

4 POLICIES AND MEASURES

4.1. POLICY-MAKING PROCESS

4.1.1. Global level

UNFCCC AND THE UNITED NATIONS

Climate change mitigation is one of the top environmental policy priorities in Finland. Finland ratified the UN Framework Convention on Climate Change (UNFCCC) on May 3, 1994. According to the burden sharing of the Kyoto target within the EU, Finland is committed to maintain the 1990 emissions level by 2008–2012. Finland signed the Kyoto Protocol on May 29, 1998. The ratification will take place in line with the other EU Member States.

Finland has signed numerous international environmental declarations and agreements within the United Nations. Among the most important regarding climate change mitigation are the Rio Declaration on Environment and Development, the action plan Agenda 21, and the Statement of Principles for the Sustainable Management of Forests that were adopted at the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil, June 1992.

The Rio conference also led to the conclusion of the UNFCCC and two other conventions that interact with climate change mitigation: the Convention on Biological Diversity: Finland has accepted the Convention on 27.7.1994 and signed its Protocol on Biosafety on 24.5.2000 and the Convention to Combat Desertification: Finland has accepted the Convention on 20.9.1995.

Finland was also among the first countries to sign and ratify the Convention for the Protection of the Ozone Layer, which was signed in Vienna in 1985, and the Montreal Protocol in 1987. Finland has been active in international co-operation within the UNECE Convention on Long-range Transboundary Air Pollution since 1979.

PARTICIPATION IN OTHER INTERNATIONAL ACTIVITIES AND ORGANISATIONS

Finland has been a member of the Organisation for Economic Co-operation and Development (OECD) since 1969. The OECD groups 30 member countries in an organisation that provides governments a setting in which to discuss and develop economic and social policy.

The OECD has a horizontal programme on sustainable development, in which climate change policy assessment is an integral part.

Finland participates in the work of the International Energy Agency (IEA), founded in 1974. The IEA's objectives include improvement of the world energy supply and demand structure, more efficient use of energy, development of alternative energy sources to reduce dependence on any one source, assistance in the integration of environmental and energy policies, and the promotion of co-operative relations between oil-producing and oil consuming countries. The IEA also maintains an emergency system to help member governments alleviate the effects of oil supply disruptions by various measures, including sharing available supplies.

Finland is a member of the International Civil Aviation Organization (ICAO) and the International Maritime Organization (IMO). Both are sub-organisations of the United Nations. Finland participates actively in these organisations with the aim at preparing mechanisms to reduce GHG emissions from international aviation and shipping.

Finland participates in both multilateral and bilateral development co-operation that often has direct links to climate change mitigation. Finland finances climate change mitigation through the Global Environment Facility (GEF). The Global Environment Facility was established to forge international co-operation and finance actions to address four critical threats to the global environment: biodiversity loss, climate change, degradation of international waters, and ozone depletion. For more information, see Chapter 7.

Finland has also contributed to the Prototype Carbon Fund (PCF) of the World Bank (see Chapter 4.6). The government of Finland has launched a pilot programme in order to prepare for the joint implementation (JI) as well as the clean development mechanism (CDM) of the Kyoto Protocol.

Finland is a member of the World Meteorological Organization (WMO). Finland participates actively in this organisation e.g. by supporting the Global Climate Observing System in ensuring that observations needed in global climate monitoring and modelling are available.

Finland's relations with developing countries are aiming at coherent goals in foreign and security policy, trade policy and development co-operation. Development co-operation's role as a significant part of foreign policy is underlined. Within the development policy objectives, reduction of poverty, prevention and mitigation of environmental problems, and promotion of equality, democracy and human rights constitute the basic elements in the promotion of global peace and security. For more information, see Chapter 7.

There is also an intensive co-operation with the other European countries e.g. under the auspices of the Ministerial Conferences on the Protection of Forests in Europe special emphasis has been focused on Nordic countries and the countries in the Baltic Sea region in the



field of environmental protection and climate change mitigation. The Baltic Sea region offers some very specific advantages to regional co-operation in climate change mitigation including opportunities for energy trade and emissions reductions. The Ministers of these countries have recommended that further work should be done with a view to make a decision on a Baltic Sea region testing ground for international co-operation in the use of flexible mechanisms.

The Baltic Sea region is the first region in the world to adopt common goals for sustainable development. In 1996, the Prime Ministers of the region took the initiative to develop an Agenda 21 for the region. This was the start of the Baltic 21 process, and sustainable development in the Baltic Sea region. In 1998, the Foreign Ministers adopted the Agenda 21 for the region, which includes agreed overall goals and sectoral goals and an action programme for sustainable development.

Finland has supported environmental protection in its neighbouring areas since 1991 through bilateral and multilateral co-operation projects. Two important goals are improving the state of the Baltic Sea and reducing emissions in neighbouring countries that have a harmful effect on the Finnish environment.

4.1.2. EU level

Finland joined the European Union at the beginning of 1995. Under the burden-sharing agreement of the EU, Finland will have to maintain the 1990 level in its greenhouse gas emissions by 2008-12. The EU commitment under the Kyoto Protocol is to reduce GHG emissions by 8% from the 1990 level. The EU has expressed its commitment to ratify the Kyoto Protocol by 2002.

The European Commission has taken many climate-related initiatives since 1991, when it issued the first Community strategy to limit CO₂ emissions and improve energy efficiency. These include a proposed directive to promote electricity from renewable energy sources, voluntary commitments by car makers to improve fuel economy, a White Paper on increased use of renewable energy sources, the Sixth Environment Action Programme of the European Community 2001-2010, energy efficiency measures, and increase of CHP. In addition, several Directives are climate relevant in the areas of horizontal legislation, air quality, waste management, water quality, nature protection, and industrial pollution control and risk management as well as the whole Energy Acquis (European Commission 2001). Measures related to sustainable development also affect GHG emissions.

The Commission launched the European Climate Change Programme (ECCP) in June 2000. The goal is to identify and develop all the necessary elements of an EU strategy to implement the Protocol. Taking a 'twin-track' approach, the ECCP is preparing a range of additional EU-level policies and measures to cut greenhouse gas emis-



sions as well as a proposal for emissions trading scheme that could start operating within the EU by 2005.

The introduction of harmonised energy taxes in the European Union has been discussed since the beginning of the 1990s. In 1997, the Commission presented a draft directive. This proposal seeks to introduce EU-wide minimum levels of taxation for a broad range of fuels and other energy products, including those products that have been tax-exempted in some member countries so far (gas, electricity, coal). Parallel to this, the member countries are encouraged to reduce other taxes, in particular the charges on labour. The European Parliament has welcomed the draft directive. Up to now it has not been approved by the Council, because a unanimous decision needed has not yet been achieved.

CARDIFF PROCESS

The adoption of the Amsterdam Treaty in 1997 was an important milestone when aiming at integrating environmental aspects into other Community policies. Article 6 of the Treaty of the European Communities requests the Member States to promote sustainable development and to integrate environmental aspects into all Community policies. The Commission Communication "Partnership for Integration" was welcomed by the Cardiff European Council in June 1998 and the ideas of this Communication were developed into practical requirements for the Commission and for the Council. In this respect, all relevant formations of the Council were invited to establish their own strategies for giving effect to environmental integration and sustainable development within their respective policy areas. The Transport, Energy and Agriculture Councils were invited to start this process. At subsequent European Council meetings, more Council formations were invited to join (i.e. Development, Internal Market, Industry, General Affairs, Ecofin and Fisheries). The EU forest strategy from 1998 also addressed climate issues.

The Helsinki Summit in December 1999 reaffirmed the commitment to sustainable development and to integration. Three Council formations (Transport, Agriculture and Energy) submitted their strategies to the Summit. In all of these strategies, the aim to reduce greenhouse gas emissions is one important objective when aiming at reducing negative environmental impacts caused by these economic activities.

Since the Helsinki Council meeting the sector integration strategies in the field of transport, agriculture and energy have been further developed and the work has continued to develop other strategies in the other fields of Community policies. In addition to sector specific integration strategies, the European Council has invited the Commission to submit a proposal for a comprehensive and long-term sustainable development strategy. Such a strategy was adopted at the Gothenburg Summit in June 2001.



4.1.3. National level

INSTITUTIONAL FRAMEWORK

Finnish regulations, policies and measures are nowadays affected by the EU directives, policies and measures in several ways. The current government has committed itself in Government Programme in 1999 to meet the target of the Kyoto Protocol and of the burden-sharing within the European Community. With that in mind, the Government appointed a ministerial working group to prepare a national action plan for meeting these targets. The National Climate Strategy was accepted in 2001 (see Chapter 4.2.1).

Finland has an extensive institutional framework for environmental management. The Ministry of the Environment is responsible for a large part of the environmental issues, while the Finnish Environment Institute, an agency of the ministry, monitors and assesses the state of the environment and provides information to the public. The Ministry of the Environment is also responsible for housing, building and spatial planning.

The Ministry of Agriculture and Forestry, the Ministry of Trade and Industry and the Ministry of Transport and Communications are responsible for climate change issues in their administrative sectors. Moreover, the Ministry of Trade and Industry is a major player in climate change policy and it has also been responsible for co-ordination of the development of the National Climate Strategy. In addition, the Ministry for Foreign Affairs and the Ministry of Finance are important parties in climate change mitigation.

Two national organisations are especially relevant to climate change: Motiva Oy is an independent, non-profit company that gets primary funding through state budget and is directed mainly by the Ministry of Trade and Industry. Motiva's main task has been the implementation of the government's Energy Conservation Programme, and it has also got the task to promote renewable energy. TEKES, the National Technology Agency is the main financing organization for applied and industrial research and development (R&D) in Finland. The funds for financing are awarded from state budget via the Ministry of Trade and Industry.

LEGISLATION AND REGULATIONS

The Environmental Protection Act (86/2000) regulates substances indirectly relevant to climate change although basically addressing other aims. The law also incorporates the EU Directive on Integrated Pollution Prevention and Control (96/61/EY).

The Land Use and Building Act (132/1999) does not explicitly promote climate change mitigation. However, its main principles, i.e. economically efficient land use and settlement structure, economical use of natural resources and promotion of the functionality of settlements and good practices in building, contribute to the aims of cli-

mate change mitigation. Based on the Act, national targets for spatial planning were adopted in 2000 especially affecting the spatial planning and urban structure. The Act on Environmental Impact Assessment Procedure has an indirect effect on GHG emissions.

The Finnish forest and nature conservation legislation were revised during the 1990s and it is now being implemented. The reform of forest legislation was based on the broadened concept of sustainable forest management, where enhancing biodiversity is one of the key concepts. Forest legislation now focuses on promoting the economic, social, ecological and cultural aspects of sustainable management of forests, and thus to sustainable development.

Regulations especially in the energy sector have clear influence on climate change mitigation (see Chapters 4.2.2 and 4.3 for details) due to economic steering. The Waste Act is also important as it regulates the planning, establishment, construction, use, management, closure and aftercare of landfills with effect on CH₄ emissions. Several other regulations and legislation affect GHG emissions mainly indirectly.

4.1.4. Regional level

Regional and municipal environmental administrations have been created in the past two decades, and are taking increased responsibility in managing local problems. They are also involved in land use planning and environmental education as well as in campaigns to reduce greenhouse gas emissions. Other important regional bodies are the regional environment centres (supervised by the Ministry of the Environment), with a prominent role in the collection of information on environmental issues, and the regional forest centres (supervised by the Ministry of Agriculture and Forestry), with responsibility for biodiversity management, among other tasks.

Three permit authorities and 13 regional environment centres give the environmental permit decisions for large and medium-sized industrial enterprises. The municipal authorities handle permits for smaller plants. Energy efficiency and BAT are considered. Regional environment centres also prepare regional programmes, which give guidance for planning process.

Finnish law requires regional planning by regional councils. The use of land for different purposes, e.g. recreation and transport or urban activities, is guided in regional plans. The regional plan acts as a guideline for municipal-level plans and other detailed planning of land use. For instance, the Regional Council of Häme concluded in the year 2000 the first regional inventory of GHG gases and sinks.

4.1.5. Municipal level

The political decision-making system in Finland is widely decentralized. The local authorities make numerous decisions on matters that affect GHG emissions, such as traffic and land use planning, waste management and energy consumption and production. Municipalities also give environmental permits to smaller plants and are major property owners.

In Finland the municipal sector works in many different ways to reduce the greenhouse gases. Some of these functions are, for example, the municipalities' own energy consumption reduction programmes and agreements, the local or regional energy agencies for energy saving and renewables partly financed by the EU as well as the local agenda processes.

The Association of Finnish Local and Regional Authorities (AFLRA) promotes and co-ordinates the climate protection campaign of municipalities, The Cities for Climate Protection Campaign (CCP Finland). The purpose of the campaign is for cities and municipalities to plan and initiate their own actions to reduce local greenhouse gas emissions (see Chapter 9.2). Approximately 20 municipalities and two regions have calculated their GHG emissions. A wide array of national and local workshops and conferences are being arranged covering such issues as energy, land use, traffic and waste management.



4.1.6. Role of industry, NGOs, and other interest groups

Industry, environmental and other interest groups play an important part in the Finnish policy-making process. NGOs are involved in different working groups, seminars and official delegations including the Climate Committee. Especially the Finnish Association for Nature Conservation, Greenpeace, Friends of the Earth, WWF Finland, Dodo and Natur och Miljö are active in this field. Agricultural producers and forest owners are particularly interested in issues related to agriculture and forestry.

Industry participates and co-operates actively in climate change mitigation. Particularly, voluntary agreements between government and industry are considered an important instrument. They cover the use, production, transfer and distribution of energy. Companies joining an agreement must first perform an energy audit, appoint an energy manager and prepare an energy conservation plan. Second, they must implement the measures identified in the plan and report annually to the sectoral association. The government will provide funding for the energy audits and for the investments of companies participating in the agreements.

At the moment, the agreement covers approximately 80% of all industrial energy consumption. Industries are also significant users of

renewable wood-based energy sources. Almost half of all fuel used by industries is wood-based. Many companies also participate in the EMAS (Eco-management and Audit Scheme) Programme of the EU or use environmental management system based on ISO 14 000 standards. Important parts of the agreement system are mid-term and final evaluations. The results of the evaluations are used for further development of the agreements. The agreements signed in 1997 will be evaluated in 2001–2002.

A visible Finnish company in activities reducing GHG emissions has been Fortum Corporation. The company has published a Climate change initiative in 2000 that will reduce GHG emissions and joined the Prototype Carbon Fund (PCF) of the World Bank. Fortum's voluntary Climate Initiative includes immediate measures, targets for 2005 as well as long term objectives up to 2010. As an immediate action Fortum has established a corporate Climate Fund to facilitate early emissions reduction projects.

Several other companies are also activating themselves in climate change mitigation. For example, the power company Pohjolan Voima is actively increasing the use of biomass and studying the use of large scale wind power and recycled fuels. Rautaruukki and the City of Helsinki have been among the most visible in the area of energy conservation.

In general, Finnish industry has expressed its readiness to the implementation of the energy conservation programme and to the increased energy use of wood, both included in the National Climate Strategy. The industry presupposes, however, that Government does not impose other obligations on industry, such as binding requirements relating to energy consumption or emission quotas for carbon dioxide. The industry has also expressed the view that Government would abstain from increases in industrial energy taxes and from imposing possible carbon dioxide taxes on industries.

