Development (R&D) by the public and private sectors. Annual average economic growth is expected to be 3.36% due to the strong growth of Korean main industries: finance, information technology, steel industry and shipbuilding industry. Moreover, the economic growth will be driven by the increased consumption of individual households and businesses.

Drastic change of the employment structure increases the number of professional workers. The expansion of five-day workweek will increase the number of part-time job holders and decrease the unemployment rate. The aged society and expansion of life expectancy provides more work forces over 65 years old. As more women focus on their careers and the development of home appliances, women tend to spend lesser hours in housekeeping. In fact, they can spend more time on leisure, volunteer activities or traveling.

The total population decreases while the number of individual household increased compared to that of 2005. The average space of a household expands as the society develops. Living in urban apartment complex is more common and land use becomes highly intensive. Popularization of home-shopping, internet shopping offers more convenient life style to people.

Scenario B

As the government implements policies and measure to realize a low carbon society, the average per capita GDP is expected to increase 2.98 % annually. People's interest in future society and tendency to seek pleasant environment shows more attraction compare to scenario A since it prefers urban lifestyle. In addition, less change in the total demographic composition occurs while the number of household members will increase.

Sharing housework and social structure change associated with the increased number of working women, time spent in housekeeping reduces. Instead the time spent on hobby, sports, volunteer

Korea

activities, or traveling will be increased.

Importance of health is emphasized more than convenient lifestyle, reducing the attraction towards apartment complex compared to Scenario A. And migration to the countryside will increase. Internet shopping, home-shopping becomes common and tourists increases with the balanced development of the nation.

Table: Possible trend-breaking options of the two scenarios

	Scenario A	Scenario B
Industry	- Energy efficient production technology	- Energy efficient production technology
Residential and Commercial	- Insulation of buildings - Diffusion of all-electric home - Diffusion of high efficiency heat pump air conditioner and water heater - Development and diffusion of fuel cells - Optimal energy control by HEMS	- Insulation of buildings - PV (especially in detached houses) - Diffusion of solar water heating - Education (Eco life navigation system)
Transportation	- Minimization of trip distance for commuting by intensive land use - Modal shift from cars to mass transit systems (buses, railways, LRTs) - Diffusion of motor drive cars such as electric vehicles and fuel cell vehicles	- Compact urban structures - Infrastructure development for foot and bike passengers (sidewalk, bikeway, cycle parking) - Diffusion of biomass hybrid cars - Modal shift from cars to railways and to ship for freight transportation
Energy supply	- Expansion of nuclear power generation - Electric load leveling and expansion of electric storage (ex. Store the electricity generated in night time and use it for electric vehicles) - High efficient fossil fuel technologies + CCS - Hydrogen production from fossil fuel + CCS - Infrastructure development for hydrogen production, transportation, storage, application	- Expansion of renewable energy use (wind, photovoltaic, solar thermal, biomass) - Application of Information technologies (IT) for load adjustment
Stock and waste management	- Less material use for production by technology development - Advancement of recycling technologies	- Expanding lifetime of the goods - Decrease in final demand due to departure from material wealth yardsticks - Recycled product preference of the consumers

Source : Lee, Dong Kun, “Low Carbon Scenarios in 2050” (2008)

Korea

3.1 Major preposition

a) GDP growth

In Scenario A, average of 3.36% is expected and in B, 2.98% is expected.

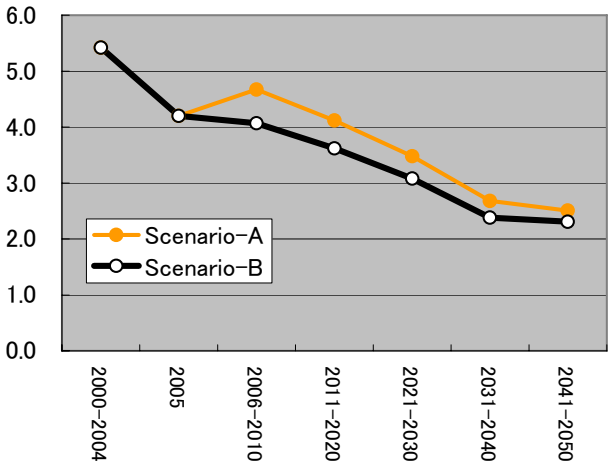


Figure: GDP Growth Rate

Source : Lee, Dong Kun, "Low Carbon Scenarios in 2050" (2008)

b) Industrial structure

The growth of manufacturing industry will remain strong, concentrating on the advanced technology and the knowledge-based industry such as high-technology and Information & Communication Technology (ICT) will continuously grow. Scenario B has a large share of agricultural sector than that of Scenario A due to less urbanization.

c) Urbanization

Migration to urban area continues and by 2050 in Scenario A, it is estimated to be 93 % and 88 % in Scenario B from 80.8 % in 2005. Scenario A assumes that establishment of compact city for more convenience and energy conservation cause further urbanization than Scenario B. Scenario B assumes that retired people will move to rural area seeking healthier lifestyle, the urbanization rate will become 88 %.

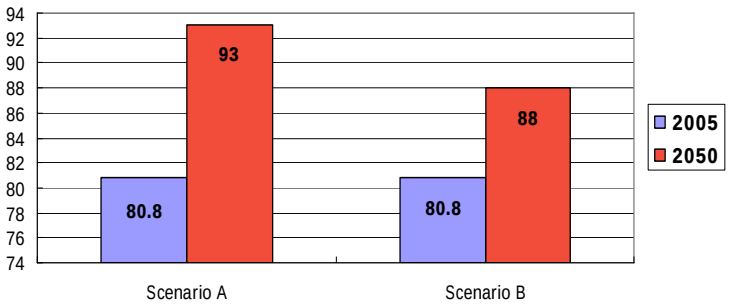


Figure: Urbanization rate

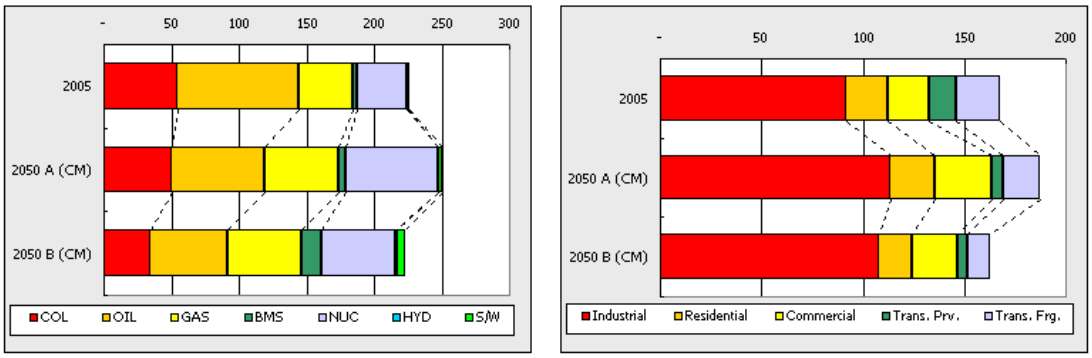
Source: Lee, Dong Kun, "Low Carbon Scenarios in 2050" (2008)

3.2 Estimation of energy consumption and CO_2 emissions

The figures show the primary and secondary energy consumptions in 2005 and 2050 for all

Korea

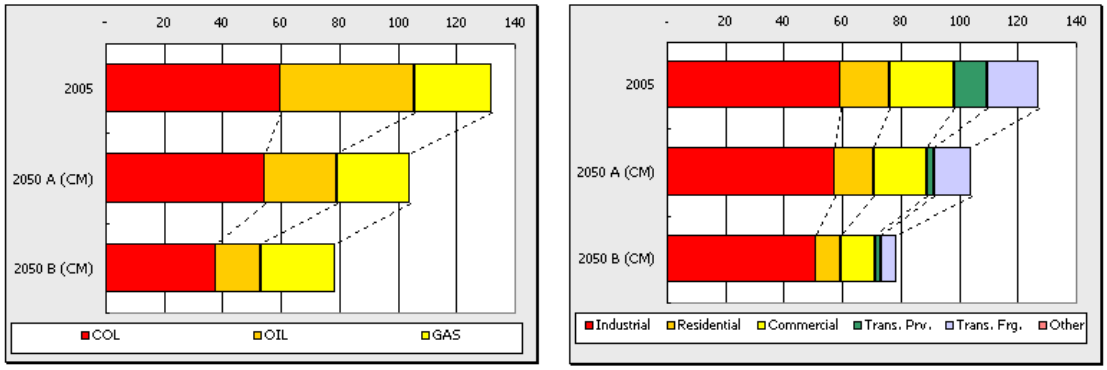
sectors. The corresponding CO_2 emissions are presented in the following figures. The CO_2 emissions in 2050 will be reduced by 17% in Scenario A, and 38% in Scenario B respectively as compared to 2005. It is worthwhile to note that 8% of CO_2 emissions will captured by CCS.



By type of energy by sector

Figure: Energy Consumption in all sectors

Source: Lee, Dong Kun, "Low Carbon Scenarios in 2050" (2008)



By type of energy by sector

Figure: CO2 emissions in all sectors

Source: Lee, Dong Kun, "Low Carbon Scenarios in 2050" (2008)

There are two scenarios to predict future energy demand in Korea which make it possible to estimate CO_2 emissions in 2050. In order to calculate the potentials of CO_2 emission reductions for each sector, the final energy demand is classified as energy demand for industry, residential, commercial and transportation sector. In each sector, there are two different scenarios to estimate future energy demand and policies and measures and life style change to reduce CO_2 emissions.

The volume of CO_2 emissions will be increased by energy service demand factor in 2050. The total CO_2 emissions will be reduced 17% (Scenario A) or 38% (Scenario B) as compared to those of 2005 due to the change of energy share, improvement of COP and related policies and measures. The CO_2 emission reductions by sectors for Scenario A and Scenario B are as follows.

Korea

In industrial sector, it is expected that CO_2 emissions will be increased 38% in case of Scenario A, and 31% in case of Scenario B, respectively as compared to that of 2005 by energy service demand factor which has effected by GDP growth and industrial structure change. However, CO_2 emissions are reduced by 2% in Scenario A and by 14% in Scenario B as compared to those of 2005, mainly due to the change of energy share and improving COP.

In residential sector, because of increasing number of households, increased average floor area, the change of operating hours and the change of operating strength, it is expected that CO_2 emissions will be increased by 51% in Scenario A, and by 24% in Scenario B as compared to those of 2005. On the other hand, CO_2 emissions in this sector will be reduced by 21% in Scenario A and 48% in Scenario B as compared to those of 2005 due to the improvement of energy efficiency, the use of BMS energy, environment-friendly life style and so on.

CO_2 emission reductions in commercial sector could be realized even if the increase of GDP growth will make CO_2 emissions increase. The substitution of energy sources and improving COP will decrease CO_2 emissions by 18% in Scenario A and by 48% in Scenario B, compared to those of 2005.

In passenger transportation sector, it is expected that CO_2 emissions will be increased by 5% in Scenario A and reduced by 5% in Scenario B as compared to those of 2005. Hydrogen fuel cell cars and the use of BMS energy will be the main sources of reducing CO_2 emissions in this sector. The reduction rate is 75% in Scenario A and 79% in Scenario B as compared to 2005.

There is reduction of CO_2 emissions in freight transportation sector. GDP growth and increasing use of internet shopping are expected to increase freight transportation service volume. However, CO_2 emissions is to be reduced by 27% in Scenario A and by 70% in Scenario B as compared to those of 2005 by technology substitution such as introduction of hydrogen fuel cell cars and the use of BMS energy.

*This chapter is prepared based on the study “Low Carbon Scenarios in 2050”(2008) by LEE, Dong Kun and PARK, Chan for which 2050 Japan LCS scenario study team summarized while adding relevant information.

Malaysia

1. Current Status of Emission

GHG emissions in 1994: 136.7 Mt-CO_2eq*

Kyoto Target: None

*Source: UNFCCC Greenhouse Gas Inventory Data

2. Countermeasures Currently Conducted

The rapid urbanization and high economic growth and industrialization in Malaysia have contributed to the relatively high GHG emission of Malaysia as compared to the world average and other Southeast Asian countries. In terms of per capita CO_2 emission, Malaysia emits 5.45 metric tons per capita, which is much higher than the world (4.22 metric tons) and Asian (excluding China) average (1.25 metric tons per capita). And Malaysia has relatively high total CO_2 emission (i.e. 138.04 million metric ton) as compared to the other developing Southeast Asian countries. It ranked the third highest after Indonesia and Thailand.

