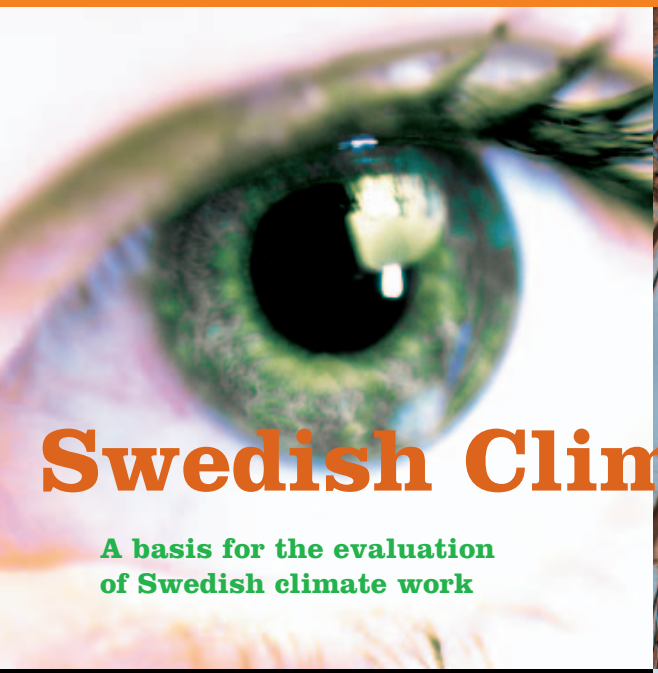
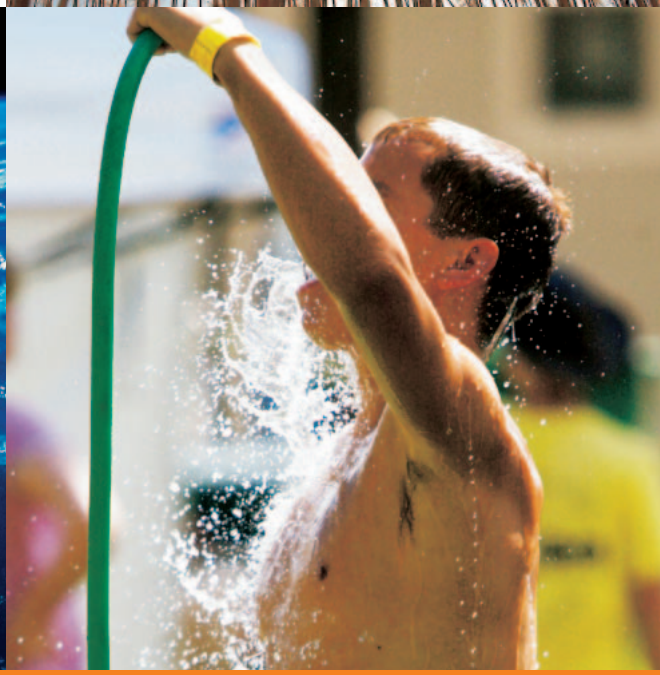
Publication Year 2004



Swedish Climate Strategy

A basis for the evaluation of Swedish climate work



Checkpoint 2004 – The Swedish Environmental Protection Agency and the Swedish Energy Agency

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Naturvårdsverket
ISBN 91-620-5418-X
ISSN 0282-7298
www.naturvardsverket.se/bokhandeln
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Ordertelephone: + 46 8 505 933 40
Orderfax: + 46 8 505 933 99

500 copies
Graphic design and original: ArtoDito
Photography: The Swedish Energy Agency, Getty Images, Per Westergård
Print: Intellecta Tryckindustri, Solna 2004-15441.

Swedish Climate Strategy

A basis for the evaluation
of Swedish climate work

Checkpoint 2004 – The Swedish Environmental Protection Agency
and the Swedish Energy Agency

Contents

Preface

The current Swedish climate strategy was adopted by the Riksdag (Parliament) in March 2002. The strategy is designed so that Swedish climate work and progress towards the national target are to be followed up on an ongoing basis. Special checkpoints were inserted for the years 2004 and 2008 in which the climate work is to be evaluated. If emission trends appear less favourable at these times, new measures can be proposed and/or the target reconsidered.

The Environmental Protection Agency and the Energy Agency have had the government's assignment of compiling a basis for the first evaluation at the 2004 checkpoint.

This report describes the most important conclusions and results of our work on this assignment. The work is described in detail in four reports:

Forecasts for greenhouse gas emissions

Evaluation of the policy instruments of the climate strategy

Flexible mechanisms and targets in climate policy

New knowledge about the climate problem

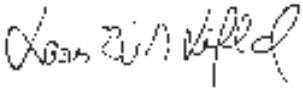
Work on the assignment has taken place in collaboration with the Swedish Agency for Administrative Development, which has taken part in the reference group for policy instrument evaluation, the Swedish Institute for Transport and Communications Analysis (SIKA), which has supplied material for the transport forecast, contributed to the evaluation of policy instruments and participated in the reference group for policy instrument evaluation, the National Institute of Economic Research which has contributed to several tasks, the National Road? Administration which has participated in the reference group for policy instrument evaluation, and the National Board of Building, Housing and Planning, which has supplied material for the policy instrument evaluation.

KARIN SAHLIN of the Swedish Energy Agency and EVA JERNBÄCKER of the Environmental Protection Agency managed the project on behalf of each authority.

Managers for the sub-projects were:

TOBIAS JAKOBSSON, Swedish Energy Agency and TEA ALOPAEUS SANDBERG, Environmental Protection Agency (forecasts), REINO ABRAHAMSSON, Environmental Protection Agency and MATHIAS NORMAND, Swedish Energy Agency (policy instruments), ULRIKA RAAB, Swedish Energy Agency and FREDRIK VON MALMBORG, Environmental Protection Agency (flexible mechanisms) and MARIANNE LILLIESKÖLD, Environmental Protection Agency and KENNETH MÖLLERSTEN, Swedish Energy Agency (new knowledge about the climate problem).

A number of other employees at the Environmental Protection Agency and the Swedish Energy Agency have also contributed material and useful opinions to the work.



LARS-ERIK LILJELUND
Director-General
Environmental Protection Agency

THOMAS KORSFELDT
Director-General
Swedish Energy Agency

"Climate change is a global problem necessitating international co-operation. The framework for international co-operation is the Climate Change Convention and the Kyoto Protocol."

Summarising Conclusions and Proposals

Background

The UN's International Panel on Climate Change (IPCC) is becoming ever more certain that human activities are contributing to climate change. The uncertainty now relates more to how *great* the increased greenhouse effect might become, how *quickly* it might develop and *which areas* of the Earth might be most affected.

Climate change is a global problem demanding international cooperation. The framework for international cooperation is the Climate Change Convention and the Kyoto Protocol. The overall target of the 1992 Climate Change Convention is for the concentration of greenhouse gases in the atmosphere to be stabilised at a level that prevents human impact on the climate system becoming dangerous[1)]. The 1997 Kyoto Protocol represents a first step in quantifying the reductions in emissions required to attain the goal of the Convention. Under the Protocol, industrialised countries, known as Annex 1 parties, have to reduce emissions of greenhouse gases by just over 5 % between 1990 and the commitment period 2008–2012. To increase flexibility for the parties in implementing their commitments and to increase costeffectiveness, three 'flexible mechanisms' were introduced into the protocol; emissions trading and climate projects abroad (joint implementation (JI)) and the clean development mechanism (CDM)). It is also possible for the member states to some extent to credit sequestration of carbon in sinks under the Kyoto Protocol.

The EU (EU 15) has a joint reduction commitment in relation to the Kyoto Protocol. The EU's joint commitment has been shared among the member states in an internal burden-sharing agreement. Under the burden-sharing agreement, Sweden has a commitment that Swedish emissions are not to exceed 1990 emissions by more than 4 %.

In the spring of 2002, the Riksdag [Swedish Parliament] took decisions on a national climate strategy which includes long-term and short-term targets

1) Such a level is to be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner..

under the environmental quality objective Reduced Climate Impact. The target up to 2050 is based on efforts needing to be made in all countries for stabilisation of the level of greenhouse gases below 550 ppm (parts per million) of carbon dioxide equivalents to be achieved in the long term. Sweden is to press internationally for global work to be oriented towards this target. The short-term target entails emissions of greenhouse gases in the country as a mean value for the period 2008–2012 not exceeding 96 % of the 1990 level. This target is to be attained without compensating for sequestration in carbon sinks or by the use of flexible mechanisms.

The strategy is formulated in such a way that Swedish climate work and development towards the national objective are to be regularly monitored. Special checkpoints have been inserted in 2004 and 2008, when work on climate is to be assessed. If emission forecasts at those checkpoints prove less favourable, new measures can be proposed and/or targets reviewed.

The Swedish Environmental Protection Agency and the Swedish Energy Agency have been commissioned by the government to draw up documentation ahead of the first assessment at the 2004 checkpoint. The emphasis in the assignment is put on the national interim target for the period 2008–2012.

National climate policy encounters new circumstances

The member states of the EU have drawn up a common strategy on climate. The most important policy instrument in this strategy is the future emissions trading scheme. The EU Emissions trading scheme (EU ETS) is due to start in 2005. Under this scheme, enterprises can buy and sell emissions allowances, so that emissions may increase in one country while at the same time decreasing in another. Total emissions are not to exceed the cap for emissions stipulated within the EU. The EU ETS has the potential both to exercise environmental control and to be cost-effective. It will, however, be important for Sweden to join in and influence development of the system so that both the environmental effect and cost-effectiveness of the system can be achieved.

The new EU-wide policy instrument alters the prospects of Sweden having a national target for total emissions *within* the country. The prospects for national control of emissions in the sectors covered by the system are altered in particular.

The future EU-wide trading scheme has therefore been an important factor in our work and our conclusions and proposals. The present scope of the system is shown in the box below. More sectors and more gases may be covered by the EU ETS in the period after 2008.

Trading sectors
Covers, with effect from 2005, emissions of carbon dioxide from power and heating plants, oil refineries, plants producing and processing iron, steel, glass and fibreglass, cement, lime and ceramics and plants producing paper and pulp.

Non-trading sectors
Covers other emissions of greenhouse gases (methane, nitrous oxide and the three industrial gases HFC, PFC and SF6). Also encompasses emissions of carbon dioxide from small-scale burning in the domestic sector, the transport sector and from the rest of trade and industry.

Swedish targets up to 2008–2012

Forecast result for Sweden

An examination of the trend in emissions in Sweden and the result of the new baseline forecast of total emissions in Sweden by 2010 shows that Swedish climate strategy to date has had an impact on emissions in several sectors. Overall, it is estimated that emissions will end up below Sweden's commitment under the EU burden-sharing agreement for the commitment under the Kyoto Protocol but above Sweden's national target. In the baseline forecast emissions are predicted to fall by just over 1 % between 1990 and 2010. Emissions need to decrease by a further 2 million tonnes of carbon dioxide equivalents if the national interim target is to be met.

However, the trend in different sub-sectors is moving in different directions. Emissions in the transport and energy sectors are increasing most. Emissions are also increasing in industry, but at a slower rate. Emissions from the heating of homes and commercial premises and from the waste sector are decreasing sharply. Emissions in the agricultural sector are also declining.

The forecast for those sectors which are initially to be covered by the EU trading scheme suggests that emissions from these activities altogether may *increase* by 25 %[2] (30 % if the carbon dioxide tax is removed) by 2010 compared with the 1990 level, while emissions in non-trading sectors may *decrease* over the same period by 12 %. Non-trading sectors also include the transport sector, whose emissions are expected to increase over the period. It is therefore other non-trading sectors, i.e. homes and commercial premises and the agricultural and waste sectors, which are predicted to contribute large falls in emissions in the forecast.

Appraisal of policy instruments

It is consistently judged both in our own work and in an examination of the assessments of policy instruments made by other countries that it is difficult to appraise separate policy instruments. The effects of a single policy instrument are difficult to differentiate from other policy instruments and other driving forces in society.

Swedish climate strategy contains a number of policy instruments which either transcend sectors or are targeted. They have either been introduced through national initiatives or as a consequence of EU strategies and international climate work. The interaction between different policy instruments is particularly significant in the area of energy. Policy instruments in other areas, particularly in the area of waste and agricultural policy, also affect emissions.

Our judgement is that, despite the difficulties mentioned above, it is the *carbon dioxide tax* (introduced in 1991) in particular that has contributed to a decrease in emissions in Sweden in the last decade. The tax also offers good potential for high cost-effectiveness to be achieved as it makes it possible for those who use energy to decide which measures are cost-effective. The effects are clearly visible in the district-heating sector and in the heating of homes and commercial premises. The analysis also shows that the present-day level of carbon dioxide tax in these sectors has a sufficient effect in terms of environmental control. Separate calculations have been made for the transport sector, showing that increases in tax on petrol and diesel have had some effect.

The electricity certificate system is judged to reduce emissions principally from the Nordic point of view. The system does not have what is required to achieve the same cost-effectiveness as an economic policy instrument with a general effect, such as the future trading scheme. The electricity certificate

2) At an assumed emission price of 10 euros per tonne of carbon dioxide

system is principally motivated by energy policy, however, the intention being to increase the use of electricity generated from renewable forms of energy.

Decisions on around a third of grant funds have been taken in the *local climate investment programme* (Klimp). This programme is judged capable of leading to decreases in emissions equivalent to 0.5 % of the total emissions in the country. An additional indirect benefit of the programme is that it contributes to the climate work of the local authorities, partly by increasing knowledge of the opportunities that exist for reducing greenhouse gases through local decisions.

Flexible mechanisms which work well (emissions trading and the project-based mechanisms of joint implementation (JI) and the clean development mechanism (CDM)) are important for continued international cooperation towards climate change. They were important in making it possible for several countries to ratify the Kyoto Protocol, and the flexible mechanisms are judge to be key factors in more far-reaching international commitments. As a result of Swedish participation in the work on the mechanisms, we can influence the design of the system and increase understanding of the demands of other countries. All the flexible mechanisms contribute to cost-effectiveness in climate measures. The difference in costs is due to countries having different situations at the outset, for example having different energy systems, having reached differing stages of economic development and having worked to differing extents with policy instruments to reduce emissions of greenhouse gases. The climatic effects of taking measures nationally in Sweden or abroad are identical; from the point of view of the climate it does not matter where the action is taken.

Implementation of the *EU emissions trading scheme (EU ETS)* begins in 2005, and will cover the member states of the enlarged European Union. The EU ETS meets the requirements for being a powerful policy instrument as it sets a cap for the level of emissions permitted and also creates the necessary basis for cost-effective measures. Cost-effectiveness increases when the system encompasses additional countries and sectors. Effectiveness is reduced, however, if the countries allocate emission allowances according to different methods and use complementary national policy instruments in a non-uniform way. It is also expected that emissions trading will affect the price of electricity. We anticipate that the price will be affected on the basis of an average electricity production cost, which represents the margin in the Nordic electricity system.

How is the target to be structured in the Swedish climate strategy?

We propose that:

- The present-day national interim target be replaced by a new structure. We call this an "offset target". In this way, the EU ETS can be integrated into the national interim target. This structure means that changes in emissions in the trading sector (both increases and decreases) which are equivalent to purchase and sale of emissions allowances are not included when target fulfilment in relation to the national interim target is calculated.

With the introduction of the EU ETS, it becomes difficult and fundamentally illogical to retain a national target structure which at the same time sets caps for total emissions in Sweden, including emissions in those sectors that are covered by the trading scheme.

An *offset target* may then be preferable. With this type of target, emissions in trading sectors are equated with the total quantity of allocated emissions allowances[3)] for the period 2008–2012. The emissions allowances bought or sold by the enterprises in the trading sector in Sweden during the period will be offset by an equivalent decrease in emissions or increase in emissions somewhere else within the framework of the trading scheme and are therefore not included.

The actual emissions are calculated for other sectors (non-trading sectors). The sum of the allocation and emissions from other sectors is to be less than 96 % of 1990 emissions.

This target structure is in agreement with the way in which the Kyoto Protocol is structured and means that Swedish climate policy is adapted to the new emissions trading scheme within the EU. The target structure means that emissions *for* Sweden decrease to the same extent as previously, while emissions *in* Sweden may be higher or lower.

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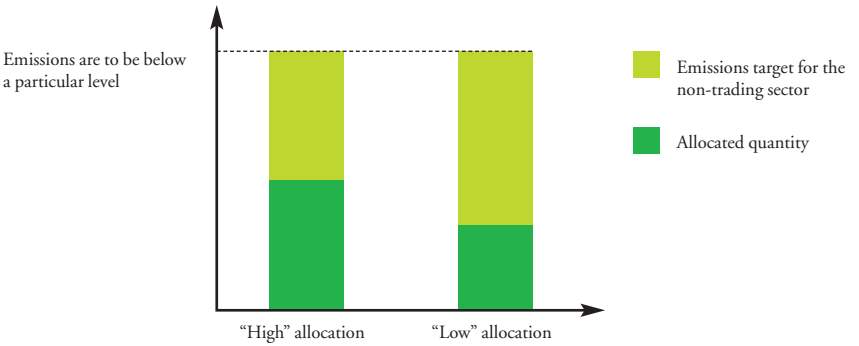
3) Under the EU emissions trading scheme, the member states are to issue rights for emissions of carbon dioxide to all facilities covered by the trading scheme. The allocation is principally made free of charge, but has to meet a number of criteria. The EU member states, following approval by the European Commission, establish in a distribution plan the total number of emissions allowances to be allocated to the trading sector.

How much emissions need to decrease in Sweden depends on the size of the allocation to the trading sector, see figure below. The need for policy instruments in the sectors outside the trading sector thus depends on the quantity of emissions allowances allocated to plants in Sweden encompassed by the trading scheme. If a *high* allocation is given to the trading sector, this means that other activities have to reduce their emissions. If a *lower* allocation is given to the trading sector, more measures are instead taken within the framework of the EU system.



Permitted emissions in the non-trading sector will vary depending on the allocation given to the trader

The assignment includes, where necessary, making proposals for further measures ahead of the period 2008–2012. To enable the need for further measures to be assessed on the basis of the new proposed target structure, information is required on how many emissions allowances altogether will be distributed to the trading sector. We do not yet know the level of the allocation for the period 2008–2012, which will not be decided on until 2006.

We estimate that a slightly lower allocation than the present forecast for the trading sector is macro-economically justified. We therefore base our proposals on such an allocation being given during the period 2008–2012[4)].

4) Such an allocation is also in line with the European Commission criteria for national distribution plans.

Proposals for further and revised policy instruments in climate strategy

The subsequent proposals are presented separately for the part of the emissions (the sectors/activities) encompassed by the EU trading scheme and the sectors that are outside the trading scheme.

Sectors outside the EU ETS

We propose the following changes to policy instruments for sectors outside the trading sector (given an allocation of emissions allowances slightly below the present forecast):

- carbon dioxide differentiated vehicle taxes for light cars,
- the benefit of free fuel for a company car is valued at a factor of 1.8 of the market price instead of the present 1.2
- tax based on kilometres travelled for trucks from 2008

It is estimated that the policy instrument proposals in the transport sector taken together will result in an annual reduction in emissions of just over 0.5 million tonnes of carbon dioxide equivalents in Sweden over the period 2008–2012.

- further and increased government subsidies over the period 2006–2008 are granted to local climate investment programmes. The programme should primarily subsidise long-term strategic measures.
- continued investment in climate information for 2006–2008
- implementation of the European Directive on the energy performance of buildings so that the potential for energy efficiency improvement is utilised.

We also propose:

- that continued and expanded government support is given to work on the project-based mechanisms JI and CDM over the period 2005–2012.

With the previously mentioned assumption of an allocation somewhat below forecast, the need to introduce policy instruments (implement measures) in sectors outside the trading scheme for the period 2008–2012 decreases as measures are also implemented under the EU trading scheme. We nevertheless consider some further measures in the climate strategy to be justified in the present situation as there is an extensive need for measures in the longer term. The proposals may also improve the prospects of tightened international commitments.

The proposals for policy instruments are long-term strategic proposals, i.e. they provide signals on changes that will be needed in the longer term. An example of this is the transport sector, where our forecast shows that emissions are continuing to increase.

The local work on climate strategies is important partly in view of the changes to inert structures that need to be made and can be stimulated with continued investment in local climate investment programmes (Klimp).

Continued efforts to develop the work on climate projects abroad, i.e. the project-based mechanisms, are of key importance as it is judged that the mechanisms may be of great significance in future global agreements.

If a *higher* allocation of emissions allowances were to be given instead to the trading sector, in our example an allocation on a par with our baseline forecast, we judge that further policy instruments which reduce emissions in Sweden by approximately 1.5 million tonnes of carbon dioxide equivalents may need to be introduced. In addition to the policy-instrument proposals presented earlier, a further reduction in emissions in Sweden can be obtained through:

- An increase in energy tax on motor fuels (petrol, diesel).
- An increase in carbon dioxide tax for the rest of trade and industry (outside the trading scheme) may result in further reductions in emissions. Further analysis is required to show the macro-economic consequences of such an increase.

An alternative way of fulfilling targets in this case would be instead to use the emission credits which Sweden is expected to receive through existing international efforts in other countries through the project-based mechanisms. The actual reductions in emissions have then taken place in countries other than Sweden.

In addition, it should be noted that Sweden may obtain a surplus of emission reduction units[5] as Sweden's national targets differ from the Swedish commitment under the EU burden-sharing agreement. The idea according to the decision on climate policy is that these reduction units could be saved. However, there are no established rules in the EU for a situation in which the EU fails to comply with its joint commitment. There is thus uncertainty as to whether Sweden can assert its right to save up emission reduction units in the future.

Activities encompassed by the EU ETS: the trading sector

We propose as follows for the trading sector:

For applicable policy instruments acting within sectors which will be encompassed by the EU emissions trading scheme, we propose that:

- The carbon dioxide tax for energy production by industry be removed,
- The carbon dioxide tax for heat production in hot-water boilers be retained but that its level be reduced,
- The carbon dioxide tax for combined heat and power plants be removed provided that:
  - The electricity certificate system is extended and the quota is raised after 2010
  - The same allocation principle (within the framework of the EU ETS) applies to biofuels and fossil fuels in new CHP plants.

We additionally propose that:

Sweden plays an active part in the forthcoming assessment of the EU ETS. An assessment of the EU ETS will start in 2005, and the European Commission is to make proposals for any changes by 2006/2007. Sweden should play an active part in this work. Issues which Sweden should emphasise include, for example, analysing whether more sectors and gases may be encompassed by the system, member states having the same allocation principles for new plants, new plants not being given emissions allowances for free and the allocation principles being such that a scarcity of emissions allowances arises.

5) Under the Kyoto Protocol, the countries have been allocated a number of assigned amount units (AAUs) for the period 2008–2012.

An important issue in the introduction of emissions trading is whether a carbon dioxide tax will continue to be imposed on the trading sectors.

Further policy instruments in the trading sector in Sweden will not affect total emissions in the trading sector in Europe. An emissions trading scheme theoretically offers the advantage that measures to reduce emissions are taken where they are cheapest. If the system is developed so that the companies can predict that the number of emissions allowances on the market will decrease, good prospects are also created for structural changes that are favourable for attaining long-term climate targets.

In a system that works smoothly, supplementary policy instruments (e.g. carbon dioxide tax) should not therefore have an impact on the activities involved in emissions trading as this can adversely affect cost-effectiveness in the trading scheme and distort competition.

At the same time, it is important during the introduction of the trading scheme, when the price of emissions allowances can be expected to be low, to retain some supplementary control to promote structural changes that make it easier to attain the long-term climate targets.

Further policy instruments may also be justified by other social objectives also having to be met. One of these is the energy-policy objective of increasing the proportion of renewable energy in the Swedish energy system. It is therefore important to maintain the competitiveness of biofuel in the production of electricity and heating when emissions trading is introduced. Another energy-policy argument is Sweden's security of supply.

Proposals with a view to developments after 2008–2012

We propose that:

- *Targets for the medium term need to be developed*. Work should be started now to draw up a basis for the development of the national climate strategy with targets and policy instruments to include the medium term, the proposal being to look at the period up to 2020. It should be possible for such a strategy to be established by the 2008 checkpoint. The focus on national strategy should correlate well with the line Sweden intends to pursue in international negotiations.
- *Sweden should channel its national climate aspiration into a strategy ahead of future international negotiations and into EU work*. Sweden should negotiate an international commitment which can also be used as a national target. As a result, other countries can be influenced to adopt more ambitious commitments.
- *Vulnerability and the risks associated with a changed climate in Sweden need to be surveyed and analysed*. Adaptation measures may need to be initiated. A survey of this type can be initiated in conjunction with the fourth national report.

It is important to keep a long-term perspective at all times in work on climate. Proposals which look towards the period 2008–2012 are therefore also featured in our documentation for the assessment of Swedish climate strategy, checkpoint 2004.

According to our forecasts, emissions will increase after 2010. A decisive factor in this trend is the assumption that Swedish nuclear power plants will be phased out after a life of 40 years and be replaced primarily by natural gas. The forecast for development in the transport sector also shows continued increases in emissions. The same trends otherwise apply up to 2010. Emissions from the heating of homes and commercial premises and emissions from the waste sector, for instance, are forecast to continue decreasing.

Under the Riksdag decision, Sweden is to *press* for the level of greenhouse gases to be stabilised in the long term at a level below 550 ppm greenhouse gases. It is assumed that stabilisation at this kind of level will create the necessary basis to enable restriction of the rise in global mean temperature to below 2°C compared with the pre-industrial level. The conclusion has been drawn by several EU member states and at EU-wide level that it is necessary to endeavour to attain such a restriction in the rise in temperature. A stabilisa-

tion level of this kind demands extensive global emission reductions, but at the same time there are several routes by which the same level can be reached. Calculations[6] show the need for reductions in emissions in industrialised countries will amount to about 80 % if equal emissions per capita are to be attained globally by 2050. As far as Sweden is concerned, emissions under these circumstances may need to decrease by 50–60 % by 2050. Sweden has comparatively low emissions per capita at the outset, but the emission forecast for the period 2010 to 2020 points in the wrong direction. There is therefore also a great need for reductions in emissions by 2050 in Sweden.

