Foreword

Under the terms of Article 14(2) of EC Directive (2006/32/EC) on energy end-use efficiency and energy services, Member States must submit National Energy Efficiency Action Plans (NEEAPs) on three occasions over the period 2007–2016. In the first action plan, Member States must describe what actions are planned to enable the Directive's two indicative energy savings targets pursuant to Articles 4(1) and 4(2) to be achieved. Member States must also describe how the specific requirements governing the public sector pursuant to Article 5(1) and the provision of information and advice to final customers pursuant to Article 7(2) are to be fulfilled.

The present document forms Sweden's first action plan pursuant to Article 14(2). The action plan is based on extensive analysis work, not least in relating energy efficiency improvements in the end-user chain to more general systemic effects of such energy improvements. An explicit aim has, for example, been to relate the effects of the EC Directive to the proposed EU target of a 20 per cent saving in primary energy by the year 2020.

The action plan has been drafted by an independent commission of inquiry under the aegis of the Ministry of Enterprise, Energy and Communications, the Energy Efficiency Improvement Commission of Inquiry (NM 2006:06). The results of the analysis work are set out in detail in the Commission of Inquiry's subreport *A more energy-efficient Sweden* (SOU 2008:25). In light of how the work on implementing the Energy End-Use Efficiency Directive has been organised in Sweden, possible future policy instruments are, among other things, described below in the form of *proposals* by the Commission of Inquiry.

Stockholm, February 2008
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Summary

Europe needs to save energy. There are many good reasons for this. By European standards, Sweden consumes high levels of energy, on a *per capita* basis. This is attributable to such factors as Sweden's cold climate, its energy-intensive industrial production, the country's sparse population and the great distances to be covered by transport. Work on improving energy efficiency has been going on in Sweden for several decades. Many steps have already been taken which have helped cut Swedish energy use within the housing and services sectors and also within industry and transport. However, there is still great potential for boosting energy efficiency. For this to be achieved, operators of all kinds need a clearer understanding of energy efficiency enhancement, the economic gains that it can yield, new technology and the costs of energy use.

The EC Directive (2006/32/EC) on energy end-use efficiency and energy services (referred to below as 'the EC Directive') is an important tool in the Community's overarching pursuit of more efficient energy use throughout the Union. A key part of this is the national indicative energy savings target of 9% by the year 2016, relative to the base years 2001–2005, as referred to in Article 4(1). Under the terms of Article 14(2), Member States must, within *National Energy Efficiency Action Plans*, describes at set times how the target is to be achieved at national level.

Strategic principles

The EC Directive's savings targets are to be achieved with energy services and other actions that lead to more efficient energy use. At the same time, another overall savings target, to cut the use of *primary energy* in the Union by 20 per cent relative to calculated total primary energy use by 2020, has been proposed by the Commission.

The overarching objective of cutting the use of primary energy can, if it were to apply also at national level, be achieved only in part through the application of the Energy End-Use Efficiency Directive. It is therefore important to clarify how *primary energy use* is affected by the actions arising from the Directive's application, as part of the basis for further discussions within the Union concerning new and more ambitious savings targets. Against this background, this action plan describes energy levels both in terms of primary energy use and as energy *end use*. This also makes it possible to clarify the *actual* effect from the resource perspective – regardless of whether this effect arises in Sweden or another country – of energy use for a certain purpose, an energy efficiency improvement measure or increased energy use.[1] Conversion to primary energy has been carried out with the aid of weighting factors. The latter should be seen as providing an analytical tool which can, among other things, be used for prioritising *what type* of energy end use, e.g. electricity for heating via electric boilers or direct-acting systems, should be prioritised for boosting energy efficiency.

The weighting factors for converting energy end use to primary energy as used in the plan are set out in Table 1. The variation between different energy types for these weighting factors, and their respective savings potentials, reflect the primary energy resources consumed in generating 1 kWh of final energy with the various energy carriers.

Table 1 Weighting factors for various energy carriers for the base years and for future energy savings

Energy type/fuel	Weighting factor for the base years(mean)	Weighting factor for energy saving (marginal)
Electricity	1.5	2.5
District heating	0.9[2]	1.0[3]
District cooling	0.4	0.4
Petroleum products	1.2	1.2
Biofuel	1.2	1.2

[1] Energy purposes should be understood to mean, for example, heating a building, running a vehicle or operating a pump.
[2] The weighting factor for district heating may end up being changed during the period up to 2016.
[3] See footnote 2.