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4.1.7. Monitoring and evaluation

The institutional framework for monitoring and evaluation of climate change mitigation is mainly based on the following elements, which have been necessary first steps in the policy formulation:

- *The implementation process of the National Climate Strategy is monitored by the Kyoto Ministerial Working Group.*
- *On the EU level the monitoring and evaluation is based on the Monitoring Mechanism of Community CO₂ and other greenhouse gas emissions (Council Decision 1999/296/EC)*
- *Finland's national greenhouse gas inventory has been based on the work of an inter-ministerial working group led by the Ministry of the Environment in consultation with the relevant ministries, institutes and experts in accordance with the provisions of the*



COP/SBSTA/SBI decisions. The annual inventory report has been compiled by the Finnish Environment Institute (SYKE) and Statistics Finland, and the collaboration with the Ministry of the Environment, the Technical Research Centre of Finland (VTT), and MTT Agrifood Research Finland and the Finnish Forest Research Institute (METLA).

In addition, several programmes at different levels, indicators and reports related to sustainable development contribute to monitoring and evaluation. Finland's indicators for sustainable development include indicators related to climate change. These are Finland's greenhouse gas emissions, mean temperature and ice break-up date of the river Tornio.

4.2. SECTORAL POLICIES AND MEASURES

4.2.1. National Climate Strategy

INTRODUCTION

The government started the preparations for the National Climate Strategy in 1999 in order to meet Finland's Kyoto commitment. According to the burden sharing agreement within the EU, Finland will have to maintain the 1990 emissions level by 2008–2012. The ratification of the Kyoto Protocol will take place together with the other EU member states. Pursuant to the Constitution of Finland, the Kyoto Protocol has to be approved by the Finnish Parliament. The final decision to ratify the Protocol is taken by the President of the Republic after the approval of Parliament.

As a member of the European Community, Finland will, pursuant to Article 4 of the Kyoto Protocol, fulfil its commitments under Article 3 jointly with the European Community and other member states. Finland will notify the UNFCCC Secretariat of the terms of the burden-sharing instrument simultaneously with the Community and other member states in connection with the deposition of the instrument of the ratification.

The ministries the most actively involved in the preparations for the National Climate Strategy were the Ministry of Trade and Industry, the Ministry of the Environment, the Ministry of Transport and Communications and the Ministry of Agriculture and Forestry. In addition, the Ministry for Foreign Affairs and the Ministry of Finance are important parties in climate change mitigation.

The Ministry of Trade and Industry has been responsible for coordinating and collecting the sector-specific programmes into a National Climate Strategy (Ministry of Trade and Industry 2001) and a background document (Kauppa- ja teollisuusministeriö 2001) in wide cooperation with the various ministries and other stakeholders. For this

co-operation, a Kyoto Ministerial Working Group and an inter-ministerial Kyoto network was set up.

The National Climate Strategy was adopted by the Finnish Government on March 15, 2001, and it was submitted to Parliament. The Parliament supported the strategy in its statement on 19.6.2001.

Finland's Third National Communication under the Framework Convention on Climate Change is largely based on the National Climate Strategy and the background document as well as the research and sectoral reports of strategy formulation (e.g. Liikenne- ja viestintäministeriö 2000; Maa- ja metsätalousministeriö 1999, 2000a, 2000b, 2001; Ympäristöministeriö 2001), and on the work of the inter-ministerial committee for preparing the Third National Communication. In addition, the latest data was used in order to update the information.

POLICY INSTRUMENTS OF THE CLIMATE STRATEGY

The basis of the climate strategy is that the Kyoto target would be met as cost-effectively as possible by domestic measures. Possibilities offered by the Kyoto flexible mechanisms are discussed in Chapter 4.6.

Research and Development

More research will be needed in order to understand the greenhouse effect resulting from many different factors and its consequences. A special research area in this field is composed of studies of the society, urban structure and the behaviour of organisations and consumers. Development of technology is one of the most important measures by which greenhouse gas emissions can be reduced, and technological solutions bring long-term, permanent changes.

Taxation

Taxation has become more important in prevention of climate change. The use of taxation is limited e.g. by competition, regional or socio-economic facts, and to a certain degree, by the EU membership. Due to the membership, many taxation models, like tax refund or production subsidy for electricity generated by the renewable sources of energy, must be approved by the European Commission.

Subsidies

Various subsidies are already widely used today. The subsidies are allocated for non-recurrent investments of the operators and are thus operational subsidies of a permanent nature. The energy subsidy is an investment aid that can be granted to companies and municipalities for environment-friendly energy investments that are made particularly in new technology. There is also a proved need in the introduction of renewable energy sources for a substantial non-recurrent demonstration aid for new technology.



Renovations improving the energy efficiency of buildings can be supported by financial aid and interest subsidies. In agriculture, it is possible to support by financial aid and interest subsidies investments that also have implications on environmental protection.

Operational tax subsidy is paid for electricity generated by wind, wood-based fuel and small-scale hydropower reducing greenhouse gas emissions. The logging and chipping of energy wood obtained from management of young forests are subsidised in the forest sector. The environmental aid for agriculture co-financed by the EU is also used to influence greenhouse gas emissions. All criteria for allocating national subsidies must be approved by the Community. However, the Community takes generally, a positive stand to the aid required for preventing climate change.

Statutes, regulations and guidelines

The use of norms is a straightforward and efficient method in those sub-sectors where it is easily applicable, such as the energy regulations of new buildings, refrigeration apparatus and of ventilation equipment. New norms often lead to intensive technological development work. Furthermore, statutes can change production structures considerably.

Due to the internal market in the Community and international trade, some of the norms must apply at least on Community. Such norms are the energy labelling and energy efficiency requirements placed on certain equipment and vehicles. In contrast, building norms, for example, can be drawn up on purely national basis

Voluntary agreements

Voluntary agreements constitute a new way of promoting environment-friendly issues. The agreements are most often concluded between the government and the trade organisations. They are flexible and may concern efficiency improvements, change activities or producing products that meet certain requirements.

The energy conservation agreements are the most significant ones in Finland. The energy conservation agreement scheme can be extended over to new fields of action, e.g. to increasing the use of the renewable energy sources. In some countries, the agreements are connected with various incentive schemes, like tax reliefs. On the Community level, voluntary agreements on the energy efficiency of products have been concluded for instance with car manufacturers (see Chapter 4.1.6).

Information dissemination, advisory services and training

Information dissemination and advisory services will be needed for influencing attitudes. In all sectors of activity, studies will be needed to develop especially new measures and to assess the effectiveness of the measures taken. Information on climate change will be included in the various stages of education and training. The climate protection



campaign of municipalities serves as a good example of spontaneous activity.

4.2.2. Energy

The general objective of Finland's energy policy has been to ensure a reliable supply of energy at competitive prices. The energy supply is quite diversified and energy imports cover about 70% of total use. During the past two decades, energy supply has shifted away from oil and coal towards nuclear energy, wood-based fuels, peat and natural gas. Finland also imports a considerable proportion of its electricity (5-17% in the 1990s). Industry accounts for about half of total energy use and its share is increasing over time. The forest industry is the largest energy consumer, but it produces more than 40% of its needs from waste wood and other by-products (i.e. black liquor). The proportion of wood and derived products of total energy supply is the highest in Europe.

Direct government intervention to guide the choice of energy sources is rare, apart from decisions regarding the use of nuclear power. However, economic instruments, taxation and subsidies, have been used to improve energy efficiency and to favour the development of domestic energy sources such as peat and biomass. Peat, in particular, as one of the few indigenous energy resources, was given substantial support in the form of R&D and investment subsidies, and tax exemptions. The use of peat has, however, declined in the late 1990s mostly due to increased wood-based fuel subsidies and liberalization of the electricity market.

Finland was the first country to introduce a CO₂ tax in 1990. This tax was based on the carbon content of fuels. Since its introduction the tax system has been modified and tax rates adjusted several times in the 1990s. The present energy taxation consists of three tax components: A basic excise tax is levied on transport and heating fuels, an additional CO₂-based excise tax is levied on fossil fuels and peat and an additional differentiated (industrial and other use) excise tax is levied on electricity consumption (see Chapter 4.3).

The Finnish electricity market has been gradually liberalised since 1995. Finland has been effectively part of the Scandinavian electricity market together with Denmark, Norway and Sweden and since 1997.

Increased competition and improved overall efficiency have lowered the price of electricity for large consumers and since 1998 also for small consumers. This trend may result in an increase in electricity consumption and, therefore, may have important unintended side-effects on greenhouse gas emissions. The price of electricity is, however, expected to rise in the future from the current level.

POLICIES AND MEASURES

Concrete policies and measures (P&Ms) affecting CO₂ emissions were defined for the energy sector already in the 1990s, so the effect of policies and measures in the energy sector in the 1990s can be compared with the base scenario of the First National Communication of Finland. This Communication presented a scenario that originated from the strategic work of the government in the early 1990s concerning future development. The base or reference scenario was defined for the years 1990–2010 (CO₂ emissions from fuel combustion). This scenario is not considered to be a ‘without measure scenario’ and assumptions behind this base scenario are considered irrelevant after 1999. See Chapter 5.2 for detailed discussion in this subject.

Discussions on policies and measures in the energy sector are therefore divided in three sections:

First, policies and measures in the 1990s are discussed as mitigation impact compared with the original base scenario can be estimated only for CO₂ during the 1990s. The mitigation impact of individual policies and measures is not quantified. Emissions trends in the 1990s are discussed in general in Chapter 5.2.

Second, policies and measures in the ‘with measures’ scenario are presented for the years 2000–2020. No mitigation impact is calculated as no comparable ‘without measures’ scenario is defined. Policies and measures in the base scenario and in the ‘with measures’ scenario are combined in Table 4–1 as P&Ms are basically the same.

Third, policies and measures in the ‘with additional measures’ scenario are presented in Table 4–2 for the years 2000–2010. Policies and measures in this scenario are basically intensified and updated versions of the ones in the previous scenarios. Energy conservation programme was revised in 2000 and new Action plan for renewable energy was accepted in 2000. Additional measures concerning electricity supply have also been defined and two main alternatives have been presented: a shift from coal to natural gas in the generation of electricity and heat or a new nuclear power plant unit replacing coal in electricity generation.¹ Policies and measures are defined until the end of the first commitment period.

The mitigation impact of individual policies and measures is not estimated in Table 4–2. The aggregate effect of additional policies and measures in the energy sector is approximately 11 Tg by 2010 compared with the ‘with measures’ scenario.

¹ Natural gas alternative is called KIO1 and nuclear alternative is called KIO2 in the National Climate Strategy.

Table 4-1.

Major policies and measures affecting GHG emissions in the energy sector in 1990–1999 and in the ‘with measures’ scenario in the energy sector in 2000–2010. Policies and measures are basically the same in the 1990s and in the ‘with measures’ scenario

Policy or measure	Objective ²	GHG affected (mainly)	Type of instrument	Status	Implementing entity
Electricity market act	To increase competition	CO ₂	Regulatory	Came into force in 1995, modified in 1997 (small consumers included)	Ministry of Trade and industry
Energy taxation	To reduce energy consumption and to improve competitiveness of renewables	CO ₂	Fiscal	Several changes in tax structure in 1990s. Latest change in 1998. Revisions have raised taxes and introduced subsidies on renewables	Ministry of Finance
Energy conservation programme	To reduce energy consumption	CO ₂	Technical, regulatory, economic, information, education	Adopted in 1995, new energy conservation programme proposed in 2000	Ministry of Trade and Industry, Motiva Oy
Voluntary agreement on energy conservation and energy auditing	Agreements on monitoring, conservation plans, energy audits, energy investment, new technology	CO ₂	Voluntary agreements since 1997	Currently 80% of industry, 90% of power production, 75% of power distribution, 70% of DH sales, 95% of government and 55% municipally owned buildings etc.	Ministry of Trade and Industry, Motiva Oy, industry, municipalities
Action plan for renewable energy	To reduce CO ₂ and non-GHG emissions	CO ₂	Fiscal, technical, information, education, economic	Several programmes in 1990s, important aspect in 1997 Finnish energy strategy, new action plan was accepted in 2000	Ministry of Trade and Industry
Energy and climate technology R&D	To reduce CO ₂ emissions	CO ₂	Technical	Continuous	Ministry of Trade and Industry, TEKES

² Related to GHG mitigation (there are also other objectives)

ENERGY CONSERVATION

The 1995 Energy Conservation Programme has been revised in 2000 to meet the needs of the National Climate Strategy and has now been integrated into the Strategy.

The proposed energy conservation measures can be divided into seven categories:

- 1) funding the development and commercialisation of energy-efficient technology
- 2) using economic steering methods, e.g., taxation
- 3) improving the efficient use of control by norms
- 4) further enforcing voluntary energy conservation agreements
- 5) further developing energy audits and analyses
- 6) supporting energy conservation measures with information services, training and motivation
- 7) supporting energy conservation activities of the EU and international organisations.

Implementing the proposed measures can reduce energy consumption by approximately 3% from the 1999 level by 2010. GHG emissions would be reduced by 3–4 Tg CO₂ equivalent, or 4–5%. Energy conservation measures have already contributed to a reduction in the electricity intensity in the service sector.

RENEWABLE ENERGY SOURCES

A national programme for enhancing the use of RES – Action Plan for Renewable Energy Sources – was approved in 1999. It was in line with the 1997 Finnish Energy Strategy and the 1998 EU White Paper (Community Strategy and Action Plan on RES). The Action Plan is now being implemented, and it has also been integrated into the National Climate Strategy.

The main objective of the Action Plan is to foster the competitiveness of RES on the open energy market. The measures can be divided into four categories:

- 1) development and commercialisation of new technologies
- 2) financial measures, especially taxation and investment subsidies
- 3) additional administrative measures
- 4) education and information dissemination.

The promotion of wind power is one element in the Action Plan. Wind power plants are already entitled to investment grants and they get a tax subsidy, the amount of which corresponds to the tax levied on electricity in the lower tax class. Exploitation of wind power is on the rise, but is still on a very low level. In 1999, the electricity output of wind power plants totalled 49 GWh (installed power at year end 38 MW). The strategic goal is an annual increase of over 10% in wind power production in the period 2000–2020.

The quantitative objective of the Action Plan is to increase energy production from RES between 1995 and 2010 by 125 PJ, or by 50%. So far, the promotion of RES use has been successful. The long-term objective is to double the use of RES by the year 2025. Furthermore, implementing the Action Plan is expected to reduce GHG emissions by 4–5 Tg CO₂ eq., or 5–7%, between 1999 and 2010.

Table 4-2.

**Major additional policies and measures included
in the 'with additional measures' scenarios in the energy sector in 2000–2010**

Policy or measure	Objective ³	GHG affected (mainly)	Type of instrument	Status	Implementing entity
Revised conservation energy	To reduce energy consumption	CO ₂	Technical information, education, fiscal	New energy conservation programme proposed in 2000	Ministry of Trade and Industry, Motiva Oy, Ministry of Finance, Ministry of the Environment
New action plan for renewable energy	To reduce CO ₂ consumption and non GHG emissions	CO ₂	Fiscal, technical, information, education, economic	Accepted in 2000	Ministry of Trade and Industry
Supply of electricity ⁴	To reduce CO ₂ emissions	CO ₂	Regulatory	Pending on Parliament	Ministry of Trade and Industry

³ Related to GHG mitigation (there are also other objectives)

⁴ Either natural gas (KIO1) or nuclear (KIO2) alternative. The Government is at present processing an application, submitted by Teollisuuden Voima Oy, for a Decision-in-Principle on its plan to build a new nuclear power plant unit. A decision is foreseeable in the autumn of 2001 at the earliest.

4.2.3. Transport

In the transport sector the climate change policy has become an integrated part of the transport policy in the 1990s both at the national level and within the European Union. The aim is to restrain the growth of transport and thereby to reduce the environmental effects of transport, including greenhouse gas emissions.

The Commission has recently published a new White Paper on the Common Transport Policy with the aim to find new measures to reduce traffic congestion and to maintain and promote the share of sustainable modes of transport in modal split. This should also support reduction of greenhouse gas emissions.