The IPCC considers, however, that it is already too late to completely avoid effects of climate change. Climate change will also affect Sweden, and although the effects may appear to be modest in comparison with other regions, certain adaptation measures may need to be initiated.

6) For a more in-depth analysis, see Swedish EPA report Post Kyoto.

“Is Sweden on the right track in work on climate change?”

1 The Assignment

The Environmental Protection Agency and the Energy Agency have had the government's assignment of compiling a basis for the first evaluation at the 2004 checkpoint.

Our assignment has included:

- Producing a new overall forecast based on common basic assumptions.
- Carrying out evaluations of current policy instruments with a direct climate focus or those which are quantitatively important for emissions
- Assessing the chance of achieving the interim target for the period 2008–2012 using current policy instruments and measures, and where needed, submitting proposals with assessed consequences for further/increased cost-effective measures.
- Making an economic and environmental assessment of the consequences of integrating the flexible mechanisms into the interim target for the 2008–2012 period and presenting an accessible overall description of costs and emission effects of implementing measures nationally in Sweden and in other countries via Joint Implementation and the Clean Development Mechanism.
- Making a survey of new knowledge on the climate problem. This task has included producing an updated assessment of society's capacity to implement the adaptations necessary to avoid the consequences of an increased greenhouse effect. Special weight is to be attached to information that is relevant to the long-term objective.

It also included producing a summarising description of developments in other countries with respect to emission, measures and policy instruments, and forecasts of future developments carried out in those countries.

The assignment did not include analysing the consequences of using carbon sinks.

Climate policy is associated with a number of uncertainties. When the climate strategy was adopted in 2002, no decision had yet been made on the introduction of a system of emissions allowances trading in the EU. Sweden

ratified the Kyoto Protocol through the climate policy decision. Now, two years on, the EU has decided to introduce an emissions trading scheme. The Kyoto Protocol is not yet in force and there is still uncertainty surrounding the actual results of the trading scheme in the EU. The first introductory period has not yet begun. A number of other Commissions of Inquiry are also working in parallel with our work. At national level, some proposals have been submitted by Commissions concerning important taxes in the area, but no significant decisions have yet been made. Decisions about the shutting down of nuclear power plants are also very important for how carbon dioxide emissions in Sweden will develop, and negotiations are ongoing between the energy industry and a specially appointed negotiator. At global level, negotiations will begin in 2005 under the auspices of the UNFCCC concerning new commitment periods and forms for global agreements for the post-Kyoto period.


“There is no longer much doubt that we are now witnessing the effects of emissions caused by humans on climate.”

2 Knowledge of Climate Change

There is no longer much doubt that we are now able to see the impact on the climate of anthropogenic greenhouse gas emissions, i.e. emissions caused by human beings. The greenhouse effect is increasing in intensity. The most recent research has generally confirmed the picture of an ever-warmer planet. The UN climate panel, the IPCC, is increasingly certain that human activity is contributing to climate change. The uncertainty that exists is about how *great* the stronger greenhouse effect will be, how *quickly* it can develop and *what areas* of our planet will be most heavily affected. There is extensive research on climate and climate change around the globe.

The IPCC made the most recent compilation of knowledge in the field in its third assessment report. The work of a fourth assessment report has begun and the report is expected to be ready by 2007. In Sweden, the research programme SWECLIM[17] has recently presented its final report containing the results of regional climate models.

The strengthening of the greenhouse effect is primarily due to the increasing levels of carbon dioxide in the atmosphere as a consequence of widespread use of fossil fuels. In the 20th century, the global population doubled and the use of primary energy increased sixteenfold. One prerequisite for this rapid increase in energy use has been the exploitation of fossil fuel reserves.

Apart from carbon dioxide, other greenhouse gases are also being emitted at higher levels now than in the pre-industrial era. These include nitrous oxide, methane and some fluoride-containing substances. Other air pollution, such as particles, also affect the climate system.

Carbon dioxide is also released by widespread global deforestation. (In boreal/temperate forests at northern latitudes, methane and nitrous oxide are also released if the land has previously been drained or is very humus-rich.)

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7) The Swedish Regional Climate Modelling Programme at Rossby Centre, Swedish Meteorological and Hydrological Institute, SMHI

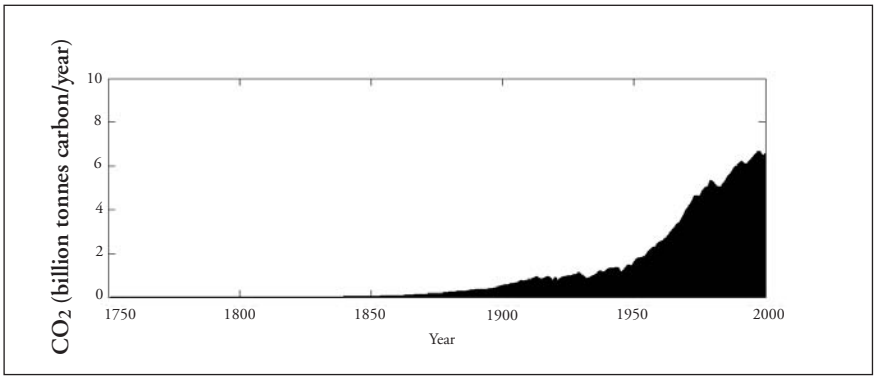

Figure 1 Global carbon dioxide emissions 1751–2000, from the use of oil, coal and natural gas.[8)]

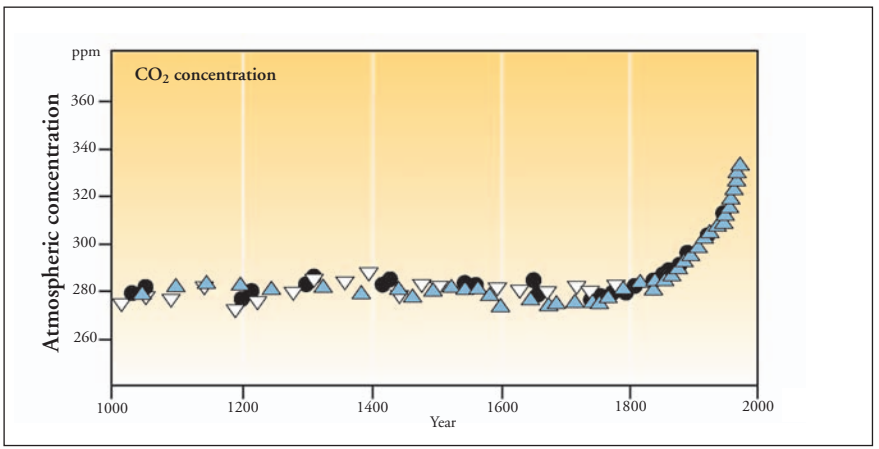

Figure 2 Atmospheric carbon dioxide levels, 1000–2002

Note to Figure 2. Regular atmospheric measurements (black line) began in the late 1950s. Data for earlier periods are based on analysis of air (grey symbols) trapped in inland ice. Current levels of carbon dioxide are extremely high compared to levels during the 400,000 years that can be studied using the Antarctic glaciers.

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8) Source: Marland, G., T.A. Boden, and R. J. Andres. 2003. Global, Regional, and National CO_2 Emissions. In Trends: A Compendium of Data on Global Change. Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, U.S. Department of Energy, Oak Ridge, Tenn., U.S.A. (See http://cdiac.esd.ornl.gov/).

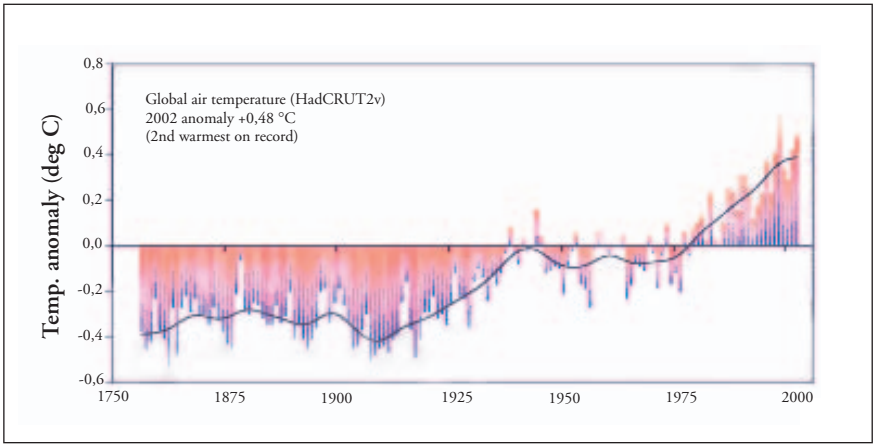

Figure 3 Developments in mean global temperature for the period 1860–2002.

Note: given as annual deviations from the mean temperature for the 30-year period 1961–1990 [9].

Between the years 1860 and 2000, mean global temperature has risen by an average of 0.6°C ± 0.2. In Europe, the mean temperature has increased by 0.8°C during the same period. The most recent ten-year period has been the warmest on record. 1998 was the warmest year since 1861, and second warmest were 2002 and 2003, which were equally warm.

2.1 The future of the global climate

Continued human influence on the composition of the atmosphere can be expected in the 21st century. The third assessment report from the UN climate panel IPCC produced a comprehensive basis for scenarios showing how life on earth could develop in terms of population, technology, economic development in different parts of the world etc. These development assumptions were then the basis of scenarios about future emissions, which in turn were used for carbon cycle models of impact on the composition of the atmosphere. Global climate models were then used to calculate how the climate could be affected. Estimates show global warming of between 1.4–5.8°C during the period 1990–2100. Sea levels will then rise by between

9) Source: Climatic Research Unit, University of East Anglia, UK.

0.09 and 0.88 m. Globally, precipitation will increase while certain areas will at the same time suffer more drought.

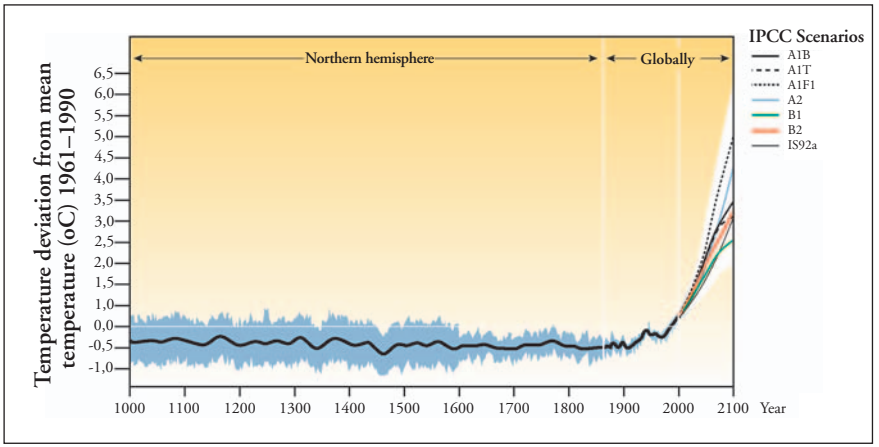

Figure 4 Global temperature development, historically and according to IPCC scenarios.

The spread in results is because there are a number of uncertainties in this effect chain. A number of different assumptions can be made about society's future development and future emissions. In addition, the climate system is complex and there is great uncertainty about *how* the climate system will react to even higher levels of greenhouse gases, how *sensitive* the climate system is. There may for example be a risk that the climate system, instead of changing gradually in proportion to ongoing changes in impact, instead suddenly changes in an unwanted direction when a threshold level is reached. This could mean, for example, the collapse of the western Antarctic inland ice with widespread resulting increases in sea level; that large amounts of methane trapped inside permafrost are released, further reinforcing the greenhouse effect; or that ocean currents change direction. There is today a lack of knowledge of how great these risks are, apart from the fact that they are conceivable and are judged to increase the more the climate is affected. The consequences would be global.

2.2 Regional climate scenarios

Regional climate scenarios primarily focusing on the Nordic region and Sweden have been produced by the Swedish research programme SWECLIM. These describe how the climate at Sweden's latitudes can develop under certain conditions. The calculations in the model are based on two global emission scenarios in which atmospheric carbon dioxide levels are assumed to be 600 and 850 ppm[10] respectively in the year 2100. It should be noted that both scenarios exceed the long-term stabilisation goals for greenhouse gas levels formulated in Sweden and the EU, see section 2.5. below. In the scenarios, the annual mean temperature for Sweden increases by 2.5–4.5°C in a 100-year perspective. The calculated regional changes in precipitation and evaporation show considerable variation. Over large regions, precipitation is expected to increase while snow cover is reduced. The growing season is extended by 1–2 months and the vegetation zones are shifted. Rate of water flow increases in the north and falls in the south. The spring floods characteristic of today will on average be less heavy. The risk of flooding is expected to fall in the spring but increase at other times of year. Future climate changes in these scenarios are not small from a Swedish perspective, even if they may appear moderate compared to other regions.

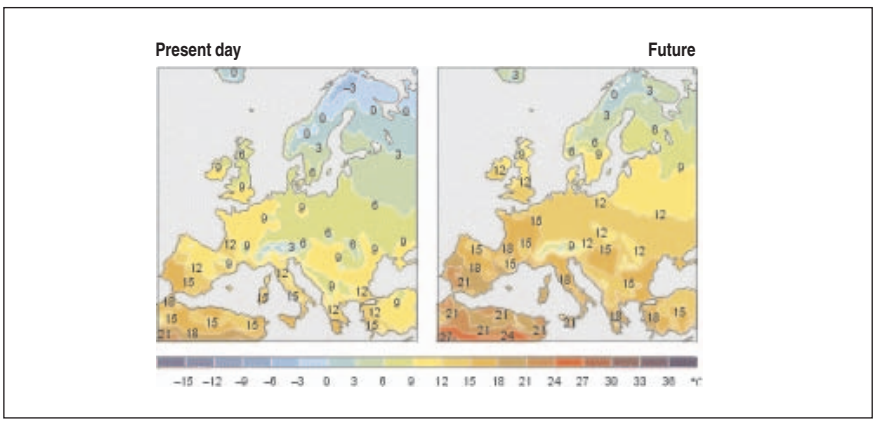

Figure 5 Changes in mean annual temperature in Europe in a 100-year perspective
Source SWECLIM

10) Parts per million

In SWECLIM's scenarios, the mean annual temperature in central Europe increases by up to 6°C. In one of the simulations, summer temperature (June-August) increases by up to 10°C while precipitation falls heavily. Changes on this scale would of course cause extensive problems in many areas, at the same time as it is highly likely that the number of extreme weather situations, such as torrential rain and long droughts, will increase in a changed climate. The variations in the results of the various simulations from SWECLIM are greater for central Europe than for northern Europe. That winters are affected in northern Europe and summers in continental Europe is however a consistent feature of both SWECLIM's calculations and those of other international research groups.

2.3 Need of adaptation — globally

The IPCC is of the view that it is already too late to entirely avoid the effects of climate change, e.g. in the shape of flooding of low-lying coastal areas. The consequences of even a small increase in mean global temperature are particularly grave for the small island nations of the South Pacific. The adaptation of a number of sectors to a warmer climate with new conditions is therefore a necessary strategy and should supplement measures designed to mitigate climate change. The Netherlands was early in starting discussions on what adaptation measures will be required to mitigate the effects of an increase in sea levels. For some regions, it may be necessary to switch crops or tree types to secure food production and forestry. Altered conditions for food production can in turn lead to population migration. In thawing permafrost regions of Russia and Canada, measures are necessary to alleviate the effects of collapsing roads, buildings and pipelines etc. Generally, developing countries will have more difficulty in dealing with climate change. They suffer in two ways – they are often in regions affected by extensive weather and climate changes, and they do not have the resources to adapt to a changed climate with different weather systems.

2.4 ...and in Sweden

Vulnerability and risks in Sweden in a changed climate have thus far been the object of only one or two analyses. No comprehensive programme has evaluated requirements, opportunities and costs. Some work has been started in recent years by a number of bodies, such as sector authorities, to examine

vulnerability and the need of adaptation, primarily related to flooding disasters. The National Board of Building, Housing and Planning, the National Rescue Services Administration and the National Roads Administration have begun some work. The SMHI and the power industry have reviewed the consequences for hydroelectric power. More work may be necessary in the field. A survey will be carried out during the work on the fourth national report to the UNFCCC, and adaptation measures may need to be initiated.

SWECLIM's scenarios show that precipitation may increase in Sweden, and that the mean annual temperature may increase somewhat more than the global average. Sweden extends over a number of zones from the subboreal zone in the south to the boreal and Arctic-Alpine vegetation zone in the north, which results in a great variation in species and biotopes. Both ecosystems and technical systems are adapted to prevailing local/regional conditions. An increase in temperature will therefore cause a shift in natural vegetation zones and may lead to the extinction of some species, primarily in the mountain regions. Increased precipitation and short-term high flow levels increase the risk of flooding and associated problems such as earth-slip, subsidence, and leaching of pollutants. For investments with long lifetimes which require large financial input, there may be problems. A number of functions are dimensioned on the basis of historic information about extreme values for flows and precipitation; extreme values that may change in a changed climate. These include the load on buildings of wind and heavy wet snow, drinking water supply, electrical power supply, dam security and anti-flood measures, and dimensioning of drain systems and sewage systems.

2.5 Possible stabilisation of the level of reenhouse gases in the atmosphere

At what level should the level of greenhouse gases be stabilised?

The overall goal of the UNFCCC is to stabilise the concentration of greenhouse gases in the atmosphere at levels that ensure that dangerous human interference with the climate system is avoided. The UNFCCC does not however define what constitutes dangerous interference with the climate system. It is impossible to scientifically define the exact meaning of the word "dangerous" in terms of a stabilisation level since (i) there is still uncertainty about how much the climate will change and what the consequences will be,

and (ii) the decision about whether a certain risk is acceptable or dangerous is based on value judgements. The adoption of a long-term stabilisation level for the concentration of greenhouse gases in the atmosphere is therefore finally a political issue.

According to the decision of the Riksdag, Sweden is to act to ensure that long-term levels of greenhouse gases should be stabilised at levels under 550 ppm carbon dioxide equivalents. Stabilisation at these levels can be assumed to help limit the increase in mean global temperature to 2100 to under 2°C compared to pre-industrial levels, but can lead to considerably greater change if the climate system proves to be more easily affected. Similar objectives have also been formulated in some other EU countries, see fact box.

The EU Council of Ministers has adopted the target that:

Mean global temperature is not to increase by more than 2°C compared to pre-industrial levels. When the target was adopted, it was thought that this target would correspond to carbon dioxide levels being stabilised at 550 ppm (corresponds to a stabilisation of the level of carbon dioxide equivalents at 650 ppm). The two targets are probably not compatible. A stabilisation at approx. 450 ppm carbon dioxide is necessary. An overview of the long-term climate strategy is under way within the EU.

Germany intends to reduce that country's emissions by 40 % between 1990 and 2020 if emissions within the EU fall by 30 % at the same time.

The United Kingdom is to act to ensure that the industrialised countries reduce their emissions by 60 % to 2050, which is probably compatible with a carbon dioxide stabilisation level of 550 ppm. With reductions in emissions in developing countries, reduction may also be compatible with carbon dioxide stabilisation at 450 ppm

France is discussing ambition levels to 2050 that are compatible with a carbon dioxide stabilisation level of 450 ppm.

The choice of stabilisation level however contains uncertainties about (i) the size of emissions that can be permitted at various points in time and (ii) the magnitude of global warming. Against the background of these uncertainties, the IPCC recommends in its third assessment report that the world's

decision-makers adopt a hedging strategy, i.e. a strategy focused on the short and long-term reduction of emissions that means that it will still be possible to achieve very low stabilisation levels in the future at reasonable cost if it should prove necessary.

2.6 Reduction requirements

Several individual countries, and the EU jointly, have thus come to the conclusion that it is best to attempt to limit global temperature increase in this century to under 2°C compared with pre-industrial levels. To achieve this, the level of greenhouse gases in the atmosphere must be limited. The UNFCCC points out that this must take place through limitation of emissions from sources and by managing and increasing sequestration to carbon sinks.

There are many ways of reducing emissions that can lead to the same stabilisation levels, but the longer measures are postponed, the quicker emissions must fall when measures are finally applied. Reviews of various scenarios produced by the IPCC to achieve stabilisation levels under 550 ppm carbon dioxide equivalents point to a requirement that emissions in the industrialised countries must be reduced to 2020 by about 10–30 % and to 2050 by about 80 %. If effective measures are applied at the same time in the developing countries, there may be a smaller need of emission reductions in the industrialised countries to 2050. (For a more detailed analysis, see the account in the EPA's report Post Kyoto.)

The background of how emissions have developed so far and the reported forecasts for the countries in question indicate that great changes will be necessary in the near future to turn developments around.

For Sweden, emissions must be reduced by 50–60 % by the year 2050 compared to 1990 levels in the above stabilisation scenarios. The reason that Swedish emissions need to be reduced somewhat less compared to the average for the industrialised countries is that Sweden is starting from a relatively low level of per capita emissions. Since emissions have remained relatively stable in Sweden since 1990 (see section 5.2.1 below), the need of emission reductions by 2050 means that wide-ranging measures must be implemented over a relatively short period of time. Total emissions must on average be reduced by just over 1–1.5 % per year during this period to match to global development limiting the temperature rise to under 2 °C.

2.7 Technical potential and the need of technical development

The size of the emission reductions that will be necessary to stabilise the level of greenhouse gases in the atmosphere at a certain level will largely depend on how global energy requirements develop in the future.

Change can therefore take place through the use of new technology that involves small carbon dioxide emissions, through the spread of existing environmentally sound technology, and also by suppressing demand through altered consumer behaviour. The view of the IPCC is that with restrained consumer demand, existing technology will be "enough" to keep emissions down so that the level of greenhouse gases can be stabilised at 550 ppm. Existing technology means, for example, greater energy efficiency, transfer from coal and oil to natural gas, renewable energy such as biofuels and wind, and the use of sinks. If, on the other hand, the demand for energy increases apace with historical developments, other technology will be required on a large scale, such as the efficient conversion of solar energy into electricity and hydrogen gas, or the separation and storage of carbon dioxide. The necessary technology development in such an event requires widespread global research, development and demonstration efforts. It has been called into question whether the Kyoto Protocol is enough to start off technology development on a sufficient scale, bearing in mind the long-term need of new energy technology. Technology-oriented policies and policy instruments must be used as a supplement to protocols based on emission targets and market-based mechanisms.


“At the global level, negotiations are due to start in 2005 under the Kyoto Protocol on new commitment periods and the forms global agreements are to take.”

3 How is the Climate Issue Developing?

3.1 International climate policy

Since the climate problem is global, it is vitally important that there is continual progress in international climate work. International co-operation has its origins in the Climate Convention and the Kyoto Protocol. The overall objective of the 1992 Climate Convention is that atmospheric concentration of greenhouse gases are to be stabilised at a level that prevents human impact on the climate system from becoming dangerous. What level this means is not stated. An important principle of the Convention is that the industrialised countries are to take the lead in combating climate change and its damaging effects.

The 1997 Kyoto Protocol is a first step in quantifying the emission reductions needed to achieve the targets of the Climate Convention. When it was signed, the Protocol meant that the industrialised countries – known as the Annex 1 countries – undertook to reduce emissions of carbon dioxide, methane, nitrous oxide and some fluorinated greenhouse gases by just over 5 % between 1990 and the 2008–2012 "commitment period". Under the Protocol, the EU is to reduce emissions by 8 % while the USA undertook to reduce emissions by 7 %. To enable greater flexibility in the parties' implementation of their commitments and increase cost-effectiveness, three "flexible mechanisms" were introduced in the Protocol – emissions trading and climate projects in other countries (Joint Implementation (JI) and the Clean Development Mechanism (CDM)). Under the Kyoto Protocol, it is also possible for countries to count the sequestration of carbon to carbon sinks to some extent.

The flexible mechanisms were centrally important to many countries' ratification of the Protocol and are a key factor in its coming into force.

The Kyoto Protocol has not yet entered into force, but there are hopes that Russia will ratify it thus making the commitments of the Protocol binding. The reduction commitments made by the industrialised countries for the first commitment period of the Kyoto Protocol are far from sufficient, and more effective measures are required in the future. The hope is, however, that the Kyoto Protocol will provide a good basis for further work. Negotia-

tions about commitments for the post–2012 period will begin in 2005. A key part of future climate regimes will continue to be the implementation of measures cost-effectively and in co-operation. It is highly likely that some sort of flexible mechanism that can lead to an evening out of costs and a spread of technology will also be an important component of future international climate co-operation.

International Climate Policy

The IPCC
The UN Climate Panel was formed in 1988. Three assessment reports on the scientific knowledge base of climate change have been produced. They analyse, among other things, stabilisation levels for the emission of greenhouse gases into the atmosphere. From 1000 to 450 ppm to the year 2100. The IPCC is working on a fourth assessment report.

The 1992 Climate Convention
UN Framework Convention on Climate Change. Contains an agreement that the level of greenhouse gases is to be stabilised at a level that stops human impact on the climate system from becoming dangerous. At the end of the decade, the industrialised countries undertook to return to 1990 emission levels.

The 1997 Kyoto Protocol
A large number of the world's industrialised countries committed themselves to reducing their emissions by just over 5 % as an average until 2008–2012. The flexible mechanisms were introduced.

Flexible mechanisms
Give cost-effective measures.

Emission rights trading. Enable parties with reduction commitments under the Protocol to buy and sell emission rights from each other.

Joint implementation[2] Parties with reduction commitments can make investments in other countries and obtain emission credits according to fixed rules.

cont. >>

The Clean Development Mechanism, CDM[2] Countries with reduction commitments can implement projects in countries without reduction commitments and obtain emission credits according to fixed rules. Is to contribute to sustainable development according to the priorities of the host country.

The Marrakech Accord
The countries could agree the principles of a regulatory framework for the project-based mechanisms, interpretation of the supplementarity1 principle and the regulations for sanctions and observance.