The Ninth Malaysia Plan (2006-2010), National Physical Plan (2005) and National Urbanization Policy (2006) provided policy stronger measures towards better environmental resource management policy strategies. Apart from these policies, the Government also has introduced energy efficiency measures, such as energy efficiency guidelines for buildings, improvement of road systems, and construction of light rail transit and electrical rail systems. The National Physical Plan (2005) provides a framework of national land use plan towards sustainable development. In this plan, protection of forests and wetland i.e. to maintain a minimum of 50% forest cover and water bodies, agricultural area is important to prevent urban sprawl in the era of rapid urbanization.

a) National Energy Policy Objectives

Since 1980, National depletion policy was launched to safeguard the depleting oil reserves. Three principal energy objectives are instrumental in guiding the future energy sector development in Malaysia. In detail, they are the supply, utilization and environmental objectives.

-The Supply Objectives

To ensure the provision of adequate, secure and cost-effective energy supplies through developing indigenous energy resources both non-renewable and renewable energy resources using the latest cost options and diversification of supply sources both from within and outside the country.

-The Utilization Objectives

To promote the efficient utilization of energy and discourage wasteful and non-productive patterns of energy consumption.

Malaysia

-The Environmental Objectives

To minimize the negative impact of energy production, transportation, conversion, utilization and consumption on the environment.

3. Mid and Long Term Scenario

H.C.Siong: "Malaysia vision and pathway towards Low carbon society(LCS)" (2008)

To explore the possible Low Carbon society of Malaysia in 2050, the dominant trends of social, economic and household, infrastructure and technology development are examined.

3.1 Scenario

a) Economy

Malaysian economy grew at an average of about 6.2% p.a. during 1991-2005. GDP per capita in current price grew at 7.1% p.a. to US$4,904 or PPP adjusted GDP per capita of US$10,318 in 2005. The economy is expected to undergo structural change from agro base to value added manufacturing and then finally into knowledge economy driven by high value added industry in IT and bio technology. This structural change may be divided into 2 main phases.

Phase 1 -Years 2000-2025 (Rapid and value added industrialization and modern agriculture development toward developed nation)

This first phase of development focused on moving the economy up the value chain. It places emphasis on a human capital driven economy acting as a solid foundation for the next stage of development by increasing the value added of Manufacturing, services and agriculture sectors.

Phase 2 - 2025-2050 (Hi tech and knowledge economy driven)

The human capital driven economy prepares the nation towards the next phase of development and focuses on hi tech and a knowledge based economy. With the emphasis of nation's workforce on knowledge intensive and higher value added activities, economic activities within the field of knowledge based industry and hi-tech will be developed and further enhanced. A strong Growth Corridor with cluster development of technopolis and cybercities will be developed through the country.

b) Population

The population is 23.49 million (2000), 26.75 million (2005) and projected at 28.96 million (2010) and 56 million in year 2050 (growth rate of about 2.6% p.a.). There will be a slight increase in population growth from 2.6% p.a. to 3% p.a. Although there will be a decrease in fertility rate due to

Malaysia

late marriages and the increased female in the workforce, the overall increase in population growth will be contributed by positive net international in-migration which are attracted by the job opportunities in the service and hi tech sectors due to the high economic growth in Malaysia. Life expectancy will continue to increase due to improved health facilities. Household size is expected to decline from 4.6 persons to 4.0 persons per household.

c) Land use development scenario

Malaysia government places great emphasis on ensuring balanced regional development between states as well as rural and urban areas. The current trends of rapid urbanization propelled by industrialization will increase the urbanization rate of 62% (2000) to 63.8% (2010) and this is projected to reach about 75% (NUP, 2006) in 2020 and 80% in year 2050. With the implementation of National Physical Plan (2005) environmental sensitive areas will be conserved whilst the sustainable development concept will be implemented in urban and rural areas.

In terms of forest reserve, a total of 19.52 million hectares or 59.5% of Malaysia land area remained under forest cover of which 14.39 million hectares were permanent forest reserve and 3.21 million hectares were totally protected areas. In addition, there is a total of about 0.31 million hectares of forest plantation.

d) Infrastructure

Infrastructure development strives towards facilitating the growth of the other economic sectors. The discussion will focus only on energy and CO_2 emission related infrastructure such as transportation, ICT infrastructure and energy related infrastructure. In terms of transportation, the development of urban transport will focus on encouraging a modal shift from private vehicles to public transport to reduce greenhouse gas emission and congestion. The present public to private transport split in Klang Valley of 16:84 (2003) needs to be further increased to 30:70 in 2010 (Ninth Malaysia Plan 2006-2010) and this is projected to be 50:50 in the year 2050. This will require integrated transport terminal between rail, buses and other modes of public transport and other incentives to attract the private vehicular users to public transport. In terms of utilization of ICT, the penetration of personal computers installed almost doubled from 9.4 per 100 populations to 21.8 in the year 2005 and projected to be 40 in the year 2010 while internet dial up subscription penetration increased from 7.1 per 100 to 13.9 in the year 2005 and is projected to be 35 in the year 2010. With the current trend and government policy, the adoption rate is projected to be 75 per 100 in the year 2050. This will enhance tele-working and digital communication in commerce, government and education.

3.2 Roadmap to achieve Low-Carbon Society

The Roadmap to achieve a Low Carbon Society certainly requires a combination of policy

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strategy implementation, institutional, technological innovation, and behavioral changes. In the case of Malaysia, the key options to achieve Low carbon society are summarized below:

(i) Introduction of more pragmatic and cost effective ways of reducing greenhouse gases emissions for example through greater use of public transport
(ii) Protection of the carbon sinks such as forest and peat/wetland as Malaysia has a large green asset (forest)
(iii) Motivation of desired behavioral changes in cutting wastage or use of 3R
(iv) Designing and building more energy efficient cities or eco villages
(v) Allocating major investment in R&D in green technology and energy efficient technology/engines
(vi) Conducting more research collaboration between experts from ASEAN and developed nation on climate change and mitigation measures on CO_2 emission.

*This chapter is prepared based on the study "Malaysia vision and pathway towards Low carbon Society(LCS)" (2008) by H.C.Siong for which 2050 Japan LCS scenario study team summarized while adding relevant information.

Mexico

1. Current Status of Emission

GHG emissions in 1990: 424.6 Mt-CO_2eq*

Current (2005): 548.5 Mt-CO_2eq*

Kyoto Target: None

*Source: UNFCCC Greenhouse Gas Inventory Data

2. Countermeasures Currently Conducted

A projection of GHG emissions was made, based on the NGHGI 1998-2002, for the Mexican Energy Sector for the years 2008, 2012 and 2030. The sector's emissions were estimated using IPCC methodology, according to the energy demand of the industrial, manufacturing and construction, and transport sectors and others.

Also considered was the use of energy in the industries producing it, including the generation of electricity, and fugitive emissions in the oil, natural gas and coal industry.

To build the base emissions scenario for the years 2008, 2012 and 2030, the Long-range Energy Alternatives Planning System (LEAP) computing platform was used. The emission factors from the LEAP computing platform are consistent with those of the IPCC. A base scenario and two alternate ones were constructed

The constructions from this exercise are that electricity generation shows a great sensitivity to GDP growth, with results of 30% less generation in the scenario with low economic growth, to 24% more in the case of high growth, both of these with respect to the Prospective scenario by the Ministry of Energy (SENER) to the year 2030. The same thing happens with the importing of gasoline, whose figures oscillate from 80% less in the first scenario, to 50% more in that of high economic growth.

Non-biogenic CO_2 emissions are little less sensitive, varying from a 22% increase, with an annual GDP growth of 4.3% to 5.2%, to a 23% reduction when the annual GDP growth falls 4.2% to 2.8%.

It was ascertained that the option of implementing efficiency standards in vehicles can considerably reduce GHG emissions and can be combined with the dieselization option.

The study concludes that 17% of GHG emissions could be abated with respect to the base scenario if the following measures were implemented:

- Electric generation with participation of 29% renewable and 12% nuclear
- Implementation of energy efficiency standards in private gasoline-run and diesel-run vehicles.
- Implementation of energy saving measures promoted by CONAE

Energy Sector

The energy sector has a decisive role to play GHG emissions mitigation. SENER, in

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collaboration with its companies and deconcentrated bodies, is continuing with the implementation of programs, actions, measures for the efficient use and saving of energy, whose goal is to reduce the rate of emissions growth in the country.

In 2005, the energy saving due to institutional programs was 19,659 million kWh, the equivalent of 4,981 MW of electric capacity. This saving represented 1.84% of the energy consumption and 2.83% of the total final consumption recorded in 2004. Saving for 2006 are expected to reach 21,882 million kWh, with a saving in capacity of 5,510MW.

The National Energy-Saving Commission (CONAE) and the Electric Power Saving Trust Fund (FIDE) are carrying out programs for a more sustainable energy use. In 2005, the savings in electric power, a result of the application of Daylight Saving and projects carried out by the FIDE, were 5,205 million kWh, which represented a 3.1% decrease in the consumption of this resource in Mexico with respect to the previous year. In generation capacity, the saving was 2,414MW; and it is calculated that this is equal to 8% of the peak demand for the same year. This made it possible to defer the investment of $2,400 million for enlarging the generation capacity, transmission and distribution of electrical power. It is estimated that the actions carried out prevent the emission of 5.6 Mtons of CO_2 into the atmosphere, by saving the equivalent of 11.7 million barrels of petroleum.

Renewable Energy

The use of renewable energy is still being promoted in Mexico. At the end of 2005, 54 permits had been authorized for electrical power generation based on renewable sources, under the schemes of self-supply, co-generation and exporting, 37 of which are already in operation. By 2007 the remaining 17 projects are expected to begin operation, whereby over 1,400MW with a generation capacity of more than 5,000GWh/year will be incorporated into the network.

In December, 2005, the Chamber of Deputies approved the Law for the use of Renewable Energy Sources (LAFRE), establishing a Program for the Use of Renewable Energy Sources. The goal for 2012 consists in achieving 8% participation for renewable energy, in its different schemes, in the total generation, not including the large hydroelectric companies.

3. Mid and Long Term Scenario

The Cuernava workshop, 25 May 2006

In the Cuernava workshop in 2006, following four scenarios were discussed.