Promotion and development of inter-modal transport, rail transport and public transport have traditionally played an important role in the Finnish transport policy. Finland has also had a national cycling policy programme since 1992.

Cities and towns sell convenient regional bus cards valid for one month in all major urban areas, and they also subsidise the ticket prices. The government funds half of the bus ticket prices in small urban agglomerations, but does not subsidise the bus tickets in large cities or towns. In freight transport the logistical efficiency of traffic chains has

been an important objective already because the traffic distances are long and volumes rather small in a large country with low population density.

Following the relatively high level of vehicle and fuel taxation in Finland compared to several other countries, the market share of public transport has remained relatively high, around 20%, of all passenger transport.

Because of the transport and fiscal policy objectives and measures, and economic recession in the early 1990s, there has been only a slight increase in GHG emissions caused by transport in the 1990s (Figure 4-1). There is some cautious optimism that to a certain extent there might be some decoupling of traffic volumes from economic growth (Figure 4-2).

Greenhouse gas emissions from transport shall be reduced by decreasing the fuel consumption of vehicles and by disseminating information on the effects of the transport mode and the manner of driving on fuel consumption.

The agreement between the European Commission and the motor industry to reduce the average fuel consumption of new motor vehicles plays a key role in attempts to reduce emissions from transport.

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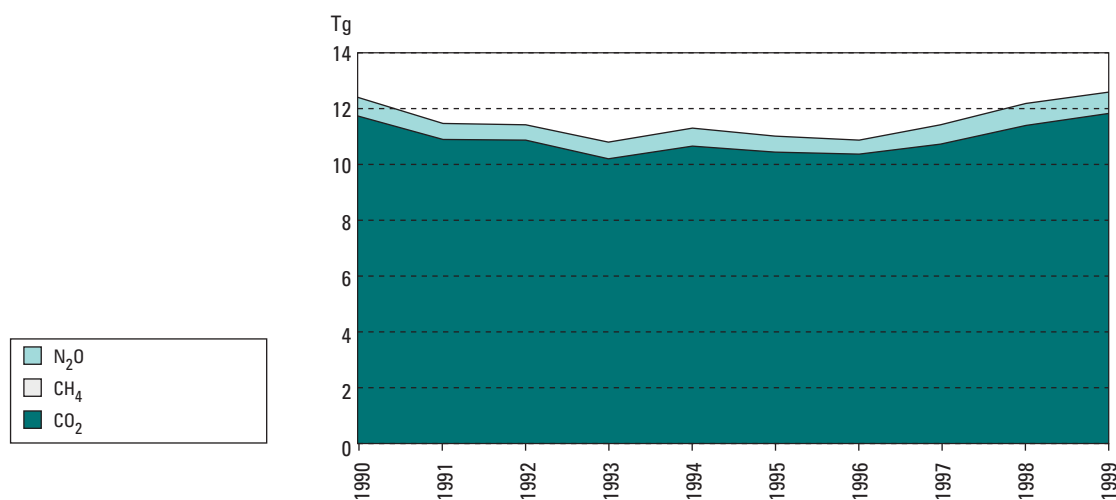


Figure 4-1.
Greenhouse gas emissions from transport in 1990–1999.

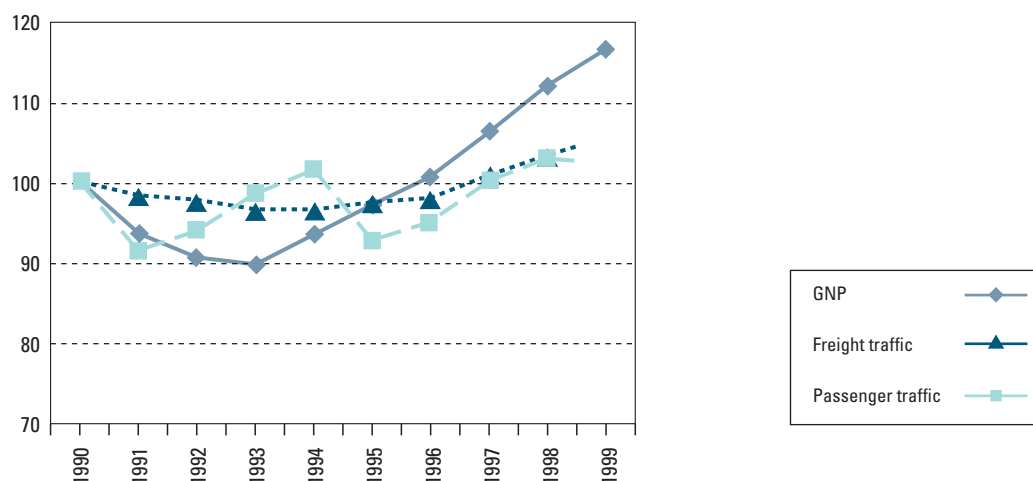


Figure 4-2.
Trends in GNP and volume of passenger and freight transport in 1990–1999.

The environmental management programme of the transport sector has clear links with climate change mitigation. The Ministry of Transport and Communications has had an environmental management programme of transport policy since 1994. This first programme “Action Programme for Reducing the Adverse Effects of Transport on the Environment” already contained the objective that the greenhouse gas emissions caused by transport should not exceed the 1990 level.

The new programme was adopted in July 1999 when “Environmental Guidelines for the Transport Sector” was published (Ministry of Transport and Communications 1999). The new programme is based on ISO standard 14001 and it provides a practical tool for the environmental management of transport policy. As to greenhouse gas emissions, the aim is that the greenhouse gas emissions in the year 2010 should not exceed the 1990 level. Under the programme, the different stakeholders share responsibility and monitoring and follow-up procedures are set up.

POLICIES AND MEASURES FOR THE YEARS 2000–2020

In the Environmental Management Programme of the Ministry of Transport and Communications the Ministry sets policy targets and measures also in the area of climate change policy of the transport sector. The measures defined in the programme “Environmental Guidelines for the Transport Sector” are much the same that are included in the National Climate Strategy. Such measures are:

- *R&D measures especially with the aim to increase knowledge in the area of information technology, logistics, interaction between transport and land use planning and Green Commuter Plans.*



- *Fiscal measures with the aim to reform vehicle taxation to encourage purchase of low-consumption and energy-saving cars and to promote and subsidize public transport.*
- *Regulatory measures with the aim to guide development of new agglomerations with the help of public transportation system plans and intention agreements in such a way that agglomerations are connected with well-functioning public and non-motorised transport facilities.*
- *Voluntary energy saving agreements with the transport carriers.*
- *Information, education and motivation, such as eco-driving, campaigns aiming at awareness raising and changing transport behaviour.*

The Ministry of Transport and Communications (2000) has also published a long-term strategic programme called “Towards a sustainable and intelligent transport sector”. The aim of this programme is to provide a vision of the transport system that could be reached by the year 2025. Such a transport system should take into account economic, ecological, social and cultural viewpoints. The strategy aims at reaching a transport system in which the demand for road transport (passenger car traffic and road freight traffic) should peak by the year 2020 and gradually start to decrease.

In accordance with the National Climate Strategy and the Environmental Management Programme, the Ministry of Transport and Communications (2001a, 2001b, 2001c) has adopted the following three programmes:

- *National Cycling Policy Programme with the aim to double cycling use from the 1998–99 level up to the year 2020.*
- *National Walking Policy Programme with the aim to incorporate walking into transport policy and planning.*
- *Public Transport Strategy with the aim to increase the attractiveness and competitiveness of public transport, e.g. with the help of establishing door-to-door travel chains and introducing travel centres.*

The annual funding in public transport is around EUR 0.4 billion. The funding in public transport is shared between the government (around 2/3) and municipalities (1/3). Even though in the National Climate Strategy the promotion of public transport is emphasised as an important measure to reduce the transport-related greenhouse gas emissions, it is not expected that the annual governmental funding in public transport will increase but funding will be directed differently aiming at increasing its efficiency: reducing the taxation rate set for the employment-bound public transport tickets lower than their nominal value and funding the development of passenger information services and establishing travel centres.

At the European Union level the reduction of transport related greenhouse gas emissions continues to be an important goal of the Common Transport Policy. One of the most important and efficient measures is the voluntary agreements with the car manufacturers (ACEA, JAMA and KAMA), which aim at reducing CO₂ emissions of new cars by 2008 (or by 2009 of Japanese and Korean cars). The aim is that average CO₂ emissions of new cars should not exceed 140 g/km by 2008. This means that average energy consumption of petrol fuelled cars should be less than 6 litres in 100 km and that of diesel cars less than 5.5 litres in 100 km. Additional measures will need to be developed to meet the EU target of 120 g/km for new cars by 2010.

Reduction of greenhouse gas emissions is an essential part of the Cardiff process (see Chapter 4.1.2). The Council strategy for integrating environment and sustainable development into transport policy was adopted in October 1999. Also various other EU initiatives, such as the revision of the Common Transport Policy, the forthcoming Green Paper on Clean Urban Transport as well as initiatives revitalising rail traffic and promoting short sea shipping, aim at promoting sustainability, restricting growth of transport and reducing greenhouse gas emissions.

Moreover, Finland will actively participate in other international co-operation (e.g. within ICAO, IMO) with the aim to prepare mechanisms to reduce greenhouse gas emissions from international aviation and shipping.



Table 4-3.

**Major policies and measures affecting GHG emissions
in the transport sector in the 'with measures' scenario, 2000–2020**

Policy or measure	Objective ⁵	GHG affected (mainly)	Type of instrument	Status	Implementing entity
Voluntary agreement with European, Japanese and Korean industries	Reduction of CO ₂ emissions from passenger cars: 140/120 g/km by 2008/2010	CO ₂	Voluntary agreement/technical	Existing	EU with car industry
Differentiation of vehicle taxation	Promoting purchase and use of energy-efficient vehicles	CO ₂	Fiscal	Proposed	Government
Promotion of public and non-motorised transport	Increasing share of public and non-motorised transport	CO ₂ , N ₂ O	Information, education, economic	Existing, new measures proposed	Government in co-operation with local authorities
Eco-driving	Adoption of ecoefficient driving skills and habits	CO ₂	Information, education, economic	Proposed	Government in co-operation with driving schools
Energy-saving	Adoption of energy saving agreements between administration and transport operators	CO ₂	Voluntary	Existing, new agreements under preparation	Government in co-operation with transport operators
Transport planning and land use planning	Maintaining compact urban structure	CO ₂	Zoning, transportation system plans, information and education	Existing	Government and municipalities

⁵ Related to GHG mitigation (there are also other objectives)

The mitigation impact of individual policies and measures is not quantified in Table 4-3, as there is no 'without measures' scenario available for the years 2000–2020. Policies and measures included in the 'with measures' scenario are, however, very ambitious and their mitigation effect is approximately 1.4–3.7 Tg compared to what would otherwise occur based on different assumptions.

ADDITIONAL MEASURES

Only a few additional measures are identified in addition to those included already in the 'with measures' scenario. Such measures are: increase of fuel taxation and wider implementation of those measures that were presented already above. However, these additional measures do not have any major additional effect compared to those measures that were presented in Table 4-3.

Table 4-4.

**Major additional policies and measures included
in the 'with additional measures' scenario in the transport sector, 2000–2010**

Policy or measure	Objective ⁶	GHG affected (mainly)	Type of instrument	Status	Implementing entity
Increase of fuel taxation	To reduce traffic volume and GHG emissions	CO ₂	Fiscal	Planned	Ministry of Finance
Additional promotion of public transport	To promote public transport	CO ₂	Information, education, economic	Planned	Government in co-operation with local authorities
Broader energy saving agreements	To broaden the scope and effectiveness of energy	CO ₂	Voluntary agreement	Planned	Ministry of Transport and Communications
Additional measures to maintain urban structure	Concentration of urban structure	CO ₂	Information, education, economic	Planned	Government in co-operation with regional and local authorities

⁶ Related to GHG mitigation (there are also other objectives)

The mitigation impact of individual policies and measures is not quantified in Table 4-4. The aggregate effect of policies and measures in the transport sector is approximately 0.3 Tg by 2010 compared to the 'with measures' scenario (see Chapter 5.3).

4.2.4. Industrial processes

GHG emission levels from industrial processes are fairly low in Finland and emissions have been quite stable during the 1990s. About half of the total emissions from this sector are N₂O emissions from nitric acid production. The CO₂-emissions come from cement and lime production. Emissions from the fuel used as a raw material in the industrial processes (about 10 Tg CO₂) are calculated into the emissions from energy production.

The level of the F-gases grew rapidly during the 1990s to 10% of the emissions from industrial processes. Without further measures their share will be about 40% by 2010.

The main policies and measures related to industrial processes aim at reducing N₂O emissions from nitric acid production and slowing down the increase of F-gases with the use of leakage control and alternative technologies and substances.

The role of industry in general as an energy user is, however, significant, and the climate strategy, especially the electricity procurement choices, would affect primarily the development of traditional energy-intensive industries. These include forestry products, the chemical industry, metallurgical manufacturing and building material industries. Therefore, policies and measures relevant for industry are mainly discussed in the energy sector.



4.2.5. Agriculture

The objectives for the Finnish agricultural policy are based on the view that the permanent competitive handicap due to natural conditions (such as a short growing period, temperature, frost and problematic drainage conditions) must be compensated for in order for the domestic production to succeed and to make agriculture sustainable and multifunctional. The concept of sustainable and multifunctional agriculture takes into account the greenhouse gas emissions and possible needs for adaptation measures along with other environmental and socio-economic considerations. These objectives can be reached by the common agricultural policy of the EU as well as through national measures.

PROGRAMMES

When Finland joined the EU in 1995, an environmental aid system part-financed by the EU, the agri-environmental programme for 1995–1999 was introduced. Environmental protection was adopted as a criterion for the allocation of agricultural subsidies. The objectives of the Finnish environmental programme for agriculture included improving water protection by farms, reducing harmful emissions into the air, and maintaining and developing the agricultural landscape and

biodiversity. The agri-environmental programme for 1995–1999 also provided aid for conversion to organic production.

In 2000 a new kind of agricultural policy became fully effective in Finland as the five-year EU transitional period came to an end in 1999. The new support measures do not differ from the transitional arrangements in any essential way. The objective of the Horizontal Rural Development Programme is to secure the income level of farms, and develop the profitability and efficiency of the production of farms taking into account the environmental considerations and expansion of the industrial basis of the countryside, which maintains the viability and contributes to the better management of the rural areas.

One part of the programme is the agri-environmental support for 2000–2006 based on the Council Regulation (1257/1999). The main focus is not to reduce greenhouse gas emissions but these actions together with the structural change in the Finnish agriculture sector have enabled a significant reduction of greenhouse gas emissions in agriculture from 9.2 Tg CO₂ eq.⁷ in 1990 to 7.3 Tg CO₂ eq.⁸ in 1999.

The agri-environmental support is an essential tool to promote sustainable development in agriculture. About 90% of Finnish farmers are implementing the measures of the support programme. The objectives are to decrease nutrient load on the environment, especially on the surface and ground waters, and to maintain the biodiversity of animal and plant species and the rural landscape. The measures also aim at maintaining or improving the productive capacity of the agricultural land.

There are no major differences between the ‘with measures’ and the ‘with additional measures’ scenarios from the GHG emissions point of view in agriculture as the main policies and measures are already included in the ‘with measures’ scenario.

4.2.6. Forestry

The climate strategy measures concerning forestry are based on the National Forest Programme (Maa- ja metsätalousministeriö 1999), which was adopted by the Government in 1999. International agreement is still pending on the calculation rules for carbon sinks e.g. how changes in the soil are taken into account. In the climate strategy, inputs of forestry-related activities were not taken into account, even though sustainable forest management practiced in Finland has a significant contribution to forest sink.