The EU Climate Strategy
Under the Kyoto Protocol, the EU has made a joint commitment to reduce greenhouse gas emissions by 8 % from 1990 to 2008–2012. An internal distribution has been done to allocate a burden to each member state. Sweden's commitment is +4 % and is legally binding. The EU's long-term target has been stated as a stabilisation of carbon dioxide levels to 550 ppm. In 2000, the European Climate Change Programme was established with the aim of identifying the most environmentally sound and cost-effective measures within the EU. An important part of the programme was to continue the work of drawing up the framework for the EU trading system for emissions rights.

The Kyoto Protocol comes into force
When at least 55 parties to the Climate Convention have joined the Protocol by ratifying, accepting, approving or adopting the text. At least 55 % of the total 1990 emissions of the Annex 1 countries are also required if the Protocol is to come into force.

Negotiations about future commitments under the Kyoto Protocol
Will commence in 2005. A key aspect of the work is to get all industrialised countries involved in the international co-operation and that more countries make quantified commitments.

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1 Use of the mechanisms is to be supplementary to domestic measures. Domestic measures are thus to make up a significant proportion of the effort made by each party in Annex 1 to meet its reduction commitments.

2 Unlike emission trading between countries, JI and the CDM refer to actual projects.

3.2 Sweden's climate and energy policy decisions

Sweden has applied programmes and measures with the aim of reducing greenhouse gas emissions since *1988, when the issue was first discussed in the Riksdag*. Energy policy decisions with climate-related areas, and several of the policy instruments in the energy policy field, also influence emissions developments.

Sweden's Climate and Energy Policy Decisions

In 1991, the energy policy agreement was expressed in a climate strategy. Sweden should work to ensure that the OECD countries stabilise their emissions at 1990 levels. The same year, Sweden introduced a carbon dioxide tax, one of the first countries in the world to do so.

The 1993 climate policy decision

Expresses the target that carbon dioxide emissions from fossil sources in 2000 are to be stabilised at 1990 levels and thereafter fall. In accordance with the Climate Convention. A programme of measures begins in the Baltic states.

The 2002 climate policy decision

Interim target to 2008–2012

Sweden's emissions of all 6 greenhouse gases as defined in the Kyoto Protocol are to fall by 4 % compared to 1990 levels. The target is to be met without compensation for sequestration to carbon sinks or by using the flexible mechanisms. The Swedish climate work and the national target are to be monitored on an ongoing basis. If emissions trends appear less favourable than predicted, or if the policy instruments adopted do not give the expected effects, the government can propose further measures or, where necessary, propose a revised target. The consequences for Swedish industry and its competitive situation are to be taken into account. Checkpoints were proposed for the years 2004 and 2008.

Long-term climate target

Sweden will work internationally for the orientation of global work towards the target of stabilising greenhouse gas levels at 550 ppm. In 2050, emissions for Sweden should in total be lower than 4.5 tonnes of carbon dioxide equivalents per year and inhabitant, and should thereafter fall further. Whether the target is met is wholly determined by international work and measures in other countries.

cont. >>

2002 års energipolitiska beslutThe 2002 energy policy decision

The goal of energy policy is to secure the supply of electricity and other energy in both the short and long term at prices that are internationally competitive. Energy policy is to create the conditions for efficient use of energy and cost-effective energy supply. At the same time, effects on health, environment and climate are to be low and the adaptation to an ecologically sustainable society is facilitated. An important part of the strategy for reduced climate effects from the energy sector is international climate measures.

3.3 Sweden's national target and international commitment

Sweden has adopted a national climate strategy which includes long-term and short-term targets under the national environmental quality objective Reduced Climate Impact. The short-term target is that greenhouse gas emissions as an average of the period 2008–2012 are not to exceed 96% of 1990 levels. This target is to be achieved without compensation for sequestration to carbon sinks or the use of flexible mechanisms.

Sweden's national target differs from its commitment under the Kyoto Protocol and the EU internal burden-sharing agreement. One stated reason for setting lower emission levels in the national climate strategy was that it would promote long-term structural change and that it is important that investments in trade and industry, the domestic sector and the public sector are made now with insight into the need to reduce greenhouse gas emissions.

One consequence of Sweden's having an emission target that differs from its commitment in the EU and under the Kyoto Protocol is that Sweden may come to hold a surplus of emissions allowances in the form of AAUs[11]. In its climate policy decision, the government stated that Sweden will assert its right to save the difference between the level of the national target and the international commitment for future use. It should be pointed out however that it is not certain that Sweden can save surplus units, since these may be needed if the EU is to meet its joint commitment under the Kyoto Protocol. There are also a number of regulations about how long they can be saved. See further in Chapter 9.

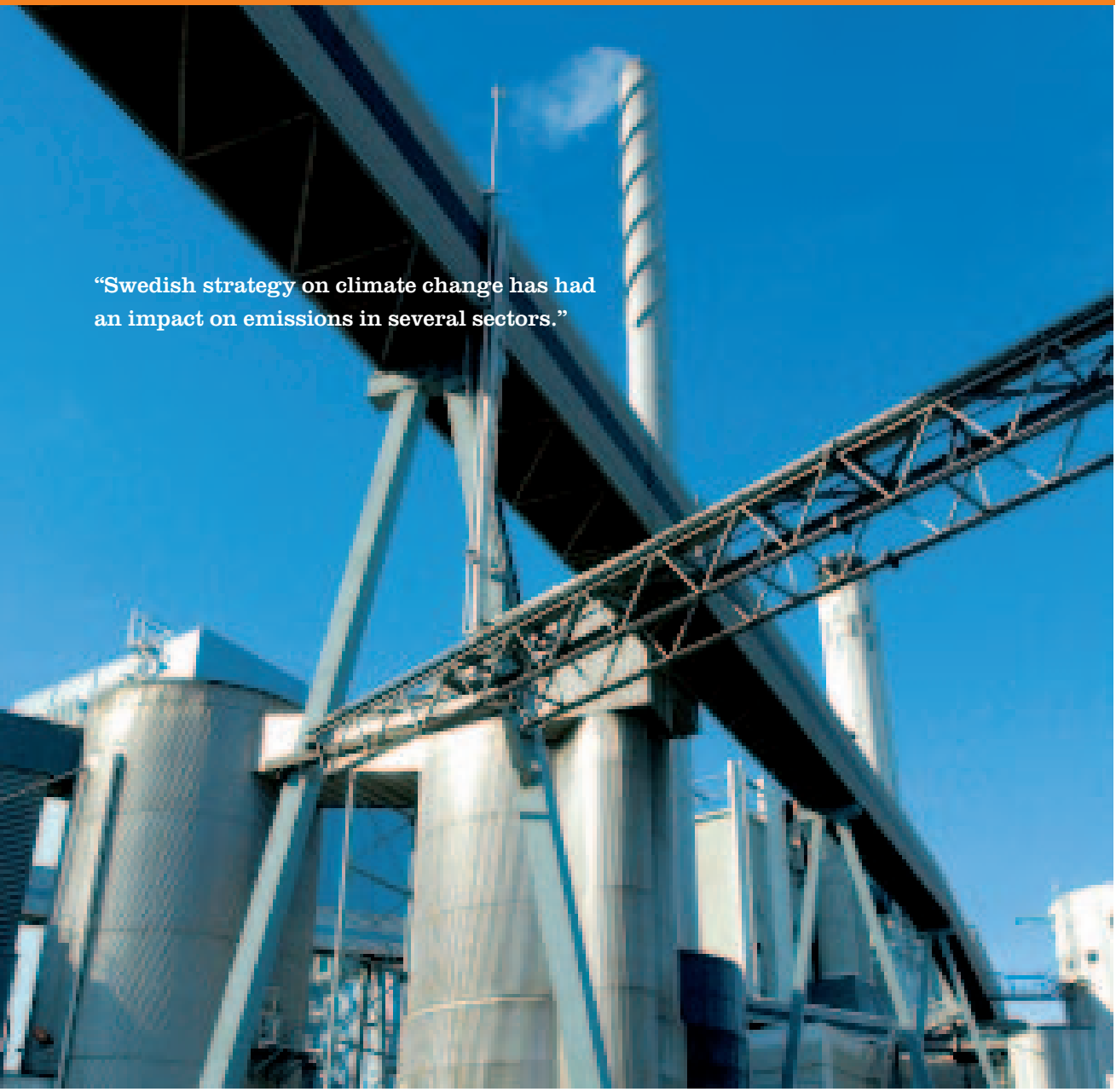
11) Allocated to each country under the Kyoto Protocol at levels corresponding to the country's permitted emissions for the current commitment period.

3.4 Sweden's climate strategy after 2008–2012

It is important that climate work is characterised by long-term thinking. Today, Sweden has a short-term target until 2008–2012 and a long-term one to 2050. The long-term target for 2050 is that total emissions for Sweden should be less than 4.5 tonnes of carbon dioxide equivalents per year and inhabitant, and will thereafter fall further. The 2050 target presupposes international collaboration. The target assumes that steps are taken in every country if stabilisation of greenhouse gas levels at a level less than 550 ppm of carbon dioxide equivalents is to be achieved in the long term. The international commitment applies until 2008–2012 but under the terms of the Kyoto Protocol, negotiations about the second commitment period, i.e. the period after 2012, are to begin no later than seven years before the end of the first commitment period, which is to say in 2005.

Sweden's climate strategy could be supplemented with a medium-term target. The link between the national ambition level and the new commitments that Sweden may undertake as a party to the Climate Convention should then be made clear, as should the means by which the target is to interact with future flexible mechanisms and other international policy instruments that may be developed, e.g. within the EU.

That Sweden's level of ambition agrees with, and is channelled into, our international commitment also has another dimension, namely how Sweden can best inspire and influence others. The occasion on which Sweden has the greatest chance of influencing other countries is during the negotiations of future international emission commitments. This opportunity is not as open to us once the negotiation round has been completed.


“Swedish strategy on climate change has had
an impact on emissions in several sectors.”

4 Greenhouse Gas Emissions

4.1 Developments internationally and in the EU

The industrialised countries and the economies in transition – the "Annex 1" countries of the Kyoto Protocol – reduced their greenhouse gas emissions somewhat in the 1990–2000 period. The reduction was largely due to the economic downturn in the EIT countries. There are great variations in emission trends between countries however. The USA, whose emissions make up about 25 % of the total global greenhouse gas emissions, lay about 12 % above its 1990 emission levels in 2000. Sweden's emissions in that year were equivalent to 0.2 % of total global emissions and were about 6 % under 1990 levels.

Total emissions from the EU member states (EU15) were just over 2 % lower in 2001 than in 1990, largely as a result of large reductions in emissions in Germany (conversion of the energy system in east Germany) and the United Kingdom (transition from coal to gas in the electricity system) and because emissions of other greenhouse gases, primarily methane and nitrous oxide, have fallen generally in the EU. Emission trends for the various subsectors in Sweden are similar to those in the EU, with some exceptions. Emissions from the transport sector increased by 20 % as an average of the EU15 during the period while the increase in Sweden to 2001 was 8 %. One explanation might be that growth in GDP was lower in Sweden than the EU average. Emissions from the domestic and service sectors increased somewhat between 1990 and 2001 at EU level, while these emissions fell heavily in Sweden.

The emissions of the United Kingdom and Germany together make up about 40 % of total EU emissions, so developments in these countries are of particular importance. The figures below show developments in the 1990–2000 period in a selection of Annex 1 countries. Information has been taken from the countries' most recent national reports to the Climate Convention.

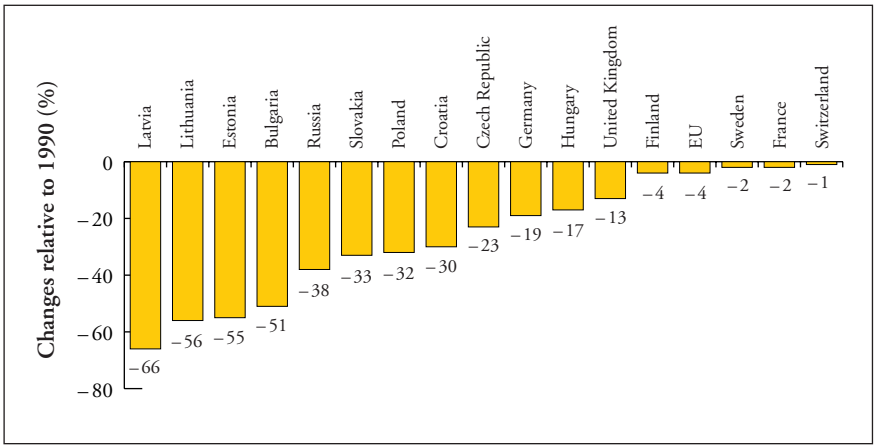


Figure 6 Annex 1 countries that had reduced their emissions in 2000 compared to 1990 levels.

Note: The figure for Sweden has been revised and is now –6 %.

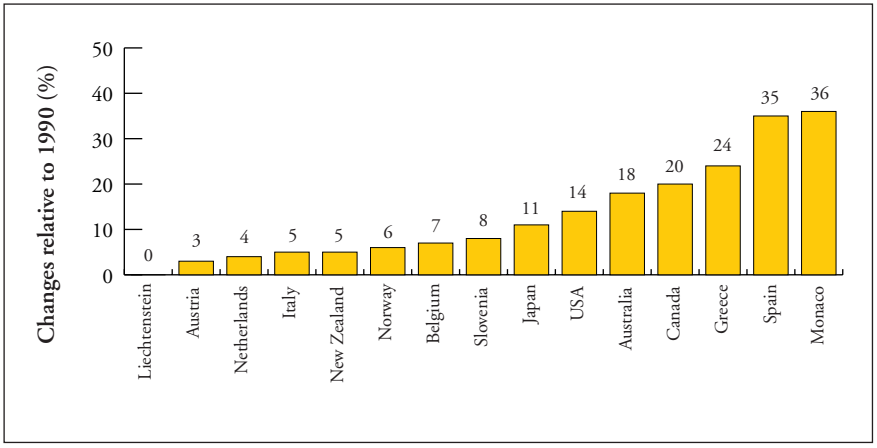


Figure 7 Annex 1 countries that had increased their emissions in 2000 compared to 1990 levels.

4.2 Emissions in Sweden – what do the statistics tell us?

4.2.1 Greenhouse gas emissions

Carbon dioxide emissions began to increase in Sweden around the beginning of the last century. Two periods of very substantial reductions in emissions occurred during the first and second world wars. After WWII, emissions increased from 5 million tonnes in 1945 to about 100 million tonnes in 1970. Emissions fell in the 1970–1990 period by about 30 % as a result of energy policy measures applied to reduce dependency on oil. This development was primarily caused by the transition from oil to electricity as nuclear power and hydroelectric power stations were built.

In the 1990–2002 period, emissions of greenhouse gases have varied between a low of approx. 67.5 million tonnes (2000) and a high of 77.2 million tonnes (1996). The differences are largely due to variations in temperature (heating requirement) between the different years, and to availability of hydroelectric power in the Nordic energy system. In 1990, which is the baseline year for the country's commitment under the Kyoto Protocol and the national interim target, emissions were around 71 million tonnes. In the past few years, 1999–2002, total greenhouse gas emissions have remained under 1990 levels. See Figure 8 below.

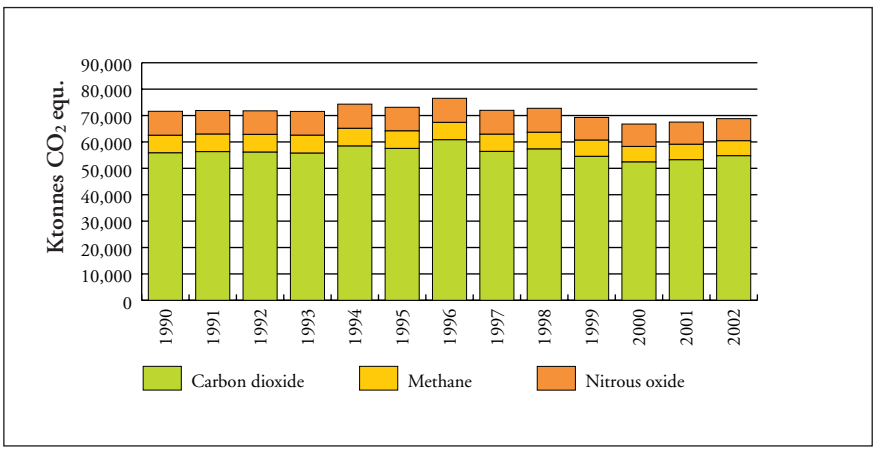


Figure 8. Emissions of various greenhouse gases, 1990–2002 (in kilotonnes carbon dioxide equivalents)

Emissions in 2002 were 69.6 million tonnes which is about 3.5 % under 1990 levels. Carbon dioxide constituted about 80 % of total emissions, calculated in carbon dioxide equivalents, while emissions of methane were around 8 %, nitrous oxide around 12 % and fluorinated greenhouse gases about 1 %, see pie chart below. Compared to 1990, emissions of methane and nitrous oxide have fallen by 8 % each while total carbon dioxide emissions were about 2 % lower in 2002.

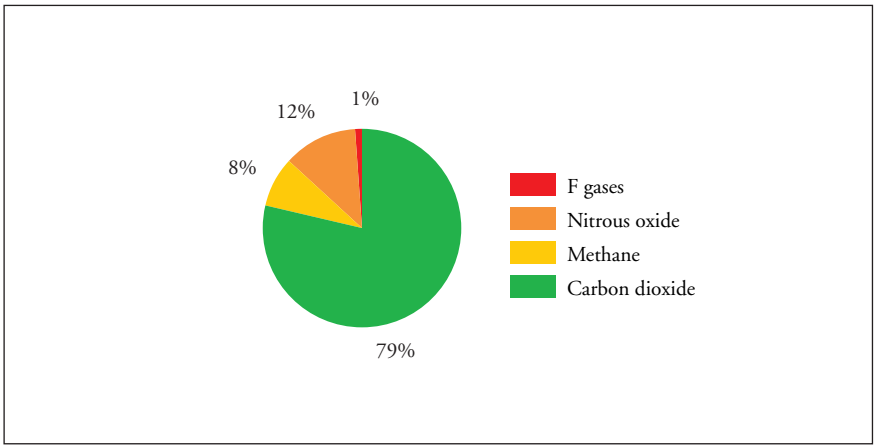


Figure 9 Emissions in 2002 by greenhouse gas

Emissions can be compared to economic developments in Sweden during the same period. Growth in GDP was on average 1.8 % per year in 1990–2002. GDP fell in the early 1990s but since 1994 has increased by an average of 3 % per year. *Total* emissions of greenhouse gases thus did not increase as a result of growth in Sweden between 1990 and 2002. Greenhouse gas emissions from various subsectors in society have however shown varying development, as shown in the diagram below.

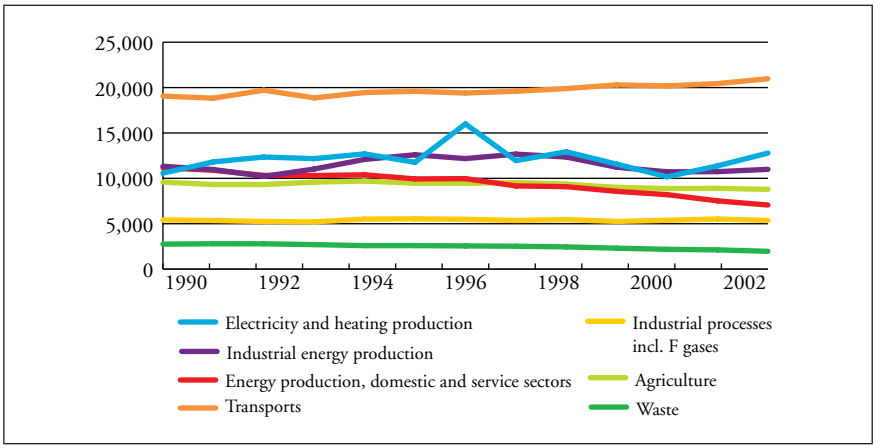


Figure 10 Emissions of greenhouse gases by various subsectors, 1990–2002.

Emissions from *electricity and heating production* vary from year to year depending on factors such as water availability and temperature. This is most clearly seen in the emissions from1996, which was an unusually cold and dry year[12]. During this period, production of primarily district heating has climbed steeply from 41 to 55 TWh. Emissions from this sector have still not increased significantly because the use of oil and coal has fallen while the burning of biofuels and waste has climbed steeply.

Emissions from *industrial energy production and industrial processes* vary between years with the economic situation, but also because of other factors such as price relationships between various types of energy (electricity and oil for example) and the ongoing structural change in trade and industry. Emissions primarily come from a few large energy-intensive sectors, so developments for these particular sectors greatly affect the overall picture.

Emissions from the *domestic and service sectors* have shown a steady decline throughout the period. Emissions in 2002 were 37 % lower than 1990 emissions. The fall is largely due to a widespread transition from small oil-burning boilers to district heating but also to heat pumps and small-scale biofuel use.

12) In recent years, the use of reserve power production in electricity shortfalls fell in the country compared to the 1996 situation. Import of electricity has instead increased during such periods.

Emissions from the *transport sector* have increased by about 10 % since 1990. Road traffic emissions of carbon dioxide dominate. The increase is due to an increase in transport kilometres, primarily for heavy goods transports, which in turn is due to trends in trade and industry towards greater exchange of goods, centralised and specialised production etc. Road transport's share of total goods transport kilometres has shown a total increase in this period. Emissions from air and rail transport fell marginally in the period.

Agricultural emissions fell by about 8 % between 1990 and 2002. The reduced methane emissions are because of less livestock keeping while the fall in nitrous oxide is primarily due to the lower use of both commercial fertiliser and natural fertiliser.

Emissions from waste landfills have fallen by 29 % during the same period as a result of the collection of landfill gas and the reduced deposit of organic material in landfills.

4.2.2 Emissions of other air pollutants

When measures are implemented to reduce greenhouse gas emissions, other emissions can also be affected. These gases also have indirect impact on the climate. Nitrogen oxides (NO_x) and volatile organic compounds (NMVOC) influence the production of ozone, which in turn influences the greenhouse effect, while sulphur dioxide (SO_2) gives rise to airborne particles that can temporarily counteract the temperature-raising impact of greenhouse gases.

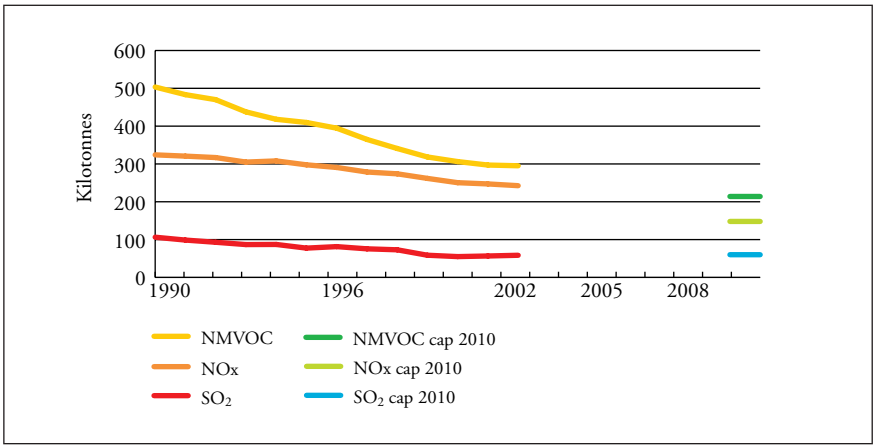


Figure 11: Emissions of nitrogen oxides (NOx), sulphur dioxide (SO2) and volatile organic substances (NMVOC), 1990–2002

Emissions of *nitrogen oxides* have fallen by 25 % since 1990. Traffic and mobile machinery are the largest sources of these emissions. The introduction of catalytic converters in passenger cars and the subsequent successively tougher exhaust standards have contributed to a reduction in emissions. The extension of district heating and the fees levied on NO_x in the early 1990s have also led to heavy reductions in nitrogen oxide emissions from the energy sector.

Sulphur dioxide emissions come from the energy, transport and industrial sectors and have fallen by 45 % compared to 1990. Emissions were already low in Sweden in 1990.

Emissions of *volatile organic substances* fell 41 % between 2002 and 1990. Road traffic and wood burning in households are the main sources of emissions while mobile machinery, some industrial activities and the use of solvents are also significant.

“The new forecast indicates that emissions up to 2010 will increase in comparison with recent years, but will nevertheless be slightly below 1990 levels.”

5 Forecasts

5.1 Forecasts for emissions internationally and in the EU

Total greenhouse gas emissions from the Annex 1 countries are expected to increase by 10 % during the 1990–2010 period. Variations between countries are significant. According to the forecast, emission increases are expected in most countries compared to today's levels. The information has been taken from the countries' most recent national reports to the UNFCCC.

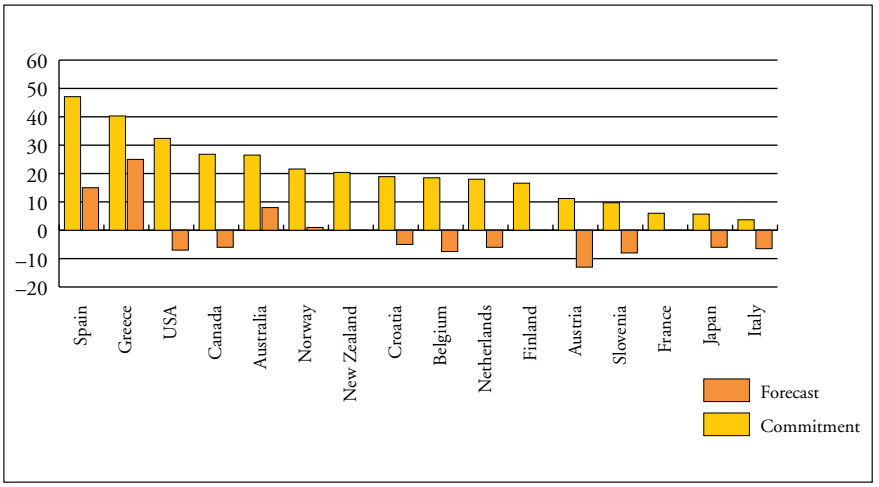


Figure 12 Forecasts for 2010 and Kyoto commitments for some Annex 1 countries.