Scenario 1 (LowGov-LowCoop)

- Economic development based on internal energy security
- Market approach in energy supply

Mexico

- Moderate government intervention in terms of rent and subsidies
- Diminished capacity to react to energy crisis and world crisis (due to low cooperation)
- Low technology transfer
- No post-Kyoto / increased GHG emissions : coal instead of expensive oil
- Poor countries become poorer because of lack of cooperation

Scenario 2 (HighGov-LowCoop)

- Internal energy security needs high government involvement
- Development of local resources even at higher cost / less pressure on international markets / less crisis and price volatility
- Low technology transfer due to introspective approach
- Environment: use of coal / nuclear energy / land for biofuels / large hydro development
- Diminished capability of international institutions

Scenario 3 (HighGov-HighCoop)

- Government active in regional and global cooperation to share expertise for sustainable development
- International agreements on GHG emissions and poverty reduction
- Poverty reduction stimulates energy demand, thus pressure on supply and infrastructure / additional resources for GHG reduction from increased GDP
- Large role for international aid and development institutions

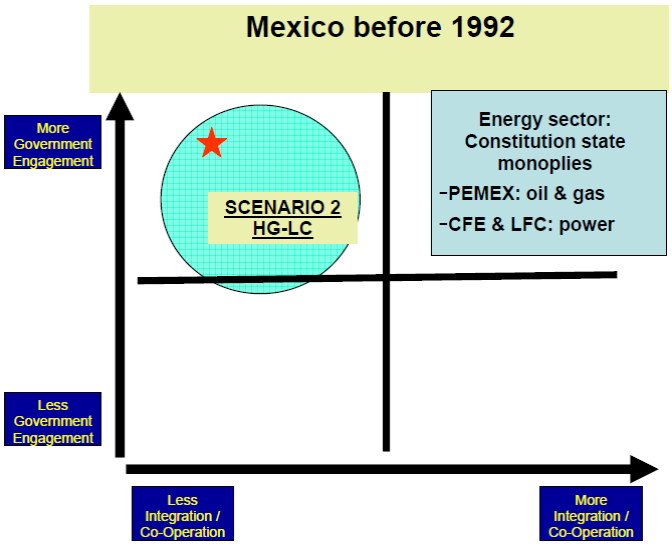
Scenario 4 (LowGov-HighCoop)

- Liberalization if global markets for increasing GDP through accessible energy prices
- Low government intervention in terms of rent and subsidies
- Few government initiatives to attenuate energy crisis impacts
- Larger flows of goods, services, technologies
- Negative effect on poorer countries that cannot afford return rates required by investors
- More GHG emissions (use of coal) but more activity in Kyoto mechanisms – JI, CDM, International emissions trading

It was pointed out that the recent evolution of Mexico, certainly located within the quadrant of High Government – Low Integration because of the constitutionally based State's exclusive charge of the energy sector, has drifted towards a lesser government involvement. There has been a deregulation of the downstream natural gas activities and a limited one of the power sector, where independent power production – for self supply and for sale to the State company CFE –, and cogeneration are

Mexico

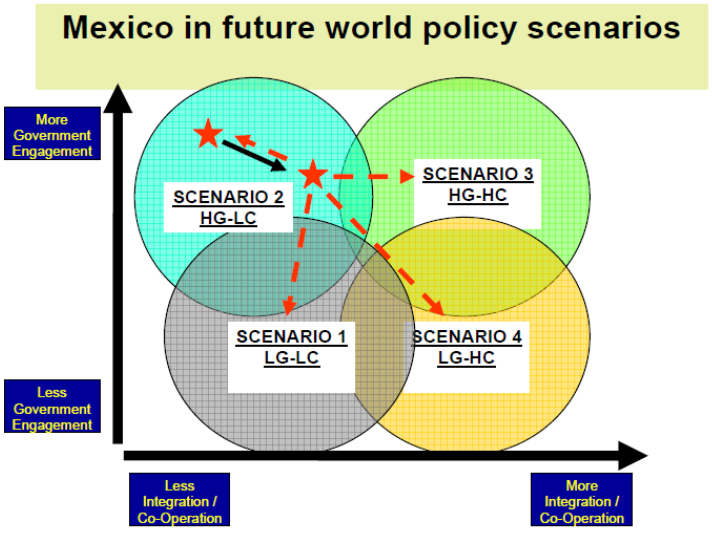
accepted, as shown in the figure.



Source : WEC, "Global Energy Policy Scenarios to 2050 Study" (2006)

There is a degree of international integration on the measure of the dependence on oil exports, and of the signing of treaties like the Pacto de San Jose to supply oil to Central America countries, NAFTA and the recent agreement for Security and Prosperity with Canada and the US.

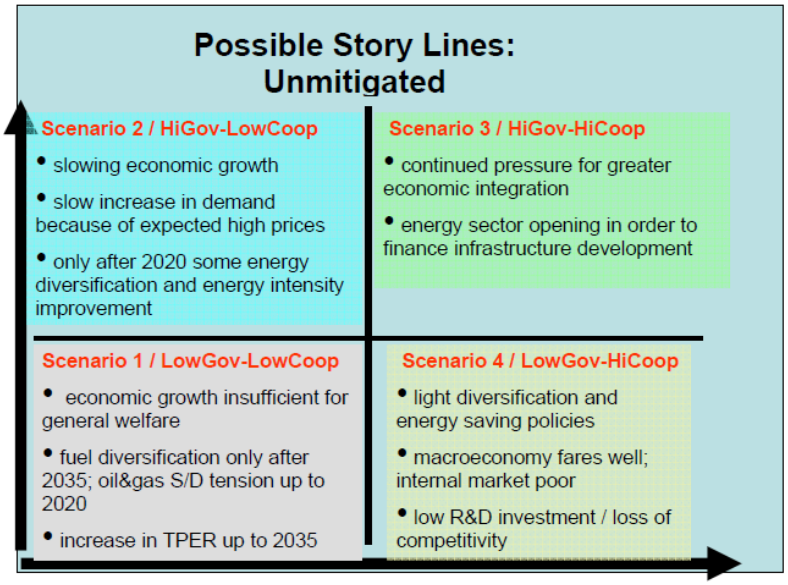
The four working groups assessed one scenario and to develop a story lines for Mexico, both in the cases of unmitigated and mitigated by policies.



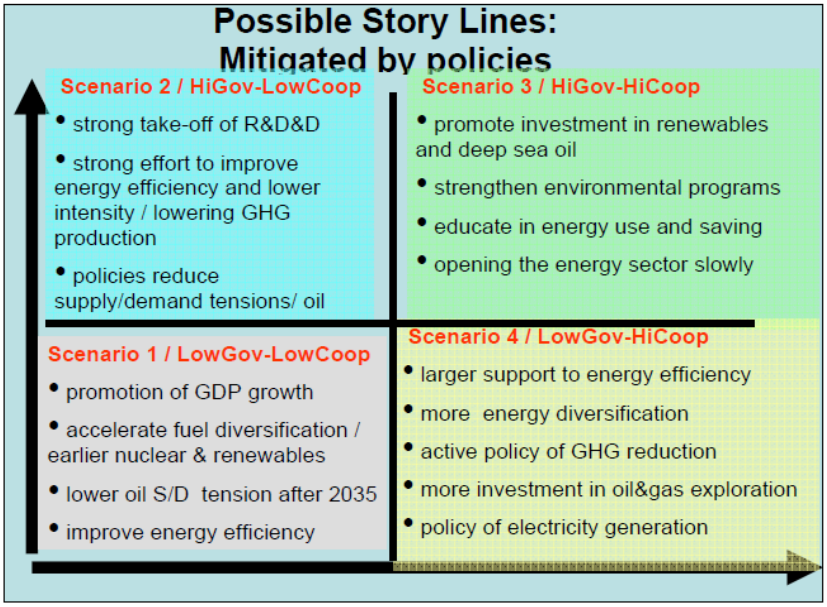
Source : WEC, "Global Energy Policy Scenarios to 2050 Study" (2006)

Mexico

The summary of the story lines derived is shown below.



Source : WEC, "Global Energy Policy Scenarios to 2050 Study" (2006)



Source : WEC, "Global Energy Policy Scenarios to 2050 Study" (2006)

*This chapter is based on the materials contributed by Edmundo de Alba A. with summarization and addition made by 2050 Japan LCS scenario study team.

Netherlands

1. Current Status of Emission

GHG emissions in 1990: 213.0 Mt-CO_2eq*

Current (2005): 212.1 Mt-CO_2eq*

Kyoto Target: -6%

*Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

The GHG emission reduction target for the Netherlands under the Kyoto Protocol is 8% in the period 2008-2012 compared to base year emissions. As a result of the burden sharing agreement within European Union, in which the common reduction target of 8% is divided amongst the Member States, the final reduction target for the Netherlands is 6%. Based on preliminary figures, this is assumed to be an average of 200 Mt-CO_2 equivalents a year in 2008-2012.

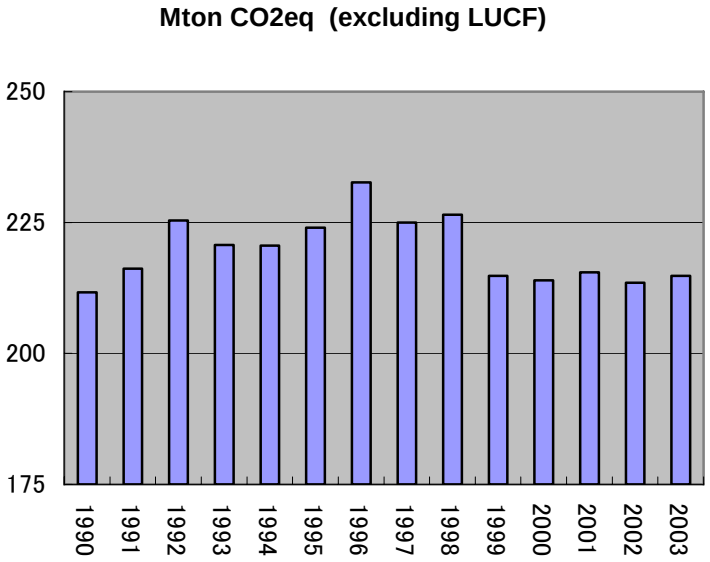


Figure: Total GHG emissions in CO_2-eq in the Netherlands
Source: "Fourth Netherlands' National Communication"

The Netherlands outlined its climate policy in 1999 and 2000 in its National Climate Policy Implementation Plan (NCPIP). It was decided that the Netherlands intends to achieve its Kyoto target both by domestic policies and measures and by using the Kyoto Mechanisms. Currently, the domestic target is set at 220 Mt CO_2 equivalents in 2010. The intended use of Kyoto Mechanisms totals 100 Mt CO_2 equivalents, that is on average 20 Mt CO_2 equivalents a year in the period 2008-2012.

In 2004, responsibility for achieving the domestic target was divided between the relevant ministries. This provides for clearly defined responsibilities and stimulates integration of climate policy in relevant policy areas. The domestic target of 220 Mt CO_2 equivalents in 2010 is divided

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amongst ministries in sectoral target values.

In the NCPIP an extensive program for monitoring and evaluation of progress in climate policy was established. Evaluations took place in 2002 and 2005.

In the Netherlands, the general approach to achieving the domestic target consists of policies that greatly reduce emissions of the non-CO_2 greenhouse gases (CH_4, N_2O and the F-gases) on the one hand, and policies that aim at decoupling the growth in emissions of CO_2 from economic growth, on the other. Policies and measures affect all economic sectors and all greenhouse gases. They range from regulations to energy tax, subsidies, fiscal incentives, and voluntary agreements with (groups of) emitters. Since 2005, CO_2 emissions trading has been implemented as a part of the European emissions trading system. This system affects both the Energy and the Industry sector. Examples of cross-sectoral policies, that affect all sectors, are the Energy Tax and the CO_2 Reduction Program. The latter provides support to large-scale investment projects that contribute substantially to reducing national CO_2 emissions.

CO_2 policies relating to the Energy sector have traditionally fallen into three general categories: those aimed at encouraging the use of renewable energy (such as the special provisions under the Energy Tax, the Environmentally Friendly Electricity Production Program, the Intergovernmental Wind Energy Agreement and the Coal Covenant), those aimed at increasing the penetration of combined heat and power (such as the special gas price, the energy tax exemption for combined heat and power) and those aimed at improving the efficiency of electric power plants. The Energy Investment Tax Deduction regime (EIA) supports measures in all three categories. In the Energy sector, in 2000 emission reductions resulting from policies since 1990 totalled 6.7 Mt CO_2 equivalent.

In the Industry sector, policies affecting CO_2 emissions are generally aimed at improving industrial energy efficiency. These include the Energy Efficiency Benchmarking Covenant, Long-Term Agreements with industrial sectors and the Energy Investment Tax Deduction regime. Furthermore the emissions of non-CO_2 greenhouse gases such as N_2O and F-gases are reduced. N_2O emission during nitric acid production will be reduced as a result of the European Integrated Pollution Prevention and Control directive. Emissions of HFC-33 have been reduced at the only producer of HCFC-22 in the Netherlands by installing an afterburner in 1997. This was partly supported by the government through the Reduction Programme for non-CO_2 Gases. PFC emissions have been reduced through an environmental covenant with the aluminium industry and support from the CO_2 reduction program and the Reduction Program for non-CO_2 Gases. In the Industry sector, in 2000 emission reductions resulting from policy since 1990 amounted to 9.7 Mt CO_2 equivalents.

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In the Transport sector, policies that affect CO_2 emissions can be grouped into the following four main categories:

- policies aimed at improving fuel efficiency through technical measures on vehicles. This includes energy labelling of new vehicles, the ACEA (association of European automobile constructors) covenant with car manufacturers and various subsidy programmes;
- policies aimed at improving fuel efficiency through driving behaviour and discouraging vehicle use;
- policies aimed at encouraging modes of transport with smaller emission impacts;
- policies that have various types of effects, such as excise duties on motor fuels and the implementation of the European Union Biofuels Directive.