The basic framework for forest management is set by forest legislation. In recent years forest policy has continued to emphasise other than legislative means (e.g. extension, education, forest management

⁷ 10.2 Tg including CO₂ emissions from mineral soils

⁸ 7.6 Tg including CO₂ emissions from mineral soils



planning, criteria and indicators, innovations, etc.) to promote sustainable forest management and to meet multiple objectives set by different stakeholders and society in general. The role of forests in the protection and enhancement of sinks and reservoirs of greenhouse gases can best be ensured and protected through sustainable forest management that meets the multiple purposes and objectives. A number of forest-related policies and measures have been implemented and further elaborated. As a result of all these policies and measures the forests in Finland have maintained their vitality and have provided multiple benefits including carbon sequestration between 10 to 38 Tg of CO₂ during 1990–1999.

PROGRAMMES

The Environmental Programme for Forestry in Finland (1994) includes the strategy for sustainable forestry, together with the targets for the year 2005. Conservation programmes approved by the Council of State improved Finland's possibilities to preserve biological diversity. EUR 550 million have been reserved for implementing the conservation programme of privately owned land for the years 1996–2007.

All thirteen Forestry Centres have compiled the Regional Forestry Target Programmes. The programmes contain an overall description of forests and forestry and of the needs and objectives for development. They also contain a description of biological diversity of forests, needs for wood production, description of forestry enterprises and recommendations for promoting employment opportunities created by forestry. An assessment of the economic, ecological and social impacts of the implementation of the Regional Target Programme is included in each programme. These programmes have enabled a bottom-up approach in the preparation of the National Forest Programme.

In March 1999 the Government approved Finland's National Forest Programme (NFP) 2010. The comprehensive idea behind the programme is that a competitive forest cluster combined with the fact that forests are a renewable resource, provides an excellent foundation for sustainable development. The programme recognises the economic, ecological, social, and cultural aspects of sustainable forest management. It also sets the objectives for the forest sector:

- *To increase the forest industry's annual use of domestic roundwood by 5–10 million cubic metres by the year 2010.*
- *To double the value of the wood industry's exports to EUR 4.2 billion per year.*
- *To increase the annual use of wood for energy production by 5 million cubic metres.*



- *To further develop the ecosystem management of commercial forests based on the Environmental programme for forestry of 1994. The support for ecosystem management will be increased.*
- *To take into account and advance hunting, reindeer husbandry, picking of wild berries and mushrooms, landscape and cultural values, outdoor recreation and tourism within forest management and protection.*
- *To advance forestry know-how and innovative activities within the forest sector by means of developing research, implementation of the results and training.*
- *To raise silvicultural and forest improvement investments to their former level of approximately EUR 250 million per year. Efforts will be focused particularly on forest planning and on advising and training forest owners.*
- *To assess the need for and further develop forest protection in southern Finland taking into account the ecological, economic, financial and social aspects.*

PROMOTING THE USE OF WOOD AS AN ENVIRONMENTALLY FRIENDLY PRODUCT

The government and different stakeholders have jointly carried out an initiative “Time for Wood” from 1996 to 2000. The purpose of this campaign was to facilitate the increased use of wood, improve employment in the woodworking industry and improve education and training in the woodworking branch. A similar kind of campaign will continue to be implemented in 2001–2005.

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FOREST CERTIFICATION AS A VOLUNTARY MARKET-BASED INSTRUMENT

Forest certification is a market-based instrument that is used to improve consumer awareness of the environmental qualities of sustainable forest management and to promote the use of wood and forest products as environmentally friendly and renewable raw materials. In April 1997 the wide working group on forest certification agreed upon a proposal for a standard for sustainable forest management and its implementation in Finland. The aim was to create a national standard compatible with the international forest certification systems and the environmental management systems.

In 1997–1999 the Finnish Forest Certification System (FFCS) was finalised. The FFCS is endorsed by the Pan-European Forest Certification (PEFC) council. The PEFC aims at establishing an internationally credible forest certification framework for forest certification schemes and initiatives. At the end of 2000 about 95% of the Finnish forests, altogether approximately 22 million hectares were certified pursuant to the FFCS.

4.2.7. Waste management

Measures in waste management have reduced GHG emissions. Government decisions on landfills and the collection and recovery of waste paper, the waste tax and the adoption of the National Waste Plan have lowered GHG emissions by 2 Tg CO₂ eq from 1990 to 1999 (Table 4-5). The mitigation impact of individual policies and measures is not calculated as there is no 'without measures' scenario available for waste management.

According to the National Climate Strategy, efforts will be made to utilise source-separated waste fractions as materials and to utilise combustible, unusable waste separated at source or at a processing utility as energy in existing energy production plants. Furthermore, more efforts are being made in waste minimization technologies. The objective is to limit more effectively than at present the quantity of bio-degradable, methane-producing waste ending up at solid waste disposal sites.

The effect of additional policies and measures in waste management is approximately 0.8 Tg by 2010 compared to the 'with measures' scenario (Table 4-6).

Table 4-5.

Major policies and measures included in the 'with measures' scenarios in the waste management sector

Policy or measure	Objective ⁹	GHG affected (mainly)	Type of instrument	Status	Implementing entity
Government decisions on landfills	To reduce CH ₄ emissions	CH ₄	Regulatory	Implemented	Ministry of the Environment
Waste minimisation, the collection and recovery of waste paper and other waste fractions	To reduce CH ₄ emissions	CH ₄	National waste plan, regulatory	Implemented	Ministry of the Environment
The waste tax	To reduce CH ₄ emissions	CH ₄	Fiscal	Existing	Ministry of Finance

⁹ Related to GHG mitigation (there are also other objectives)

Table 4-6.

**Major additional policies and measures included
in the 'with additional measures' scenarios in the waste management sector**

Policy or measure	Objective ⁹	GHG affected (mainly)	Type of instrument	Status	Implementing entity
Landfill gas recovery and utilization	To reduce CH ₄ emissions	CH ₄	Regulatory, fiscal	Planned	Ministry of the Environment, Ministry of Finance
Waste minimisation, the utilisation of source-separated waste fractions as material and energy	To reduce CH ₄ emissions	CH ₄	Regulatory, fiscal	Planned	Ministry of the Environment, Ministry of Finance
Development of waste taxation	To reduce CH ₄ emissions	CH ₄	Regulatory, fiscal	Planned	Ministry of Finance

⁹ Related to GHG mitigation (there are also other objectives)

4.2.8. Combined effects of policies and measures

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The combined effects of sectoral policies and measures in the 'with additional measures' scenario in 2000–2010 are presented in Table 4-7.

If energy is utilised more efficiently, as assumed in the energy conservation programme and the present strategy, emissions can be reduced by the equivalent of a further 3-4 Tg of CO₂ eq. Implementing all the measures included in the programme promoting renewable sources of energy could result in the reduction of emissions to 4-5 Tg of CO₂ eq maximum in 2010. A reduction in emissions equivalent to a one Tg of CO₂ eq can be achieved with measures concerning methane and other greenhouse gases. Meeting these objectives calls for highly intensified economic control measures and success in their focusing. In electricity procurement, a reduction in emissions equivalent to 6-10 Tg of CO₂ eq minimum should be achieved by the year 2010. This reduction in emissions can be achieved either by allowing the construction of additional nuclear power generation capacity, or by limiting coal consumption.

Table 4-7.

**Combined effects of policies and measures
in the 'with additional measures' scenario in 2000–2010 (Tg CO₂ eq)**

Set of policies and measures	Reduction in emissions by 2010 (Tg CO ₂ eq.)
Energy conservation	3–4
Promotion of renewable sources of energy	4–5
Measures concerning other greenhouse gases	More than 1
Action concerning electricity production	6–10
Total of necessary emissions reduction	14

4.3. TAXATION

Finland was the first country to introduce a CO₂ tax in 1990, initially with few exemptions for specific fuels or sectors. Since then, however, energy taxation has been changed many times and substantially, from a low but “pure” CO₂ tax to a much higher but much less CO₂-related tax. After a number of increases in the CO₂ tax rate in the early 1990s, the first major change occurred in 1994, when an additional component based on the energy content of the fuels was introduced, as well as special taxes on nuclear power and hydropower. Imported electricity was taxed at the average rate applied to domestically produced electricity.

The second important revision of energy taxation took place in 1997, prompted by the opening of the Nordic electricity market. Domestic industries, and in particular the electricity sector, felt disadvantaged by the fact that energy-intensive sectors were exempted from the CO₂ tax in the other Nordic countries while electricity imports could not be taxed according to their carbon content. At the same time, the border tax on imported electricity was found to be out of line with the EU single market legislation. Therefore, to avoid harming the competitiveness of domestic industries, the carbon/energy tax based on fuel inputs in the electricity sector was scrapped and an electricity consumption tax was introduced, with a lower rate for industry and greenhouse cultivation (slightly above half the rate on households and service sectors). Source fuels for heating and transport continued to be taxed, but only on their carbon content, with a reduced rate for natural gas and peat. Since then, tax rates have been raised on several occasions and further exemptions added. In addition, some taxes paid by energy-intensive industries are refunded since 1998.



The present energy taxation consists of three tax components:

- a basic excise tax is levied on oil products,
- additional CO₂ based excise tax is levied on transport and heating fuels,
- additional differentiated (industrial and other use) excise tax is levied on electricity consumption.

To improve the competitiveness of renewables in electricity production, wood based electricity production, wind power, small hydropower and small CHP plants using peat as fuel get a tax subsidy. This subsidy is equal to the industrial electricity tax, except for wind power the subsidy is paid according to the higher tax rate.

An energy intensive industry is entitled to a tax refund under certain conditions. A company which has paid energy taxes more than 3.7% of its value added has a right to a refund. The amount of the refund is 85% of the taxes paid over the 3.7% limit. However, refund is paid only for the part exceeding the limit of EUR 50 500.

The present tax rates came into force in September 1998. The basis for the additional tax on transport and heating fuels is EUR 17.2/t CO₂. The tax on electricity is EUR 4.2/MWh for industrial users and EUR 6.9/MWh for other users.

Vehicle and fuel taxation have traditionally been at a relatively high level in Finland by international comparison. The state receives an income from vehicle taxation of about EUR 1.2-1.3 billion (Table 4-8). In 1999 the state received EUR 1.2 billion through the vehicle taxation (4.6% of total incomes). Moreover, each passenger car owner has to pay annually a user charge of EUR 117, if the car is registered after 31 December 1993 or EUR 84 if the car is registered before 31 December 1993. The state receives an income annually of around EUR 200-220 million.

The fuel taxation in Finland contains differentiation scheme according to which the price of diesel fuels is differentiated taking into account the sulphur content. The differentiation of petrol fuels is implemented between the reformulated and non-reformulated fuels.

The waste tax is EUR 15.1/t and it is applied to wastes excluding soils disposed to municipal landfills. The annual energy and other environment-related tax revenues between 1980 and 1999 are illustrated in Figure 4-3. The Figure includes also other environment-related taxes and charges.



Table 4-8.

**Environmentally-related taxes, fees and charges
in Finland in 1999, EUR million**

MOTOR FUELS, total		1 967
Unleaded petrol	Basic tax	1 253
	Surtax	98
Diesel oil	Basic tax	523
	Surtax	93
OTHER ENERGY PRODUCTS, total		313
Light fuel oil	Basic tax	50
	Surtax	125
Heavy fuel oil	Surtax	52
Coal	Surtax	47
Peat	Surtax	15
Natural gas	Surtax	25
ELECTRICITY		369
Electricity consumption		369
VEHICLE-RELATED TAXATION, total		1 422
Car sales tax		1 028
Vehicle tax ("sticker tax")		209
Motor vehicle tax ("diesel tax")		185
AGRICULTURAL INPUT, total		2
Pesticides		2
OTHER GOODS, total		23
Beer surtax		12
Soft drink surtax		1
Oil waste tax		3
Oil pollution control fee		6
WATER AND WASTEWATER CHARGES, total		636
Water charges		275
Wastewater charges		360
Water protection fee		1
WASTE DISPOSAL AND MANAGEMENT CHARGES, total		141
Waste tax		34
Municipal Waste Charges		107
TOTAL		4 503
Charges		742
TOTAL, TAXES AND FEES		3 761
Total tax revenue (OECD)		56 180
– Central Government		29 699
– Local Government		12 131
– Social Security Funds		14 208
– Supra-national Authorities (EU)		142
Total tax revenue (OECD)*		41 830
Share of the environmental taxes and fees (%)		2

* social security contributions not included

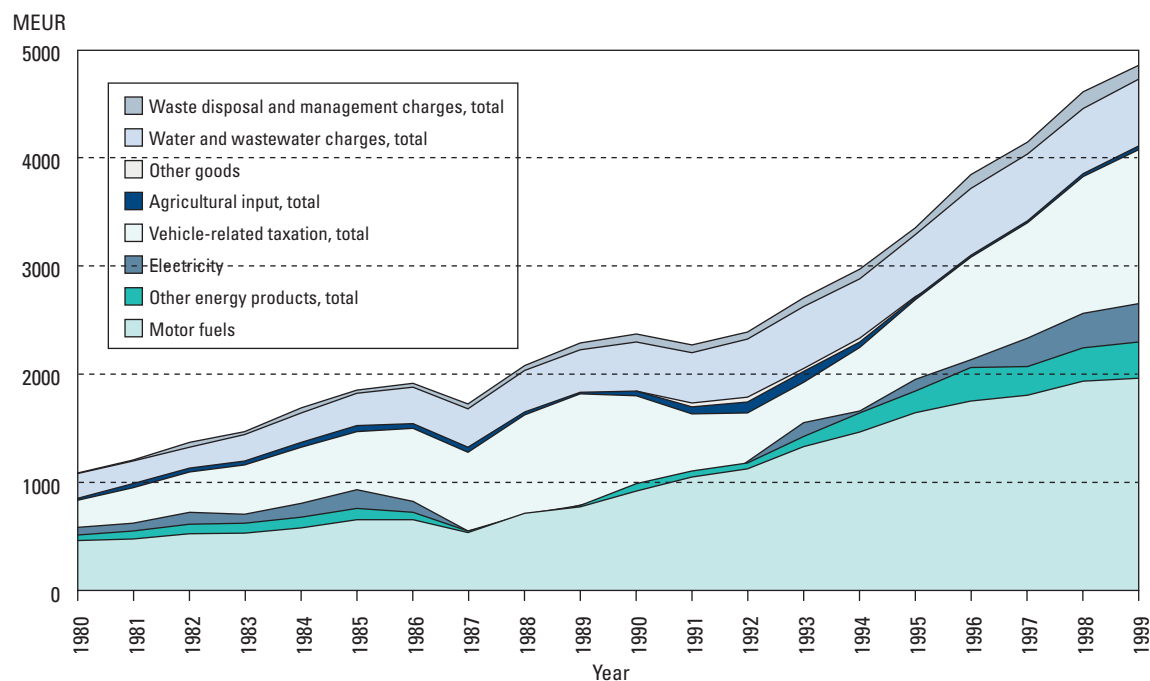


Figure 4-3.
Trends in energy tax and other environment-related tax revenues between 1980 and 1999.

4.4. OTHER CROSS-SECTORAL POLICIES AND MEASURES

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Several cross-sectoral policies and measures also affecting GHG emissions can be identified including national programmes and policies related to biodiversity, regional structure, ecologically sustainable construction, protection of the ozone layer, transboundary air-borne pollution and co-operation in environmental protection in neighbouring areas. Especially important are UNCSO, Agenda 21 and Rio +10. In Finland, the promotion of sustainable development has been comprehensively adopted as the goal of broad cooperation between the government, the private sector, interest groups and other NGOs, the scientific community, the education system and the media. The Finnish National Commission on Sustainable Development (FNCSD) was set up in 1993 to promote cooperation for this purpose. The mandate of the FNCSD is extended to the end of year 2002.