Note: From the countries' most recent reports to the Climate Convention, 2001.

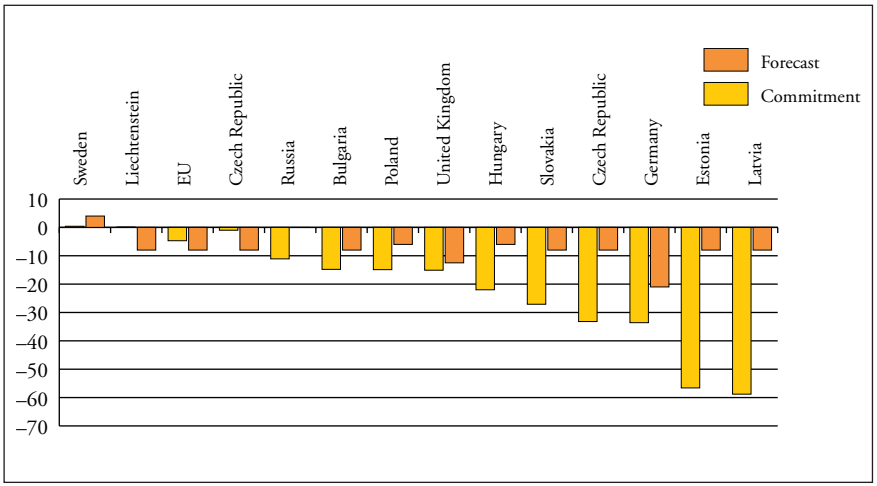


Figure 13 Forecasts for 2010 and Kyoto commitments for some Annex 1 countries.

Note: From the countries' most recent reports to the Climate Convention, 2001.

In the EU (EU15), only Sweden, the United Kingdom and Germany are expected in the 2001 forecasts to meet their commitments using policies within the country under the EU burden-sharing agreement. According to the EEA 2003 report, Germany will not meet its commitment under the burden-sharing agreement by 2010 using only policies within the country.

5.2 Forecasts for emissions in Sweden

A new forecast has been produced for greenhouse gas emissions in 2010 and 2020. The forecast includes a main alternative and four sensitivity alternatives. The sensitivity alternatives above all operate on emissions of carbon dioxide from the energy system. A combination of expert assessments and model calculations has been used in the work.

The forecast is based on currently applying climate and energy policy decisions. The fact box below summarises the various alternative forecasts and some of the most important basic assumptions.

Assumptions in the baseline forecast

- Nuclear power shut down after 40 years' operational lifetime.
- Barsebäck 2 nuclear power reactor closed before 2010.
- EU ETS included by assuming a price for emissions allowances of 10 euros per tonne CO_2.
- CO_2 tax retained in the trading sector.
- Otherwise, we assume current taxes and other policy instruments, the IEA's assessment concerning the development of fossil fuel prices, the Energy Agency's assessment of the development of biofuel prices and the National Institute of Economic Research's assessments of economic growth.
- For the 2010-2020 period, we assume that the quota for the electricity certificate system is retained at the level decided for 2010. The same method applies to the price assumed for emission allowances in the EU ETS, i.e. 10 euros per tonne

	1990–2000	2000–2010	2010–2020
GDP	1.9%/yr	1.7%/yr	1.8%/yr
Private consumption	1.5%/yr	2.6%/yr	2.6%/yr
Industry's production value	4.4%/yr	2.6%/yr	3.3%/yr

	2000	2010	2020
Crude oil, USD/barrel	28	21	25
Coal, USD/tonne at harbour	35	39	41
Natural gas USD/Mbtu	3.0	2.8	3.3

Sensitivity alternatives:

1. No CO_2 tax in the trading sector.
2. Higher GDP
3. Nuclear power shut down after 32 years
4. Nuclear power shut down after 60 years.

- An emissions allowances price of 10 euros per tonne applies in all sensitivity alternatives. A separate analysis studies the effects of various prices of emissions allowances, and their effects on the Swedish energy system and on growth.

It is important to remember that the forecast is a result of many different assumptions and assessments, each one of which has some degree of uncertainty. The results should therefore be interpreted with this in mind.

5.2.1 Overall results

Baseline forecast

The table below shows the result of the baseline forecast distributed over a number of subsectors.

Table 1 Forecast emissions of greenhouse gases to 2010 and 2020 for the baseline forecast (thousand tonnes CO_2 equivalents)

	1990	2000	2010	1990 –2010	2020	1990 –2020
Energy*	53,983	50,756	55,985	3.7%	61,352	13.7%
of which refineries	2,132	2,599	3,499	64%	3,561	67 %
of which transports	19,241	20,129	22,731	18%	25,143	31%
Industrial Processes**	5,826	5,689	6,184	6.1%	6,405	9.9%
Agriculture	9,581	8,876	8,090	–15.6%	8,090	–15.6%
Waste	2,749	2,181	966	–64.9%	407	–85.2%
Total Emissions	**72,139**	**67,502**	**71,225**	**–1.3%**	**76,254**	**5.7%**

** Energy includes production of electricity and heating, industrial burning, domestic and services, refineries and transports.*

*** Industrial processes include process emissions, fluorinated greenhouse gases and solvent use.*

Total greenhouse gas emissions have varied in the 1990–2002 period but emissions in the past four years have been lower than the level of the baseline forecast by an average of about 5 %. The new baseline forecast points to an increase in emissions to 2010 compared to the levels of recent years but that emissions in 2010 will still be at levels under those of 1990.

Sweden will meet its EU burden-sharing commitment to the Kyoto Protocol by a good margin in the forecast. Compared to the national emissions target of emissions 4 % lower than in 1990, however, emissions in the baseline forecast are just under 2 million tonnes of carbon dioxide equivalents too high. Emissions will increase at a greater pace after 2010. This is primarily based on the assumption that the Swedish nuclear power plants will be closed after 40 years' lifetime and will then partly be replaced by natural gas.

Developments in the transport sector for heavy road transports also have bearing on the results. Counterbalancing factors are above all the forecast reduction in emissions in the domestic and service sectors and the forecasts for emissions from the agricultural and waste sectors.

Carbon dioxide, the most important greenhouse gas, was in 2002 responsible for 80 % of total greenhouse gas emissions in Sweden. Emissions of this greenhouse gas increase most in the forecast. The table below shows the forecast trend for carbon dioxide by sector. In the baseline forecast, these emissions are expected to increase by 4 % to 2010 and 14 % to 2020 compared to 1990 levels. It is thus the reduced emission of other greenhouse gases, primarily methane and nitrous oxide, that significantly slows the pace of emissions increase, as the table below shows.

Table 2 Emissions of carbon dioxide by sector (thousand tonnes)

	1990	2001	2010	2020
Industrial burning	11,090	10,453	11,868	12,047
Transport	18,302	19,506	21,717	23,975
Electrical and district heating	7,663	8,077	10,077	13,999
Other heating (domestic and service)	10,512	6,924	4,426	3,065
Other energy	1,813	1,350	1,656	1,970
Petroleum refineries	2,133	2,548	3,499	3,561
Industrial processes	4,012	4,192	4,605	4,767
TOTAL CO_2	**55,526**	**53,050**	**57,678**	**63,067**

Table 3 Forecast greenhouse gas emissions to 2010 and 2020, per greenhouse gas

Greenhouse gas/year (mill. tonnes CO_2e)	1990	2000	2010	1990 –2010	2020	1990 –2020
Carbon dioxide	56	53	58	4%	63	14%
Methane	7	5	4	–34%	4	–44%
Nitrous oxide	9	8	8	–7%	9	–4%
Fluorinated greenhouse gases	1	1	1	49%	1	60%
Total Emissions	**72**	**67**	**71**		**76**	

Note: The table above contains rounding errors

5.2.2 Results at subsector level

The diagram below shows the results of the baseline forecast by subsector.

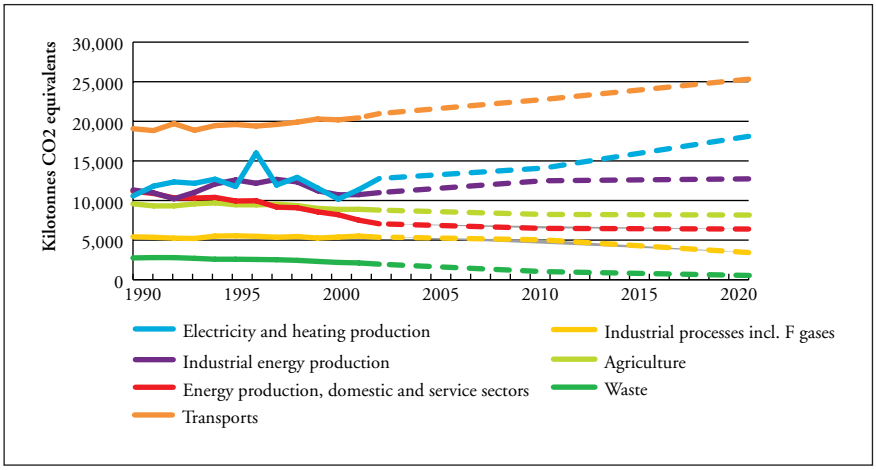


Figure 14 Emissions of greenhouse gases by sector, actual emissions and forecast.

Electricity and heat production

Emissions from the production of electricity and heating including refineries increases compared to developments in the 1990s. Looking at the 2000–2010 period, the increased emissions of carbon dioxide are primarily due to an increase in electricity and heating production from natural-gas based combined heating and power plants and partly to an increased use of waste in district heating production. In the 2000–2010 period, extra production of electricity consists of biofuels and natural gas-based heating and power, and wind power. According to the forecast, Sweden will export about 3 TWh of electricity in 2010. The increased carbon dioxide emissions of the later period are largely a result of increased use of natural gas in combined heating and power plants and condensing power plants. For the 2010–2020 period, the electricity production of nuclear power plants is expected to fall by about 20 TWh (assumed 40-year lifetime). At the same time, the demand for electricity is assumed to rise, making new production capacity necessary. This new production capacity consists primarily of electricity production from natural gas condensing, natural gas heating and power, and wind power. A net import of just over 2 TWh is expected for 2020.

Industrial energy use
Emissions from this sector are expected in the forecast to increase somewhat up to 2010 and stabilise during the 2010–2020 period. The stabilisation of emissions in the latter period is explained by the increasing use of natural gas at the expense of oil use. Industrial energy use is expected to increase by approx. 17 TWh during the 2000–2010 period., For the 2010–2020 period, energy use is expected to continue to increase, but at a somewhat slower pace because of a somewhat lower rate of growth in energy-intensive industry. Electricity use increases throughout the period. The increase in energy use in the industrial sector is larger in the 2000–2010 period than in the 2010–2020 period. This is because production growth in electricity-intensive industry is assumed to be lower during the later period and that the higher price of electricity has negative effects on some activities.

Energy use in the domestic and service sectors etc.
Overall, the forecast shows a heavy reduction in emissions from the sector, but the pace of reduction slows somewhat compared to developments in 1990–2000 (emissions from the sector fell by 37 % in 1990–2002). Total energy use is expected to fall in the sector by about 7 TWh from 2000 to 2020. The main fall is in oil use, which falls by 60 and 80 % to 2010 and 2020 respectively, compared to 1990 levels. The reduced use of oil is compensated by, among other things, district heating which means reduced conversion losses. Over and above this, the reduction is primarily due to the more efficient use of energy for heating and hot water, and that the use of heat pumps increases. Electricity use is expected to increase during the period. Use of household electricity to run various electrical appliances and operating electricity in commercial premises contributes to the increase.

Transports
Emissions from the transport sector increase in the prognosis at a higher rate than before throughout the whole forecast period, 2000–2020. The increase is largely due to increased diesel use. Developments are very hard to assess however. Petrol use is expected to rise slightly during the period up to 2010 because of assumptions about the introduction of cars with better fuel economy, increased use of biofuels – primarily ethanol mixed into petrol at low proportions – and a transition to diesel for light trucks. The increase in diesel use is explained by a high rate of increase in goods transports using heavy

vehicles, which is based on assumptions about the rate of growth of industry in the transport-intensive sectors. The IEA forecast that oil prices will only increase slightly by 2020 also affects results. Cautious assumptions are also made about the introduction of renewable fuels during the 2010–2020 period.

Industrial processes and flourinated greenhouse gases
In the forecast, total emissions will increase by 6% to 2010 and 9% to 2020 compared with 1990 levels. It is primarily carbon dioxide emissions from certain industrial processes that are expected to increase while emissions of other greenhouse gases are expected to fall or be stabilised. An EU directive regulating the emission of fluorinated greenhouse gases from some central areas of use is expected to be adopted shortly. If the regulations are adopted largely in accordance with the Commission's original proposal, this is expected to lead to a reduction of flourinated greenhouse gases by 2020 compared to 1990 levels, and only a weak increase until 2010[13)].

Agriculture
Emissions from the agricultural sector are expected to continue to fall to 2010. The reduction is primarily due to the changes in livestock farming that are expected to take place because of the EU's CAP, and which will probably be reinforced by the most recent agriculture decision (MTR[14)]). The forecast is largely based on the effects of the structural changes taking place in agriculture, and to a lesser degree on direct measures to reduce greenhouse gas emissions. The consequences of the MTR have been taken into account in the forecast, but the actual effects of the government's proposals for national application of the MTR are still very hard to assess.

13) This effect has however not been included in the baseline forecast since the regulation has not yet been adopted.
14) Mid Term Review. The EU's mid-term review of agricultural policy.

Waste

The release of methane from waste landfills is expected to fall heavily, by 65 % and 85 % to 2010 and 2020 respectively, as a result of the implementation of decisions banning landfill deposit of combustible and organic waste. Developments assume that deposit is replaced by new treatment capacity in the form of waste burning and material recycling. Emissions from landfills have, according to current emissions statistics, already been reduced by just under 30 % compared to 1990 levels.

Reductions in the waste and agricultural sectors are assessed to be so large overall by 2010 in the forecast that other emissions need only be stabilised compared to 1990 levels for an overall reduction of emissions of 4 % to be achieved.

5.2.3 Comparison with the forecast in the third national report

The forecast in the third national report (NC3) had higher emissions in both 2010 and 2020 compared to the new forecast. It is the forecast for the emissions trend for the domestic and service sectors that differs most, but the forecast for emissions from industrial processes and energy production, as well as the agricultural forecast, are lower than the NC3. The forecast for electricity and heating supply and refineries is considerably higher this time compared to NC3. The new transport forecast is also higher.

5.2.4 Results for trading and non-trading sectors

An important policy instrument to limit carbon dioxide emissions is the new EU emissions trading scheme, EU ETS, see in more detail in Chapter 7. The total allocation of emissions allowances to the plants covered by the EU scheme will largely control how much other sectors must reduce their emissions so that the targets set for 2010 for reduced climate impact are to be reached overall. This applies both at EU level and in Sweden.

Trading sectors

Covers from 2005 the emission of carbon dioxide from power and heating plants, oil refineries, plants that produce and process iron, steel, glass and fibreglass, cement and ceramics, and plants that produce paper and pulp. More gases and more sectors may be covered by the system after 2008.

Non-trading sectors

Covers other emissions of greenhouse gases (methane, nitrous oxide and the industrial gases HFC, PFC and SF6). Also covers emissions of carbon dioxide from small-scale burning in the domestic sector, the transport sector and other trade and industry.

Table 4 shows estimated size of carbon dioxide emissions from plants in the trading sector in 2010 in Sweden in the baseline forecast, with an emission price of 10 euros/tonne and with current levels of carbon dioxide and energy tax.

Results show that emissions in Sweden for the trading sector increase by 2010 and are 25 % higher than 1990 emissions. The greatest increase, in percent, comes from refineries but the greatest quantitative increase in levels is in emissions from electricity and district heating plants. Emissions in the non-trading sectors are expected to fall in the same period by an average of 12 % in spite of the fact that emissions from the transport sector are expected to rise. So it is the other non-trading sectors, such as domestic and commercial premises and the agricultural and waste sectors that are expected to contribute large reductions in emissions in the forecast.

By 2020, the electricity and district heating sectors are expected to increase their emissions in Sweden to a level that is 80 % higher than 1990 emissions (see Table 2) and the trading sector overall by 47 %. It is mainly an extension of natural gas-based electricity and heating production which will become financially viable with current policy instruments and the assumed emissions price.

Table 4 Emissions historically and forecast until 2010 and 2020 distributed over trading and non-trading sectors (million tonnes carbon dioxide equivalents).

	Emissions 1990*	Emissions 2000	Forecast 2010	1990 –2010	Forecast 2020	1990 –2020
Trading sectors	21.1	20.6	26.5	+25%	30.9	+47%
Transports	19.2	20.1	22.7	+18%	25.1	+31%
Miscellaneous	31.8	27.1	22.0	–31%	20.2	–36%
Total, non-trading sectors	51.1	47.3	44.7	–12%	45.3	–11%
Total Emissions	**72.1**	**67.5**	**71.2**	**–1.3%**	**76.3**	**+5.7%**

** No careful allocation to non-trading and trading sectors exists for 1990. An estimate of what proportion of emissions are from the trading and non-trading sectors is based on 2000 proportions.*

5.2.5 The sensitivity alternatives

The table below summarises the results of the four sensitivity alternatives.

Table 5 Greenhouse gas emissions for the various sensitivity alternatives (thousand tonnes CO_2 equivalents)

Total Emissions	1990	2000	2010	1990 –2010	2020	1990 –2020
Baseline forecast	72,139	67,502	71,225	–1.3%	76,254	5.7%
Without CO_2 tax	72,139	67,502	72,292	0.2%	80,923	12.2%
Nuclear power 32 yrs	72,139	67,502	72,226	0.2%	82,877	15%
Nuclear power 60 yrs	72,139	67,502	71,179	–1.3%	72,814	0.9%
Higher GDP	72,139	67,502	73,752	2.2%	81,890	13.5%

The baseline forecast assumes that carbon dioxide tax is retained in the trading sector. The sensitivity alternative in which this tax is abolished points to an increase in emissions of about 1 million tonnes to 2010 compared to the baseline forecast to roughly 1990 levels. The difference is expected to be larger by 2020 when emissions are about 5 million tonnes higher in the alternative without carbon dioxide tax compared to the baseline alternative.

If the lifetime of the remaining nuclear power plants is assumed to be 60 years, then the increase in emissions between 1990 and 2020 is estimated at less than 1%. If instead all nuclear power plants are assumed to close during the period up to 2020, which will be the case if a lifetime of 32 years is assumed, then emissions increase so that they are 1.5 percentage points above the baseline forecast in 2010 and 9 percentage points above it in 2020. In the

alternative with higher GDP growth, from an average of 1.8 % per year to 2.3 % per year, emissions increase steeply to both 2010 and 2020 compared to the baseline alternative.

The result of all forecast alternatives can also be studied in the diagram below:

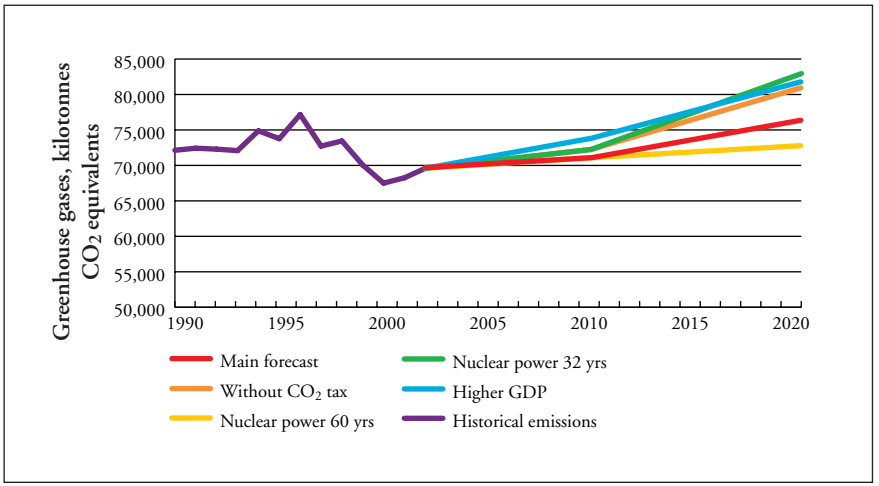


Figure 15 Result of all forecast alternatives


“The Swedish strategy includes taxes, subsidies, regulations, information and various market-based trading schemes.”

6 Policy instruments in Climate Policy

6.1 Background

Achieving reduced emissions of greenhouse gases requires the implementation of a number of different measures, both technical measures and behavioural change, see diagram below. Various policy instruments can be used to achieve this. Policy instruments are those instruments that achieve, or contribute to, a certain readjustment.

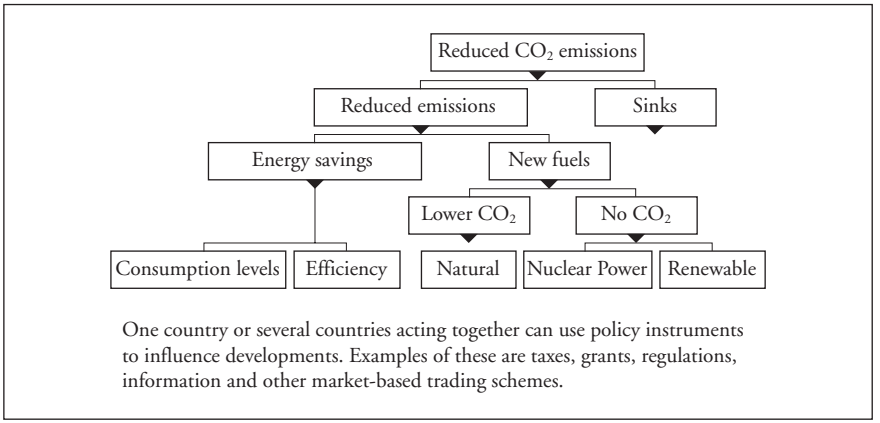


Figure 16 Ways to reduce carbon dioxide emissions from energy supply and useage

The box below shows the policy instruments used today in Sweden that are of importance in greenhouse gas emissions. It is followed by a compilation of legal framework at EU level that is relevant to climate work. As a member of the European Union, Sweden participates in the development and implementation of the EU body of regulation and strategies that aim to directly or indirectly reduce greenhouse gas emissions.

Policy Instruments in Use – National

Intersectoral

Energy and carbon dioxide tax including petrol and diesel tax

Today's energy tax system is based on a combination of carbon dioxide taxes, energy taxes on fuel, capacity tax on nuclear power, and consumer taxes on electricity. Carbon dioxide tax was introduced in 1991 and today is SEK 0.91/kg. A reduced tax level applies to parts of trade and industry and the production of heating and power.

The Environmental Code

All overarching legislation in the environment field has been gathered in an Environmental Code since 1 January 1999.

Implementation of the EU trading system

See further, fact box on relevant EU directives.

LIP/Klimp – local investment programmes

LIP was adopted in 1997 and means that Swedish municipalities could apply for government grants to local investment programmes to improve the environment and create employment (SEK 6.2 billion). Support to local climate investment programmes has been available since 202 (SEK 1,040 million). Examples of measures that have been awarded grants: energy savings in property, use of waste heating, extension of district heating, recovery of methane for heating or fuels.

Information

Climate information campaign.

Energy (including domestic sector)

Grants for energy production from renewable energy sources (being phased out)

Investment support to electrical production from biomass, wind power and hydroelectric power and an environmental bonus for electricity produced from wind power. The environmental bonus for electricity is to be phased out to the year 2010.

Electricity certificate system.

Replaces previous grants and began in 2003. Obligatory for users of electricity to buy a certain number of certificates in relation to their electricity consumption. The target is an increase of electricity from renewable energy sources of 10 TWh to 2010.

cont. >>

Programme for energy efficiency
Long-term contracts with energy-intensive industry. Energy-intensive companies undertake to carry out an energy analysis, introduce energy management systems and implement energy efficiency measures that influence electricity use. In return, the government will offer tax relief from the EU minimum electricity tax.

More efficient energy use
Information and training, grants for procurement of energy-efficient technology, testing, labelling and certification and grants to municipal energy advisory services.

Building regulations
Requirements concerning the energy efficiency of buildings and permitted loss of heat are set out in the National Board of Building's Building Regulations and General Recommendations. Energy performance requirements only apply to new construction.

Transport
Tax reduction biofuels
Five-year exemption from tax to 2008 for biofuels.

Fuel tax
Vehicle fuels for road transports are subject to energy tax and carbon dioxide tax. Apart from fuel taxes, cars are liable to an annual vehicle tax and a road user charge is levied on trucks with a total weight exceeding 12 tonnes that run in international traffic.

Automotive industry's voluntary commitment
See EU policy instruments.

Waste
Banning of landfill deposit
In 2002, the landfill deposit of combustible waste was banned. A ban on the deposit of organic waste will be introduced in 2005.

Research/development
Research and development are not a policy instrument that affects emissions in the short term, but can in a long-term perspective be seen as a way of guiding developments in the required direction. Examples of research areas are renewable energy and energy efficiency.

Policy Instruments in the EU – EU Directives
with direct or indirect impact on greenhouse gas emissions

Overarching policy instruments

EU emissions rights trading system

Begins in 2005. Covers the emission of carbon dioxide from combined heating and power plants, oil refineries, plants that produce and process iron, steel, glass and fibreglass, lime, cement and ceramics and plants that produce paper and pulp. The first trading period is between 2005 and 2007. Emission rights are allocated free according to a number of established criteria.

Directives that link project-based flexible mechanisms to the EU emission rights trading system

Companies covered by the EU trading system are allowed to use their credits from projects to fulfil their obligations under the trading system.

The IPCC Directive

Co-ordinated measures to prevent and limit pollution. The Commission is to be responsible for an exchange of information on BAT (Best Available Technology) for those sectors covered by the Directive.

Energy

Directive on the promotion of electricity production from renewable sources

Contains an indicative target (non-compulsory) about increasing the proportion of electricity production from renewable sources to 22.1%. The member states are to take the steps necessary to achieve the target and implementation is to be assessed in 2005.