In 2000, reductions realised in the Transport sector as a result of policies since 1990 were 1.2 Mt CO_2 equivalents.

In the Agriculture sector, the largest source of CO_2 is the greenhouse horticulture sector, which is responsible for around 80% of emissions from this sector. The most important policies affecting CO_2 emissions from greenhouse horticulture are a covenant and regulations, that both aim at improving energy efficiency. The Netherlands has no specific policies aimed at reducing emissions of the non-CO_2 gases from the agricultural sector. However, since the dairy herd decreases because of milk quota, and the application of nitrogen to soil is regulated in manure policies, CH_4 and N_2O emissions do decrease. In the Agriculture sector, in 2000, the reduction as a result of policies since 1990 was 1.4 Mt CO_2 equivalent.

In the Waste sector, government policies aim at reducing the amount and composition of waste to be dumped and at collecting and utilising land fill gas for energy production. In 2000, reductions as a result of policies since 1990 totalled 4 Mt CO_2 equivalent.

The package of policies deployed in the Buildings sector has been designed to address specific issues in three segments of the target group: new buildings, retrofitting existing buildings, and appliances. The package consists of a mixture of regulations, economic instruments and information and outreach programs, supported by the Energy Tax.

Agreements have been negotiated with important intermediary parties in the residential sector (such as housing developers and local governments) and with branch organisations in the non-residential sector. The main policy instrument pertaining to new buildings in both residential and

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non-residential sectors is the Energy Performance Norm (EPN). The most important framework for encouraging energy conservation in existing residential buildings (including appliances) during the period 1990-2000 was the Environmental Action Plan (MAP) of the energy companies. After the MAP expired in 2000, financial support continued in a somewhat modified form under the Energy Premium Rebate (EPR) program, which was in effect from 2000 to 2005. Information on energy-saving potential is currently provided through the Energy Performance Advice (EPA) program. In the Buildings sector, reductions in 2000 as a result of policies since 1990 totalled 3.6 Mt CO_2 equivalents.

An estimation of emission reduction effects shows that, for all sectors together, domestic policies and measures between 1990 and 2000 reduced emissions by 26 Mt CO_2 equivalents in 2000.

The Netherlands intends to purchase 100 Mt CO_2 equivalent emission reductions based on the Kyoto Mechanisms, i.e. on average 20 Mt CO_2 equivalents a year in the period 2008-2012. The clean development mechanism (CDM) is expected to provide about two thirds, Joint Implementation (JI) the remaining third. By 2005, the target is entirely covered by either framework agreements with intermediary organizations, participation in funds, or project contracts. Institutional and financial arrangements have been made. The Netherlands was a first-mover on the market for emission reductions based on Kyoto Mechanisms, thereby contributing to the development of this market and the instrument itself. An analysis of the supplementarity of the Netherlands' climate policy shows that domestic actions exceed the use of CDM and JI, independent of the chosen indicator of effort.

The Dutch climate policy is embedded in a general policy for sustainable development, for which the Netherlands set up an action program in 2003. In addition to the ongoing work within the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO), the Netherlands' government would prefer the EU to also think about measures. The Netherlands strive at minimizing the adverse effects of climate change by implementing policies and measures for all sectors, all gases and by making use of the Kyoto Mechanisms. The Netherlands has several domestic programs and legislative arrangements in place to enforce climate measures. The Dutch Registry for emission allowances has been online since February 2005.

Norway

1. Current Status of Emission

GHG emissions in 1990: 49.8 Mt-CO_2*

Current (2005): 54.2 Mt-CO_2*

Kyoto Target : 1%

*Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

Norway's energy and industrial profile is quite different from that if other industrialized countries. Half of all energy use is from renewables, and nearly all electricity is hydropower, which generates virtually no greenhouse gas emissions. However, there is only limited potential for further development of hydropower production. There is an energy-intensive industrial cluster based on the availability of hydropower which generates substantial process-related emissions. Over the past thirty to forty years, Norway has also developed an oil and gas sector which today is the country's largest industry, and is responsible for about one fourth of the county's greenhouse gas emissions.

Norway's decentralized settlement pattern gives rise to a relatively high demand for transport. In addition, the Norwegian economy is largely based on the extraction of raw materials and export of goods, which means that there is a large volume of goods transport. Nevertheless, because of the amount of renewable energy used in Norway, per capita emissions of CO_2 are lower than the OECD average.

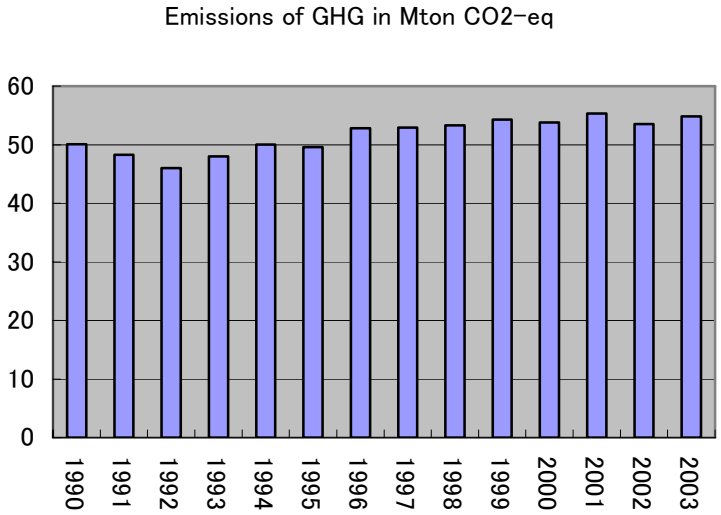

Figure: Emissions of GHG in Mton CO_2-eq

Source: Norwegian Pollution Control Authority

Norway's total emissions of greenhouse gases, measured in CO_2 equivalents, were about 54.8 million tonnes in 2003. CO_2 emissions account for approximately 80 per cent of this. N_2O accounts for about 10 per cent of total greenhouse gas emissions, and methane for about 9 per cent.

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For the period 1990-2003, the increase in total greenhouse gas emissions expressed in CO_2 equivalents was about 9 per cent. The main increase was in emissions of CO_2, which rose by 26 percent from 1990 to 2003. The petroleum sector made the greatest contribution to the growth in CO_2 emissions, and transport was second in importance. A relatively large share of transport-related emissions was generated by coastal shipping and the fishing fleet. The growth in CO_2 emissions has to some degree been counteracted by the decrease in emissions of fluorinated gases from metal plants. Overall emissions of CH_4 and N_2O have been relatively stable in this period. Agriculture and waste treatment are responsible for about 79 per cent of CH_4 emissions. Agriculture and two plants producing nitric acid (fertilizer) are the main sources of N_2O. There has also been a considerable increase in emissions of N_2O from road traffic. Emissions of fluorinated greenhouse gases have been reduced from 5.5 to 1.1 million tonnes of CO_2 equivalents from 1990 to 2003, mainly by reducing emissions of PFCs from aluminium production and SF6 from magnesium production.

Total net sequestration from the land-use, land-use change and forestry sector was about 21 million tonnes of CO_2 in 2003, which would offset 38 per cent of Norway's total greenhouse gas emissions in the same year. Sequestration increased by 56 per cent from 1990 to 2003. Forest land is the most important contributor to carbon stock changes, and in 2003 was the only category that made a contribution to total sequestration, approximately 23.4 million tonnes of CO_2.

Policies and Measures

Climate change has been a major concern of Norwegian policy since the late 1980s. Most sources of greenhouse gas emissions are currently addressed through economic measures (taxes, emissions trading) that put a price on emissions. Norway has advocated cost-effectiveness across emission sources, sinks, sectors and greenhouse gases both domestically and internationally.

The Commission on low emissions was established early 2005. The Commission will deliver a report in 2006 with a description of how Norway can cut emissions by 50-80 per cent by 2050.

A tax on CO_2 was introduced in 1991 as the first measure designed only to curb emissions of greenhouse gases. The tax covers about 68 per cent of Norwegian CO_2 emissions (more than half of total greenhouse gas emissions) and rates range up to NOK 387 per tonne. High rates apply to petrol and the petroleum activities, and lower rates to the use of mineral oils.

A tax on import and production of HFCs and PFCs was introduced on 1 January 2003. From 1 July 2004, this tax was supplemented by a reimbursement scheme which applies to all HFCs and PFCs delivered for destruction. An environmental tax on final disposal of waste is also used to limit emissions from waste and increase utilization for energy purposes.

The Pollution Control Act applies to greenhouse gas emissions. Hence greenhouse gas emissions are included in the discharge permit which for instance industrial installations are obliged to obtain pursuant to the Pollution Control Act. As a general rule, the emitter is granted a discharge permit for

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CO_2 corresponding to the amount in the application. One of the main reasons for this is that greenhouse gas emissions to a large extent are covered by other specific policy instruments such as the CO_2 tax, the emission trading system and specific agreements with the industry to cap emissions to a certain level.

These instruments have been regarded as more efficient tools for reducing greenhouse gas emissions. The Pollution Control Act may still be used to specify technological requirements relevant to greenhouse gas emissions. However, this option's relevance in practice only applies to the establishment of new gas fired power plants.

The government has concluded a number of agreements with specific sectors of industry concerning the reduction of greenhouse gas emissions. Agreements and voluntary measures apply mainly to emissions of fluorinated gases from aluminium and magnesium production and N_2O emissions from fertilizers. When the national emissions trading scheme was being established, the government and the energy-intensive process industry also established an arrangement to reduce emissions from this sector by 2007. This arrangement and the emissions trading scheme together apply to about 30 per cent of total Norwegian greenhouse gas emissions.

On 1 January 2005, Norway's Greenhouse Gas Emission Trading Act entered into force, and an emissions trading scheme that is to operate from 2005 to 2007 came into effect. The scheme applies to 10-15 per cent of Norway's total greenhouse gas emissions. The main features of the scheme are the same as those of the EU emissions trading system. However, one difference for the period 2005-2007 is that Norwegian installations that are subject to the CO_2 tax are not included in the emissions trading scheme, even if they would come within the scope of the EU's emissions trading system. The general rule was to allocate 95 per cent of average emissions in the period 1998-2001. The provisions of the Emission Trading Act are only intended to be suitable for the period 2005-2007. The establishment of a statutory trading scheme for 2005-2007 makes it possible to test various elements of the system (monitoring/reporting, the registry, compliance, penalties etc.) before the Kyoto commitment period 2008-2012. Since monitoring and reporting systems already exist for most emissions that are not currently covered by the trading scheme, its scope can easily be widened. The effects of the trading scheme for the period 2008-2012 cannot be assessed before decisions on its scope and the allocation of allowances have been made. The government will put forward to the Parliament a proposal for a revised national emissions trading scheme for the Kyoto period.

According to projections and the assessment of the effects of the emissions trading scheme and the arrangement with the process industry, the total greenhouse gas emissions per year will be about 10 million tonnes higher than Norway's commitment under the Kyoto Protocol, or about 50 million tonnes for the period 2008-2012. Introduction of further domestic policies would reduce the need for acquiring Kyoto Units. Industrial enterprises included in the emissions trading scheme, will be able to acquire Kyoto units through the emissions trading system. There is a general provision for such

Norway

acquisition in the Emission Trading Act. Details for the period 2008-2012 have not yet been decided.

These will depend partly on how Norway's emissions trading system is linked to other trading schemes, in particular the EU ETS. Almost all electricity produced on the Norwegian mainland is based on hydropower. The government has granted construction and operating licences for four combined cycle power plants fuelled by natural gas. Only two of the plants, Snohvit and Karsto, are under construction, and the owners of the two other plants have not yet taken the decision to build the plants. The government is committed to initiating the process that will make it possible to install carbon capture and storage facilities at the gas-fired power plant at Karsto at a later stage. The aim is to realize this within 2009, and the government will contribute financially to this. The government will see to that new licences for gas-fired power plants are based on carbon capture technology. On 1 January 2005, the government established a state centre for sustainable gas technologies, Gassnova. Gassnova will promote technologies for carbon emission abatement, including carbon capture and storage.