Work on the plan

An independent Commission of Inquiry under the aegis of the Ministry of Enterprise, Energy and Communications, the Energy Efficiency Commission of Inquiry (NM 2006:06), has been instructed to come up with proposals on how the EC Directive should be implemented in Sweden. Its terms of reference also include drawing up a draft version of the first energy efficiency action plan for Sweden in accordance with Article 14(2) of the Directive. The plan is based on extensive analysis work by the Commission of Inquiry. The results of this, and the considerations that prompted the drafting of the plan, are set out in further detail in the Commission of Inquiry's subreport *A more energy-efficient Sweden* (SOU 2008:25).

Savings targets and policy instruments

In light of what has, by way of introduction, been stated regarding the *systemic perspective* of energy use improvements, efficiency improvement results, etc. are set out below in terms of *primary energy*. In parallel with this, the results are, for information purposes, also described in terms of end-used energy levels. Such data are reported within brackets or in separate columns.

Quantification of the indicative target

The national indicative energy savings target means that a reduction in energy end use of at least *9 per cent* is to have been achieved by 2016 relative to average energy end use over the period 2001–2005. The energy savings target must be set as an absolute measure expressed in TWh or a corresponding unit. For Sweden, this means, in terms of primary energy use with the application of the weighting factors in Table 1, that a saving through increased energy efficiency of in total 41.1 (32.3) TWh is to be achieved by the year 2016.

Under Article 4(2) of the Directive, an indicative intermediate target must also be laid down, which is to be achieved by 2010. The Commission of Inquiry proposes that this subgoal, based on mean energy use for the baseline period of 2001–2005, be established as being *at least 6.5 per cent* more efficient energy use. This subgoal

means that a saving of at least 30.0 (23.3) TWh must be achieved by 2010. The scale of the subgoal has been determined on the basis of an assessment of reasonableness of what can be achieved during the remaining time till the year 2010. The subgoal must in practice be achieved by actions implemented during 2009. A quantification of the subgoal for the year 2010 and the final target for the year 2016 is shown in Table 2.

Table 2 Quantification of indicative target according to Articles 4(1) and 4(2) of the Directive, TWh

	Primary energy use with weighting factors in accordance with Table 1	Energy end use
Energy use in the base years	456	359
Subgoal 6.5 per cent of energy use in the base years, 2010	30.0	23.3
9 per cent of energy use in the base years, 2016	41.1	32.3

Effects of early actions and policy instruments already decided upon

The Directive allows ‘early actions’ whose impact is still being felt in 2016 to be credited when determining whether the indicative target has been achieved. Such actions must have been performed no earlier than 1995. In the case of general actions, e.g. taxes, effects as from 1991 may be credited.

The work on more efficient energy use has been going on in Sweden for decades. A large number of measures have already been implemented and have helped cut Swedish energy consumption. Chapters 5, 6 and 7 describe measures within housing and services, etc., industry and the transport sector, which have been implemented as from 1991 and 1995 respectively. These chapters also provide an assessment of the energy efficiency improvement effects expected to persist in 2016.

In spring 2007, at the instance of the Swedish Government, the Swedish Energy Agency conducted an appraisal of policy instruments available to date whose effects may be credited in accordance with the EC Directive. The Swedish Energy Agency has also calculated what scale of savings effect the policy instruments in question produce in relation to the savings target of at least 9 per cent. The Commission of Inquiry has assessed the quality of, and reviewed and supplemented, the Swedish Energy Agency's analyses.

Early actions (1991–2005)

In the case of housing and services, etc., the impact of actions conducted as from 1991 and 1995 respectively until 2005 is put at approx. 17.9 (11.5) TWh[4] according to Table 1. In the case of the transport sector, the residual impact of early measures is considered to be at least 6.0 (5.0) TWh. No early measures with a residual effect have been identified in the industrial sector.

In all, this means that approx. 24 (16.5) TWh more efficient energy use has been achieved by early actions.

Expected impact of policy instruments decided upon (2005–2016)

Besides the effect of early measures on improving energy efficiency, the impact of policy instruments *already decided upon* which are expected to be adopted between 2005 and 2016 must also be assessed.

In the case of the construction sector, the estimated impact of such measures is approx. 19.4 (8.9) TWh. In the case of the industrial sector, actions arising from policy instruments already decided upon are estimated to have a residual effect on energy end use of approx. 1.8 (0.7) TWh. Actions arising from policy instruments already decided upon for the transport sector over the same period are estimated to have a residual effect of at least 1.1 (0.9) TWh in 2016.