The Energy Tax Directive

The member states are directed not to have energy taxes below a set minimum for fossil fuels, motor fuels and electricity. The Directive sets out conditions for reduction of energy taxes.

Directive to promote co-production of electricity and heating

The motives are increased energy efficiency and security of supply by increased diversification of production. It is proposed that it is to be obligatory to set national potentials for combined heating and power production and that the countries are to evaluate current legislation with the aim of reducing barriers for combined heating and power production.

Directive on deregulation of the energy market
The market for gas and electricity is to be fully opened to all industrial customers in 2004, and to all domestic customers in 2007.

Energy efficiency

Directive on the energy performance of buildings
Entered into force in 2002. The aim is to increase information about cost-effective energy saving measures for buildings. The Directive is a framework directive, within which the member states set minimum requirements for example energy performance, energy declarations and inspections or advice about boilers. The directive is to be implemented by the end of 2005, with some exceptions.

Framework directive on energy labelling of household products
The Directive states what products are to be labelled and regulations about how the labelling is to be determined.

Directive on ecodesign of energy-consuming products
Is to contribute to integrating the lifecycle perspective into product design. Does not involve any new legal obligations for producers, but is instead a framework for the harmonisation of ecodesign requirements. In the first hand, the Directive is to act as an incentive to industry to conclude voluntary agreements about ecodesign. The Council of Ministers has agreed on the proposed Directive and it can come into force once it has been approved by Parliament.

The energy services directive
The aim of the Commission proposal is to promote energy efficiency measures and to improve the market for energy services. The proposal contains a general energy saving target of 1% per year, a special target for the public sectors of the member states and an undertaking for energy distributors and energy suppliers to provide energy services.

cont. >>

Transport

Directive to promote biofuels in the transport sector

Gives a target that at least 2 % of total fuel sales on 31 December 2005 are to be biofuel. In 2010, the total proportion of biofuel will be 5.75 % of fuel sold.

Voluntary commitment by the automotive industry

In 1996, the EU environment ministers adopted a strategy to reduce emissions of carbon dioxide from passenger cars. The target is that the carbon dioxide emissions of passenger cars hare to have fallen by an average of 210 g/km no later than 2010. An agreement has been concluded with the European automotive industry's organisation ACEA. Similar agreements have also been concluded with the Japanese and Korean automotive industry organisations, JAMA and KAMA.

Trade and Industry

Regulation on emission of fluorinated greenhouse gases

The proposal was adopted by the Commission in 2003. The proposal is currently being negotiated by the Council and Parliament.

6.2 Policy instruments in the Swedish climate strategy

The assignment includes evaluating existing policy instruments, and the focus is on those policy instruments that have had direct importance for greenhouse gas emissions. The Swedish strategy includes taxes, grants, regulations, information and various market-based trading schemes. Our review has also shown that the policy instruments introduced in the waste and agricultural policy sectors influence developments. We have however not evaluated these here.

On the basis of our own work and after a review of the policy instrument assessments of other countries, our overall assessment is that it is difficult to evaluate individual policy instruments. The effects of individual policy instruments are difficult to distinguish from other policy instruments and other forces in society.

We have however in our work chosen to analyse each policy instrument separately while attempting to include the interplay of the policy instrument with other instruments and other factors in society that could have influenced developments.

The following brief account concentrates on the effects on emissions. A final table reports a summarising assessment of the effects on other social objectives as well as cost-effectiveness.

6.2.1 Intersectoral policy instruments

Energy and carbon dioxide taxes

Energy and carbon dioxide taxes are important policy instruments in Sweden. Carbon dioxide tax has direct controlling effects by making fossil fuels relatively expensive compared to other types of energy. Energy taxes make the use of energy more expensive, and so the tax can suppress use.

Carbon dioxide tax was introduced in 1991 and has increased from SEK 0.25/kg carbon dioxide to SEK 0.91/kg in 2004. Manufacturing industry, agriculture, forestry and aquiculture pay a lower rate than the general level. In 1991, the tax rate for industry was SEK 0.10/g and in 2004 was SEK 0.19/kg. There are also special regulations for reductions in the tax for energy-intensive industry. From 2004, fuels used in combined heating and power plants have also had reduced tax.

Energy tax varies between different fuels. The manufacturing industry, and fuels for production in heating and power plants, pay no energy tax. Fuels used in the production of electricity are exempt from both energy and carbon dioxide tax. Biofuels are also exempt from energy tax.

Energy and carbon dioxide taxes bring considerable revenue to the government. A total of approximately SEK 58 billion of which SEK 19 billion are for carbon dioxide tax. Of the different fuel types, petrol is the largest proportion, around SEK 25 billion.

In our evaluation, the emphasis has been on carbon dioxide tax, even if it is important to remember that society's actors encounter the total tax, i.e. both carbon dioxide and energy tax. Households also pay VAT.

How much the tax has influenced emissions in various sectors varies with its level.

In the district heating sector, where carbon dioxide tax has been applied to the full extent, the use of fossil fuels has fallen heavily. At the same time, the use of biofuels in this sector has increased to a corresponding degree. This

development, which is favourable from a climate viewpoint, can largely be ascribed to the tax regulations. Investment support, and the environmental profiling of the various companies (often municipally-owned) are also contributing factors.

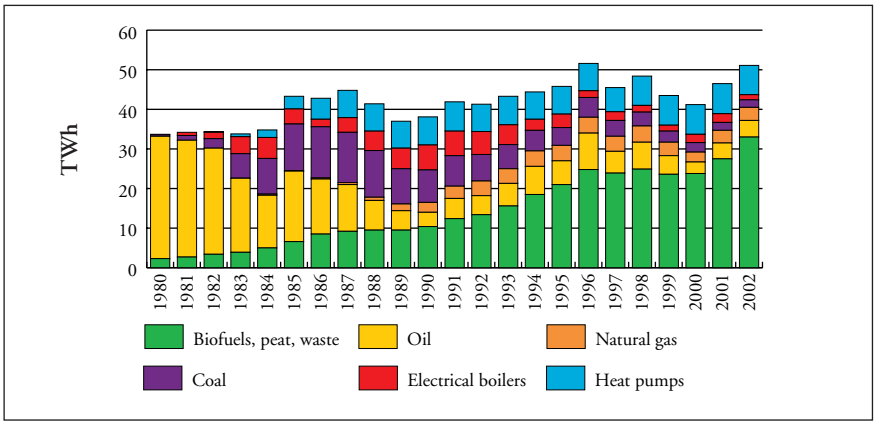


Figure 17: Energy supplied in district heating 1980–2002

Source: Energy in Sweden 2003

In the domestic and commercial premises sector, oil use has fallen heavily since the 1970s. Oil crises, increased energy prices, investment programmes and not least taxation have all influenced the transition from oil to other energy carriers. The shift in heating has largely been to electricity and district heating.

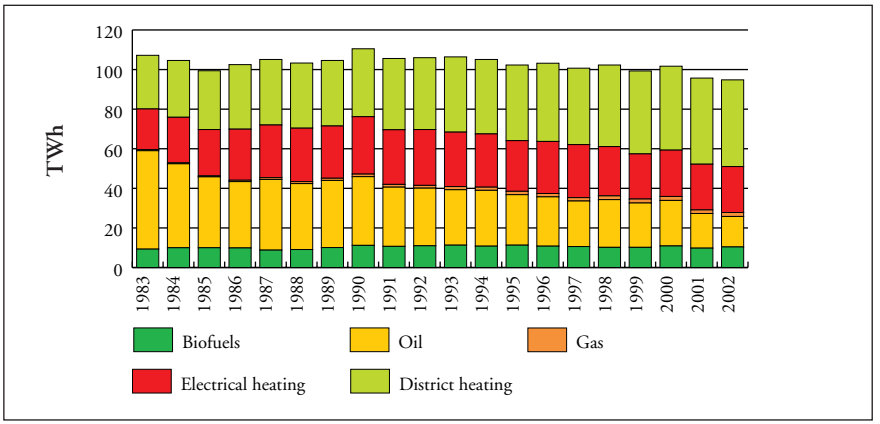


Figure 18: Total heating in the domestic and commercial premises sectors, corrected for normal year, 1983–2002

Source: Energy in Sweden 2003

Calculations in the checkpoint 2004 work confirm that carbon dioxide tax influences emissions[15]. With today's carbon dioxide tax rate, emissions are calculated as approx. 3 million tonnes lower in 2009 and approx. 5 million tonnes lower in 2016 and 2023 compared to a situation in which the tax has been abolished. See figure below.

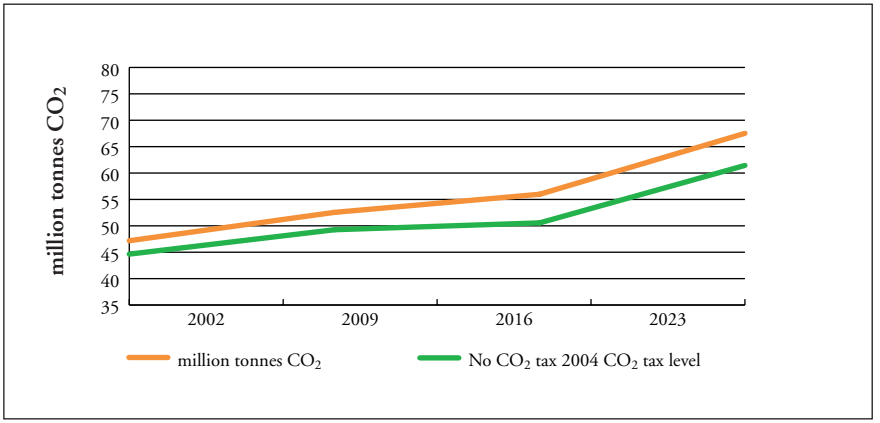


Figure 19: Carbon dioxide emissions with (at 2004 levels) and without carbon dioxide tax.

Source: Calculations with MARKAL (Nordic) Profu

15) The model calculation can be described as a future-oriented evaluation. Meaning that it shows differences between different tax levels for developments from 1995 and towards 2009 and 2016.

The model calculation above did not include the transport sector. Separate calculations were made to assess the effect of the increases in motor fuel tax from 1990 to today. The tax increases were mainly implemented at the beginning of the decade. The result shows that carbon dioxide emissions for 2002 are expected to be between 0.7 and 1.4 million tonnes lower as a result of the implemented tax increases. The interval is dependent on what price elasticity has been used (i.e. how much a price increase is assumed to influence demand for petrol).[16)]

The Environmental Code

Since 1 January 1999, all overarching legislation in the environmental field has been collected in the Environmental Code. The Environmental Code contains, among other things, a number of principles of due caution for all commercial activity, including the use of best possible technology, and that all those running a commercial activity or taking action are to make efficient use of resources and energy, and utilise the potential for recycling and reuse. Renewable energy sources are to be used in the first hand. The due caution requirement does not apply to an extent that its fulfilment can be deemed unreasonable. Large environmentally hazardous activities require a permit. Consideration under the Environmental Code covers the issues of allowability and permits and what conditions are to apply to the activity. Greenhouse gas emissions are part of the consideration.

Consideration under the Environmental Code has not been widely used and its full potential to reduce greenhouse gases emissions is therefore uncertain. No conditions for greenhouse gas emissions have yet been applied under the Environmental Code according to our information. The orientation has instead been to set requirements for energy efficiency and the switch of fossil fuels to renewable ones. Requirements have also been set concerning efficient transports.

There is also great uncertainty about whether parts of the Environmental Code may become inapplicable for plants covered by the EU ETS (from 2005). Under the trading directive, it is to be impossible to prescribe emission limits for carbon dioxide for plants covered by the trading directive. It is also possible that the government may propose further changes, among these

16) The effects of new CO_2 taxes in 2005 and effects on road traffic 2010 and 2020, memorandum of 25 March 2004, SIKA.

being that it is not to be possible to set requirements for the first-hand use of renewable energy, thereby limiting the use of fossil fuels, and to make demands concerning the energy efficiency of incinerator plants. Such a proposal was submitted by the "FlexMex 2" Commission of Inquiry in the spring of 2004.

Local investment programmes LIP/Klimp

LIP (Local Investment Programmes for ecologically sustainable development) were launched in 1996. The programmes began in 1998 and the last LIP grants were decided in 2002. A total of SEK 6.2 billion have been granted to 211 investment programmes in 162 municipalities. The purpose of LIP was both improved environment *and* increased employment. A relatively large proportion of the grants have gone to measures with a climate orientation. The effects of the local investment programmes include their having resulted in an estimated reduction in carbon dioxide emissions of approx. 1.5 million tonnes per year. One uncertainty in the context is however that not all projects have submitted their final reports. It is also difficult to assess the extent to which the projects would have been implemented even without grants, even if at a later date. The evaluation carried out of the district heating and waste heating projects in LIP however indicates that only a small part of these projects would have been carried out without the grants.

Starting from the year 2002, support has been given to local climate investment programmes (Klimp). There are more stringent accounting requirements in Klimp than in LIP, which allows the effects of the programme to be estimated with a greater degree of accuracy. According to our calculations, Klimp is expected to lead to about 0.4 tonnes lower emissions per year, if the results of the first decision rounds are extrapolated to the rest of the funds. The programme can however lead to somewhat greater reduction in emissions if cost effectiveness is further stressed in future decision rounds. Support must not be given however to measures that are profitable without grants. In both LIP and Klimp, energy measures have on average led to greater reductions in emissions per SEK granted than have grants to other types of measures. The work of submitting applications has also strengthened the environmental work of the municipal organisation and reinforces knowledge of potential local climate measures and their efficiency. The projects that have been given funds are "good examples" that provide ideas and inspiration to other municipalities.

Climate information campaign

The Riksdag decided in 2002 that 30 million SEK per year for the 2002–2004 period would be earmarked for a national climate information campaign. Climate information work would take place at national and local level. The final step, i.e. the local activities, was however smaller in scope than planned since funding was withdrawn in the final year.

Information measures are important given the background of the long-term perspective that characterises climate policy decisions and measures. Information is however in many respects a poor policy instrument which, if it is to be effective, works best in combination with other policy instruments. Achieving a positive attitude to measures using information is no guarantee of changed behaviour, but it can increase understanding for more vigorous policy instruments.

Nor was the point of the climate information campaign to achieve *direct* reductions in emissions. Instead, the goal of the climate information campaign was to

- increase knowledge among the general public and the business community about the causes and impact of the greenhouse effect
- increase knowledge about the effects of individual action in reducing greenhouse gas emissions
- increase understanding concerning the adjustments in society that will be necessary in the long term to secure sustainable development

The result of the campaign was monitored by interviews before and afterwards. The results of the interviews show that the attitudes and knowledge of the Swedish population altered during the year in which the campaign was under way. According to the study, the campaign has for example contributed to greater knowledge about the climate issue.

Implementing the EU emissions trading scheme

The EU's scheme for trading in emissions allowances will commence on 1 January 2005. This means that plants within energy-intensive industry and plants that produce energy will be covered by a joint EU policy instrument. This also means that national climate policy will be conducted in a new situation. See the next chapter about the consequences of the EU trading scheme for a more detailed description.

6.2.2 The energy area

Policy instruments for greater energy efficiency and reduced energy use
There currently exist, or are discussions about, policy instruments for greater energy efficiency in a number of areas, not least within the EU. Shifting energy use towards greater energy efficiency largely involves taxes and the forthcoming system for emissions allowances trading. Both of these have the effect of suppressing energy use since they affect the price for the final consumer.

The most recent energy policy decision from 2002 includes continued funding of information and training as well as labelling, testing and certification. The aim is to influence developments towards more energy efficient products and systems. This includes municipal energy advisory services directed towards consumers to facilitate the choice of cost-effective environment-friendly technology and support for the public procurement of technology, with the intention of facilitating the market introduction of energy efficient technology.

No quantitative estimate of how much each policy instrument has contributed to reduced emissions has been able to be made. As we mentioned earlier in the section about the climate information campaign, it is difficult to point to any actual reductions in emissions as a consequence of information and training measures. These however support other policy instruments and increase public knowledge of energy efficient solutions and can in the long term lead to actual measures. A general problem is also knowing what would have happened in the absence of the policy instrument. The greatest effect is probably the *long-term influence* on the behaviour of consumers and businesses, leading them to more energy efficient investment decisions.

Starting from 2004, the measures will be reinforced by a *programme for greater energy efficiency* in energy-intensive industry (PFE). The programme will primarily cover energy intensive trade and industry covered by the new minimum tax on electricity[17]. In other words, more efficient use of electricity will be the primary focus. In the forthcoming programme, companies will undertake to introduce energy management systems and implement energy analysis on an ongoing basis, and carry out certain measures to increase energy efficiency[18]. It is very difficult to assess in advance what effect the pro-

17) Under the directive, the minimum tax is to have been introduced no later than 1 January 2006. Sweden has however chosen to introduce the minimum tax on electricity from 1 July 2004.
18) Measures that pay for themselves in 4 years must be implemented if the tax reduction is to be granted.

gramme can be expected to have, among other things because the programme will not contain any quantitative targets. In combination with the EU ETS, the requirement for the introduction of energy management systems may be an effective tool to bring about greater energy efficiency.

Energy efficiency in buildings is partly controlled by the requirements of the National Board of Building (*Building Regulations and General Recommendations*). This is an important area since the requirements of today will affect the energy efficiency of buildings for a very long time, more than 100 years into the future. The effect is difficult to assess from a climate viewpoint. More stringent requirements will have great importance in the long term but have small effects in a short-term perspective, to 2010 for example. Follow-up of current regulations shows that energy consumption in new buildings is 20 % higher than the requirements. The National Board of Building is currently considering making the building regulations more stringent.

In spite of the fact that the energy policy decision in 2002 changed direction by shifting away from grants and subsidies, some *investment support* has just been introduced. Tax reductions for investments in energy-efficient windows and biofuelled heating systems were introduced in 2004. A special tax deduction for building work to make public buildings more energy efficient has also been announced.

Several initiatives are under way in the EU regarding the more efficient use of energy. A directive on the energy performance of buildings came into force in 2003. The government has appointed a special Commission of Inquiry with the task of submitting proposals for how the directive is to be implemented in Sweden. The directives on ecodesign of energy-consuming products and efficient final use of energy and energy services (the energy services directive) are currently being negotiated. All of these directives have the potential of making a contribution to the long-term climate target.

The electricity certificate system

From the early 1990s until the present, several different systems have been used to support electricity production from renewable energy sources. These have included investment support for electricity production from biomass, wind power and hydroelectric power, and an environmental bonus for electricity produced using wind power. An evaluation of these types of support is described in the report "Evaluation of the Policy Instruments of the Climate

Strategy". Here, our review concentrates on the electricity certificate system that replaced the previous types of support.

A new support system for renewable energy was introduced in 2003. The main object of the system is to bring about a shift in the energy system to a greater proportion of renewable energy production. Climate effects are also achieved through the greater use of renewable fuels. From 2002 to 2010, the proportion of renewable electricity production is to increase by 10 TWh, which is a quadrupling when compared to the objectives of the 1997 energy policy decision. The system means that electricity producers are given an electricity certificate for each MWh of renewable energy produced. The certificates are sold to electricity users, who are legally required to purchase electricity certificates corresponding to a certain proportion of their consumption.

Calculations show clear effects on carbon dioxide emissions. How much this is depends on assumptions about what the renewable electricity is replacing. If it leads to lower electricity import, global emissions will fall but not national emissions.

6.2.3 Transport

Tax reduction for biofuels

In 2003, the EU Council of Ministers and Parliament adopted a directive that gives indicative (non-binding) targets for the replacement of fossil fuels with biofuels. The objective is that 2 % of energy is to be from biofuels in 2005 and 5.75 % in 2010. The political motives for biofuels vary in different countries. Security of supply and the climate issue are the main ones in many countries, while in southern Europe this is largely an agricultural policy issue.

In the 2003 Budget, the government set out a strategy for abolishing carbon dioxide tax and energy tax on carbon-dioxide neutral fuels from 2004 to 2008. Sweden is thereby the country that has probably come farthest in implementing the biofuels directive. In Germany and Spain too, biofuels now have tax-exempt status.

In 2003, the oil companies began large-scale mixing of ethanol into petrol. The EU's petrol quality requirement for petrol however limits possible mixing to a maximum of 5 %.

Our assessment is that the EU objective for 2010 will not be met in Sweden because of the EU quality requirement for petrol. The use of purely biofuel-adapted vehicles is estimated to continue to be relatively low until 2010. The reduction in emissions is estimated at about 0.6 million tonnes in

2010. Furthermore, the tax exemption is not expected to have any effects on employment, Swedish agriculture or industrial competitiveness, since the increased demand for ethanol is expected to be met primarily through import. The results of the evaluation also point to full tax exemption amounting to over-subsidisation by about SEK 2/litre of replaced petrol volume for the import of tropical ethanol. General exemption from carbon dioxide tax and reduction of energy tax by half would probably be enough to achieve 5 % mixing in all petrol. This would reduce the loss of tax revenues by SEK 350 million to 2005; otherwise, it will be approximately SEK 1 billion.

Questions touching on policy instruments for the introduction of biofuels and other renewable vehicle fuels are currently under consideration by the Commission of Inquiry studying renewable vehicle fuels, M2003:02, which will present its findings on 30/12 2004.

The automotive industry's voluntary commitment to reduce carbon dioxide emissions from new cars

In 1996, the EU environment ministers adopted a strategy to reduce emissions from passenger cars by an average of 25 % by 2010 at the latest. The basis of the strategy is a voluntary agreement, in the first hand with the European automotive industry organisation. Similar agreements have also been concluded with the Japanese and Korean automotive industry organisations. The commitment in the agreement applies to the 1995–2008 period. Requirements for fuel economy labelling for new cars and the use of financial policy instruments are also mentioned in the EU strategy. The commitment is an average for the whole of the EU market, and does not have to be fulfilled in each individual member state.

In Sweden, specific CO_2 emissions of new cars have on average fallen by 11% from 1995 to 2002. This is in line with developments in the rest of the EU. A faster reduction is required for the rest of the period in order to reach the 2008 target. Developments have slowed in the past few years, so it appears that it will be difficult to achieve the commitment in the Swedish market. There has been a sharp increase in the weight and engine power of new cars over the past few years in the Swedish market. New diesel cars in particular have become heavier and more powerful.

Our assessment is that the automotive industry's target of a 25 % reduction by 2008 will not be achieved in Sweden. By 2008, emissions per km driven are instead expected to fall by 20 % compared to 1995. Developments

are primarily influenced by trends in household income. There is nothing to indicate that the voluntary commitment in itself has resulted in a trend shift with respect to the fuel efficiency of new cars. Looking at historical developments, specific fuel consumption in various vehicle segments has improved at about the same average rate as during the period in which the commitment began to apply.

Tax regulations for company cars

About 25 % of new car sales are company cars. They are on average heavier and have higher fuel consumption than the rest of the vehicle pool. Current company car benefit regulations were changed in 1997 and 2002. The change in regulations in 1997 was to make those with company car benefit pay for the fuel used in private driving. This target has only been met to 50 %. The evaluation of the change in regulations shows, however, that the decision to tax the free fuel has had a significant effect in the form of fewer kilometres driven. As a result of this change in regulations, carbon dioxide emissions are expected to fall by 0.2 million tonnes per year. Company car benefit tax was reduced for environmentally-friendly cars in 2002. The effect of this change in the regulations has not been able to be distinguished from other factors influencing the increase in environmentally-friendly cars. Sales of environmentally-friendly cars increased from 3,500 cars in 2002 to 6,000 cars in 2003. Most of these cars are company cars.

Table 6 Summary of conclusions from the evaluation of existing policy instruments.

Environmental impact	Cost-effectiveness/-macroeconomic effects	Effects on other social objectives
Carbon dioxide tax		
Reduces the use of fossil fuels and thereby carbon dioxide emissions. The effect varies with sector. The current tax level has brought about a great fall in carbon dioxide emissions from heating.	A cost-effective instrument since it allows various actors to choose the most cost-effective adaptations. On account of conflicting objectives, the tax is differentiated between sectors, which reduces cost-effectiveness.	Contributes to energy efficiency, energy saving and increases the proportion of renewable energy. Negative effects on the competitiveness of energy-intensive industry.

cont. >>

Environmental impact	Cost-effectiveness/-macroeconomic effects	Effects on other social objectives
Trade in emissions allowances		
Effects on the total carbon dioxide emissions of the trading sector depend on the total amount of emissions allowances allocated.	The more sectors included, the more cost-effective. Different allocation principles in different countries (within the EU directive's criteria framework) for allocation of emissions allowances reduces effectiveness.	Depends on the price established in the EU market. Is expected to raise electricity prices, which can reduce the competitiveness of energy-intensive industry. Because of the costs of reducing emissions for the individual actor, a larger proportion of the necessary emission reductions may take place in other regions. Relatively low prices are expected to increase fossil fuel use in Sweden.
The Environmental Code		
Hard to say.	The cost-effectiveness of the Environmental Code from a climate viewpoint is hard to evaluate, since few permits have been issued in which climate or energy aspects have been raised.	Hard to say.
Klimp/LIP		
LIP is estimated to lead to 1.5 million tonnes lower emissions in the 2008–2012 period. Early estimates of the total effects of Klimp grants (total allocated 1040 million) are 0.4 million tonnes lower annual emissions of carbon dioxide equivalents.	Grant systems lack the basic potential to be as cost-effective as e.g. taxes. Energy-efficiency and energy adaptation measures are most cost-effective in LIP.	Many of the measures have involved the energy sector, which has led to increased use of biofuels. Some positive effects on employment.
Project-based mechanisms		
See Chapter 8.		
Information/education		
Hard to measure reductions in emission due to information. Changes in attitudes and intention to change behaviour that will reduce emissions can be measured. But it is hard to distinguish the effects of information from other instruments.	Hard to measure cost-effectiveness of information (see environmental impact). Information is most effective in combination with other instruments. Information can provide knowledge of cost-effective measures that the actors do not have.	