Other policies and measures affecting GHG emissions include environmental management systems and environmental labels and declarations. In accordance with EC Directive 1999/94 relating to the availability of consumer information on fuel economy and CO₂ emissions in respect of the marketing of new passenger cars, a decree has been adopted on providing information on fuel economy and CO₂ emissions of new passenger cars. This decree came into force on 18 January 2000.

*URBAN AREAS, REGIONAL STRUCTURE
AND TRANSPORT SYSTEMS*

Developments in the urban structure have a long-term effect on greenhouse gas emissions. The urban and regional planning activities of municipalities and provinces shall be monitored with a view to reducing emissions, in order to ensure that the objectives of the Land Use and Building Act (132/1999) will be met. The Act aims at a safe, healthy, environmentally-friendly and socially well-functioning city structure in which the availability of public transport services and non-motorised transport should be taken into account.

The main trends in the urban and regional structure in Finland are, on the one hand, increasing urban sprawl, and on the other hand, concentration of the population in a few urban regions, mainly the Helsinki metropolitan area, Tampere, Turku and Oulu, including the cities themselves as well as their surrounding communities. This means increasing challenges for the co-ordination of transport and land use planning in the future. These challenges should be met, on the one hand, by increasing the co-operation between the authorities responsible for transport and land use planning, and on the other hand, by producing research information that can be used in planning.

The main urban areas in Finland have been developed on the basis of availability of public transport services. As population in these cities is relatively dense, it has been possible to maintain a high level of public services even though passenger car traffic has continued to increase.

Since 1996 Finnish municipalities have implemented the so-called transportation system plans. These are long-term strategic plans, which are aimed at developing an entire travel-related system. Transportation system planning creates a foundation for assessing the need to develop the transport network and services. Transport system planning has been carried out for all 12 major urban areas in Finland.

The intention agreements between the government, municipalities and regional councils provide an instrument for the implementation of transportation system plans in the urban areas. The municipalities are responsible for maintaining and developing the transport system and transport infrastructure inside the urban agglomerations. With the intention agreements the government provides funding for the implementation of such transport projects that are in accordance with the transportation system plans. With the help of intention agreements the government has some possibilities to guide the transport planning of the municipalities which otherwise can autonomously decide on transport planning at the local level. So far 15 intention agreements have been agreed between the government, municipalities and regional councils.

4.5. RESEARCH AND DEVELOPMENT

There are several important national research and development programmes that have an impact on GHG emissions. Development of energy technology is one of the key activities in national energy and climate policy. Advanced technology and utilisation of technology play an important role in achieving reduction in energy use and emissions. Furthermore, the goal is to increase the export of energy technology.

The government contributes to the determined development of new technology for energy generation and use. Supporting energy technology R&D with governmental funds serves strategic goals of national energy policy. Public support is directed at the development, commissioning and commercialisation of new, environmentally benign technology. Development of new technology and promotion of its introduction onto the market is directed at sectors of technology and know-how that are inherent in the Finnish conditions. Thus, promotion of energy conservation and use of bioenergy are in a prominent position. Government energy research, development and demonstration expenditure was approximately EUR 100 million in 1999.

The government's support for research and development work is channelled via the Technology Development Centre (TEKES), which operates under the Ministry of Trade and Industry. TEKES finances and organises projects for developing industrial products and production methods, applied technical research at research institutes and universities as well as joint technology projects run by companies and research institutes. Funding by the Ministry of Trade and Industry covers the first full-scale applications (demonstrations) resulting from the research and development activities.

Other funding organisations are the Academy of Finland and the Finnish National Fund for Research and Development (SITRA). Ministries and several foundations also fund climate change related research. The Technical Research Centre of Finland (VTT) is responsible for the implementation of a number of the national energy technology research programmes. VTT carries out both its own technical research work and testing as well as work commissioned by companies and the public sector.

Finnish energy research and development is organised into national research programmes where all the relevant parties, such as industrial companies, research institutes and universities, are involved. The developers of Finnish energy technology form an energy cluster. The first, broad package of 11 research programmes were carried out in 1993–1998 with the total funding of EUR 250 million. Most of the programmes that are active now have started in 1999. New programmes are being planned and implemented continuously as the need for a new one arises.



Energy technology programmes active in 2000 were:

- *Engine Technology Programme ProMOTOR, 1998–2003*
- *Energy and the Environment in Transportation MOBILE², 1999–2003*
- *Fusion Energy Research Programme FFUSION 2, 1999–2003*
- *Information Technology and Electric Power Systems Technology Programme TESLA, 1998–2000*
- *Materials for Energy Technology KESTO, 1997–2001*
- *Modelling Tools for Combustion Process Development CODE, 1999–2002*
- *Process Integration Technology Programme, 2000–2004*
- *Technology and Climate Change Programme CLIMTECH, 1999–2002*
- *Waste to REF & Energy, 1999–2001*
- *Wood Energy, 1999–2003*



The total funding of the above-mentioned programmes is estimated to be EUR 170 million. VTT has also launched energy technology programmes that are established to pool the wide resources of VTT Energy in order to enhance internal collaboration.

The Technology and Climate Change Programme (CLIMTECH), investigates the development needs and possibilities of the technologies which can be applied to control greenhouse gas emissions and climate change. The programme includes both the control and limitation of emissions within Finland as well as the use of Finnish technology to limit emissions elsewhere. CLIMTECH is discussed in more detail in Chapter 8.

The development of bioenergy technologies is given a high priority within overall energy R&D work. New energy technology for growing markets of waste management is being developed under the Waste to REF & Energy Technology Programme launched by TEKES. During the period 1993–1998, TEKES also had a specific technology programme for wind and solar energy called NEMO, Advanced Energy Systems and Technologies.

In addition, several TEKES funded construction technology programmes have relevance in climate change mitigation. These include for example:

- *Raket*
- *Environmental Technology in Construction 1994–1999*
- *Healthy Building 1998–2002*
- *Nordic Wood 2*
- *Progressive Building Process – ProBuild 1997–2001*
- *Wood in Construction 1995–1998*

The Ministry of Trade and Industry has financed a research programme on energy conservation decisions and behaviour (Linkki 2)

in 1997–2001. The programme aims at promoting the implementation of the energy saving programme.

The Ministry of Transport and Communications, the Ministry of the Environment and various agencies and offices, transport enterprises and companies have established a research programme which is aimed at producing information that should facilitate implementation of integrated and sustainable policies and planning (the so-called LYYLI programme). Useful background information on the interaction between the transport and community structure has been produced for preparation of the National Climate Strategy. Some of the recent studies that have been conducted in the context of this programme are:

- *Interaction between transport and land use in the Helsinki metropolitan area*
- *Modelling of urban sprawl and fragmentation*
- *Long-term impacts of fuel price changes and removal of tax reduction based on commuting costs.*
- *Changes in the urban form and transport demand in Finnish cities by the year 2020.*
- *Impacts of the telecommunications sector on transport and the environment.*
- *The travel behavioural effects of changes in the transport system and the location of housing, working places and services.*

In addition to the LYYLI programme, there are several other research programmes that aim at promoting sustainable transport with reduced energy consumption and emissions. Such programmes, in addition to the above-mentioned MOBILE and ProMotor programmes, are:

- *Väylät 2030 is a research programme with the aim to increase knowledge on how the transport infrastructure should be developed in the future in order to respond to the challenges and needs of other factors (such as environment, industry, etc.).*
- *Ketju is a research programme that provides information on means of increasing transport efficiency and logistics.*

4.6. THE USE OF THE KYOTO MECHANISMS

The use of the Kyoto Flexible Mechanisms has been excluded from the National Climate Strategy for the present due to the uncertainties concerning the final rules. The Report by the Committee on the Kyoto Mechanisms, however, has suggested that the use of flexible mechanisms should be further promoted in Finland.

The government of Finland has launched a pilot programme in order to prepare for the implementation of joint implementation (JI)

as well as the clean development mechanism (CDM) of the Kyoto Protocol. The Ministry for Foreign Affairs is in charge of the implementation of the programme in co-operation with other relevant ministries. The aim of the programme is to gain experience in the issues specific to the JI/CDM project cycle. The government has reserved around EUR 8.4 million the implementation of the projects during 2000-2002. It is expected that the pilot projects implemented under the programme will result in high-quality emissions reductions or carbon removals by sinks. So far, one project is being implemented and several are in the pipeline.

The Finnish government has signed Memorandums of Understanding about Joint Implementation with Estonia, Latvia, Lithuania, Poland and Ukraine. The government has also invested approximately EUR 9 million in the Prototype Carbon Fund of the World Bank in order to obtain around 2 Tg CO₂eq in emission credits for the first commitment period.

4.7. CAPACITY-BUILDING, EDUCATION, TRAINING AND AWARENESS-RAISING

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Capacity-building, education, training and awareness-raising are discussed in detail in Chapter 9. There are, however, a few activities that have a more direct impact on GHG emissions. Motiva Oy's role is especially important in this area, as its task is to motivate companies and private consumers to use energy more efficiently by increasing knowledge of the opportunities for more economical and environmentally friendly operations. This will eliminate unnecessary use of energy and facilitate the introduction of new methods and techniques. Motiva's main task is the implementation of the government's Energy Conservation Programme.

Eco-driving is one instrument that has been identified in the National Climate Strategy. Since 1997 eco-driving has been increasingly integrated into the general driving education that is given in Finland. European Car Free Day was organised in Finland for the first time in 2000 and the aim is that it will become a tradition also in Finland. Seventeen cities participated in events related to Car Free Day.

Promotion of public and non-motorised transport is an integrated part of the Finnish transport policy, which is continuously aimed at increasing the attractiveness and market share of these transport modes. An annual cycling week is held at the beginning of May. The new cycling and walking programmes also contain new proposals for specific campaigns and awareness raising.



4.8. THE EFFECT ON LONGER-TERM TRENDS OF POLICIES AND MEASURES

There is no quantitative integrated analysis available yet on longer-term trends of policies and measures on GHG emissions. Since the National Climate Strategy is defined until 2010, no mitigation impacts are presented here beyond 2010.

The National Climate Strategy formulation process and recent research work has, however, indicated that for example changes in the building stock and urban structure have especially a longer-term effect on energy consumption and GHG emissions. Some calculations for mitigation impacts are available until 2020 and beyond.

4.9. POLICIES AND MEASURES NO LONGER IN PLACE

Major policies related to GHG emissions have been maintained in recent years with some modifications.

However, the peat support has been considerably decreased when the energy investment grants have been limited only to renewable energy sources and energy efficiency, as well as to new technology investments. In this connection peat fired power plants are no more relevant.

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4.10. NON-GHG MITIGATION BENEFITS

The measures covered by the climate strategy will promote positive development in many areas of environmental protection, as described before, regardless of the scenario and the energy production solution. These measures will help to reduce acidification and ozone concentrations in the troposphere, and are aimed at controlling urban sprawl.

The effect of the energy production alternative chosen, for example, on acidification, will only be observable in the long term, well after the follow-up period provided in the Kyoto Protocol. The climate strategy will not affect the current positive trend as far as the emissions of particles and volatile organic matter are concerned.

4.11. COSTS

4.11.1. Impacts on the central government finances

In 1999, a little less than EUR 100 million was spent as government expenditure for development of the technology of energy production and use, for energy conservation and for promotion of renewable energy modes. Of this total sum, around EUR 10 million was spent for auditing, investments, renovation subsidies of buildings and for information dissemination in order to encourage energy savings. Around EUR 20 million of investment subsidies and operational aid was used to promote renewable energy sources. In addition, EUR 35 million of tax subsidies was granted for electricity generated by renewable energy sources (Table 4-9).

Table 4-9

Estimate on the Government's financing need and financing to be channelled through the energy taxation scheme, EUR million (at the currency value of 1999)

Object of Financing	In 1999	Average need by 2010
R&D, energy use and conservation	35	35
R&D, energy production	28	33
Promotion of energy conservation	5	13
Investment aid for renewable energy sources	20	33
Total of financing	88	115
Renovation of energy and heating systems of residential buildings	5	17
Total of financing from the Budget and funds	93	131
Tax subsidy for electricity generated by renewables	35	60
Total of financing and tax subsidies	128	190

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Furthermore, if the use of coal was limited in energy production by administrative measures, additional expenses might incur for the Government in the form of a compensation obligation concerning the so-called frustrated costs. According to a certain estimate, such costs could amount to a fixed compensation of at least EUR 115–130 million, but energy producers have made considerably higher estimates on the possible compensation claims.

The government has agreed on the spending limits of central government finances for the period 2002–2005, in which the appropriations required by the improvement of the efficiency of the climate strategy have been taken into account.

In addition, there are smaller items, such as the ministries' own R&D funds, the felling and chipping subsidy for wood material obtained from management of young forests and part of the funds of co-operation with neighbouring areas, which amount to approximately to few million euros. The impacts on the government financing are shown in Figure 4-4.

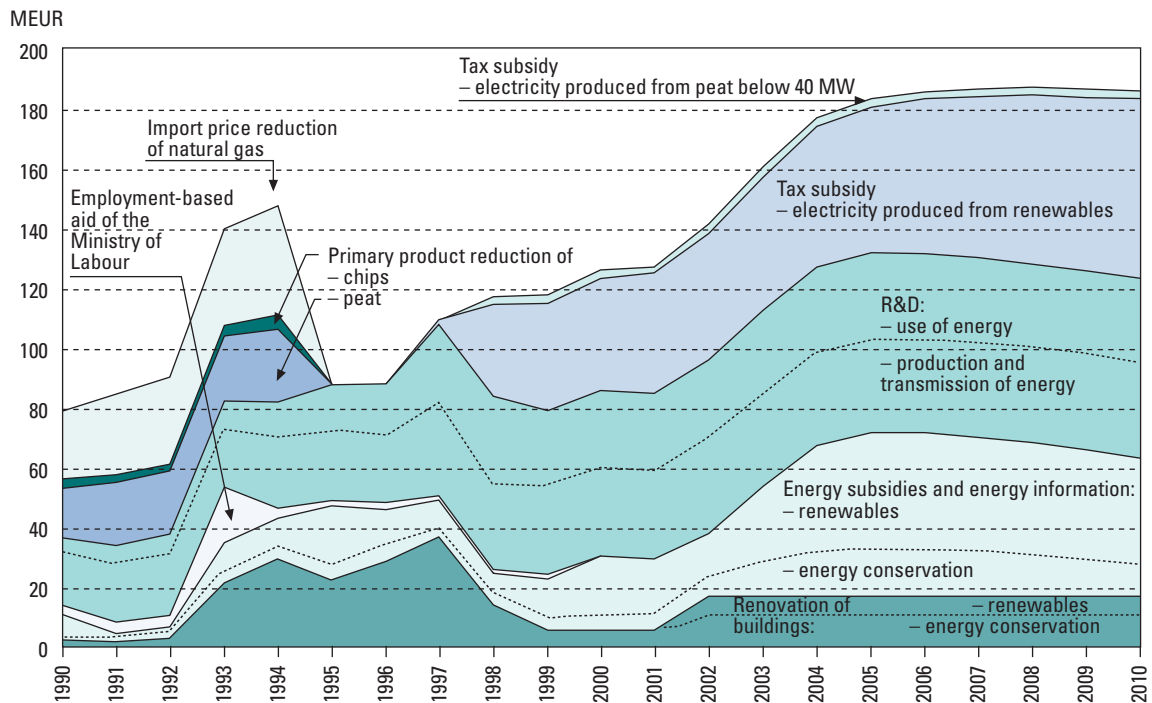


Figure 4-4.

Government subsidies for energy economy in the 1990s and the need for subsidies up to 2010, EUR million. The figures do not include loans, the future amounts at the 1999 currency value, history at the currency value of the year concerned.