In all, this means that actions between 2005 and 2016 which are implemented with the aid of policy instruments already decided upon are estimated to lead to a primary energy improvement effect of approx. 22 TWh in 2016. This equates to approx. 10.5 TWh more efficient energy end use.

[4] Bracketed information in this and following sections relates to energy *end* use.

Summary of early actions and policy instruments already decided upon (for the period 1991–2016)

It is clear from Table 3 that the impact of early actions from the period 1991–2005 and the estimated impact for the period 2005–2016 of policy instruments already decided upon is approx. 36 TWh in 2010 and approx. 46 TWh in 2016. This means, still from a *primary energy perspective*, a total saving of 7.8 per cent in 2010 and 10.1 per cent in 2016.

From an *end-user perspective*, on the other hand, a savings effect of approx. 21 TWh would be achieved in 2010, with a savings effect of 27 TWh being obtained in 2016. For 2016, this saving equates to approx. 7.5 per cent of energy end use for base years 2001–2005, which on average totalled 359 TWh.

Table 3 Effects of early and existing policy instruments, and policy instruments decided upon, by social sector in 2010 and 2016, TWh

Sector	2010		2016	
	End-use	Primary	End-use	Primary
Early actions 1991/1995–2005				
Housing and services, etc.	11.5	17.9	11.5	17.9
Industrial sector	–	–	–	–
Transport sector	5.0	6.0	5.0	6.0
Existing policy instruments, estimated effects 2005–2016				
Housing and services, etc.	3.6	8.9	8.9	19.4
Industrial sector	0.7	1.8	0.7	1.8
Transport sector	0.7	0.9	0.9	1.1
Summary	21.5	35.5	27.0	46.3
Proportion of average energy use 2001–2005	6.0%	7.8%	7.5%	10.1%

Source: The Swedish Energy Agency, Dargay and the Energy Efficiency Improvement Commission of Inquiry.[5]

Results and the need for supplementary policy instruments

In 2005, Sweden had, as a result of early actions, achieved a primary energy efficiency improvement equivalent to approx. 24 (16.5) TWh compared with energy use in the base years. If the estimated impact of policy instruments decided upon is also taken into account, approx. 46 (27) TWh primary energy use, i.e. an efficiency improvement of more than 10 per cent, will be achieved in 2016. This should, in the view of the Commission of Inquiry, be regarded as an expression of the calculated *actual energy efficiency improvement* in the Swedish energy system. The conclusion drawn by the Commission of Inquiry is, in this light, that the energy improvement target is in practice already achieved by the accumulated impact of the early, existing and planned policy instruments.

Great potential for improving efficiency

What has just been stated does *not* mean that further energy efficiency improvements would be unnecessary or unwarranted. This is due, among other things, to the fact that the Commission of Inquiry has identified significant overall potential for improving energy efficiency in Sweden, which is conservatively put at approx. 65 (40) TWh. A principle adopted in the assessment of the scale of such potential is that only *profitable* energy efficiency improvements should be carried out.

Generally speaking, the results for the construction sector are considered to be the most reliable, whereas the results for the industrial and transport sectors are subject to greater uncertainty.

[5] Joyce Dargay, Effects of taxation on energy efficiency. Report to Energieffektiviserings-utredningen. Institute of Transport Studies, University of Leeds. February 2008.

Table 4 Estimated economic potential for improving energy efficiency in the respective sectors, TWh

	District heating and fuels [TWh]	Electr: [TWh]	Total potential, final [TWh]	Total potential, primary [TWh]
Construction	14	10	25	41
Industrial sector excluding ETS fossil fuels	3	3	6	11
Transport sector	10	-	10	12

An energy saving, via profitable actions, of approx. 65 TWh primary energy, equivalent to 40 TWh final energy, may be assumed to lead to significant economic savings for households and activities of all kinds. This should in all likelihood lead to favourable socioeconomic effects. Society's costs in respect of future policy instruments must, however, of course also be taken into account.

Against this background, and with regard to the aims underpinning the Energy End-Use Efficiency Directive, the authorities should in any event, and regardless of how the results of early, existing and planned policy instruments are calculated, strive to ensure that the rate of energy efficiency improvement increases. There are also close links between climate issues and energy efficiency improvement. The need to take vigorous action to limit greenhouse gas emissions is therefore another strong reason for bolstering efforts to boost Sweden's energy efficiency.

An important conclusion is that more significant improvements in energy efficiency, beyond those considered achievable, will not happen by themselves. Policy instruments of various kinds are required in order to go further. Such policy instruments entail costs for the general public. An overarching restriction is, however, that policy instruments must be cost-effective. Actions to improve efficiency must also be motivated from a socioeconomic perspective.