In 2001, a national energy agency called “Enova SF” was established. Enova is responsible for promoting an integrated strategy for renewable energy and energy savings. Enova's long-term goal is to achieve 12 TWh per year in new renewable energy production and energy savings by 2010. The government parties have stated that Enova's targets for renewable energy and energy savings will be increased. The most important policy measure administered by Enova is the scheme for investment grants from the Energy Fund.

The CO_2 tax has been the most important instrument for reducing emissions in the petroleum sector and has had a substantial effect. It has led to general improvements in technology and to the introduction of emission-reducing measures such as reduced use of energy and reduction of flaring. Emissions of CO_2 per produced oil equivalent fell by 22 per cent from 1990 to 2003. However, the improvements have not been sufficient to counterbalance the increase in energy use caused by higher levels of activity of new technologies. Storage of CO_2 has a huge potential for reducing emissions. Since 1996, 1 million tonnes of CO_2 has been stored annually in a subsea geological formation in connection with the processing of gas from the Sleipner field in the North Sea. From 2006, about 0.7 million tonnes CO_2 produced with gas on the Snohvit field is to be separated and stored beneath the seabed in a water-filled reservoir. The policy declaration from the present government (September 2005) states that the government will reinforce various policy measures and public financing in order to advance the realisation of relevant infrastructure and facilities for CO_2 capture and storage. Some of these tasks will be the responsibility of a slate-owned company. The government intends to establish a "value chain" for carbon capture, transport and storage on the Norwegian continental shelf.

The CO_2 tax is also an important instrument for limiting CO_2 emissions from the transport sector. In addition, the Norwegian purchase tax on cars is one of the highest in the world and has since 1996 been differentiated according to car weight, engine output and engine volume. From July 2001,

Norway

car producers have been obliged to include information on fuel efficiency and CO_2 emissions in their marketing. Taxation policy has been changed in a number of ways that favour the use of electric cars in Norway. As a result, the total price of electric cars will be reduced by 25 per cent. The government will promote the use of biofuels in accordance with the targets established in the EU directive on the promotion of the use of biofuels (2003/30/EC). The directive has not been included in the EEA agreement. It has not yet been decided which instruments will be used to achieve these targets. To encourage research and development on alternative fuels, funds have in recent years been allocated to projects on the development and testing of low-emission technologies including the production and use of hydrogen and biofuels.

Several voluntary measures and agreements have led to reductions of emissions from energy- and emission-intensive industries since 1990. This applies particularly to fluorinated gases from aluminium and magnesium production and N_2O from fertilizers. In recent years, CO_2 emissions from energy use in industry have been reduced considerably as a result of improved energy efficiency and changes in the energy mix. Under the arrangement established in 2004, the process industries have undertaken to keep emissions from specified installations below 13.5 million tonnes in 2007, equivalent to a reduction of 1.1 million tonnes CO_2 equivalents compared to the baseline. A proportion of these emissions reductions will be acquired through the emissions trading scheme. SF6 emissions from a magnesium plant – the main source of SF6 emissions in Norway – were reduced during the 1990s through voluntary measures, as well as reduced production level. Emissions from the agricultural sector and emissions and sequestration of greenhouse gases in forests are mainly dependent on general agricultural and forestry policies.

The method of calculating emissions from landfills was altered in several ways in 2004. It is now more in accordance with the IPCC guidelines and with the methods for calculation used in other countries. As a result, the calculated emission figures for 2002 were 45.6 per cent lower than they would have been using the old model. The most important policy instruments for reducing methane emissions from landfills are licensing requirements laid down under the Pollution Control Act and a tax on the final disposal of waste. Since 1990 substantial quantities of waste have also been delivered for recovery. The policies and measures implemented have offset the growth in waste volumes and led to a 20 percent reduction in emissions between 1990 and 2003.

The government will introduce climate action plans for all relevant sectors of society, including specific targets for each sector.

Projections and the effect of policies and measures

Assessment of Norway's current climate policy instruments and measures indicate that emission growth from 1990 to 2010 would be at least 17-22 percentage points higher without the policy instruments and measures that are already in effect. According to the projections, Norway faces

Norway

an average "deficit" of about 11 million tonnes CO_2 equivalents compared to the commitment under the Kyoto Protocol in 2010. Taking into account recently adopted measures and the probable effects of the arrangement with industry, the figure is reduced to roughly 10 million tonnes CO_2 equivalents.

The net CO_2 sequestration in Norwegian forests has been estimated at about 21 million tonnes CO_2 in 2003. Annual net CO_2 removals are expected to reach nearly 24 million tonnes CO_2 by 2012.

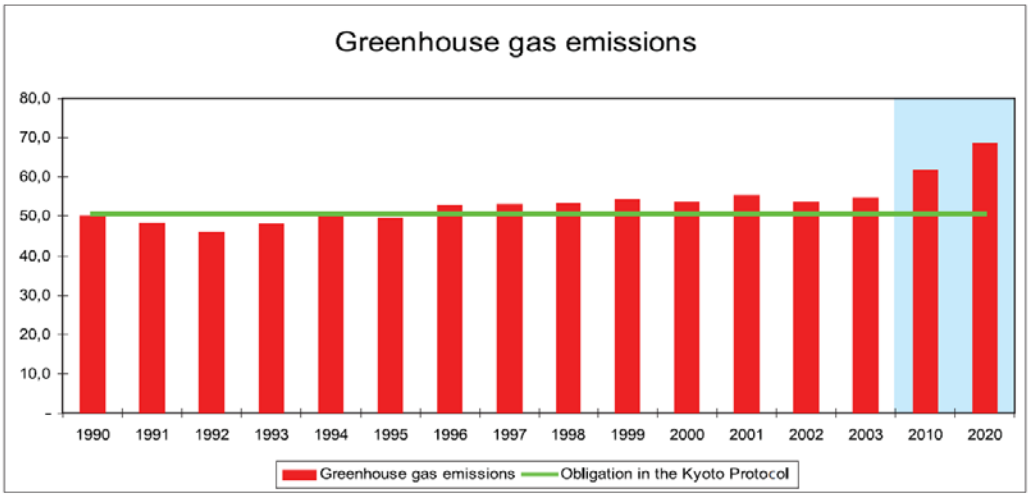


Figure: Emissions of greenhouse gases for the years 1990-2003 and projections for 2010 and 2020 in CO2 equivalents.

Source: Norwegian Pollution Control Authority

Russia

1. Current Status of Emission

GHG emissions in 1990: 2,989.8 Mt-CO_2eq*

Current (2005): 2,132.5 Mt-CO_2eq*

Kyoto Target: 0

*Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

After 1990, the number of population continued to decrease. Macroparameters of national economy and of energy industries have fluctuated appreciably. Besides the decrease of the GDP and energy demand in 1998, the rising tendency has been clear in recent years. The figure shows GHG emission in Russian Federation for each sector.

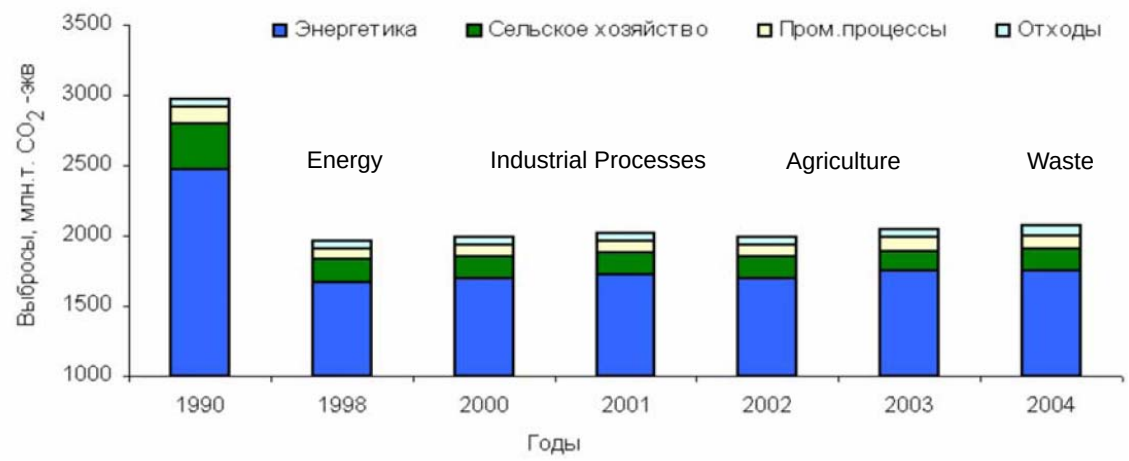


Рис. I.1 Динамика выбросов парниковых газов в 1990, 1998 и 2000-2004 гг. без учета землепользования, изменения землепользования и лесного хозяйства.

Figure: Absolute change in Russian GHG emissions

Source: "The Fourth National Communication" (2006)

a)Policies and Measures to Limit and Reduce Emissions and to Increase Removals of Greenhouse Gases

Due to dominance of CO_2 emissions from fossil fuels in power industry, the major provisions of emissions reduction strategy should focus primarily on reductions of CO_2 emissions in the power industry. Development of such a strategy and of a system of measures is currently based on the principles included in the following State Acts:

Russia

1. **"Basic Provisions of the Energy Strategy of Russia for the Period to 2020"** were approved by the Government of the Russian Federation (Ref. No39, November 23, 2000). The aim and the highest priority of the national energy strategy for the period to 2020 is the most efficient utilization of natural resources and of the available scientific, technical and economic potential in the fuel-energy complex for improving the quality of life of the population.
2. **"The Energy Efficient Economy"** Federal Target Program for 2002-2005 with prospects to 2010 was endorsed by the Government of the Russian Federation on November 17, 2001 (Ref No 796). In accordance with "Basic Provisions of the Energy Strategy of Russia for the Period to 2020", wide-scale energy efficiency and saving arrangements are to be realized in the framework of this program starting in 2002.

b)Measures to Limit and Reduce Anthropogenic Greenhouse Gas Emissions Related to Energy Production and Use

The implementation of overall objectives of the energy strategy requires solving a number of interrelated problems including increase of energy use efficiency, which is of a special importance for the UNFCCC. These should be accomplished with a view to attaining a global goal of sustainable development on the basis of energy saving technologies and structural optimization of power generating facilities, while at the same time ensuring growth of energy supply and improvement in working and living standards, reduced load on the environment and improvement of national productive forces for raising economic efficiency and market competitiveness.

Substantial increase in the energy efficiency of the economy is among the core tasks for social and economic recovery of the country. The growth rates, and especially restructuring of the economy and technological advances, will in turn determine the dynamics of energy efficiency increase. The growth of domestic energy consumption decreases with the GDP increase and with growth of the share of services and high technology products. Thus, restructuring of the economy would compensate for more than a half of the required increment of energy consumption.

Besides the structural modification, the Energy Strategy envisions intensive institutional and technological measures to ensure saving of fuel and energy, i.e. targeted energy saving policy. Russia has a large potential for organizational and technological energy savings. Realization of domestic and world-wide (low and upper values respectively) organizational and technological measures for saving energy resources enables reducing their current consumption within the country by 40-48% or by 360-430 Mtce/yr.

As a result of anticipated GDP growth and measures planned to reduce its energy intensity,

Russia

domestic consumption of power resources from 2001 to 2020 would increase approximately 1.35 times in case of positive economy development (the rate of increase is about 1.5% per annum). For lower rates of development, it would rise 1.15 times only (the increase is 0.7-0.8% per annum).

The "Energy Efficient Economy" Federal Target Program for 2002-2005 with prospects to 2010 provides for the implementation of the Energy Strategy of the Russian Federation. A considerable increase in production of electric power and renewable energy resources is envisioned within the period up to 2020.

Table: Production of electric power and renewable energy resources in the Russian Federation

Type of energy resources	Units	2001	2005	2010 (projection)
Total electric power production, including:	TW-hr	888.4	1,008.8	1,158.9
Heat power plants	TW-hr	576.4	665.9	765.9
Hydropower plants	TW-hr	175.1	168.9	181
Nuclear power plants	TW-hr	136.9	174	212
Production of renewable energy resources	Mtce	1	2	3–5

Source: "The Third National Communication" (2002)

The implementation of measures on energy efficiency increase in fuel and energy complex will lead to GHG emission reduction to 80 Mt CO_2-eq. per annum by 2005, and to 330 Mt CO_2-eq. per annum by 2010.