In 1999, the revenue from energy taxes totalled around EUR 2.6 billion, of which taxation on traffic liquid fuels accounted for about EUR 2 billion, electricity taxation about EUR 0.3 billion, as was the case with carbon dioxide taxation: approximately EUR 0.3 billion.

The use of energy taxation as a major steering mechanism of the National Climate Strategy would lead to an increase of the energy tax accrual by EUR 0.6-0.8 billion by the year 2010. If the taxation on traffic liquid fuels is not tightened, the growth of the revenue from energy taxes would be of the order of EUR 0.15 to 0.5 billion.

4.11. 2. Impacts on the economy as a whole

ENERGY EXPENDITURE OF ENERGY CONSUMERS

The energy expenditure of energy consumers will rise, as energy taxation becomes more stringent, the price of energy excluding tax will

go up along with the costs and because the energy conservation investments will bind more resources than before. Lower consumption due to energy savings will, naturally, bring down the costs of energy.

Two research projects (Forsström and Honkatukia 2001; Kemppi et al. 2001) compared to changes in the energy expenditure of energy consumers. The costs will be highly dependent on the energy taxation alternative¹⁰ chosen and on the electricity supply decisions¹¹.

According to both research projects, the annual direct energy costs of energy consumers would rise, depending on the electricity supply alternatives, by EUR 0.8-1.25 billion by 2010 compared with the 'with measures scenario'.

IMPACTS ON THE NATIONAL ECONOMY

If energy taxes will be used considerably more in implementing the climate strategy, other taxation can be alleviated by using the increasing energy tax revenue for e.g. bringing down the income tax and social security contributions. The studies showed that the choice of the redistribution procedure did not have any significant impact on the final outcome with the tax levels studied.

The both research projects (Forsström and Honkatukia 2001; Kemppi et al. 2001) indicate, that implementation of the strategy would impair the development of national economy. However, the intensity of the effects will mainly depend on the structure of electricity procurement chosen and, to a lesser degree, on the energy taxation alternatives.

The climate strategy would lead to a decrease in employment by 6 000–11 000 persons/year by 2010. The KIO1 alternative based was in all the cases studied weaker. The climate strategy, especially the electricity supply choices, would most affect the development of the traditional energy-intensive industries, such as the forest products industry, chemical industry, metal manufacturing and the building material industry.



¹⁰ Three alternatives were studied: a) Energy taxes will be raised considerably, b) Energy taxes will be raised except taxes on traffic liquid fuels c) Energy taxes will not be raised.

¹¹ KIO1 alternative is mainly based on the use of additional natural gas in electricity generation, while KIO2 is based on construction of additional nuclear power capacity.

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5 PROJECTIONS AND ASSESSMENT OF POLICIES AND MEASURES

5.1. INTRODUCTION

Total CO₂ eq emissions in the base year 1990 were 77.1 Tg according to the latest inventory (excluding land-use change and forestry). Emissions in 1999 were 76.2 Tg, a 1% reduction compared with the base year of 1990. Finland has to maintain its emissions at the 1990 level by 2008–2012 under the burden-sharing agreement of the EU.

The major source of GHG emissions is the energy sector followed by transport, agriculture, industrial processes and waste management. In the 1990s, CO₂ emissions from fuel combustion have grown from 53.9 Tg to 56.8 Tg in 1999, whereas CH₄ emissions from waste management and all GHG emissions from agriculture have been reduced. The following analysis first gives an overview of fuel combustion related to CO₂ emissions in the 1990s with the background of the Government's energy and climate policies. Subsequently, projections of all GHGs based on the National Climate Strategy are presented.

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5.2. CARBON DIOXIDE EMISSIONS IN 1990–1999

The First National Communication of Finland reported a scenario that originated from the strategic work of the government at the beginning of the 1990s. This scenario, called the base scenario, assumed an unchanged energy policy: energy taxation, energy investment subsidies and support to energy research were assumed to stay at their 1990 levels in real terms. Moreover, a prudent view concerning the possibilities of future electricity imports was taken. It was seen that in certain circumstances the demand for electricity would have to be wholly covered by indigenous production and the electricity imports might gradually be replaced by coal-fired power plants. So the base scenario cannot be regarded as a 'business as usual' or 'without measures' scenario but a threat scenario. It is natural that these assumptions lead to high emission levels (CO₂ emissions from fuel combustion), as can be seen in Fig. 5-1. Assumptions behind this scenario are considered irrelevant after 1999.

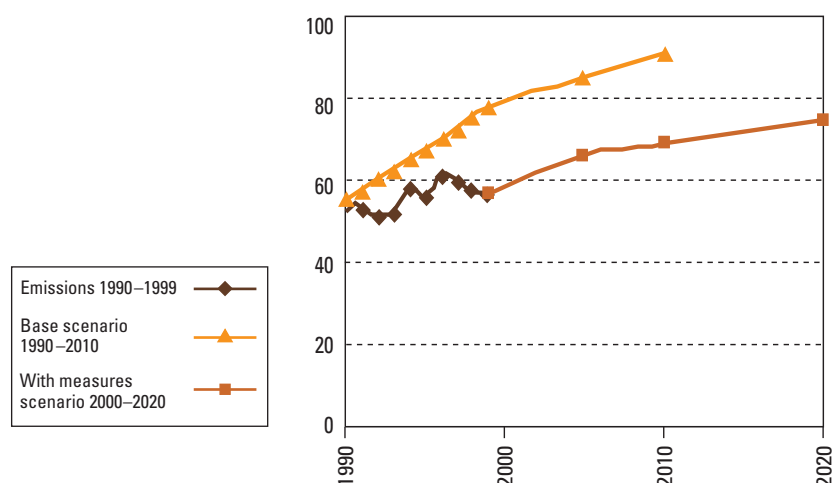


Figure 5-1.
Comparison of the base (reference) scenario of Finland's First National Communication with the 'with measures' projections (CO₂ emission from fuel combustion).

The increase of emissions of the base scenario never materialized, owing to an active energy policy, favourable trends in the Nordic electricity markets and milder than normal weather conditions, among other things. In 1999 the actual CO₂ emissions from fuel combustion were approximately 57 Tg, which is significantly lower than the emission level of the base scenario.

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Nearly half of the difference between the emissions in the base scenario and actual emissions in the 1990s can be explained by abundant electricity imports. Electricity generation capacity in the Nordic market was in most years high in comparison with electricity demand. Therefore, production of coal-fired condensing power in Finland remained on a relatively low level. One-quarter of the difference between the base scenario and the actual emissions is due to a change in the fuel mix in the electricity and heat production. The capacity of the existing nuclear plants was increased in the second half of the 1990s, the use of natural gas increased substantially in the CHP plants and wood-based fuels increased their share in municipal CHP plants and also in industry. The last quarter of the difference is a result of several factors, the most important of which are, energy conservation, mild weather conditions in the 1990s and the severe economic recession in the first half of the 1990s. The role of policies and measures have also been important in this positive development (see Table 4-1), but their mitigation impact in relation to the base scenario has not been quantified in detail.

5.3. PROJECTED GREENHOUSE GAS EMISSIONS FOR 2000–2020

5.3.1. Scenario formulation

The preparations for the National Climate Strategy were started by sector in 1999. The ministries most involved were the Ministry of Trade and Industry, the Ministry of the Environment, the Ministry of Transport and Communications, the Ministry of Agriculture and Forestry. The Ministry of Trade and Industry has coordinated the preparation process and a Kyoto Ministerial Working Group has formulated policy options.

The process of scenario formulation is described in Figure 5-2. The background material for the National Climate Strategy was compiled of sector-specific reports made by the ministries. In order to make economic assessments of various policy options, two separate model projects was used (ETLA-VTT Energy and VATT-VTT Energy). By the help of model calculations the emissions were finetuned to the target level in the years 2008–2012. This was not exactly the result of the sectoral programmes.

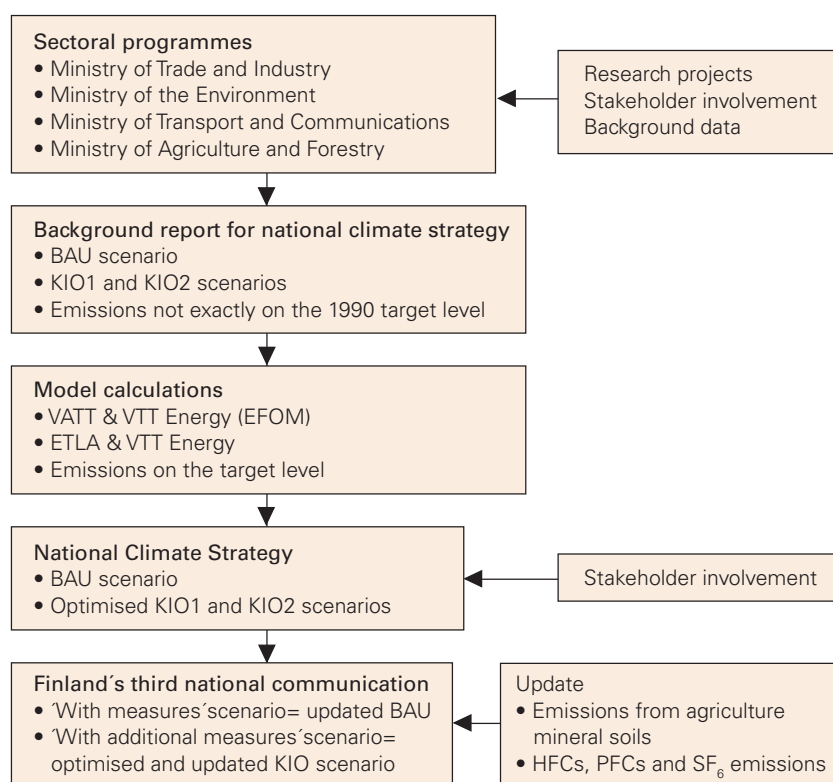


Figure 5-2

Scenario formulation. Two scenarios are discussed in this context: a 'with measures' scenario for the years 2000–2020 and a 'with additional measures' scenario for the years 2000–2010. Both scenarios are based on the National Climate Strategy. Basic assumptions are given in Table 5-1. The methodology of scenario formulation is described in Chapter 5.3.5.

Emissions from agriculture and HFCs, PFCs and SF₆ emissions are updated in both scenarios for this Communication according to the most recent findings.



Table 5-1
Basic assumptions and features for the scenarios. No policies and measures are defined for the 'with additional measures' scenario for the years 2010–2020.

	Scenario	2000–2005	2005–2010	2010–2020
Global operational environment	Stable	Stable	Stable	Stable
Population	Both scenarios	Slow growth	Slow growth	Slow growth
Regional structure	Both scenarios	Urbanization continues	Urbanization continues	Urbanization continues
Transport policy	With measures With additional measures	Current P&Ms Some additional P&Ms	Current P&Ms Some additional P&Ms	Current P&Ms Some additional P&Ms
Agricultural policy	With measures With additional measures	Agenda 2000 Renewed Agenda 2007 onwards	Agenda 2000 Renewed Agenda 2007 onwards	Agenda 2000 Agenda 2007
Economic growth	Both scenarios	> 3%/a	> 2%/a	2%/a
World-market prices of fuels	Both scenarios	Stable	Stable	Stable
Energy taxation	With measures With additional measures	Current level Stricter, same structure	Current level Clearly stricter increase, same structure and development within EU	Current level Clearly stricter increase, same structure and development within EU
Development of technology	With measures With additional measures	Current rate Faster rate	Current rate Faster rate	Current rate Faster rate
Norms	With measures With additional measures	Current Increase	Current Major increase	Current Some increase
Hydropower	Both scenarios	No major addition	No addition	No addition
Competitiveness of bioenergy	With measures With additional measures	Slight improvement Improvement	Slight improvement Improvement	Slight improvement Improvement
Use of other renewables	With measures With additional measures	Current growth Major increase	Current growth Major increase	Current growth Major increase
Natural gas grid	With measures With additional measures	Current Current	Extended in Southern Finland Extended in Southern Finland	No further extensions No further extensions
Nuclear power	With measures With additional measures (natural gas alternative) With additional measures (nuclear alternative)	Current Current Current	Current Current 1300 MW increase in 2010	Current Current No further increase
Use of coal	With measures With additional measures (natural gas alternative) With additional measures (nuclear alternative)	Increase Clear decrease Decrease	Increase Phase out within gas grid area and in condensing plants Displaced partly by nuclear power	Increase No use within gas grid area and in condensing plants Displaced partly by nuclear power
Imports of electricity	Both scenarios	8 TWh/a	6 TWh/a	6 TWh/a

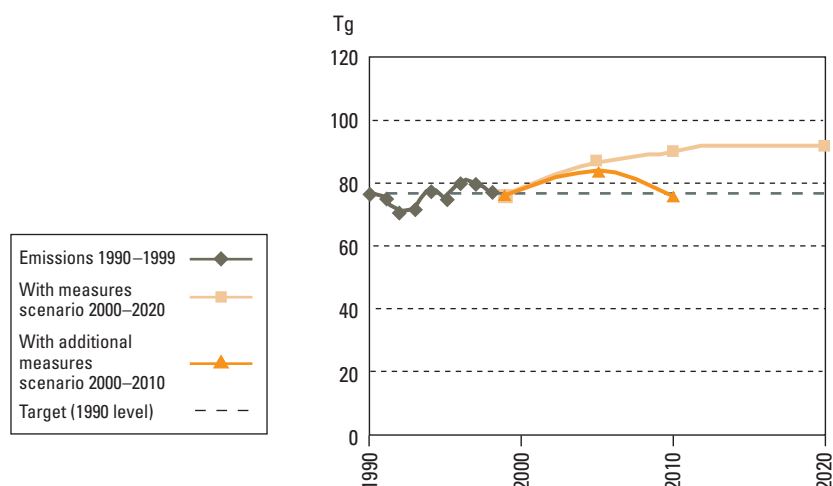


Figure 5-3
 Comparison of the 'with measures' scenario for the years 2000–2020 with the 'with additional measures' scenario based on the National Climate Strategy for the years 2000–2010. All GHG emissions.

The main characteristic of the 'with measures' scenario is the assumption of unchanged energy and climate policy. The prevailing measures would be kept in force in real terms but no new additional measures would be taken. Under these assumptions the emissions would increase from 77.1 million tonnes (Tg) equivalent of CO₂ in 1990 to close to 90 million tonnes in 2010 (Fig. 5-3; Tables 5-2 and 5-3).

In order to meet the climate strategy targets, the Government finds it necessary to implement a new energy conservation programme, and a programme for promoting renewable sources of energy. Together these programmes may account for about half of the targeted annual emissions reduction. A reduction in emissions equivalent to a one Tg of CO₂ may be achieved with measures concerning methane and other GHGs.

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Table 5-2

Greenhouse gas base year emissions, current emissions and projected emissions (Tg CO₂ eq) in Finland

Greenhouse gas	Base year (1990)	1999	2005	2005	2010	2010	2020
			With measures	With add. measures	With measures	With add. measures*	With measures
CO ₂	62.5	64.2	73.3	71.5	76.4	64.7	81.7
CH ₄	6.1	3.9	3.7	3.8	3.5	2.8	3.1
N ₂ O	8.4	7.7	8.3	7.8	8.3	7.4	8.4
HFCs+PFCs	0.001	0.35	1.1	0.6	1.7	0.9	2.2
SF ₆	0.07	0.03					
Total CO₂ eq	77.1	76.2	86.3	83.8	89.9	75.8	95.4

* The base year (1990) figures have recently been revised. Therefore the target figure for 2010 (75.8 Tg) differs from the revised 1990 emissions (77.1 Tg).

The rest of the targeted emissions reductions would also be achieved in the heat and electricity supply sectors, where the use of coal must be reduced considerably by increasing the utilisation of natural gas, or by building more nuclear power capacity, or by a combination of these two measures.