Environmental impact	Cost-effectiveness/-macroeconomic effects	Effects on other social objectives
Electricity certificate system		
Reduces carbon dioxide emissions but the amount depends on assumptions of what renewable energy is replacing.	In the short term, not a cost-effective instrument since cheaper measures are available within the EU emissions trading scheme. In the long term, renewable electricity production is required for climate and energy policy reasons that justify support in the form of electricity certificate systems.	Industrial competitiveness benefits from the electricity certificate system. Suppresses long-term system price of electricity. Increases domestic electricity production with renewable energy sources. Leads to increased security of supply. Guarantees income to the government through VAT and quota obligation charge.
PFE (long term voluntary agreements)		
Reduced electricity use reduces carbon dioxide emissions from electricity supply in the Nordic energy system. Effects of PFE on electricity use are difficult to estimate.	Energy surveying and energy analysis can identify measures that are profitable for the company over and above its undertaking. Cost-effectiveness is reduced by the programme's covering a specific sector and also measures in a special field.	Minimises negative effects on growth and competitiveness since it is voluntary. Loss of government revenue from energy taxes of a maximum of SEK 200 million per year. Large industries that already have energy management systems are at a greater advantage than smaller companies. Interacts with emissions trading. Energy surveying gives a basis for cost-effective measures to reduce use of electricity and fossil fuels. The Environmental Code's requirement for energy efficiency coincides with the purpose of PFE. Necessary to ensure that the undertakings in PFE are additional to the environmental conditions.
Tax-exemption alternative fuels		
About 0.6 million tonnes less CO_2 emissions globally to 2010.	Domestic ethanol production cannot compete with import. Most cost-effective (0.4 SEK/kg CO_2) using tropical ethanol.	Does not provide employment in Sweden. Does not change energy supply situation. Tax exemption is expected to oversubsidise low-level mixtures in petrol by 500–600 million SEK/year from 2004.
Automotive industry's voluntary commitment to reduce CO_2 emissions in new cars to 2008		
Does not seem to have led to increased fuel-efficiency for new cars more than normal technical development would. The commitment of 25 % reduction within the EU is not expected to be met in Sweden.		Voluntary commitment which has not led to significant effects, so no significant consequences can be expected.

6.2.4 Overall effect on emissions in the energy sector

We have carried out model calculations to see how the overall financial policy instruments of today affect the energy system compared to the corresponding financial instruments used in 1990. The results of the model calculation, see Figures below, show lower carbon dioxide emissions in Sweden with today's policy instruments compared to those of 1990 throughout the period analysed.

To obtain the whole picture, we also show the effects of the change in policy instruments in Sweden from a Nordic perspective. Since electricity import is estimated to be significantly higher using 1990 instruments, the difference between the financial instruments of today and those of 1990 is estimated to be greater when the Nordic perspective is included. In the calculations, it is assumed that coal condensation is at the margin of the Nordic electricity production system. In the 1990 policy instruments, the absence of emissions trading and the electricity certificate system mean that other, cheaper, Nordic electricity production is retained, at the same time as there is limited access to cost-effective domestic alternatives. So, we can say that emissions take place outside Sweden to a greater extent with the 1990 policy instruments.

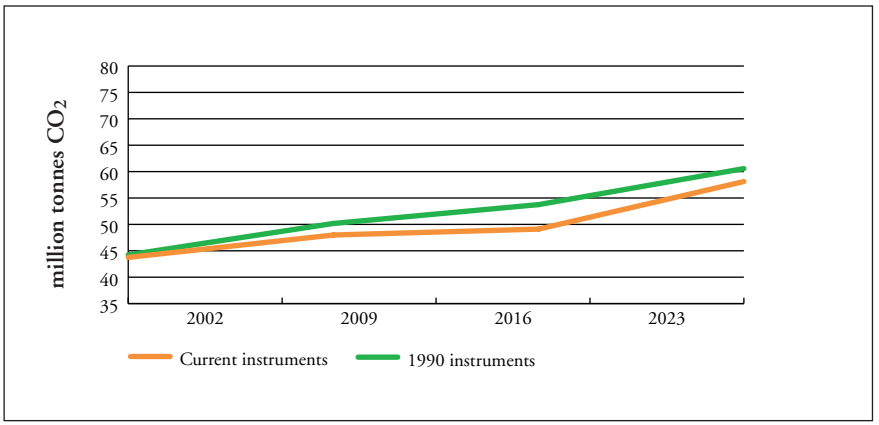


Figure 20: Carbon dioxide emissions for Sweden, national effects.

Source: Calculations with MARKAL (Nordic) Profu

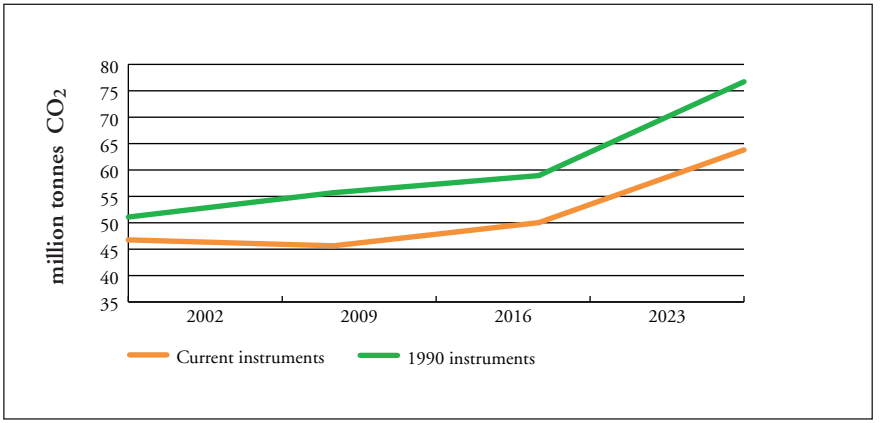


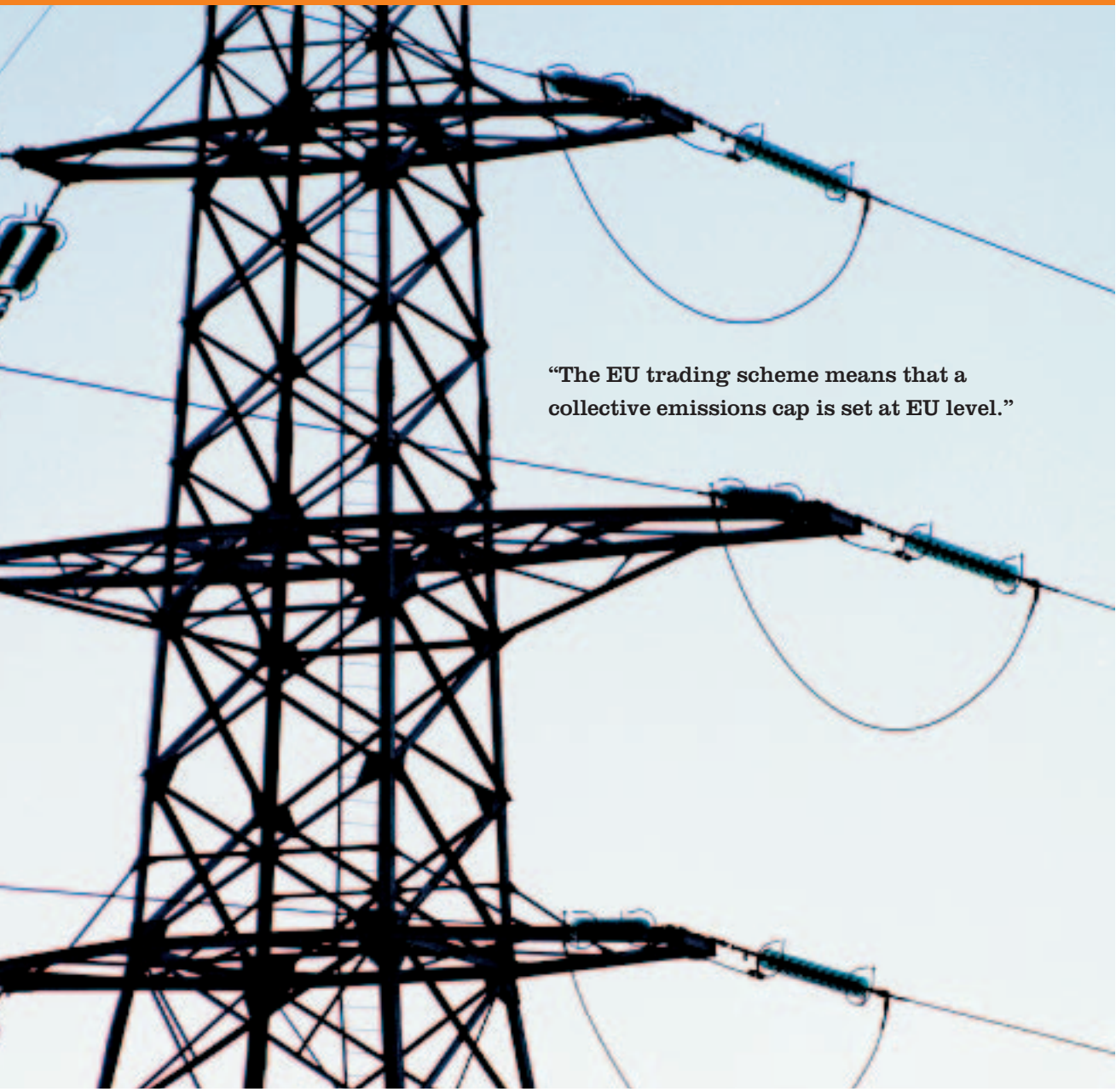
Figure 21: Carbon dioxide emissions for Sweden, Nordic effects.

Note: For import, coal condensation is assumed to be at the margin.

Source: Calculations with MARKAL (Nordic) Profu

The interplay of policy instruments

Most policy instruments interact directly or indirectly with a large number of other policy instruments. The interplay is striking in some cases, due to the parallel application of several policy instruments to achieve the same objectives. The report "Evaluation of Policy Instruments in Climate Policy" makes a quantitative review of the interplay of the policy instruments. One example of results is that the emissions trading scheme and the electricity certificates system are expected to affect each other's price. A higher market price for emissions allowances tends to lead to lower prices for electricity certificates. The introduction of trade in emissions allowances leads to an increase in the competitiveness of renewable fuels which in turn leads to a reduction in the extra costs for producing electricity from renewable energy sources.


"The EU trading scheme means that a collective emissions cap is set at EU level."

7 Consequences of the EU Emissions Trading Scheme

To meet the EU's Kyoto commitment, the EU has produced a climate programme (European Climate Change Programme). The programme contains several parts of which the most important is a joint trading scheme for emissions, EU ETS.

7.1 Description of the system

The EU trading scheme starts in 2005 and from the start covers large areas of energy-intensive industry and combined heating and power plants (electricity and heating production). The system is currently under construction in the individual member states and at joint EU level. The first trading period is between 2005 and 2007 and is an introductory phase prior to the 2008–2012 period which is within the framework of the Kyoto Protocol's first commitment period. The system will cover all EU member states – 25 countries.

The system involves the setting of an overall cap for permitted emissions at EU level.Below the cap, companies may trade emissions rights and this means that a price will come to be set on emissions. A well-functioning sanctions system is to ensure that emissions do not exceed the predetermined cap.

The EU directive for the trading scheme says that at least 95 % of the emissions allowances in the introductory period are to be allocated free of charge. For the period starting in 2008, at least 90 % is to be allocated free. A smaller volume may thus be allocated after payment, and can for example be auctioned off. The directive says nothing about how allocation will take place for the post–2012 period.

The total amount of emissions allowances will be the same as the capcap for emissions. Within this cap, companies' actions on the basis of the price of emissions allowances will determine where the emissions will take place/be reduced.

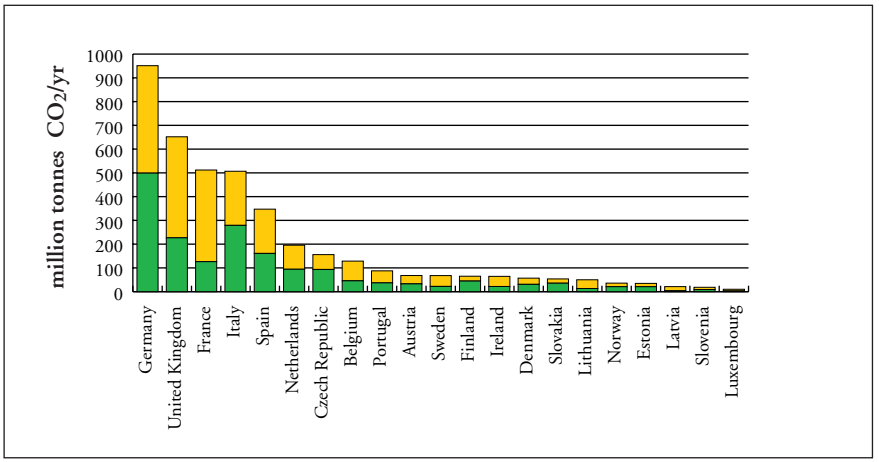


Figure 22: Allocation of emissions allowances in relation to the Kyoto commitments of 21 (out of 25) member states.

Note: The lower field corresponds to the amount of emissions allowances allocated within the framework of the EU ETS. The upper field corresponds to the remaining emission of greenhouse gases according to the countries' commitments under the Kyoto Protocol (EU internal burden-sharing agreement.)

Source: Preliminary data from allocation plans submitted so far, not approved by European Commission.

A system for trade in emission allowances has an innate momentum that will bring down the costs of a given reduction in emissions. This has been shown in a large number of model calculations using national, regional and global data. The scale of the environmental effect for the EU as a whole – i.e. what level of emissions will be permitted (the emissions cap) – depends on what principles the EU will jointly apply on application, particularly in the allocation of emissions allowances. Appendix 1 shows the allocation criteria of the directive. The total emissions cap will also be decisive in determining the price. It is important that the total allocation takes place so that there is a scarcity in the system. The system can link to other systems under the Kyoto Protocol. Another hope is that more countries outside the EU will eventually join.

7.2 Consequences for Sweden

7.2.1 Emissions

The extent to which companies will be buyers or sellers will depend on the costs of reducing emissions in the activity involved in relation to the market price of emissions allowances. If Swedish companies purchase emissions allowances, that means that emissions in Sweden will increase. At the same time, emissions in another EU country will have fallen. The opposite applies if companies sell emissions allowances.

We do not know at present what price will be established in the market. We have carried out model calculations to analyse the consequences for the energy system and emissions of carbon dioxide of different emissions allowances prices. See box below.

The price of emissions allowances falls from 10 to 5 euros per tonne
Carbon dioxide emissions will be just over 0.5 million tonnes higher per year in Sweden
The price of emissions allowances climbs from 10 to 25 euros per tonne
Carbon dioxide emissions will be just over 2 million tonnes lower per year in Sweden

The difference in the results of the model calculations results from more or less use of fossil fuels/biofuels for power and heating production. The higher emission price also gives more wind power in the long term according to the model.

Other assumptions in accordance with our baseline forecast, see section 6.2

For all Nordic countries, the model result is as follows:

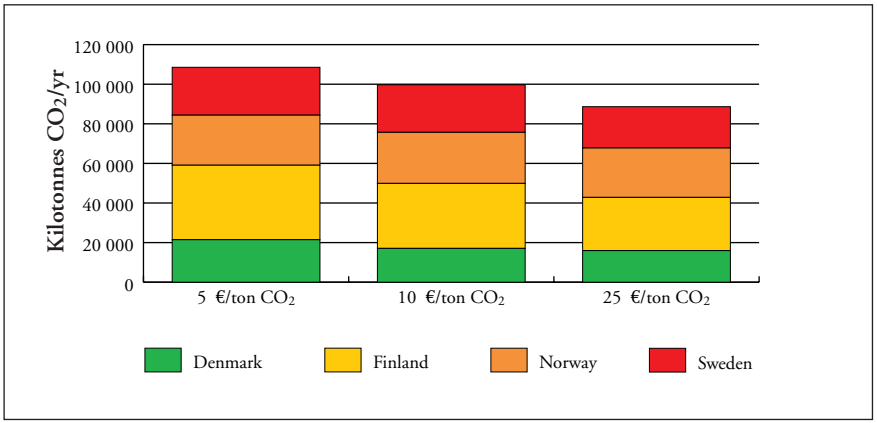


Figure 23. Carbon dioxide emissions from industry and electricity and heating production as a function of the price of emissions allowances in 2009 in four Nordic countries.
Source: MARKAL-calculations, Profu.

In our prognosis, emissions in the trading sector increase by 25 % from 1990 to 2010. If this increase in emissions is related to the framework that now applies to the government's plan for the allocation of emissions allowances, it indicates that Swedish plants (the companies that own them) will be net purchasers of emissions allowances.

7.2.2 Electricity prices

The cost of electricity production based on fossil fuels will climb when the trading scheme starts. How much that affects the market price of electricity is dependent on the price of emissions allowances and what type of production is in the margin at different times of year. Various model calculations show increases in the price of electricity in the interval SEK 0.1 – 0.8 per kWh. The highest price corresponds to a situation where coal-based electricity production is in the margin and has a price-setting effect all year round.

In our calculations, we assume that the average marginal production controls the average price over a year. A price for emissions allowances of 10 euros will then entail an electricity price increase of SEK 0.02 - 0.03 per kWh. See the figure below for how the model's results are affected by the various price levels for emissions allowances.

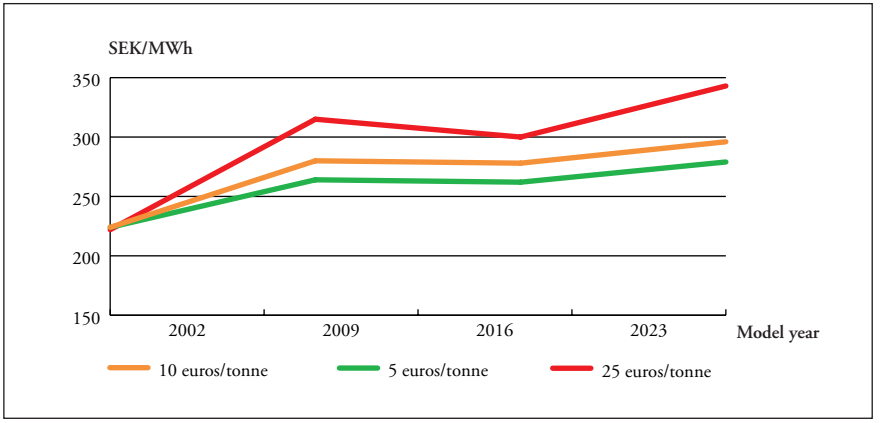


Figure 24. System price of electricity in the Swedish price area as a function of time and the price of emissions allowances.

Note: The results apply on the assumption that nuclear power will be shut down, as in the main alternative of the baseline forecast. Note that electricity prices show a relatively large increase even if we assume unchanged emissions allowances prices over time. It is important to remember that trade in emissions allowances is only one of several parameters affecting the price of electricity.

Source: Calculations with MARKAL (Nordic) Profu

7.2.3 Economic growth

The introduction of a scheme for emissions trading will bring about increased growth in some sectors and lower growth in others. The diagram below shows how the 17 sectors included in the EMEC model of the Swedish Institute of Economic Research are affected by the different assumed cost levels for emissions of carbon dioxide. The variations in cost are dependent on various prices for emissions allowances but also on whether carbon dioxide tax is retained.

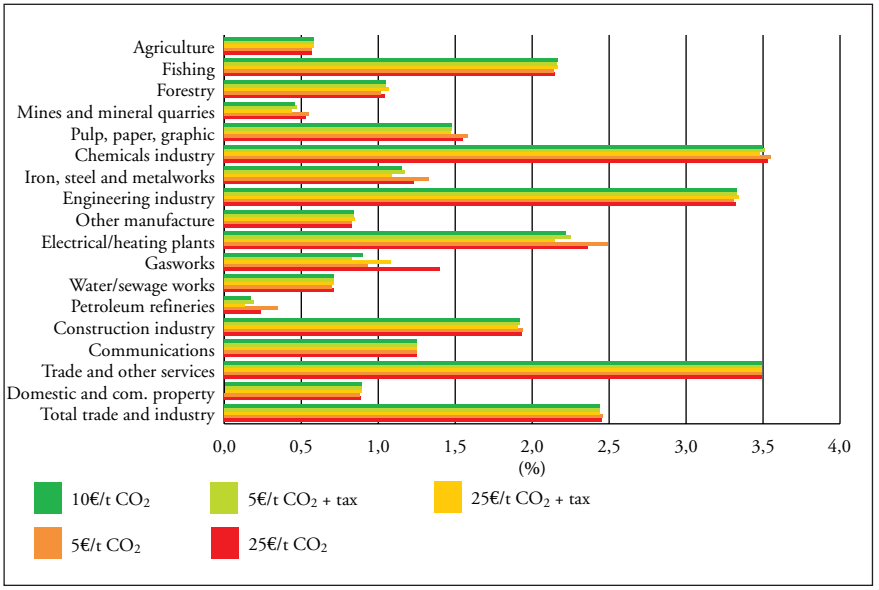


Figure 25. Changes in the value added in various sectors between the years 2000–2010 with different assumed carbon dioxide tax levels.

Note: Various prices for emission allowances, and with/without current carbon dioxide tax.

Source: Calculations using EMEC, National Institute for Economic Research

7.2.4 Structuring Sweden's national target

As described previously, Sweden has a national interim target that differs from Sweden's international commitment. That Sweden will participate in the EU ETS from 2005 puts the structure of the Swedish climate policy target in a new light. Today, Sweden's objective is that emissions are to fall by 4 % without the flexible mechanisms, i.e. *in* Sweden. Apart from emissions allowances trading, there are two other flexible mechanisms, known as project-based mechanisms. The EU ETS links to the project-based mechanisms.

A trading scheme means that you know in advance what the emission level will be for the whole system, but it will be harder to assess what the emission level might be in an individual country and thus what policy instruments must be used to achieve a *particular* emissions target (that expresses actual levels within the borders of one country). Furthermore, the Swedish govern-

ment cannot by itself influence the design of the system, which is a result of negotiations between the countries within the system.

We have analysed two different *target structures* for a situation in which Sweden has both an international commitment and a national interim target. One is the target structure of today, the "national emissions target", and the other is a definition in which purchased emissions allowances are offset against emission increases in Sweden, the "national offset target".

Different policy instrument strategies have been produced for the two different target designs. The strategies mean that the national policy instruments are either directed towards the non-trading sector alone, or are directed towards all sectors.

Trading sectors

Covers from 2005 the emission of carbon dioxide from power and heating plants, oil refineries, plants that produce and process iron, steel, glass and fibreglass, cement and ceramics, and plants that produce paper and pulp. More gases and more sectors may be covered by the system after 2008.

Non-trading sectors

Covers other emissions of greenhouse gases (methane, nitrous oxide and the three industrial gases HFC, PFC and SF6). Also covers emissions of carbon dioxide from small-scale burning in the domestic sector, the transport sector and other commercial sectors.

What both policy instrument strategies have in common in a national emissions target is that they make relatively large demands on rapid follow-up and control of emission trends in both sectors in order for the interim target to be achieved.

With an offset target, there is less need of follow-up and control of actual emissions in the trading sector. When allocated emissions allowances have been deducted, it does not matter what size the emissions are. It is enough that each tonne of emissions corresponds to an emission right. The allocated volume then also determines the size of the scope for emissions occurring in the non-trading sector. A decisive factor in the ability to meet the target is

therefore what size the allocation will be, and so how big the requirement will be for emission reductions in the non-trading sector.

Supplementary instruments can be used in the trading sector, but will not however make achievement of target easier in the structure using an offset target, and it will reduce cost-effectiveness in the system as a whole. On the other hand, there may be other reasons for not allowing emissions trading to be the only policy instrument in the trading sector, such as other social objectives in e.g. in energy policy or long-term objectives in the field of climate policy.

The target structures have been analysed from various viewpoints. One starting point has been the reasons given in Sweden's current climate strategy for having a target that differs from our international commitment. Below are some brief remarks on these.

1. Climate impact and cost-effectiveness. If we "buy" emissions allowances, emissions will not fall in Sweden, but may in other places. There is instead a possibility that total emissions will fall more using the same financial input if the flexible mechanisms are used, since cost-effectiveness will be greater.

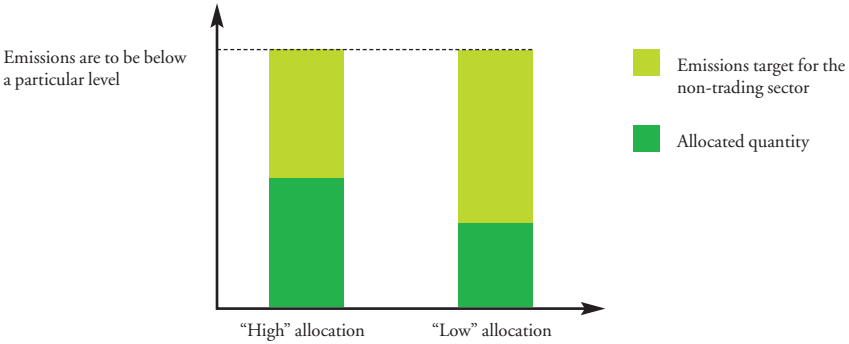
2. Sweden as a good example in international climate policy. Sweden's potential to appear as a good example need not be less because flexible mechanisms are included in the climate objective. On the contrary, Sweden's credibility can increase if the flexible mechanisms are used, not least that of emissions trading, at the same time as Sweden acts to secure and develop their environmentally controlling effect.

3. Rigid structures. With respect to the potential for influencing rigid structures and promoting development and distribution of new technology, our view – which is supported by international research – is that an environmental target (emission target) is not in itself enough to lead to the desired effect (in terms of innovation), but that it must be combined with directed policy instruments. What policy instrument(s) is most suitable depends on what technology one wishes to develop. So, an offset target does not put obstacles in the path of influencing rigid structures and promoting technology development.