The main condition for implementation of measures under the subprogram is to ensure ecological safety, including assessment of nuclear power plants impacts on the environment. Thus, new safety regulations are envisioned on the basis of national and international experience and the IAEA regulatory documents. The development of nuclear power will provide an increase in generating capacity by 33% in 2005 relative to 2000 when the electricity production amounted to 131 GW-hr. The 1.6-fold growth in the nuclear power generation relative to 2000 is projected by 2010.

The table shows the expected energy savings resulting from measures scheduled by energy consuming sectors of the national economy.

The totals for energy resources saved in consumption sphere are estimated as about 150 Mtce in 2002-2005 and 295-325 Mtce for the entire period of Program implementation.

It is envisioned that in case of positive scenario of economic growth, the arrangement under the Program would result in a decrease of GDP energy intensity by 13.4% in 2005 and by 26% in 2010 relative to 2000 level. For unfavorable scenario of economic growth, the expected decrease would be by 4.7% and 18% respectively.

Russia

Table: The projected savings of fuel and energy by power consuming sectors in 2002-2005 and in 2006-2010

Consumers	Year	
	2002-2005	2006-2010
Power-consuming industries	49-52	50-54
Agriculture	5.5-6.5	6.0-7.0
Housing and communal services	35-38	38
Transport:		
Railway transport	4.0-4.6	5.0
Other transport	4.0-4.9	4.3-5.5
Federal (government-funded) institutions	4.6	8.3
Branches of energy sector	42	44

Source: "The Third National Communication" (2002)

A significant range of energy saving measures and mitigation of the CO_2 emissions is being realized in the frameworks of branch (sector) programs. The "Electric Power" Branch Energy Saving Program for 1999-2000 and prospects to 2005 and 2010 is aimed at increasing efficiency of fuel and energy use. It was adopted by "Unified Energy Systems of Russia" Joint Stock Company in 1999.

In 1999, the implementation of the Program resulted in improvement of parameters of fuel and energy use efficiency. The specific fuel consumption for electric and thermal power generation decreased by 1.8 and 0.7 g/kW-hr respectively. The energy consumption for internal needs reduced by 520 GW-hr (or by 2.8%). Total fuel and energy conservation in 1999 increased to 3.8 Mtce (including 1.2 Mtce from energy saving program). This amounts to 0.02 % of the total fuel consumption, compared with 1998. In comparison with 1998, the CO_2 emission reduction was 15 Mt CO_2/yr (including 2.5 Mt CO_2/yr obtained within the framework of energy saving program).

In 2000, fuel consumption increased by 4.7 Mtce due to intensified thermal and electric energy production. The GHG emission increased by 17.3 Mt CO_2/yr. The certain reduction of the CH_4 emission in the coal mining sector was achieved as a result of considerable shift from underground to open mining. In 1990, the share of the open coal mining was 55.5 % and has already reached 64.7 % by 1999. In accordance with a program for coal branch reorganization, it should rise up to 75 % in the future.

The latest assessments show that reduction of the underground mining by 1% leads to a drop of CPU emissions by approximately by 2.1%. Even in case of relatively considerable increase of coal mining and lack of specific CH_4 utilization measures, the anticipated CH_4 emission from 2000 to 2010 would not exceed 70-80% of 1995 level.

South Africa

1. Current Status of Emission

GHG emissions in 1990: 347.3 Mt-CO_2eq*

1994: 379.8 Mt-CO_2eq*

Kyoto Target: None

*Source: UNFCCC Greenhouse Gas Inventory Data

2. Countermeasures Currently Conducted

Compared to other major developing countries, South Africa's emissions intensity is relatively high, in that it emitted 0.96 kg CO_2 per dollar of GDP in 1999 compared to a non-OECD average of 0.66. Reliance on coal resources for electricity production is the main reason behind this emission profile, and other reasons include the production of synthetic liquid fuels, a high proportion of energy intensive industry and mining, and the inefficient use of energy.

South Africa's emissions per capita are high, at 8.23 tons of CO_2 (tCO_2) per capita, much higher than Africa's average of 0.94 tCO_2 and four times higher than the non-OECD value of 2.24 tCO_2.

Table: Energy sector carbon emissions intensity and per capita in 1999

	CO_2/cap	*CO_2/GDP*	*CO_2/GDP PPP*
	tonnes/capita	*Kg/1995 US$*	*kg/1995 PPP$*
South Africa	8.23	2.11	0.96
Africa	0.09	1.28	0.49
Non-OECD	2.24	1.79	0.66
OECD	10.96	0.46	0.52
World	3.88	0.71	0.58
Key: PPP = purchasing power parity, GDP = Gross domestic product			

Source: IEA, "World energy outlook"

Being a non-Annex 1 country with no binding target to reduce GHG emissions, South Africa has generally taken the approach of sustainable development to create a platform for developing into a low carbon society. Three main areas are seen as being critical toward achieving such objectives, namely energy efficiency, renewable energy and cleaner fossil fuels.

- **Energy efficiency and demand-side management** : There is great potential for energy efficiency in South Africa, across a range of sectors from industry, commercial, transport to residential. Interventions for energy efficiency in the residential sector can contribute significantly to development for households – improved quality of life at reduced cost.
- **Renewable energy** : The Renewable Energy White Paper (2003) has set a target of 4%. A strategy of implementing this target needs to be formulated, honing in on specific projects and their financing. The government has always outlined its intention to improve the local content of renewable energy technologies used in South Africa.

South Africa

3. Mid and Long Term Scenario

Winkler, H, Mukheibir, P, Mwakasonda, S & Garg, A, Halsnaes, K : "Electricity Supply Options, Sustainable Development and Climate Change Priorities; Case studies for South Africa" Roskilde, UNEP Risø Centre (2007).

In this study, a base scenario and low carbon "policy" scenario were analyzed for future CO_2 emissions till 2030 for South Africa.

In the base scenario, electricity supply system is assumed, on the basis of National Electricity Regulator (NER, now National Energy Regulator of South Africa, NERSA) 'base plan'. The base case is dominated by coal which continues to supply most of the electricity capacity, even though some coal power plants come to the end of their life around 2025.

The low carbon "policy" scenario is characterised by the following attributes;

- Base-load coal stations, with flue-gas desulphurisation (FGD);
- 'Cleaner coal' technologies, in particular the Fluidised Bed Combustion (FBC) technology;
- Nuclear technology in the form of the Pebble-Bed Modular Reactor;
- Imported hydro-electricity from Mozambique, Zambia or the DRC; and
- Imported gas
- Renewable energy technologies (wind, solar thermal, biomass, domestic small hydro).

It is estimated that combining all the policies analysed in this study would reduce emissions below their projected growth. The emission reductions achieved by the above electricity supply options add up to 36 Mt by 2020 and 84 Mt CO_2 for 2030, 7% and 13% of the projected base emissions for each respective year.

*This chapter is prepared based on the study "South Africa Low Carbon Scenario Report" (2008) by S.A.Mwakasonda for which 2050 Japan LCS scenario study team summarized while adding relevant information.

Thailand

1. Current Status of Emission

GHG emissions in 1994: 223.99 Mt-CO_2eq*

Kyoto Target: None

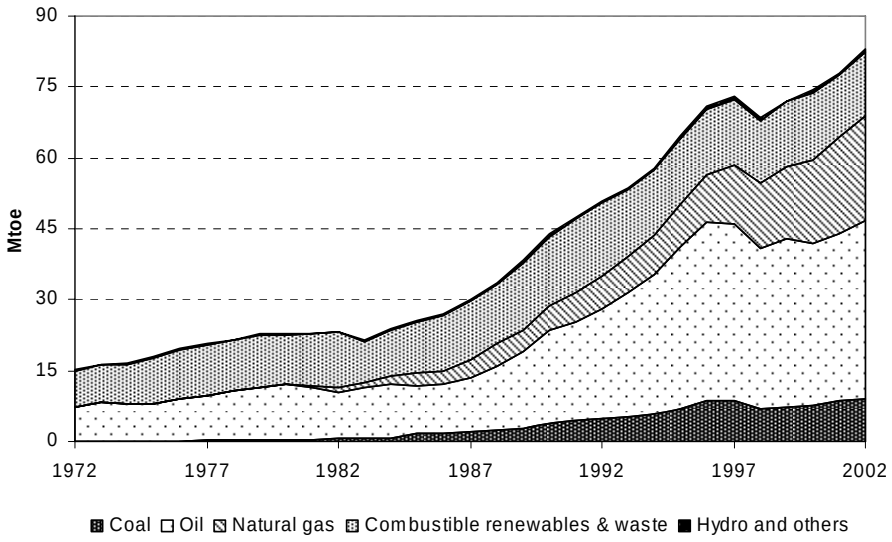
*Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

2.1 Country Profile

Thailand is the second largest economy among the countries in the Association of South East Asian Nations with a GDP of US $ 206 billion in 2006. Thailand had had a strong economic growth during 1990s and till 1997 when the country was affected by the Asian financial crisis. The GDP growth rate has increased from 4.5% to 5% from year 2005 to 2006. The country has 63 million populations. The population growth rate in Thailand has slowed down from 3.6% in 1950 to about 0.7% in 2006 and it is projected that the population growth will further fall to about 0.01% during 2045-2055 primarily due to fall in total fertility rate.

Thailand has significantly increased its energy consumption in the past three decades. Thailand was the second largest energy consuming country in the ASEAN region with total primary energy supply 103 Mtoe in year 2005 which was 6.8 times than the corresponding figure in 1972. The country's per capita energy and electricity consumption was 1.52 toe and 1,865 kWh in 2004, respectively. These figures of Thailand are much higher than the corresponding figures for Asia as a whole.



Source: IEA,"Energy balances of non-OECD countries" (2004)

Figure: Total Energy Supply (Notes: Others include geothermal)

Thailand

Historically the TPES of Thailand has been dominated by fossil fuels. The share of fossil fuel products has been dominating TPES, the oil products has larger share among other fuel types. The country is a net importer of energy and the imports of crude oil, natural gas and electricity (hydro) accounted for almost 83% of TPES in 2004. This shows the country is highly dependent upon imported energy.

The total fuel consumption (TFC) has been growing with an annual average growth rate (AAGR) of 4.65% during 1991-2000. The transportation sector accounts for the highest share (37.7%) of TFC followed by the industrial sector and others. The power sector is mainly based on fossil fuels with the share of gas and coal accounting for 83.7% and oil products 5.6% of the country's electricity generation. The share of natural gas has increased from 41.5 to 66.5% while the share of coal and lignite increased from 20% to 17.2% during 1996-2006. Also there is a steady rise of the share of imported electricity 0.9% to 3.6% in the same period. Hydro and other renewable energy has a minimal share in the power sector.

The country is also the second largest emitter of CO_2 in the ASEAN region. The CO_2 intensity of the country in 2004 was nearly 2.9 times that of the OECD as a whole (IEA, 2004). With the economy growing at over 5% per annum and increasing urbanization at 29.3% (2006), the CO_2 emission in the country is expected to grow significantly in the future.

Thailand's total CO_2 emission was 78.58 million tons in 1990; it increased by 2.62 times (i.e. 206 million tons) by 2004. Thailand's share in the world's total CO_2 emission was only 0.4% in year 1990 and has increased steadily to 0.7% in 2000 and 0.8% in 2004. The total CO_2 emission from the country has increased by 163% during 1990-2004, which is quite higher in comparison to the 28% growth of the world's CO_2 emission in the same period.

2.2 National Energy Policies

Thailand is going to implement the Tenth Five-Year Plan (2007-2012). Thailand enacted the Energy Conservation Promotion Act established in 1992 to conserve and develop energy as well as to promote the efficient use of energy. The Energy Conservation Promotion Fund (ENCON Fund) established under this Act provides financial support for implementing measures to improve efficiency in energy utilization. The Thai energy policy also highlights the measures to be undertaken to reduce energy import dependency. The country's energy policies/measures have targeted reduction in energy use in designated buildings and factories, and energy efficiency improvement of appliances (Encon Act 1992). Biofuel are promoted in the transport sector with price incentive and expansion of mass rapid transit is underway. The Government has included nuclear power plants and additional coal fired power plants in its recently modified power development plan 2007 in order to meet its huge power demand in future (EGAT, 2007).