Table 5-3

Greenhouse gas base year emissions, current emissions and projected emissions (Tg CO₂ eq) in Finland by sector

Sector	Base year (1990)	1999	2005	2005	2010	2010	2020
			With measures	With add. measures	With measures	With add. measures ***	With measures
Energy*	46.4	49.7	59.0	57.3	62.3	51.3	67.6
Transport	13.2	13.5	13.8	13.7	13.9	13.7	13.8
Industrial processes	2.9	2.8	3.6	3.0	4.5	2.6	5.2
Solvents**	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Agriculture	10.2	7.6	7.4	7.4	6.8	6.7	6.8
Waste	3.8	1.7	1.7	1.7	1.6	0.8	1.2
Other	0.6	0.8	0.7	0.7	0.7	0.7	0.7
Total CO₂ eq	77.1	76.2	86.3	83.8	89.9	75.8	95.4

*Excluding transport, **Solvents and other product use, ***The base year (1990) figures have recently been revised. Therefore the target figure for 2010 (75.8 Tg) differs from the revised 1990 emissions (77.1 Tg).

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5.3.2. Indirect greenhouse gas emissions

Changes in indirect greenhouse gas emissions (Table 5-4) are based on the Strategic Environmental Impact Assessment of the National Climate Strategy (Hildén et al. 2001). SO₂, NO_x and particle (PM) emissions decrease from the current level already in the 'with measures' scenario. Further reductions are achieved with additional measures, but differences between the two 'with additional measures' scenarios are minor.

Emissions of volatile organic compounds (NMVOC) are projected to decrease regardless of the GHG scenarios. Additional measures are, however, needed for targeted sources in order to reduce NMVOC emissions at internationally agreed levels. The GHG scenarios have no effect on carbon monoxide (CO) emissions.

Table 5-4

Indirect greenhouse gas emissions (NO_x and SO₂) 1998–2020, Gg/a

Pollutant	Emissions in 1998	With additional measures in 2010	With additional measures in 2020 (natural gas alternative)	With additional measures in 2020 (nuclear alternative)
NO _x	252	187	170	172
SO ₂	90	114	91	88
PM	48	42	41	41

5.3.3. Sectoral data

Introduction

Sectoral data are based on the common reporting format (CRF) of the Framework Convention on Climate Change (UNFCCC) with the exception of the transport sector. Transport is separated from the energy category because its policies and measures differ from the general ones in the energy sector. The 1990 and 1999 data are based on the official latest UNFCCC reporting (March 2001), whereas projections are based on the National Climate Strategy (see Chapter 5.3.1 for details). Emissions from international bunkers are reported in accordance with the UNFCCC requirements.

Energy

Carbon dioxide emissions associated with energy generation and utilisation are key factors in meeting our national target. The government's climate strategy is based on a commitment to continued improvements in the efficient use of energy. The use of renewable sources of energy will be boosted. The actions in these fields will be taken regardless of the measures implemented in electricity production.

Despite improved energy conservation measures, total energy and electricity consumption is estimated to continue rising, albeit clearly slower than in the past decades. Because of the rise in electricity consumption and phasing out of ageing power plants, new power plants should be built. Basing the climate strategy on large imports of electricity is not justified. The measures concerning electricity production are based on the assumption that electricity imports will diminish from their record high levels of recent years.

In addition to the principles and actions concerning electricity supply outlined above, other measures are required to provide further electricity that is less GHG intensive. To achieve this, there are two main approaches to choose from: allowing the construction of addi-

tional nuclear power production capacity, or banning the combustion of coal in the power-only and in CHP generation.

Table 5-5

Primary energy sources in 1990–2020 (PJ),
'with measures' and 'with additional measures'

Source	1990	1999	2010		2020
			With measures	With add. measures**	With measures
Oil	375	364	348	327	343
Coal *	167	151	247	84	281
Natural gas	91	138	218	301	268
Nuclear	198	241	239	239	230
Imports of electricity	39	40	21	21	21
Hydro	39	45	46	50	46
Wind	0	0.2	2	4	3
Wood and peat ***	231	335	373	368	394
Total	1 140	1 315	1 495	1 394	1 585

* coal, coke, blast furnace and coke oven gases

** data is based on original KIO1 scenario of the background report of the National Climate Strategy, not EFOM optimised 'with additional measures' scenario.

*** includes small amounts of municipal solid waste and reaction heat of industry.

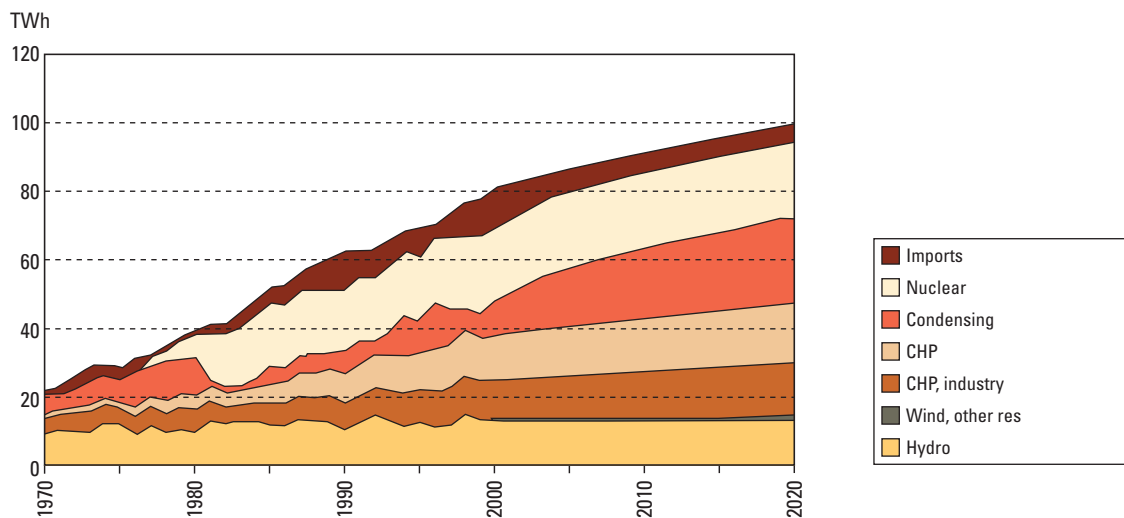


Figure 5-4
Electricity production by source in 1970-2020 (TWh), 'with measures' scenario.

Table 5-6

**Base year emissions, current emissions and
projected emissions (Tg CO₂ eq) from energy (excluding transport)**

Greenhouse gas	Base year (1990)	1999	2005	2005	2010	2010	2020
			With measures	With add. measures	With measures	With add. measures	With measures
CO ₂	45.0	47.6	56.5	54.8	59.8	48.2	64.9
CH ₄	0.4	0.4	0.4	0.5	0.4	0.5	0.3
N ₂ O	1.1	1.8	2.1	2.0	2.1	2.6	2.4
Total CO₂ eq	46.4	49.7	59.0	57.3	62.3	51.3	67.6

Transport

The long-term vision and strategy of the Ministry of Transport and Communications called “Towards a sustainable and intelligent transport sector” contains projected trends of passenger and road transport volumes until 2025. Behind these trends is the vision of a future transport system that should be based to an increasing extent on sustainability and increasing use of information technologies. Such a transport system should take into account economic, ecological, social and cultural viewpoints. The strategy aims at reaching a transport system in which the demand for road transport (passenger car traffic and road freight traffic) should peak by the year 2020 and start gradually to decrease (Fig. 5-5; Fig. 5-6).

The ‘with additional measures’ scenario based on the EFOM optimised KIO scenario related to traffic emissions leads to a conclusion that the CO₂ eq emissions caused by transport would slightly increase by the year 2010 compared to the base year level (Table 5-7). This is somewhat contrary to those projections that have been calculated using the LIPASTO model and which have been used when preparing transport sector specific measures for the National Climate Strategy. This is due to the fact that the EFOM optimisation suggests emissions reductions to be more cost-effective in other sectors compared to transport. According to the LIPASTO projections, transport sector policies and measures are considered to be sufficient to guarantee that emissions levels in 2010 do not exceed the 1990 level.



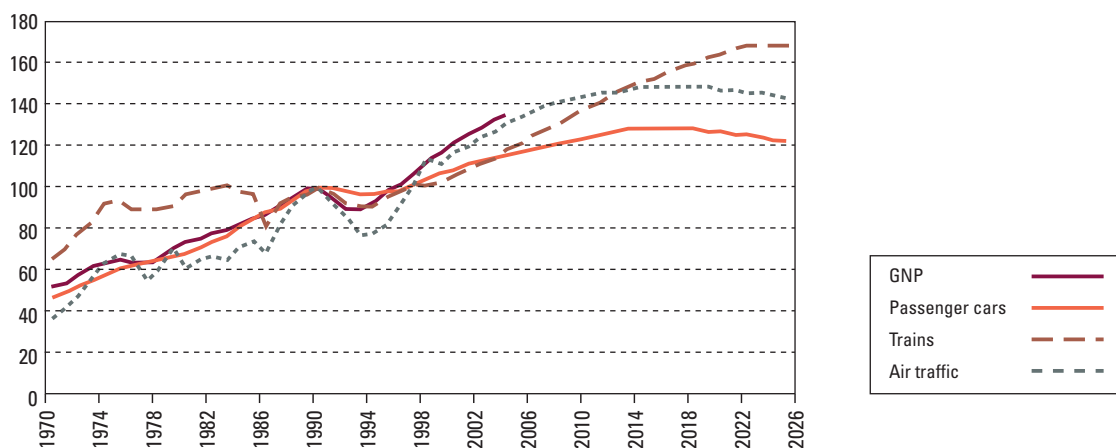


Figure 5-5
 Volume of passenger transport (number of passengers) according to the Strategy of “Towards a Sustainable and intelligent transport system” (1990=100).

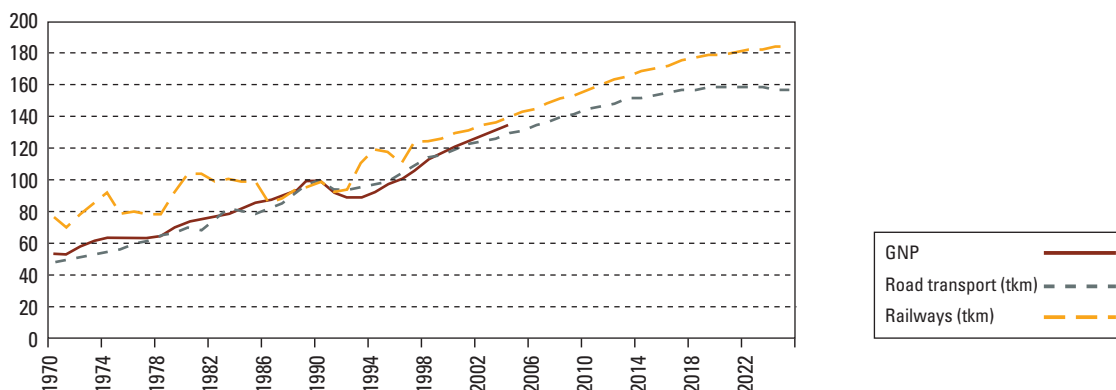


Figure 5-6
 Volume of freight transport according the Strategy of “Towards a Sustainable and intelligent transport system” (1990=100).

Table 5-7.

Base year emissions, current emissions and projected emissions (Tg CO₂eq) from transport

Greenhouse gas	Base year (1990)	1999	2005	2005	2010	2010	2020
			With measures	With add. measures	With measures	With add. measures	With measures
CO ₂	12.5	12.7	12.8	12.7	12.8	12.7	12.8
CH ₄	0.07	0.07	0.04	0.06	0.03	0.06	0.03
N ₂ O	0.6	0.7	0.9	0.9	1.1	0.9	1.0
Total CO₂ eq	13.2	13.5	13.8	13.7	13.9	13.7	13.8

Table 5-10

Base year emissions, current emissions and projected emissions (Tg CO₂ eq) from other sources (emissions from fuels used as feedstocks)

Greenhouse gas	Base year (1990)	1999	2005	2005	2010	2010	2020
			With measures	With add. measures	With measures	With add. measures	With measures
CO ₂	0.6	0.8	0.7	0.7	0.7	0.7	0.7
Total CO ₂ eq	0.6	0.8	0.7	0.7	0.7	0.7	0.7

Agriculture

Greenhouse gas emissions from agriculture have diminished since 1990. This trend will be safeguarded in the common agricultural policy of the EU by adopting support measures encouraging such production that minimises the burden on the greenhouse gas balance, besides other objectives.

Action designed to reduce methane emissions from livestock farms will continue to be taken, and the use of field biomasses for energy production will be developed.

The estimated development of agriculture covers the changes in agricultural production and structure since 1990 and their impacts on the greenhouse gas emissions, and also on the agri-environmental measures for 2000–2006 based on the Agenda 2000 reform. The ‘with measures scenario’ of the development of agricultural production and emissions of greenhouse gases in the first commitment period 2008–2012 and after this until 2020 has the same basic assumptions (Fig. 5-7, Table 5-11).

Figure 5-7
Emissions from agriculture according to the ‘with measures scenario’ in 1990–2020 by sources (excluding CO₂ emissions from mineral soils)².

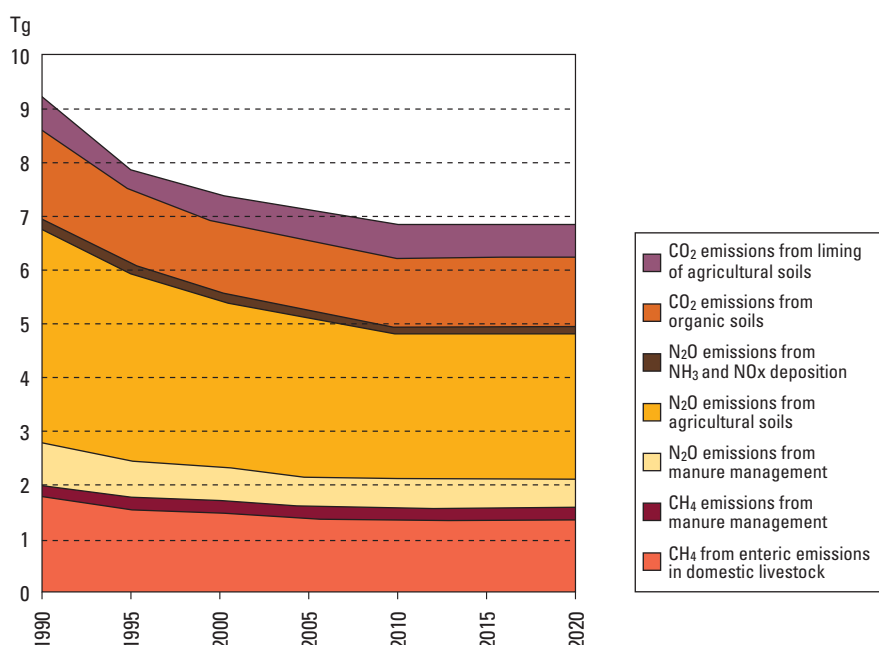


Table 5-11

Base year emissions, current emissions and projected emissions (Tg CO₂ eq) from agriculture²

Greenhouse gas	Base year (1990)	1999	2005	2005	2010	2010	2020
			With measures	With add. measures	With measures	With add. measures	With measures
CO ₂	3.2	2.0	2.2	2.2	1.9	1.9	1.9
CH ₄	2.0	1.8	1.6	1.6	1.6	1.5	1.6
N ₂ O	4.9	3.8	3.6	3.6	3.3	3.3	3.3
Total CO₂ eq	10.2	7.6	7.4	7.4	6.8	6.7	6.8

² Inclusion of CO₂ emissions from agricultural soils is not yet fully agreed upon internationally. They are currently included in the inventory as well as in projections. Exclusion of them would decrease CO₂ emissions from agriculture by 1 Tg in 1990, 0.3 Tg in 1999 and 0.3 Tg in 2005. Depending on the accounting system to be agreed upon, and on the development of land management practices, CO₂ emissions from mineral soils due to land use change may turn out to be a net sink and not a source by 2020. A net sink estimate for 2020 ranges between 0.1 and 0.6 Tg CO₂.