4. Links to other policy areas. One link is other environmental targets, such as emissions of other pollutants than CO_2. One of the most important problem sectors for other environmental quality targets, the transport sector, will initially be outside the trading sector. Control of emissions therefore takes place outside the trading scheme, regardless of what target structure is used. We do not know today what sectors will be covered by the emissions trading scheme in the future. In order to obtain an overview of how other emissions are affected, we must take into account that those measures that take place within the framework of the trading scheme in other countries near ours might have positive effects on the emission of e.g. nitrogen oxides and sulphur. The energy policy objective of promoting bioenergy can be furthered by the use of supplementary policy instruments in the whole or parts of the trading sector should it appear that emissions trading is unfavourable to bioenergy.

5. Practical feasibility. Last but not least, an offset target is much simpler to handle in practice as soon as emissions trading has begun. The EU trading scheme makes it harder to assess emissions development in those sectors covered by the system, since the price of emissions allowances is uncertain. As a result, it is harder to assess what scope of policy instruments is necessary to achieve a national emissions target.

Against the background of our analysis, we have found that the target structure that involves the deduction of allocated emissions allowances from the emissions cap, i.e. the offset target, has many advantages over that of a simple emissions target. The target structure is illustrated in the figure below.



Permitted emissions in the non-trading sector will vary depending on the allocation given to the trader.

We repeat two important consequences of the selected target structure.

- How many policy instruments are required in the non-trading sector is dependent on how large the allocation of emissions allowances is to the trading sector.
- Using supplementary policy instruments in the trading sector does not affect the fulfilment of the climate target in the 2008–2012 period. If supplementary policy instruments are used, then it should be for other reasons.

It is also important to emphasise that the target structure applies in a relatively short-term perspective and that it is at present difficult to know what structure is suitable in the medium term. One uncertain factor is how international climate work will develop. What happens after the first commitment period of the Kyoto Protocol? This affects Sweden's climate work, and what target structures and ambition level should be set in Sweden. The future design of the trading scheme is also important in this respect.

There is still great uncertainty in Sweden concerning the forthcoming agreement on nuclear power. Within the framework of the chosen target structure above, early closure with possible resulting increasing emissions in Sweden would not affect the ability to achieve the target for the 2008–2012 period if such closure takes place after the allocation decision has been made. On the other hand, it affects to some extent the costs of reaching the target

level (cap for emissions) in the EU trading scheme. In other words – there will be more emissions that are to be covered with a given amount of emissions allowances.

7.3 The future development of the EU ETS

The EU ETS that starts in 2005 has the potential to become a powerful policy instrument. It leads to definite effects on emissions at the same time as emission reductions take place in a cost-effective way. It also has the advantage that it includes a large number of countries. For the system to lead to reduced emissions however, it is important that the total allocation takes place so that there is a scarcity of rights within the framework of the system. An important part of Swedish climate work is therefore to participate actively in the forthcoming evaluation of the system that starts in 2005 and that is to be reported by the European Commission in 2006/07. Sweden needs for example to have analyses made of whether more sectors and gases can be covered by the system. Since the trading scheme also includes energy-intensive industry which in a number of cases is active in an international market, it is also of great importance if the system in the future can include countries outside the EU. Other important issues are that the allocation criteria are such that a scarcity of emissions allowances is allocated and that the principles for how countries allocate emissions allowances to new plants are the same, and that emissions allowances are not allocated free of charge to new plants. Sweden also needs to work to ensure that emissions allowances in the long term (after 2012) are not allocated free, but that companies instead pay via an auction system.

“Sweden has a long tradition when it comes to international co-operation on climate issues”

8 How Can Sweden Use the Other Flexible Mechanisms?

Apart from the EU ETS, it is possible to use the project-based mechanisms (see fact box). Sweden has a long tradition of international climate co-operation in the energy field. In the years 1992–94, a total of SEK 140 million was allocated, mainly intended as grants to the construction of environmentally-adapted energy systems with less climate impact in the Baltic states and eastern Europe. Within the framework of the 1997 energy policy decision, SEK 350 million were allocated for international climate policy measures for the 1997–2004 period within the framework of the UN Framework Convention on Climate Change and the project-based flexible mechanisms of the Kyoto Protocol. International climate work on the basis of energy policy was said to be an important part of the strategy to reduce the climate impact of the energy sector.

Project-based mechanisms

Joint implementation

Introduced in the Kyoto Protocol. Countries with commitments under the Kyoto Protocol and that invest in projects in other countries can obtain credits for the emission reductions that the project gives rise to, emission reduction units, ERUs.

Clean Development Mechanism, CDM

Countries with reduction commitments under the Kyoto Protocol can, by investing in projects in countries with no commitments under the Protocol, obtain credits for emission reductions, CERs (certified emission reductions). The CDM contributes to sustainable development in accordance with the priorities of the host country.

cont. >>

Sweden is currently working as follows with the project-based mechanisms.

- Participant and investor in the World Bank Prototype Carbon Fund.
- Participant in a fund created within the framework of the Baltic Sea Region Energy Co-operation (BASREC). Testing Ground Facility.

SICLIP (Swedish International Climate Investment Programme)

– Intends to conclude agreements for a total of 4 JI projects which lead to the acquisition of emission rights units. Proposals have come from Estonia, Poland, Rumania, Russia and Hungary.

– Compile a portfolio of small and medium-sized CDM projects. Of 46 proposals, a small number of projects have been selected. Agreements have been concluded for CDM projects in India and one in Brazil and some projects are in the final stages of negotiation. Discussions are also under way within the framework of a multilateral investment fund oriented towards small-scale projects in the least developed countries.

Credits from the project-based mechanisms can also be traded freely in the EU trading system. From 2008, the member states are able to set a ceiling at plant level for how much companies may use to meet their obligations under the trading system.

World Bank Prototype Carbon Fund

Countries and companies are members. Through the implemented projects, the members obtain emission reduction units. Another aim is to exchange knowledge of the project-based mechanisms of the Kyoto Protocol.

The project-based mechanisms, and emissions trading, can contribute to making climate measures more cost-effective. The climate impact of national measures undertaken in Sweden or abroad are the same – it does not matter to the climate where the measure is undertaken. The difference in costs is due to the fact that countries have varying starting points, for example different energy systems, have reached different stages of economic development and have worked to varying extents with policy instruments to reduce greenhouse gas emissions. It is possible to get a rough idea of this if you look at the carbon intensity (here expressed as gramme of carbon in relation to energy supply in MegaJoules [gC/MJ]) in various countries[19].

19) Calculations done for the Environmental Advisory Council, 2002

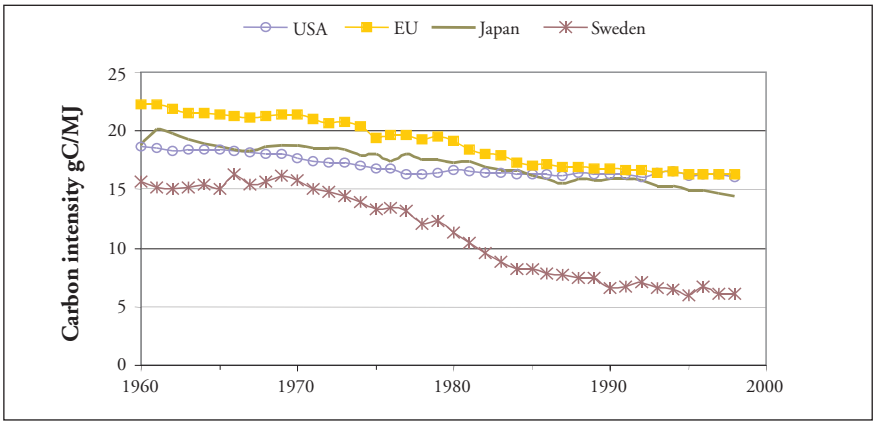


Figure 26. Carbon intensity (gramme carbon in relation to total energy supply) for some industrialised countries.

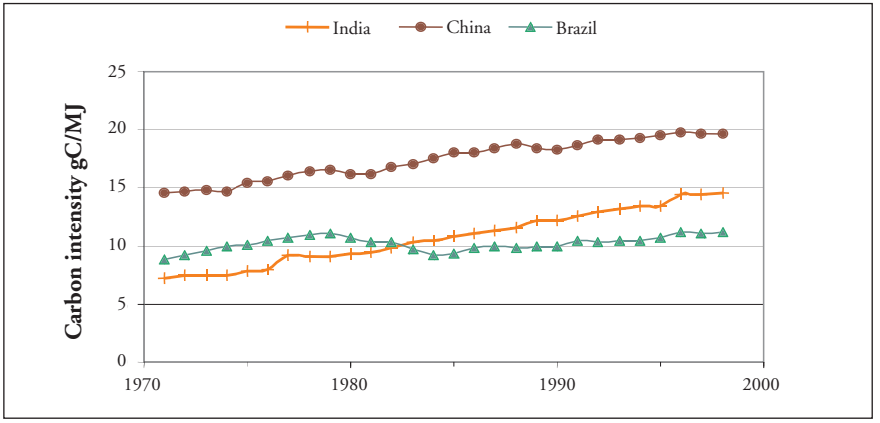


Figure 27. Carbon intensity in grammes carbon in relation to total energy supply for some developing countries.

We have found the following reasons for Sweden to work with the project-based mechanisms.

1. Well-functioning flexible mechanisms are important for continued international co-operation to counteract climate change. They are important factors in several countries' ratification of the Kyoto Protocol and will be important in more far-reaching international commitments after the first commitment period of the Kyoto Protocol.
2. Emission reductions are achieved at low cost.
3. Deeper relationships with the countries in which the projects are implemented.
4. Increased environmental awareness in the recipient countries.

The long-term goal is that trade and industry is to shoulder responsibility for application of the mechanisms. The EU emissions trading scheme and the link to the project-based mechanisms might be an incentive for businesses to get involved, but there are still difficulties. The Kyoto Protocol has still not come into force and the body of regulation is still being written and methods created. Programmes at national level have an important role as standard bearers and can bridge the period to a phase in which the market actors regard the risk as acceptable. Among other things, programmes at national level, by initiating and preparing CDM and JI projects, can contribute to the development of the body of regulation and methods, and to making the process more established and effective.

The work should be oriented as follows:

1. Continued government involvement within the framework of SICLIP (Swedish International Climate Investment Programme)
2. Capacity-building measures in Swedish trade and industry, primarily in the trading sector.

Emission reduction units from implemented JI and CDM projects will come to Sweden in different ways. Sweden already has a government programme for climate projects and is also a participant in two funds that invest in climate projects. With the funds now earmarked, about SEK 280 million, it is expected that reduction credits will be earned amounting to about 5 million tonnes of carbon dioxide equivalents. A small part, about 0.5 million tonnes, will however be delivered after 2012. In total, this is equivalent to 0.9 million

tonnes of carbon dioxide equivalents per year in the 2008–2012 period. These emission reduction units can in the first hand be used as a reserve, but can also be saved for future commitment periods. The price of the emission credits acquired by Sweden is between 5 and 8 dollars per tonne.

Reduction credits from the project-based mechanisms will also come to Sweden via companies, both those that are participants in the EU emissions trading scheme and those that are not. Reduction credits can be traded and used freely in the EU emissions trading scheme but from 2008 there will be a cap at plant level that states how large a proportion of reduction credits the plant may use to comply with the rules. The level of this cap is to be set in the national allocation plan.

8.1 Effects of using project-based mechanisms

8.1.1 For Sweden

The project-based mechanisms reduce the cost of measures and the same climate effect can thereby be achieved but at a lower cost. International demand for climate-efficient technology and climate-efficient services can be expected to be boosted when the countries are to begin meeting their commitments by reducing greenhouse gas emissions and using the various mechanisms of the Kyoto Protocol. The project-based mechanisms can aid the spread of technology and the commercialisation of new renewable and efficient environmental technology. It can also help Swedish environmental technology to find a broader international market base.

8.1.2 For the host countries

The countries that can be hosts for JI and CDM are different from each other. Possible hosts for JI projects are countries with quantitative commitments, above all the transition economies of eastern Europe. Hosts for CDM projects are countries that do not have quantitative emission commitments under the Kyoto Protocol, primarily developing countries. CDM projects are to bring about reduced greenhouse gas emissions but also contribute to sustainable development in the host country, and each project requires the consent of the host country.

Through the Climate Convention and the Kyoto Protocol, the industrialised countries have undertaken to be in the forefront, to support sustainable

development, and assist developing countries to reduce the negative effects of climate change. Against this background, the CDM is an important instrument since it can contribute to knowledge and technology transfer to developing countries. This is particularly important since the energy system in developing countries is under construction and investments made today will have consequences for several decades. The introduction of energy solutions that contain renewable energy is of great importance. The potential of renewable energy, and energy efficiency, is often disregarded in developing countries and the CDM means that knowledge of the potential and the environmental benefits of renewable energy can be spread to those developing countries that will be the hosts of CDM projects. Experience from JI projects in eastern Europe also shows that they have had positive impact on the attitude to environmentally-adapted energy supply and energy use in the authorities and companies that were involved in the recipient countries.

For the host countries, the project-based mechanisms can be a means of obtaining foreign investment. It has been said, particularly by developing countries, that with the CDM they are not passive recipients, but that the CDM can be an instrument that is used to serve their ambition to build up more environmentally-adapted energy systems. Several countries are building up institutions to deal with the CDM on a large scale and are actively prioritising technology that they judge to be of interest for the country's development.

8.1.3 For the climate

Both the Climate Convention and the Kyoto Protocol emphasise cost-effectiveness. Using the flexible mechanisms enables the differences in cost between different countries to be evened out and the cost of meeting the commitments to be reduced, and greater reductions in emissions can also be achieved at a given cost. There may of course be other barriers that result in the actions chosen not being the most cost-effective ones. Examples of such barriers are lack of knowledge or administratively complex systems that make implementation difficult.

Concrete reductions in emissions with the project-based mechanisms
Unlike emissions trading between countries, JI and the CDM are used in *actual projects* to reduce greenhouse gas emissions from various plants and activities. The projects, and the related reductions in emissions, undergo a very thorough, public examination process that includes verification and

certification to ensure that the emission reductions are actual and are larger than those that would have occurred if the project had not taken place.

Even if the JI and CDM projects focus on greenhouse gas emissions, projects that have other negative environmental aspects are not permitted. The projects undergo a strict review process that also includes an environmental impact assessment.

9 What Will Happen to Sweden's Emission Reduction Units?

There are different kinds of emissions allowances and reduction credits, and different rules for how they may be saved (see below). As described earlier, the EU has a joint commitment under the Kyoto Protocol and is jointly responsible for meeting this commitment. This may affect how much control Sweden has over the emissions allowances/reduction credits that Sweden does not use during the first commitment period.

The Units of the Kyoto Protocol and the EU Trading System

Entitle the holder to emit 1 tonne of carbon dioxide equivalents under a certain defined period.

AAU – Assigned Amount Unit. Allocated to each country under the Kyoto Protocol at amounts that correspond to the country's permitted emissions for the applying commitment period.

EAU – In the EU trading system, the emission rights are called "Emission Allowance Units", and they are converted from the countries' AAUs.

ERU – Emission Reduction Unit. Emission rights units that are converted from the countries' AAUs through projects within the framework of Joint Implementation.

CER – Certified Emission Reduction, emission rights units that are issued by the board of the CDM after verification of emission reductions from projects. tCER and ICER are time-limited credits from sink projects within the CDM.

RMU – Removal Units. Created by carbon sinks resulting from land and forestry measures in countries with reduction commitments.

Rules for saving between the commitment periods of the Kyoto Protocol.
AAUs – can be saved with no restrictions.

EAUs – member states can give companies the right to save EAUs between the period 2005–2007 and 2008–2012. Most member states have however declared that they do not intend to allow this.

cont. >>

ERUs and CERs – A country may save ERUs and CERs corresponding to 2.5% of the amount of AAUs.

RMUs – may not be saved.

The Linking Directive – supplements the EU's directive for emission rights trading.

Companies covered by the EU trading system for emission rights can trade with ERUs and CERs within the trading system. CERs will work in the system during the first period between 2005 and 2007, but ERUs will not be available until the beginning of the first commitment period. From 2008, member states are able to put a ceiling at plant level for how large a proportion of ERUs and CERs the companies can use to meet their obligations under the trading system.

Sweden has a national target of –4% without flexible mechanisms and sinks, and an international commitment of +4% that includes flexible mechanisms and sinks. The international commitment is legally binding, and if it is not met sanctions may be expected. If Sweden does not use all the assigned amount units (AAUs) allocated in the Kyoto Protocol, which will be the case if Sweden meets the national target, then Sweden will have surplus permitted emissions of about 6 million tonnes of carbon dioxide equivalents per year under the Kyoto Protocol. What happens with any surplus that Sweden does not use is important for the environment but is also an economic issue.

If the emission surplus is saved and Sweden makes a larger reduction commitment in the forthcoming commitment period that would otherwise be the case, an environmental gain is achieved.

If the emission credits are however saved to be used in the forthcoming commitment period, the environmental impact will be small in a long-term perspective, since emissions are simply being redistributed over time. It may be economically advantageous to save emissions allowances, since emissions allowances can be assumed to be more expensive in the future.

Another way of dealing with emissions allowances that you do not intend to use is to sell them on the market. If you do that, someone else will use them, and no positive environmental impact will result. It might instead help reduce the price of emissions allowances.

A surplus of credits may be necessary if the EU(15) is to meet its commitment. The credits can then either be traded in the EU or used in other politically agreed ways that we are unable to predict today.

The most important issue for the EU to meet its commitment is that it has a vigorous climate action plan and that steps are actually taken in good time. If this is not enough, the EU has a number of other possible ways of dealing with the situation. Assigned amount units (AAUs) can be purchased on the world market, you can choose to count the sinks that you are in fact entitled to count under the Marrakech Accord, and you can use the project-based mechanisms. Of these three possibilities, the project-based mechanisms may be the most attractive. Project credits are actual reductions and the risk of "hot air" is minimal with the strict regulations.


“Sweden is on the right track in work on climate change, but new measures
are required as there is a great need for emission reductions in the long term.”

10 Need Sweden's Climate Strategy be Altered in the Short Term?

The assignment of producing a basis for the evaluation of Sweden's climate policy is mainly focused on the national interim target for the 2008–2012 period. Among other things, an assessment is to be made of the possibility of achieving the national interim target using current policy instruments and measures. Proposals for new or extended policy instruments, the consequences of which have been assessed, are to be submitted where necessary. The assignment also includes a study of the consequences of integrating the flexible mechanisms into the interim target.

Our proposals for how the Swedish climate strategy could be reinforced have their roots in the above assignment, but we also wish to stress the following important points.

- Solving the climate problem requires a high degree of international collaboration. It is, for example, of great importance that the EU countries find joint ways of reducing emissions, thus enabling them to drive global developments forward. In the Swedish national strategy, there should be a stronger link to international and joint EU policy instruments.
- The proposals must also have a long-term perspective and not simply be based on the short-term achievement of targets in Sweden.

10.1 Strategically important measures in a long-term perspective

There is a risk of attaching too much importance to different ways of meeting short-term targets. At the same time, it is important to pay attention to changes that are important in achieving long-term targets. We have identified some strategic areas that are particularly important if long-term targets are to be achieved in Sweden and globally.

In Sweden, for example, we have so far managed to reduce methane emissions to a quite large extent, primarily from waste landfills and agriculture, and the forecast points to possible further reductions of these emissions, contributing to meeting the target by 2010. Methane has a very significant impact on the climate, while the period in which it remains in the atmosphere

is relatively short, so early action to achieve reductions in methane emissions does not really have very great importance with respect to long-term goals. Action to reduce emissions of other greenhouse gases, particularly carbon dioxide, does however.

Investments with a very long lifetime are of particular interest in a long-term climate strategy since the investment decisions of today are the basis for the use of resources for a long time to come. *Buildings and transport infrastructure* are key areas[20]. New construction provides the greatest opportunities for reducing energy use at low cost. It is also important to provide incentives for reduced energy use during extensive renovation.

Infrastructure investments and localisation issues in physical planning often have relatively short-term, limited effects on total transport kilometres but as the various actors adapt themselves to new transport conditions, they might have long-term importance for developments in transport kilometres.

It is of great importance that favourable, stable conditions are provided for *increased introduction of renewable energy* in the ongoing adaptation of the energy system. It is also of central importance that wide-ranging economic investment takes place primarily in types of infrastructure that have long-term potential for use even when emissions of greenhouse gases need to be further reduced. This is also highly relevant in developing countries in which the economy and the energy system are being built up.

Greater energy efficiency in all sectors of society is a further key area. The ongoing extension of the district heating network, replacing direct electricity and other sources of heating, is one example of an efficiency measure that can contribute to the achievement of both short-term and long-term targets. Improvements in the fuel efficiency of new cars provide positive effects in a short-term perspective, but also influence emissions in the long term since cars have a relatively long lifetime in the Swedish car pool.

Technology dissemination and development of new technology are also central factors in meeting long-term targets and consist of an interplay between inventors, entrepreneurs and the market. Market demand is necessary for technology development to pick up speed and the creation of niche markets can be one contribution to the achievement of the long-term climate targets. Trust in stable rules of play will be important in getting various actors to take

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20) Radanne P. 2004. *Reducing CO_2 emissions fourfold in France. Introduction to the debate.* French Interministerial Task Force on Climate Change (MIES).

the initiative. Implementation of new technology in developing countries can also contribute to sustainable development of these countries.

10.2 Forecast and targets

A review of emission trends in Sweden and the results of the new forecast of total emissions in Sweden to 2010 show that Sweden's climate strategy has so far influenced emissions in several sectors. Overall, emissions are assessed as being lower than Sweden's commitment under the EU burden-sharing scheme under the Kyoto Protocol, but will exceed Sweden's national target. Developments in the different sub-sectors are heading in different directions however. Total emissions are estimated to increase after 2010. The forecast for those sectors[21] initially covered by the EU ETS points to emissions from these sectors showing an overall *increase* of 25 % to 2010 compared to 1990 levels, while emissions in the non-trading sectors *fall* during the same period by 12 %. The non-trading sector also includes the transport sector, whose emissions are expected to increase. So it is the other non-trading sectors, such as domestic and commercial premises and the agricultural and waste sectors, that contribute large emissions reductions to the forecast.

If the short-term national target of 4 % lower emissions in 2010 compared to 1990 is to be achieved, emissions must fall by a further 2 million tonnes carbon dioxide equivalents. Should the Riksdag choose to abolish carbon dioxide tax in the trading sector, emissions must fall by a further 1 million tonnes. Sweden's commitment within the EU and under the Kyoto Protocol is however achieved in our forecast even if carbon dioxide tax is abolished.

As we showed earlier, the introduction of the EU ETS makes it illogical in principle to retain a national target definition that puts a cap on total emissions in Sweden, including the emissions that are included in the trading scheme. We instead propose the introduction of an offset target[22] so that emissions in the trading sector are deemed equivalent to the total amount of emissions allowances allocated to plants in the sector for the 2008–2012 period. Changes in emissions in the trading sector (increases as well as decreases) will have a corresponding purchase or sale of emissions allowances.

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21) Covers from 2005 the emission of carbon dioxide from power and heating plants, oil refineries, plants that produce and process iron, steel, glass and fibreglass, cement and ceramics, and plants that produce paper and pulp. More gases and more sectors may be covered by the system after 2008.

22) The Flex Mex 2 Commission of Inquiry, in its sub-report Trading for a Better Climate (SOU 2003:60) has also presented this proposal.

The purchased emissions allowances are in this way offset when the achievement of the national interim target is calculated. To meet the target, the sum total of allocated rights in the trading sector and the actual emissions in the non-trading sector must be lower than the target of 4 % lower emissions. Such a revised target structure will not increase emissions in the EU, since the increase in emissions that takes place at plants in one country within the trading scheme are compensated by reductions in emissions in another country.

10.3 The need for further and revised policy instruments

With the target structure that we propose, the need of policy instruments in the sectors outside the trading sector is thus dependent on the amount of emissions allowances allocated to the plants in Sweden that are covered by the trading scheme. If the trading sector is given a *high* allocation, this means that other sectors must reduce their emissions to a corresponding degree. If the trading sector is given a *low* allocation, more measures will instead be implemented within the framework of the EU system. The allocated amount of emissions allowances for the 2008–2012 period has not yet been decided. The Commission has not yet made a decision on the countries' allocation plans for the introductory period. Sweden is to submit a proposal for a national allocation plan for the 2008–2012 period in the summer of 2006. The basis for this is to be produced by the Flex Mex 2 Commission of Inquiry.

According to our calculations and those done using the EMEC model, there are socioeconomic motives for an allocation of emissions allowances somewhat below the current forecast for the trading sector[23].

The model calculations show that the aggregate economic effect, measured in effects on GDP, is small. The result however supports the above conclusion, since a somewhat lower allocation to those sectors covered by the trading scheme in combination with lower taxes in other sectors will *overall* have positive effects on GDP, even if these effects are small. For more detail, see the report on flexible mechanisms.

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23) An overall allocation according to this principle is also in line with the European Commission's criteria for national allocation plans. It should be emphasised that our assignment has not included analysing *how* allocation should take place in the trading sector.

The result is due to the assessment that the average cost of reducing emissions in sectors outside the trading scheme is higher than the assumed price of emissions. The cost of measures varies between different sectors, and is influenced by a number of factors, including what carbon dioxide tax level has applied/applies. The use of fossil fuels for domestic heating and for transports is today subject to a relatively high carbon dioxide tax. The general carbon dioxide tax is today SEK 0.91 per kg and we have in our calculations worked on the basis of an emissions allowances price in the trading scheme of SEK 0.10 per kg.

Sweden would also be able to use emission reductions from measures carried out in other countries (emission credits from JI/CDM). Our assessment is that the emission reduction units given within the framework of the ongoing programme can be used as a reserve and can be saved for the next commitment period. Read more about this in Chapter 10. Emission credits from the project-based mechanisms will also be included in the trading sector through links from the trading scheme to the project-based mechanisms.

It should also be noted that Sweden, with its national emission target of –4 %, will hold saved assigned allowance units (AAUs) under the EU burden-sharing agreement (as a party to the Kyoto Protocol).

The figures below illustrate the various components that together make up Sweden's options prior to the target period (both international and national) 2008–2012. The aim is to clarify and describe. The route chosen can be a combination of some of the described options. Our proposal, presented later in this chapter, is a combination of the two middle bars.