Thai government has the policy to restore the conditions and quality of natural resources and

Thailand

bio-diversity, to prevent degradation and depletion of natural resources, and to recycle and reuse the natural resources and bio- diversity (EPPO, 2005). According to MOEN (2003), there are primarily four main plans that make up country's energy strategy:

- Enhancing the efficiency of domestic energy consumption – raising energy consumption efficiency in the transport and industrial sectors;
- Enhancing national energy security so that the country continues to have access to energy for at least 50 years, thus enhancing the security of energy reserves for Thailand;
- Becoming a regional energy trading center through leveraging energy infrastructures for greater competitiveness; and
- Enabling consumers to gain access to energy at reasonable prices for better lives, by enhancing overall capability of energy management and integration.

Specific measures related to energy in some sectors are as follow.

a) Industrial Sector

Energy Management and Audit

The Royal Decree on Designated Factories, B.E. 2540 (1997) has stipulated regulations on designated factories having energy consumption more than 1 MW (enforced from year 2000). The regulations required designated factories to have energy audit. Other voluntary and complimentary programs for energy management and energy audits are also implemented.

In parallel, special programs like High Efficiency Motor Program, Industrial Energy Efficiency Program, and Energy Service Business Program were implemented, which focused on load management, reducing peak loads, promotions of high efficiency motors.

b) Power Sectors

The government is planning to supplement future domestic power generation by using nuclear and coal technologies. Recently modified power development plan 2007 has included nuclear power plant. According to the plan, nuclear power plants will be introduced by 2020 with a capacity of 2000 MW and additional 2000 MW will be connected by 2021. The government has a plan to gather public acceptance for nuclear power development.

The government is also looking forward to having more electricity imported from neighboring countries in order to supplement its power demand in future. For this, the government has entered into agreements with power sharing deal with the neighboring countries.

By 2015, the government has agreed to purchase 5000 MW from Lao PDR. Similarly, 1500 MW from Union of Myanmar,. 3000 MW from China is expected. The PDP 2007 has

Thailand

assumed that 6371 MW of hydropower from Lao PDR will be connected to the national grid by 2021. Also, the alternative plan of PDP 2007 suggested to increase the import of hydro electricity from Lao PDR in an amount of 11,450 MW by 2021 (EGAT, 2007).

c) residential and Commercial Sector

Building Energy Codes

The Environmental Conservation Promotion Act. B. E. 2532 (A. D. 1992) (ENCON Act) has stipulated regulations on building energy codes for designated buildings. The buildings are designated by type, quantity of energy use and methods of energy utilization. The regulation has been in force since 1995. The regulation has enforced maximum limits on new and existing buildings for the Roof Thermal Transfer Value (RRTV), Overall Thermal Transfer Value (OTTV) of air conditioned areas, lighting loads and air conditioning loads inside the buildings (EPPO, 2000).

Green Building Programmes

The country has implemented energy efficient building program called as the Green Building Program. The program has emphasized on reducing the overall loads of building using continuous monitoring and evaluation of energy consumption in key areas having high energy intensity. Currently this program has been stopped due to lack of fund (TEENET, 2004).

Energy efficiency labeling of appliances

Thailand has been implementing energy labeling programs mostly on voluntary basis since 1995. The voluntary energy labeling program has been implemented for household refrigerators, air conditioners, fluorescent lamp ballasts, compact fluorescent lamps (CFLS), electric fans and rice cookers (EPRP, 2007).

d) Transport Sector

Thailand has developed transport sector policies which are as follow: (Kornsombut, 2007)

1) To lower logistic cost per GDP from 19% to17% in 5 years.

2) To promote Multi-modal Transport

3) To implement modal shift from high energy intensive transport to less energy intensive transport mode.

- To increase the Inland Water Transport (IWT) share from 10% to 11%.
- To increase rail transport from existing 3% to 10%
- To reduce road based transport from existing 87% to 79%.

4) Less reliance on petroleum:

Thailand

- To promote CNG fuel use in vehicles.
- To replace current diesel run train with electric locomotives with medium speed train (120-140 km/hr average)

5) To develop mass rapid transit (MRT) in Bangkok and other regional metropolises (MRT of 291 km are planned to be completed by 2012).

6) Promote mass transit to replace private vehicles (813 km long double track trains are planned in between different provinces)

7) Develop intercity electric train to reduce private vehicles usage within urban city.

8) Research, development, promotion of biofuel (Gasohol and Biodiesel) has become one of the top agenda of the Thai government, aiming to reduce oil consumption. The following targets are kept:

- Promoting Gasohol to reduce 10% of overall gasoline consumption by 2011.
- Promoting Biodiesel to reduce diesel consumption by 10% in 2012.
- Providing price incentives to lower the price of these alternative fuels.

9) Developing Thailand as as a major strategic transport hub in Greater Mekong Sub-region (Vimolsiri, 2007 and MOT, 2007).

3. Mid and Long Term Scenario

In the study of Asian Institute of Technology, School of Environment, Resource of Development, the effect of different carbon tax rates along with other plausible measures is considered as future alternative scenarios for the reduction of CO_2 emission in Thailand. The implications of such options are a means towards future Low Carbon Society in Thailand which are analyzed in the study. The study uses a bottom-up energy system model developed for Thailand using the Asia Pacific Integrated Assessment Model (AIM)/Enduse framework.

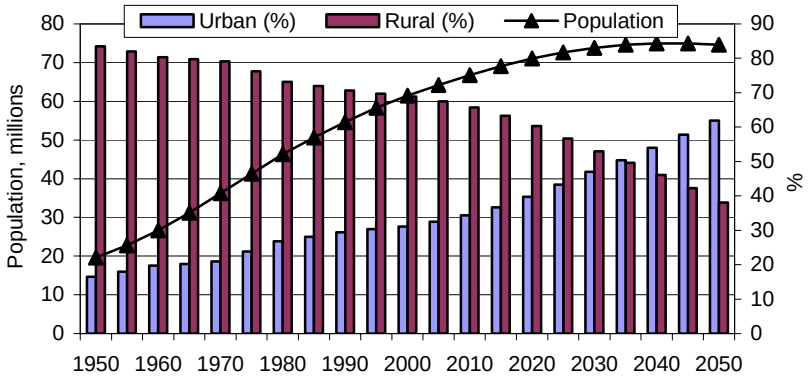


Figure: The population during 2020-2050 with rural and urban share

Source: R. Shrestha, "Role of Carbon Tax and Climate Friendly Technologies in Achieving a Low Carbon Society", (2008)

Thailand

Thailand's economy is expected to grow 6.4% till 2016 which will continue till 2030. With more stabilization of the national economy, the economy will have a slightly decreased growth rate of 5.32% from 2030-2040 and 4.47% from 2040-2050. The population of 61.4 million in year 2000 is estimated to grow to 74.6 million by 2050 with growing aging population over 60 years from 10.1% in 2000 to 29.8% in 2050. Present urbanization of 29% is expected to grow to 62% by 2050. In year 2035 urban population will exceed the rural population.

There would be a 7 fold increase in CO_2 emission in the base case during 2000-2050. Three sectors i.e., transport, industry and power together accounted for over 92% of the total CO_2 emission in 2000 and they would account for 95% of the CO_2 emission by 2050.

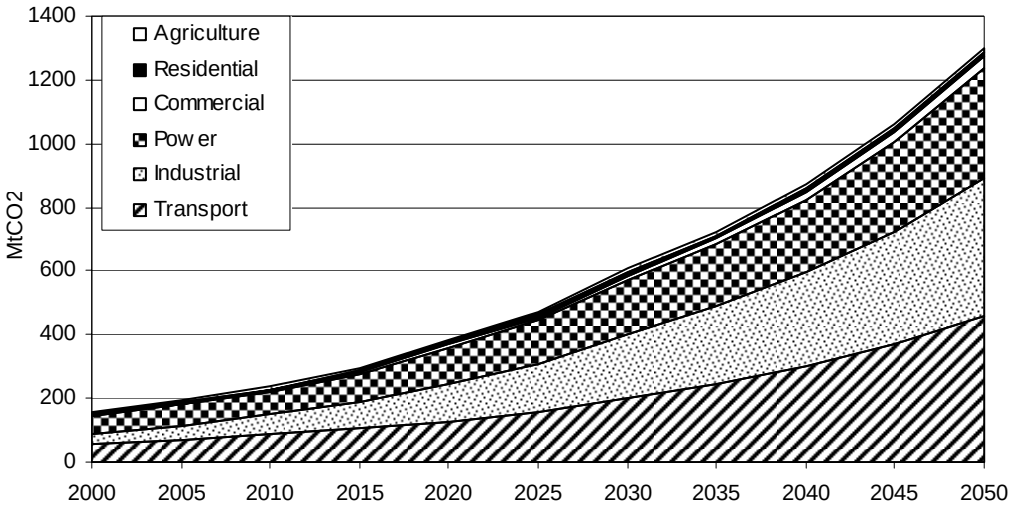


Figure: Sectoral CO_2 emission under base case MtCO2

Source: R. Shrestha,"Role of Carbon Tax and Climate Friendly Technologies in Achieving a Low Carbon Society"(2008)

Effects of three carbon tax rates: a) gradual rising of US \$10/$MtCO_2$ in 2013 to US \$100/$MtCO_2$ by 2050, b) constant rate of US \$75/$MtCO_2$ from 2013 to 2050 and constant rate of US \$100/$MtCO_2$ from 2013 to 2050 were analyzed. As a result of carbon tax, there would be a shift in energy mix from coal to natural gas and nuclear in the power sector while there would be a shift from coal to natural gas in the industrial sector. In the transport sector, the share of gasoline would increase while that of natural gas, diesel and LPG would decrease.

With carbon taxes, a cumulative reduction in CO_2 emission of 5.5% could be achieved if gradually rising carbon tax beginning at \$10/tCO_2 in year 2013 to \$100/tCO_2 in year 2050 would be imposed while the cumulative reduction would be 16.4% at a heavier carbon tax scheme of \$100/tCO_2 throughout the period of 2013 to 2050. However, additional CO_2 emission can be achieved if the modal shift of passenger transport from low occupancy vehicles to mass rapid transits (MRTs)

Thailand

operated by electricity is considered along with the carbon tax. With this counter measure, CO_2 emission reduction would be 10.1% with the carbon tax of US \$10/tCO_2, 16.5% with the carbon tax of US \$75/tCO_2 and 19.2% with the carbon tax of US \$ 100/tCO_2.

Most of the CO_2 reduction (over 76%) would take place in the power sector under the carbon tax scenarios. This is mainly due to the adoption of Carbon Capture and Storage (CCS) and nuclear power generation technologies. Thailand depends largely on imported energy and this dependence is expected to increase from 49% in 2000 to 87% in 2050. The imposition of carbon tax does not seem to have much effect in reducing the energy import dependency in terms of % while energy import is reduced by 11 Mtoe, 4 Mtoe and 16 Mtoe in year 2050 under carbon tax rate of US \$10, US \$75 and US \$100 per tCO_2.

The results of the study also show that if Thailand is to pursue a development path towards a low carbon society, CCS and nuclear technologies are the major options to be adopted for power generation in the country. Given the heavy reliance on low occupancy personal vehicles for passenger transport, the results of the present study also show a very significant potential for CO_2 emission reduction through significant change in the transport system of the country to the electrified MRTS and railways.

*This chapter is prepared based on the study "Role of Carbon Tax and Climate Friendly Technologies in Achieving a Low Carbon Society: Case of Thailand" (2008) by Asian Institute of Technology and R.Shrestha for which 2050 Japan LCS scenario study team summarized while adding relevant information.

United Kingdom

1. Current Status of Emission

GHG emissions in 1990: 771.4 Mt-CO_2eq

Current (2005): 657.3 Mt-CO_2eq*

Kyoto Target: -12.5%

* Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

Apart from Kyoto target, -12.5% of base year, the UK has adopted a domestic goal to reduce CO_2 emissions by 20% below 1990 levels by 2010, which is expected to be achievable.