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Furthermore, an alternative and illustrative scenario was elaborated in order to estimate the sensitivity of the possible review in the common agricultural policy of the EU. In this alternative, the 'with additional measures' scenario, further emphasis is put on environmental, social and cultural aspects and non-marketable benefits. According to this hypothetical scenario, greenhouse gas emissions are slightly lower compared to the 'with measures scenario'.

Forestry

According to Finland's National Forest Programme (NFP) 2010, total production in 2010 is expected to be between 63 - 68 million m³. Based on a number of studies made for the preparation of the National Climate Strategy, net removals from forests (excluding soils and subject to level of total production) are estimated to be between 3 and 10 Tg CO₂ in 2010. Provided that total production would be 65 million m³, annual increment in forests is estimated to be 102 Tg CO₂ and drain 94 Tg in 2010, In 2020, annual increment would be 110 Tg CO₂ and drain 91 Tg (Figure 5-8).

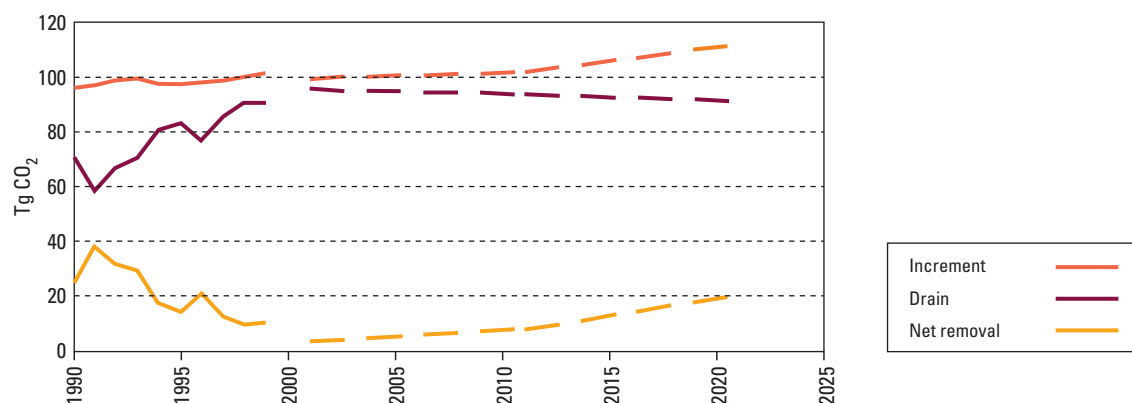


Figure 5-8
 An estimation of the 'with measures scenario' of increment and drain of forests in Finland in 1990-2020 (according to the National Forest Programme 2010), Tg CO₂/a.

Waste management

In waste management, efforts will be made to utilise source-separated waste fractions as materials, on the one hand, and to utilise combustible, unusable waste separated at source or at a processing utility as energy in existing energy production plants, on the other hand. Furthermore, more and more efforts are being made to reduce the generation of waste. The objective is to limit more effectively than at present the quantity of biodegradable, methane-producing waste ending up at solid waste disposal sites.

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Table 5-12

Waste disposal on land (Gg)

Type of waste	1990	1999	2005	2005	2010	2010	2020
			With add. measures	With add. measures	With add. measures	With add. measures	With add. measures
Municipal solid waste	2450	1488	1537	1178	1377	643	1222
Municipal sludge (d.m.)*	62	7	4	4	2	2	0
Municipal sludge (d.m.)*	210	152	140	128	122	100	108
Industrial solid waste	2618	2479	905	862	773	694	671
Constr. and demolition waste**	1262	457	572	564	530	514	427

* dry matter, ** without soil and stones

CH₄ emissions from waste disposal on land (Table 5-12) are estimated using the IPCC default method. If the IPCC first order decay method had been used the emission reductions would have been considerably smaller. The summary of emissions in the waste sector is given in Table 5-13.

Table 5-13

Base year, current emissions and projected emissions (Tg CO₂ eq) of the waste sector

Greenhouse gas	Base year (1990)	1999	2005	2005	2010	2010	2020
			With measures	With add. measures	With measures	With add. measures	With measures
CH ₄	3.7	1.7	1.6	1.6	1.5	0.7	1.1
N ₂ O	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total CO₂ eq	3.8	1.7	1.7	1.7	1.6	0.8	1.2

International bunkers

Emission projections from international bunkers are based on estimates by Statistics Finland. A slight increase of emissions from international bunkers is expected (Table 5-14), and no policies and measures are currently defined for this sector.

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Table 5-14

Base year emissions, current emissions and projected emissions (Tg CO₂ eq) from international bunkers (aviation and marine)

Greenhouse gas	Base year (1990)	1999	2005	2005	2010	2010	2020
			With measures	With add. measures	With measures	With add. measures	With measures
CO ₂	2.8	2.8	3.0	3.0	3.2	3.2	3.2
CH ₄	0.026	0.002	0.002	0.002	0.002	0.002	0.002
N ₂ O	0.4	0.2	0.2	0.2	0.2	0.2	0.2
Total CO₂ eq	3.2	3.1	3.3	3.3	3.4	3.4	3.4

5.3.4. Sensitivity Analysis

Depending on the assumptions put forward in the studies - for example, what is the volume of electricity imports to Finland - the findings of the scenarios vary considerably. These sensitivity analyses are de-

scribed in more detail in the publication by the Ministry of the Trade and Industry (MTI) publication on the Background Report to the National Climate Strategy (Kauppa- ja teollisuusministeriö 2001). However, the calculations come clearly to the conclusion that Finland's greenhouse gas emissions cannot be brought down to the target level during the period 2008–2012 unless energy consumption intensity can be made clearly even more efficient than today and unless energy supplies can be based on modes of energy with low or zero emission levels.

There are many activities causing GHG emissions on which government actions have little if any effect, for example, activities such as net electricity import, domestic hydropower production and the growth of the energy-intensive industry. The treatment of the carbon sinks can have a very large effect on the Finnish greenhouse gas balance. Many other assumptions also affect also the scenarios.

If the growth of the energy-intensive industrial branches of the industry is only moderate and the competitiveness of indigenous electricity production insufficient in relation to imports, the carbon dioxide emissions from combustion would clearly remain at a lower level than predicted. On the other hand, the levels of emissions can also rise higher than expected, if the production conditions of the energy-intensive industry are better than anticipated or if there are only a few possibilities of importing electricity.

The trend will decisively depend on a few factors that are difficult to predict. The general economic development is one of the main factors, but the assumptions on the production growth rate of the energy-intensive branches, such as the pulp and paper industry, manufacture of metals and the chemical industry, will play a special role. The sensitivity analyses presented in the background report to the strategy indicate that carbon dioxide emissions can vary quite widely within the next few decades.

Assumptions on which forms of production should be used to cover the growth of electricity consumption are also in a central position. On the other hand, it must be taken into account that the national energy or climate policy can be used to influence those factors of competitiveness that affect both the development conditions of industry and the relationship between indigenous electricity generation and imported electricity.

Uncertainty as to economic development will also be reflected on a wider scale (vehicle stock, demand for services, etc.) on the development of emissions, but it will have minor effects compared to the factors mentioned above. Meeting the wood-felling targets will also be directly reflected in the utilisation potential of energy from wood and thereby on achieving the targets set for greenhouse gas emissions.



5.3.5. Methodology

Sectoral programs

The Ministry of Trade and Industry has combined the results of sectoral programmes (see chapter 5.3.1), which were based on several other models (Ministry of Trade and Industry 1997). Emissions from waste management were based on a sectoral report by the Ministry of the Environment. The Finnish Environment Institute has made the calculations using the mass balance method (Dahlbo et al. 2000). The energy consumption of buildings has been estimated partly with the REM model (Nippala et al. 1995) developed by VTT and Tampere University of Technology in collaboration with MTI.

Projections related to traffic emissions are included in the sectoral report of the Ministry of Transport and Communications. The results have been calculated using the LIPASTO model developed by VTT (2000). Emissions from international bunkers are based on data provided by Statistics Finland

Emission projections from agriculture are based on the sectoral report of the Ministry of Agriculture and Forestry. The methods were developed by VTT Energy (Pipatti et al. 2000). The climate strategy measures concerning forestry are based on the National Forestry Programme (Maa- ja metsätalousministeriö 1999). Calculations related to HFCs, PFCs and SF₆ are based on work by Finnish Environment Institute and VTT Energy (Oinonen & Soimakallio 2000, Oinonen 2000).

Pipatti (2001) has recently summarized the methodologies used for compilations of the Finnish inventories.

Economic and environmental impacts

In order to study the effects of the climate strategy two major research projects were launched at the beginning of 1999. In one project the Government Institute for Economic Research (VATT) studied the effects in collaboration with the Technical Research Centre of Finland (VTT), and in the other project, the Research Institute of the Finnish Economy (ETLA) and VTT produced joint estimates of the effects (Kemppi et al. 2001, Forsström & Honkatukia 2001).

The prime aim of both studies was the assessment of the climate policy packages set up by the ministerial group. The balanced budget principle was an important premise for the projects. The principle implies that extra tax revenues should be recycled and a fall-back in tax revenues should be recouped. Concerning the economic effects of different scenarios see also Chapter 4.

ETLA/VTT model

ETLA and VTT have developed a computable general equilibrium model that combines a top-down approach of economic behaviour with a bottom-up description of energy and paper industries. The model facilitates a simultaneous analysis of both economic and technological choices.

The energy sector comprises separate electricity generation, district heat generation, and combined heat and electricity generation. Each of these is further divided according to production technologies, following an engineering approach. The model takes into account fuel switching and improvement of fuel efficiency.

Forest industries are modelled separately for the mechanical and chemical forest industries. The former comprises the manufacture of wood products and timber and, as a by-product, wood waste that is used as a fuel or a fibre source in chemical paper industries. Chemical paper industries consist of the six most important product lines ranging from pulp to fine graded papers.

It is assumed in the model that imports and exports are imperfect substitutes. This substitutability differs both between industries and products.

Consumers are modelled with a representative consumer. The consumer receives wages and rental for capital from firms and income transfers from the public sector, and uses its income optimally for consumption, taxes, and savings. Investment is determined both by the demand for capital by firms as well as supply of savings by the firm. The rental for capital depends on the time-span under study and also on the assumptions concerning the rest of the world. In the short run, a balance-of-payments restriction is imposed, but this can be modified in a longer-run treatment. World demand and world market prices are taken to be exogenous.

The public sector produces a public good that does not improve the consumer's utility. This assumption can easily be lifted and is made only to keep the public sector as exogenous as possible. The public sector nevertheless affects the economy via its decisions on taxation.



VATT/VTT models

In the VATT/VTT project two large models were used in an iterative manner. The energy sector calculations are carried out by means of the EFOM model, managed by VTT Energy. The economic evaluation is largely based on calculations with KESSU, which is owned by the Ministry of Finance but deployed in VATT.

EFOM is an optimisation energy model. Its original design is rooted in an initiative of the European Commission to obtain a model standard for energy system modelling throughout Europe. The Finnish version has been extended and tuned to the Finnish circumstances.

The model looks for the cheapest combination of energy carriers and energy technologies, given the indicated boundaries on emissions, price levels of primary and secondary energy sources, costs of energy saving technologies, the potentials of energy saving technologies, the default improvement of energy efficiency by type of use, the current structure and age distribution of (main) energy conversion and energy using technologies, the economic growth by sector, growth of the buildings stock, growth of the vehicle stock and annual mileage.

Next to energy use per fuel type per sector and emission by type of greenhouse gas, the output from EFOM concerns annualised costs per sector distinguished by:

- *investment in energy conversion capacity (both utilities and heavy industry)*
- *extra use cost due to switches in fuels and/or energy technology*
- *extra investments in energy efficiency*
- *extra energy/carbon tax levied*
- *extra subsidies (mostly on renewables) received*

In addition, the model also gives output on total incited investment by period and by sector as well as the marginal cost levels for energy use and abated emissions.

KESU is an econometric model of the Finnish economy developed and used by the Ministry of Finance (Hetemäki and Kaski, 1992; Kaski et al. 1998). The latest version of the model (KESU V) is deployed in VATT and at several places adapted to be able to absorb energy cost information better than in the standard KESU. KESU is meant for medium-term forecasts, which implies that the interpretation of results preferably focuses on forecast years between 3 and 10 years. In the study of concern, policy impulses were set to start in 2005, which means that the results for the years 2008, 2010 and 2015 were in focus.

KESU V has separate blocks for commercial production sectors, households, the public sector and taxation and foreign trade. Important exogenous variables (i.e. can be set 'freely' by the model user) are among others:

- *demand developments on export markets;*
- *international trade prices (import and export) such as the oil price;*
- *technical development;*
- *public sector consumption and investment (volumes);*
- *demographic variables (employable population by age cohort, migration, under aged and retired population, number of households/homes).*

Fig. 5-9 gives an overview of the information flow from the policy packages through the models. The policy programmes are first trans-

lated into EFOM input. The results from EFOM are fed into KESSU. In case of large macro-economic impacts, the production levels pictured in KESSU's output have to be fed back into EFOM in order to reassess the energy and emission levels.

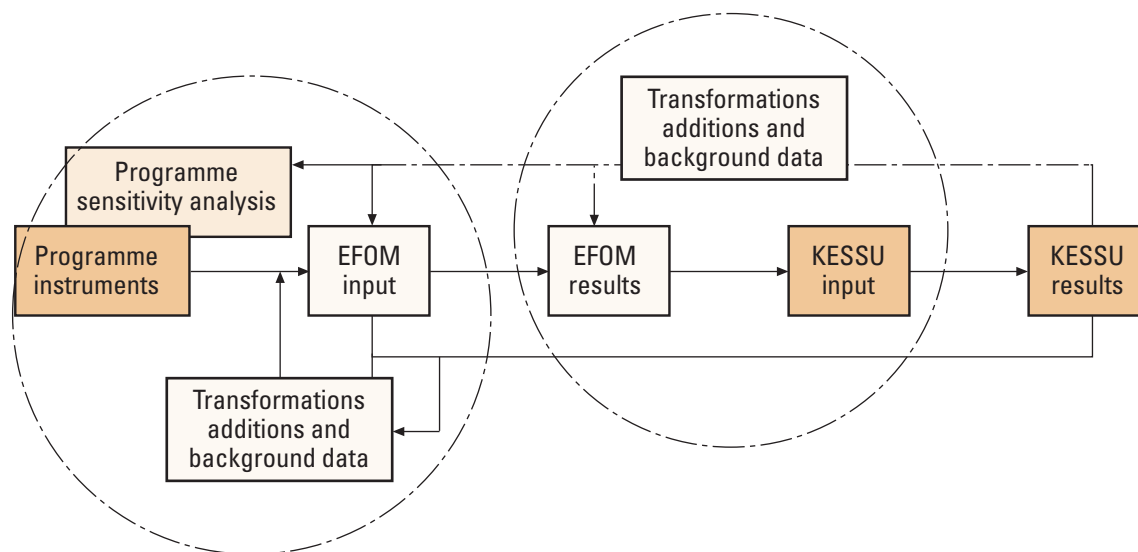


Figure 5-9
Overview of the linked model evaluation system.

Strategic EIA has been conducted by the Finnish Environment Institute (Hildén et al. 2001) based on the input of the various above-mentioned models.

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