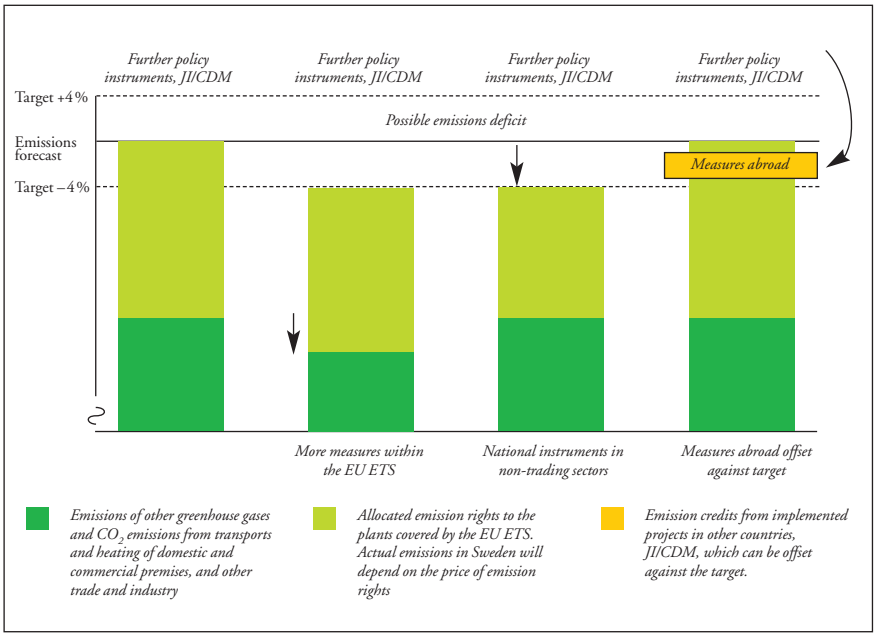

Figure 28. Sweden's options prior to the 2008–2012 commitment period (national target and international commitment).

A calculation with allocations according to the current proposal for the period 2005–2007

As mentioned previously, the allocated amount of emissions allowances for the 2008–2012 period has not yet been decided. We wish to illustrate how the allocation level can affect results anyway, using a calculation.

If, *for example*, emissions allowances corresponding to approx. 23 million tonnes of carbon dioxide equivalents are allocated for the 2008–2012 period (corresponds to the cap in the interval proposed in the Swedish allocation plan for the 2005–2007 period), allocation will be 13 % under the forecast emissions in the trading sector in the alternative in which carbon dioxide tax is retained, and 16 % under the forecast emissions when carbon dioxide tax is abolished.

In this example, Swedish plants are expected to be net purchasers of emissions allowances and the emissions for Sweden, i.e. the sum total of the allocated amount and the forecast emissions in the non-trading sectors, is about

68 million tonnes, which is 6% below 1990 emissions. So, emissions *for* Sweden are under –4%. Even with a somewhat less stringent allocation to the trading sector, a 4% target, expressed as an offset target, is met. No proposal for further or extended policy instruments would in principle be necessary if such an allocation is given.

10.3.1 Sectors outside the trading scheme

Our view is that regardless of whether the interim target for 2008–2012 appears to be achieved, it is still justified to make some changes to the climate strategy now, since there is an extensive need of measures in the long term. The proposals will also help in a future scenario involving more stringent international commitments. The policy instruments are long-term strategic ones, i.e. provide direction on changes that will be needed in the longer term.

We propose the following changes to policy instruments for sectors outside the trading sector (assuming an allocation of emissions allowances somewhat below the current forecast)

- introduction of CO_2-differentiated vehicle taxes for light vehicles,
- that the free-fuel benefit for company cars be valued at a factor of x1.8 market price, instead of the present 1.2,
- introduction of kilometre tax for trucks from 2008,
- continued and increased national funding support to local climate investment programmes during the period 2006–2008. The programmes should primarily give grants to long-term strategic measures,
- continued climate information campaign for 2006–2008,
- The EC Directive on the energy performance of buildings is implemented in a way that utilises the potential for greater energy efficiency.

We also propose that

- continued and increased national funding be given for work on a programme of Joint Implementation and the Clean Development Mechanism in 2005–2012.

The motives for the proposals are above all their long-term significance, but in the short term, the measures in the transport sector are deemed to lead to an overall reduction in emissions in Sweden of just over 0.5 million tonnes carbon dioxide equivalents per year for the 2008–2012 period.

The reasoning behind the policy instruments is described below. For more detailed description of the proposals, see the reports on policy instruments and flexible mechanisms.

Proposal for new and revised policy instruments in the transport sector

The need of change in the transport sector is particularly great since emissions are expected to continue to increase in this sector. The proposals contribute to suppressing the heavy increase in emissions shown in the forecasts.

The current Swedish passenger car pool has a high level of fuel consumption and high carbon dioxide emissions compared to other European countries. We propose that *annual vehicle tax for new cars be differentiated according to cars' carbon dioxide emissions and that it be adjusted for existing cars.* The proposal is estimated to reduce the average fuel consumption of new cars by approx. 2%. A similar proposal has just been submitted by the Road Tax Commission of Inquiry (SOU 2004:36).

Differentiation of annual vehicle tax will only to a limited extent influence the selection of company cars. Company cars are heavier, more powerful and consume more fuel than the average new car. Since company cars are 25% of all new cars, the design of company car benefit rules controls a significant portion of the energy-efficiency of the car pool. One important factor that counteracts energy efficiency is that company car drivers who receive free or partly free fuel do not need to pay the full cost of fuel for their private use. One of the goals of the 1997 change in regulations in which the free fuel benefit was taxed for the first time was that company car holders would pay the fuel for private driving. Today, that target has only been met to 50%. To contribute to achieving the target of reaching full cost for private driving, the *benefit value factor for free fuel must be raised from the current 1.2 to at least 1.8.*

A kilometre-based *tax on trucks over 3.5 tonnes should be introduced to cover society's economic costs for road transport of goods, starting in 2008.*

The European Commission has produced a proposal for kilometre tax. The governments of several countries have also expressed a willingness to introduce this type of system. Switzerland already has a system and Germany has decided to introduce km taxes.

The level of the charge determines the extent to which goods transports will become more energy efficient. The higher the moveable fee, the greater the transfer to more energy-efficient types of transport such as railways and maritime transport. The fee is also an incentive to make truck transports more efficient. The kilometre tax that we propose is expected to suppress the increase in transport kilometres by road by 10 percentage points, from a 35 % increase to a 25 % increase to 2010 compared to 2001 levels. Our proposal is based on the proposal recently submitted by the Road Traffic Tax Commission of Inquiry.

Local climate investment programmes, Klimp

The development of *local climate strategies* in which the potential of physical planning is utilised and transport developments are weighed in can be stimulated using government grants such as *Klimp*. Local climate investment programmes can thereby become an instrument that contributes to long-term structural change. To support this local climate work, we propose further and increased government funding in the form of climate investment programmes for the 2006–2008 period.

The programme of grants to local climate investment cannot be justified in the short term using cost-effectiveness arguments, but can by the motive of increasing long-term knowledge and commitment in the municipalities about climate work. There are many cases in the municipalities when the physical measures are carried out by companies, individuals and the municipalities themselves. The work of municipal and regional targets and programmes of measures in the climate, energy and other fields that are important in the climate issue is therefore an important part of an overall strategy. National grant systems like Klimp can assist in this work.

Climate information

Information measures are important given the background of the long-term perspective that characterises climate policy decisions and measures. Information and communication with the right focus and convincing arguments can help raise awareness of what must be done to limit climate change. This increases understanding and acceptance of policy instruments. Directed information together with other policy instruments can increase the effects of these. Continued climate information measures can also supplement the resources (municipal energy advisory services) that exist in the energy field.

Other energy efficiency

Besides the transport sector, the domestic sector and trade and industry are other key areas for increased energy efficiency. Within these sectors, there are or will be a number of policy instruments. We are for example currently drawing up a programme for energy efficiency for energy-intensive industry. The EC directive for the energy performance of buildings is currently being implemented in Sweden. Here, we feel that Sweden should implement the directive in a way that utilises the potential for greater energy efficiency. There are also other directives within the EU that aim to influence developments towards more energy-efficient solutions. The directive on ecodesign of energy-consuming products (the ecodesign directive) and on efficient final use of energy and energy services (the energy services directive) are currently being negotiated. All of these directives have the potential of making a contribution to the long-term climate target.

We think that no more initiatives should be taken at present, but that the strategy instead should be to:

- ensure that the directives have a strong position, with clear requirements and targets
- clarify and fine-tune existing policy instruments

Project-based mechanisms

Measures in the project-based mechanisms are to contribute to an international adaptation of the energy system towards one with less climate impact and will be part of Sweden's contribution to developing the flexible mechanisms of the Kyoto Protocol. The measures will give the government and businesses the opportunity to participate in JI and the CDM, in the process acquiring emission reduction units which are to be able to be used to supplement domestic measures to meet Sweden's obligations under future international commitments.

The programme should consist of three parts:

1) Swedish investments in JI and CDM projects
2) Special measures for small-scale CDM projects in the least developed countries
3) Support and advice to Swedish companies participating in JI and CDM

The need of further policy instruments in a high allocation

In a high allocation to the trading sector, in our example at the level of the baseline forecast, our assessment is that policy instruments that reduce emissions in Sweden by a total of approx. 1.5 million tonnes carbon dioxide equivalents[24] may need to be introduced. Apart from the proposed policy instruments described earlier, further reductions in emissions in Sweden can be achieved through:

- Increased energy tax on motor fuels (petrol, diesel),
- Furthermore, an increase in carbon dioxide tax for other trade and industry (outside the trading scheme) might lead to some reduction in emissions. Further analysis is required to show the socioeconomic effects of such an increase.

Another way of achieving the target in this case might be to use the emission credits that Sweden is expected to receive through ongoing measures in other countries via the project-based mechanisms.

Comments on an increase in energy taxes:

Current energy taxes on petrol are SEK 2.68/litre and for diesel SEK 0.78/litre. Since 2000, energy taxes on fuels have been reduced to the same degree that the general carbon dioxide tax has been increased, so that the total tax burden in real terms (adjusted for the consumer price index) has remained constant.

The energy tax can be justified both for fiscal reasons and as a means of internalising the external costs to society to which that the use of fuel gives rise. The effects of the successive reduction in energy taxes has been that the energy tax revenues of today do not bear the external costs to society that arise during use. There are, then, socioeconomic motives *for raising current energy taxes.* If energy tax is to be raised, then it should be done in stages to give fuel consumers time to make the adjustment prior to a long-term increase of energy tax to achieve full internalisation. Other environmental effects, then, than carbon dioxide emissions would justify an increase in energy tax but the effect

24) Further reductions in emissions of a total of 0.5 million tonnes of carbon dioxide equivalents are not part of the baseline forecast. These are deemed to arise as a result of the coming regulation limiting fluorinated greenhouse gases that is now being negotiated in the EU, and the ongoing Klimp programme. These policy instruments therefore reduce the overall need of measures.

of a fuel tax increase is the same from a climate viewpoint. An increase in energy tax on fuel should take place within the framework of a green tax exchange with reductions of other taxes so that no overall loss of wealth arises.

10.3.2 Activities covered by the EU trading scheme

One important issue in the introduction of trade in emissions allowances is whether the trading sectors in the future are to pay carbon dioxide tax. Using the offset target that we propose, total emissions for the sectors covered by the trading scheme in Europe are determined by the total allocation to the trading scheme. Further policy instruments in the trading sector in Sweden will not affect total emissions in Europe.

A trading scheme for emissions allowances has the theoretical advantage that measures to reduce emissions will take place where this is cheapest. If the system is developed so that the companies can predict that the amount of emissions allowances on the market will fall, good conditions are also created for structural change that is favourable to the achievement of long-term climate targets.

In a well-functioning system, supplementary instruments (such as carbon dioxide tax) should therefore not be charged to activities that are in the emissions trading scheme, since this can lower the cost-effectiveness of the trading scheme and distort competition.

At the same time, it is important at the initial stages of the trading scheme, when the price of emissions allowances can be expected to be low, to retain some supplementary instruments to promote the structural change that will make it easier to achieve long-term climate targets.

Further policy instruments in the trading sector can also be justified in that other objectives must also be fulfilled. One of these is the energy policy objective of increasing the proportion of renewable energy in the Swedish energy system. It is therefore important to maintain the competitiveness of biofuels in the production of electricity and heating, even when trade in emissions allowances is introduced. Another energy policy argument is the security of Sweden's energy supply.

Proposals for current policy instruments in the sectors that will be covered by the EU ETS

For current policy instruments in sectors that will be covered by the EU emissions allowances trading scheme, we propose that:

- Carbon dioxide tax for industrial energy use is abolished.
- Carbon dioxide tax for heat production in hot-water boilers is retained, but the level can be reduced.
- Carbon dioxide tax for combined heating and power plants is abolished, provided that:
  - The electricity certificate system is extended, and the quota raised after 2010
  - The same allocation principle (within the framework of the EU trading scheme) applies to biofuels and fossil fuels in new CHP plants.

The reasoning behind the policy instruments is described below.

Carbon dioxide tax for industry is abolished

To maintain the competitiveness of international trade and industry, we propose that carbon dioxide tax for these companies be abolished. Industrial enterprises that are in the emissions allowances trading scheme act in a competitive international market where prices are set globally. An increased cost of carbon dioxide emissions thus means that these companies cannot shift these costs onto their customers by increasing prices. A large proportion of the companies' emissions are related to production that in an international comparison already takes place at relatively low carbon dioxide intensities. These companies will find it difficult to reduce their carbon dioxide emissions without reducing production.

Levying higher costs for carbon dioxide on these companies than on their European competitors might have unwanted effects on growth and employment. Today, industry within the trading scheme uses fossil fuels to a very large extent. Our analyses show that emissions would increase by over 0.2 million tonnes of carbon dioxide[25] to 2010 if carbon dioxide tax was abol-

25) At an emission price of 10 euros per tonne.

ished for industry's energy use. We feel that an increase of this scale does not justify levying carbon dioxide tax on this part of the trading sector.

Carbon dioxide tax is retained in heating plants – but the tax level is reduced
The use of biofuels in district heating has climbed steadily throughout the 1990s and today represents about 60 % of total fuel use. Such use is even greater in pure heating production. An important component in the conversion has been the ever-higher tax levels on fossil fuels for heat production. So that use of biofuels will remain at a high level, we recommend that the tax on carbon dioxide is retained for heating plants. Our model calculations show that when carbon dioxide tax is abolished, the use of fossil fuels increases at the expense of biofuels, above all in the post–2010 period.

Heating plants are active in a local market without international competition. So if the tax is retained, this will not affect the competitiveness of the companies in relation to other plants that are in the emissions trading scheme. It is however important to maintain the competitiveness of district heating compared to other types of heating. We propose therefore that carbon dioxide tax is retained but that it is reduced so that the total cost of carbon dioxide (tax plus emissions allowances price) will not exceed today's carbon dioxide tax level.

So that the emission trading scheme and a retained carbon dioxide tax will have a controlling effect together, it is important not to introduce deductions for emissions allowances costs against today's carbon dioxide tax. Such a structure would reduce the effect of the trading scheme. A lower level of carbon dioxide tax is preferable. The lower level should be set with some margin for changes in the price of emissions allowances. This means that the total carbon dioxide cost (tax plus emissions allowances price) will be somewhat lower than today. Our view however is that a carbon dioxide cost that is lower than today's carbon dioxide tax will still have a controlling effect. Exactly what the reduced level should be and what margins are necessary to avoid double taxation should be investigated further within the framework of the reform of the energy tax system that the Cabinet Office is working on.

Carbon dioxide tax is abolished for combined power and heating plants, under certain conditions

We propose that carbon dioxide tax for combined heating and power plants be abolished provided that new CHP plants, including biofuel plants, are allocated emissions allowances in the same way in the future application of the trading scheme, and that the system of electricity certificates is extended to 2020 with continued raised quotas.

If new fossil-based heating and power is allocated some emissions allowances free, at the same time as biofuelled heating and power is not given an allocation, this means that fossil-based heating and power is favoured in relation to biofuel at the time of investment. Calculations of production costs for new plants show that the allocated amount of emissions allowances is important if competitiveness is to exist between fossil-based and biofuelled heating and power.

The primary aim of the electricity certificate system is not explicitly to favour biofuelled power and heating in relation to fossil-fuelled power and heating. The set electricity certificate quota controls how much renewable electricity will be generated within the energy system overall. What production technology or what fuel is used is not controlled by the electricity certificate system. Our calculations however show that the electricity certificate price plays an important role in the ability of biofuels to compete in combined heating and power if carbon dioxide tax is abolished. If the electricity certificate quota is not raised in the period beyond 2010, our forecast assessments show that with a low emission trading price, extra electricity from CHP plants will be fossil-based. To maintain the competitiveness of biofuelled combined heating and power, without carbon dioxide tax, we propose that the electricity certificate system is extended with raised quotas after 2010.

It should be pointed out however that the competitive situation between the fuels is finally dependent on several prices that are determined in different markets: fuel prices, emissions allowances prices, electricity certificate prices.

With the combination of proposals outlined above, we think that the competitive situation of biofuels has been taken into account at the same time as the competitiveness of combined heating and power with regard to condensation power and other combined heating and power on the Nordic market is retained.

10.4 Socioeconomic effects of our proposals

The table below gives a short summary of the socioeconomic effects of our proposals. The report "Evaluation of the Policy Instruments of the Climate Strategy" gives a more detailed description.

Table 7 Socioeconomic effects of our proposals

Summary of socioeconomic effects	The proposal for differentiated CO_2 vehicle tax gives a socioeconomic gain of reduced CO_2 emissions – calculated at SEK 0.91/kg – which is greater than the socioeconomic losses of negative growth/employment. The socioeconomic calculation shows a total of approx. SEK 1.5 billion in gain over 20 years.
	Introduction of Km tax makes goods transports by road pay for their costs (emissions, accidents, road wear etc.) That is to say, without Km tax the socioeconomic losses are higher than what trucks pay in energy tax. The proposed Km tax level is weighted for maximum socioeconomic efficiency.
	An increase in the factor for free fuel in the car benefit rules will contribute to company car benefit holders' paying the full fuel costs of their private driving. Not assessed as having any negative consequences for employment/growth.
Environmental impact	2010: Reduction of 0.5 million tonnes CO_2-eq, 2 thousand tonnes NOx
	2020: Reduction of 0.8 million tonnes CO_2-eq, 2.5 thousand tonnes NOx
Growth	Km tax: For trade and industry as a whole, transport costs are under 2 % of the goods value of the transported goods. For the forestry and construction industry sectors, transport costs are a somewhat higher proportion.
Employment	The redesign of vehicle tax is estimated to influence employment in the car sector to a small extent.
	Km tax limits future employment in the road transport industry somewhat, but gives increased employment for maritime transport/rail.
Distribution effects	A redesign of vehicle tax gives a transfer of wealth from households with big cars (often large households in rural areas) to households with small cars (more common in urban areas).
	Km tax increases costs for the road transport industry which benefits rail/maritime transport. No regional distribution effects are expected to arise. Revised company car benefit rules give increased costs for those company car holders who have free fuel.

Economic effects at government level are summarised in the table below. For an overview of the national economic effects, the proposals submitted by the Road Traffic Tax Commission of Inquiry should be taken into account as should the ongoing work of the Flex Mex 2 Commission of Inquiry and the work of reforming the energy tax system that is ongoing in the Cabinet Office.

Table 8 National economic effects of our proposals

Proposed policy instrument	Budgetary revenue/cost
Km tax	Will likely give at least 5 billion in annual revenue.
Increase in vehicle tax for older cars	Gives approx. 0.5 billion in increased revenue.
Differentiation of vehicle tax for new cars	Neutral in budgetary terms
Abolished carbon dioxide tax on CHP plants under certain conditions	Involves a loss of tax revenue of about SEK 500 million per year.
Reduced carbon dioxide tax for heat production in hot water boilers.	Involves a loss of tax revenue that is dependent on how great the reduction is. Current tax levels give government revenue of about 250 million SEK per year.
Abolished carbon dioxide tax for industry in the trading sector	Involves a loss of tax revenue of about SEK 650 million per year.
Extension of electricity certificate system with raised quotas	Neutral in budgetary terms, since the certificate system is outside the national budget. If the electricity certificate fees continue to be subject to VAT, the system generates considerable annual tax revenue to the government.

10.5 Conclusions concerning other policy instruments in the Swedish climate strategy

Research/development are important for long-term developments

Our assignment has not included an analysis of this field however.

Extended trading scheme to more sectors/gases

One conceivable change that we have not analysed in depth is a possible extension of the EU trading scheme to more sectors (emissions). Sectors that might come into question are the entire chemicals industry, the aluminium industry, plants for incineration of domestic waste and transport sectors. The consequences of this are being examined in more detail by the FlexMex2 Commission of Inquiry.

Effects of tax increases in the domestic and service sectors

The domestic and service sectors are already covered by a high level of carbon dioxide tax. The calculations we have done show that further tax increases lead to very small reductions in emissions. The measures that a further increase would lead to are also more expensive than measures in other sectors that have a lower tax burden. Bearing in mind that we have not been able to show significant reductions in emissions as a result of increased taxes in this sector, it is not justified from a cost-effectiveness viewpoint to further increase general carbon dioxide tax for the domestic and service sectors.

Tax-exemption alternative fuels

The most important conclusions of our evaluation of tax exemption for biofuels is that it gives an over-subsidisation of low-level mixing of ethanol into petrol, will not lead to increased ethanol production in Sweden and that the EU quality requirement permitting a maximum of 5 % ethanol mixture in petrol prevents the achievement of the target of 5.75 % biofuel in the transport sector.

The most cost-effective way of increasing the proportion of renewable energy in the transport sector is today low-level mixing into conventional motor fuels. It is therefore important that Sweden in the EU continues to take the initiative to achieve a change of the highest permitted alcohol mixture from 5 % to 10 %.

cont. >>

In principle, we think that research to develop new process technology that can produce biofuels at lower cost is more important, for example in the form of pyrolysis of cellulose to synthesis gas for further production of various biofuels. At present, we do not wish to submit a specific proposal about biofuels, but will allow the ongoing Commission of Inquiry[26] to propose policy instruments for the introduction of biofuels. This Commission of Inquiry is to submit its findings on 31 December 2004.

Proposals for other trade and industry

One conceivable change is to increase carbon dioxide tax for other trade and industry (those activities not included in the trading scheme). More information must be produced however to show the socioeconomic effects of such an increase (both emissions and growth). Alternative policy instruments should be investigated at the same time. For example, policy instruments that influence developments towards greater energy efficiency.

Proposals for transports

Carbon-dioxide differentiated company car benefit rules

We propose a special Commission of Inquiry with the task of submitting a detailed proposal for the redesign of the Swedish system of assessing the value of the company car benefit so that it becomes based on carbon dioxide emission

Index-link fuel taxes to GDP rather than CPI

We propose that a recalculation of carbon dioxide and energy taxes on vehicle fuels to follow growth of GDP rather than the CPI should be investigated together with Statistics Sweden (SCB).

26) Dir. 2003:89, Introduction of renewable vehicle fuels, 3 July 2003.

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Criteria for the national allocation plans

1. The total quantity of allowances to be allocated for the relevant period shall be consistent with the Member State's obligation to limit its emissions pursuant to Decision 2002/358/EC and the Kyoto Protocol, taking into account, on the one hand, the proportion of overall emissions that these allowances represent in comparison with emissions from sources not covered by this Directive and, on the other hand, national energy policies, and should be consistent with the national climate change programme. The total quantity of allowances to be allocated shall not be more than is likely to be needed for the strict application of the criteria of this Annex. Prior to 2008, the quantity shall be consistent with a path towards achieving or over-achieving each Member State's target under Decision 2002/358/EC and the Kyoto Protocol.

2. The total quantity of allowances to be allocated shall be consistent with assessments of actual and projected progress towards fulfilling the Member States' contributions to the Community's commitments made pursuant to Decision 93/389/EEC.

3. Quantities of allowances to be allocated shall be consistent with the potential, including the technological potential, of activities covered by this scheme to reduce emissions. Member States may base their distribution of allowances on average emissions of greenhouse gases by product in each activity and achievable progress in each activity.

4. The plan shall be consistent with other Community legislative and policy instruments. Account should be taken of unavoidable increases in emissions resulting from new legislative requirements.

5. The plan shall not discriminate between companies or sectors in such a way as to unduly favour certain undertakings or activities in accordance with the requirements of the Treaty, in particular Articles 87 and 88 thereof.

6. The plan shall contain information on the manner in which new entrants will be able to begin participating in the Community scheme in the Member State concerned.

7. The plan may accommodate early action and shall contain information on the manner in which early action is taken into account. Benchmarks derived from reference documents concerning the best available technologies may be employed by Member States in developing their National Allocation Plans, and these benchmarks can incorporate an element of accommodating early action.

8. The plan shall contain information on the manner in which clean technology, including energy efficient technologies, are taken into account.

9. The plan shall include provisions for comments to be expressed by the public, and contain information on the arrangements by which due account will be taken of these comments before a decision on the allocation of allowances is taken.

10. The plan shall contain a list of the installations covered by this Directive with the quantities of allowances intended to be allocated to each.

11. The plan may contain information on the manner in which the existence of competition from countries or entities outside the Union will be taken into account.

The current Swedish climate strategy was adopted by the Riksdag (Parliament) in March 2002. The strategy is designed so that Swedish climate work and progress towards the national target are to be followed up on an ongoing basis. Special checkpoints were inserted for the years 2004 and 2008 in which the climate work is to be evaluated. If emission trends appear less favourable at these times, new measures can be proposed and/or the target reconsidered.

The Environmental Protection Agency and the Swedish Energy Agency have had the government's assignment of compiling a basis for the first evaluation at the 2004 checkpoint.

This report describes the most important conclusions and results of our work on this assignment. The work is described in detail in four reports:

SWEDISH ENVIRONMENTAL
PROTECTION AGENCY