New Climate Change Programme published in March 2006 sets out the policies and measures with more challenging targets by 2010.

Table: UK GHG Emissions, MtC

Gas	Base Year	1990	1995	2000	2004	2010	2015	2020
Total carbon dioxide[61]	161.5	161.5	149.9	149.0	152.5	144.3	149.0	146.6
Methane	25.1	25.1	21.8	16.3	12.5	10.8	10.0	9.5
Nitrous oxide	18.6	18.6	15.5	12.1	11.1	11.0	11.0	11.0
HFCs	4.2	3.1	4.2	2.5	2.4	2.7	2.6	2.5
PFCs	0.1	0.4	0.1	0.1	0.1	0.1	0.1	0.1
Sulphur hexafluoride	0.3	0.3	0.3	0.5	0.3	0.4	0.3	0.3
Total greenhouse gas emissions by sources minus removals by sinks[62]	209.9	209.0	191.9	180.5	178.9	169.2	173.0	170.0
Total greenhouse gas emissions including only mandatory Article 3.3 LULUCF activities and forest management cap under Article 3.4 LULUCF[63]	209.5	208.2	191.6	180.3	179.0	168.9	172.1	168.5
Change from base year levels (for row above)		-0.6%	-8.5%	-13.9%	-14.6%	-19.4%	-17.9%	-19.6%
Percentage changes and emission estimates may differ slightly due to rounding								

Source: "Climate Change The UK programme 2006"

Energy Supply Sector

The Renewables Obligation (January 2002) requires suppliers to annually increase percentage of electricity they supply from renewable sources.

Business Sector

The Climate Change Levy (February 2001), a tax on the use of energy, is introduced in this sector in exchange of another offsetting tax deduction. Climate Change Agreement is applied to 30 energy intensive industries such as steel and cement. It provides an 80% discount from the levy for those that sets challenging targets based on one of the four indicators they selected. The UK Emission Trading Scheme (April 2002) covers 6 GHGs while EU-ETS treats only CO_2. The Carbon Trust is an independent company with the government fund, established to provide information and impartial advice on energy saving.

United Kingdom

Transport Sector

Renewable Transport Fuel Obligation (RTFO) requires transport fuel suppliers to ensure a set percentage of their sales from a renewable source, with the obligation set at 2.5% in 2008-09 and 5% in 2010-11, besides the EU's Voluntary Agreements on new car fuel efficiency.

Domestic and Service Sector

Under Energy Efficiency Commitment (EEC), the principal policy mechanism in this sector, electricity and gas suppliers are required to achieve targets for the promotion of energy efficiency improvements. For new buildings, energy standards have been strengthened since 1990 under the building regulations, improving its efficiency by 70%. Further strengthening was implemented in April 2006.

3. Mid and Long Term Scenario

3.1 Government

a) Climate Change Bill (2007)

Newly-appointed Prime Minister Gordon Brown committed the UK to reduce CO_2 emissions by 60% by 2050. The Climate Change Bill proposed an independent committee on climate change to monitor and advise on the progress towards these targets; and it called for new powers to enable the government to more easily implement emissions policies. It also included an interim target of a 26% to 32% reduction by 2020.

b) Energy White Paper 2003 (2002)

It addressed three challenges the UK is facing: the environment; the decline of indigenous energy supplies; the need to update energy infrastructures. It also set out four goals for the UK's energy policy:

- to cut the UK's carbon dioxide emissions by some 60% by about 2050;
- to maintain the reliability of energy supplies;
- to promote competitive markets in the UK and beyond, helping to raise the rate of sustainable economic growth and to improve the productivity;
- to ensure that every home is adequately and affordably heated.

3.2 Others

a) Stern Review (2006)

This report estimates that if we don't act, the overall costs and risks of climate change will be equivalent to losing at least 5% of global GDP each year. If a wider range of risks and impacts is taken into account, this could rise to 20% of GDP or more. In contrast, it also estimates that the costs of

United Kingdom

action – reducing greenhouse gas emissions to avoid the worst impacts of climate change – can be limited to around 1% of global GDP each year, and the benefits of strong and early action far outweigh the economic costs of not acting.

b) "The 80% challenge Delivering a low-carbon UK": WWF, RSPB (2007)

It's shown that it is both technically and economically feasible to reduce CO_2 (emissions including international aviation by 80% by 2050, without relying on unsustainable technologies. The research uses the same models that were used by the government in the 2007 Energy Review and in Stern's review

http://www.wwf.org.uk/filelibrary/pdf/80percent_report.pdf

http://www.wwf.org.uk/filelibrary/pdf/80summary.pdf

c) "Home Truths: A Low-Carbon Strategy to Reduce UK Housing Emissions by 80% by 2050": University of Oxford (2007)

This report shows that CO_2 emissions from UK homes could be cut by up to 80% by 2050. Its blueprint for future low carbon homes includes:

http://news.bbc.co.uk/1/hi/sci/tech/7113165.stm

d) "40% House": Environmental Change Institute (2005)

This is a demand-side energy strategy to deliver 60% carbon saving in the residential energy use by 2050. It concluded that 40 percent house can be realized.

http://www.40percent.org.uk/

*This chapter is based on the materials contributed by S. Cornelius and A. Bolitho with summarization and addition made by 2050 Japan LCS scenario study team

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United States of America

1. Current Status of Emission

GHG emissions in 1990: 6229.0 Mt-CO_2eq

Current (2005): 7241.5 Mt-CO_2eq*

Kyoto Target: -

* Source: UNFCCC GHG Emissions Data

2. Countermeasures Currently Conducted

U.S. climate policy takes two approaches to climate change issues. The first approach is a regulatory structure based on economic incentives, typically employing cap-and-trade CO_2 emissions permit systems or CO_2 taxes. Although the idea of an economy-wide cap-and-trade system seems to have a good deal of political support, many important design elements have yet to be decided.

The second approach toward climate change issues is to rely on more conventional, prescriptive regulatory approaches. The ENERGY STAR program pioneered by the U.S. Environmental Protection Agency (EPA) relies on appliance labeling to help consumers better understand the energy efficiency of the appliances they purchase. In addition, the Corporate Average Fuel Economy (CAFE) standards used to promote the energy efficiency of motor vehicles.

The dynamics of environmental policy in the United States differ from those of many other nations. State governments sometimes implement more advanced environmental regulations before the federal government acts.

a) Energy Star

ENERGY STAR which is a joint program by DOE and EPA addresses the climate issue by reducing energy consumption in business and individuals. Among several programs in it, a program on products sets energy efficiency standards for products in more than 50 categories. Qualified products can have an ENERGY STAR label, which helps consumers identify energy efficient products.

b) CAFÉ

The CAFE regulates the sales-weighted average fuel economy of motor vehicles sold by a company. CAFE can be considered an emissions standard for CO_2 at the auto company level. The program is run by National Highway Traffic Safety Administration and EPA.

Although CAFE was first enacted in 1975 to enhance energy security, it contributes to reduce GHG emissions through reduced fuel consumption. There is also a discussion about allowing automakers to trade credits if they improve fuel economy more than required. Several recent cap-and-trade proposals recommend emissions standards for vehicles.

United States of America

c) Initiatives in the Northeastern States: RGGI

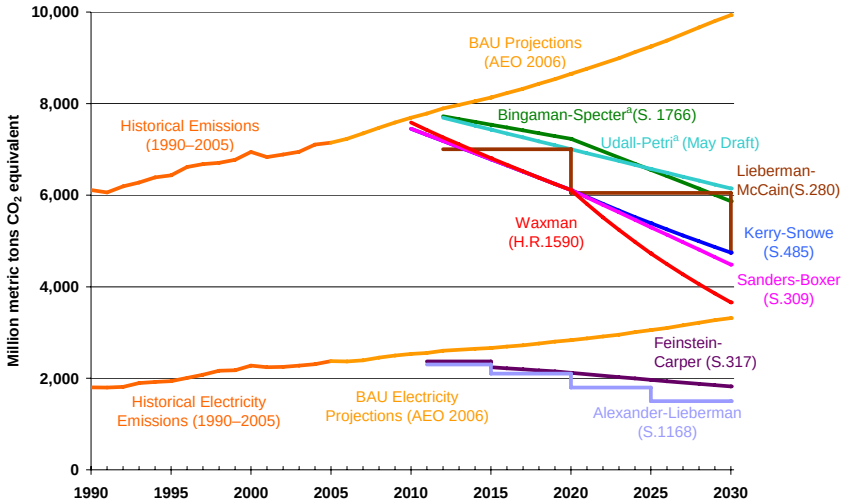
The RGGI was launched in April 2003 when New York Governor George Pataki sent letters to 11 governors encouraging the development of a regional strategy to combat global climate change. The discussions centered on a regional cap-and-trade program to regulate carbon dioxide emissions from power plants.

The RGGI cap and trade will start in 2009 and include coal fired, oil fired, and gas fired electric generating units with a capacity of 25 megawatts or more. In 2009, among the nine original states in RGGI (excluding Maryland), the initial distribution of allowances for emissions of CO_2 from power plants will be capped at approximately current levels (i.e., 150 million tons annually). Over the next four years, the number of allowances put into the market will be reduced incrementally to achieve a 10 percent reduction by 2019. One allowance, or permit, will be issued for each ton of CO_2 emissions allowed under the cap. Plants will need an allowance for each ton of CO_2 emitted and can buy or sell allowances. Allowances can also be banked for use in future years.

Although the cap-and-trade program is regional, states will receive an annual emissions budget. Compared to a baseline that includes emissions increases without RGGI, the cap-and-trade program "will result in an approximately 35 percent reduction by 2020" (RGGI 2006).

3. Mid and Long Term Scenario

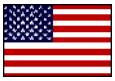
Emissions targets differ across market-based policy proposals. The Figure shown below exhibits the trajectories of emissions targets for the economy-wide and electricity-sector proposals. In



Source: Kopp et al., "Summary of Market-Based Climate Change Billls Introduced ini the 110th Congress", (2007)

Figure: Comparison of Emissions Reduction Goals in Legislative Proposals in

general, the less detailed proposals tend to have more stringent targets: Waxman, Sanders-Boxer, and Kerry-Snowe have the most stringent targets; Bingaman-Specter and Udall-Petri have less stringent



United States of America

targets; and Lieberman-McCain is in between. Lieberman-Warner proposes 2005 emissions levels in 2012, and 10 percent and 30 percent below 2005 levels in 2020 and in 2030, respectively; this is roughly similar to the Lieberman-McCain targets. (The Lieberman-Warner bill is not depicted in the figure because a detailed draft has not yet been released.)

The Federal government has introduced the following long-term policies on an axis of energy security. Through these policies a significant GHG reduction will be achieved, however, reduction levels are not given in a quantitative manner.

a) Renewable Fuel Standards (RFS), Advanced Energy Initiative

Renewable Fuel Standards (RFS), formulated in the Energy Policy Act of 2005, requires fuel producers to use bio fuels by 7.5 billion gallons by 2012. This policy was followed by Advanced Energy Initiative which was presented in the State-of-the-Union address in January 2006. From energy security viewpoint, this Initiative aims to convert 75% of oil imported from the Middle East to alternative energies by 2025, by means of:

- diversification of energy sources;
- diversification of automobile fuels;
- zero-emission coal-fired plant (future generation).

b) State of the Union Address of 2007

In January 2007, US President George W. Bush released additional energy policies during his State of the Union address, including a large increase of R&D budgets:

- expansion of supply volume of biofuel to 35 billion gallons by 2017;
- 20% reduction of gasoline consumption.

URL:http://www.whitehouse.gov/news/releases/2007/01/20070123-2.html

Source: Toshi H. Arimura, Dallas Burtraw, Alan Krupnick, and Karen Palmer (2007)
U.S. Climate Policy Developments, DISCUSSION PAPER, Resources for the Future
http:// www.rff.org/Documents/RFF-DP-07-45.pdf

*This chapter is prepared based on the study "U.S.Climate Policy Developments" (2008) by T.Arimura, D.Burtraw, A.Krupnick and K.Palmer for which 2050 Japan LCS scenario study team summarized while adding relevant information.