Potential future policy instruments

The Commission of Inquiry has identified thirty potential policy instruments which are recommended in the light of what has just been stated. The future policy instruments are described in greater detail in Chapters 4–6 in this action plan. Through the application of the future policy instruments, Sweden will, by a broad margin and regardless of the method of calculation, exceed the Energy End-Use Efficiency Directive's indicative savings targets. The policy instruments also mean that much of the calculated potential for boosting energy efficiency will be achievable.

One of the most significant policy instruments in the *housing and services, etc.* sector concerns more efficient electricity use through conversion of heating systems from electroheating to district heating, heat pumps and individual biofuel burning and also more efficient use of electricity consumed by households, businesses and operations. A separate *programme for more efficient electricity use* is planned. Other important policy instruments in the housing and services sector entail requirements governing energy conservation in connection with conversion and more rigorous application of the system of energy certificates for buildings.

In the *industrial sector*, an extension of ongoing programmes for improving energy efficiency in energy-intensive industry is planned together with broader scope so that forms of energy other than electricity are covered by energy efficiency improvement actions under the programmes. A completely new support system is proposed for other industry which is not energy-intensive, but which nevertheless accounts for about half of industrial energy use. The design of the system must be investigated further, but a conceivable model entails enterprises being allowed to make tax-free appropriations to an investment fund, which may be used for investments designed to boost energy efficiency.

In the transport sector, the most important new policy instruments entail tightening up vehicle taxation and preferential taxation for company cars, increased fuel taxes and State investments in research, development and demonstration projects. The new tax rules mean that the levying of tax will to a greater extent than now be linked to fuel consumption.

The public sector's special responsibilities

The general public, with the State, local authorities and county councils, must show other players the way in terms of boosting energy efficiency. The Commission of Inquiry proposes that the State should set an example to other players in the public sector via an extensive programme of more efficient energy use in State activities. The programme comprises energy management systems, energy-efficient procurement and special requirements governing the energy characteristics of new builds and in connection with the State leasing building or premises.

The local authorities, which are autonomous in relation to the State, are invited to conclude energy efficiency improvement agreements with the State as the counterparty. It is strategically important that the State sets a good example, including in the public sector. The agreement is to be harmonised with the requirements in the State energy efficiency improvement programme. During 2008, in collaboration with the Swedish Association of Local Authorities and Regions, a local authority interest group, the Energy Efficiency Improvement Commission of Inquiry intends to propose how framework agreements with local authorities of differing size can be devised. A similar agreement structure can also be applied in relation to county councils, which are the authorities responsible for, among other things, health care and public transport in Sweden.

Information on energy efficiency improvement and the community's specific responsibilities

Information drives regarding energy efficiency improvement and the community's specific role and responsibilities are coordinated within a *Forum for Energy Efficiency Improvement.* The main arena for such information dissemination will be a web-based information portal. An important task is, for example, the dissemination of information concerning good examples to various kinds of energy users such as households, property owners of various sizes, industrial and other enterprises and also, not least of all, public administrations within the State, local authorities and county councils.

A system for *benchmarking* is being introduced within the Forum for Energy Efficiency Improvement, whereby the general public can compare different authorities and local authorities with one another.

The issue of boosting energy efficiency is topical and of general interest. This is due not least to the great attention that climate issues have attracted recently. As a result, it can be expected that, for example, local authority inhabitants will make demands of their politicians if the local authority in question does not perform as well as others in its efforts to improve the efficiency of energy use. The media can be expected to play an important role in disseminating knowledge and information on the performances of different local authorities and State authorities and differences between them.

An overall strategy for a more energy-efficient Sweden

It is incumbent on the Commission of Inquiry to devise an overall strategy for a more energy-efficient Sweden. Some of the issues that should provide a focus for the coming Commission of Inquiry work in this connection are described below.

As has emerged from the foregoing, there are a number of close links between climate and energy policy. Boosting energy efficiency is an important tool in climate work. A general principle should therefore be for energy efficiency improvement to be viewed as *a central component* of overall work on climate and energy issues.

This strategy should, based on what has been set out above regarding, among other things, the Directive's scope and the central requirement for energy efficiency improvements to be viewed from a systemic perspective, encompass issues concerning *improved statistical information*, combined analyses of *the impact of policy instruments* and their mutual effect and concerning *information and advice* for various kinds of energy user. Improving the statistical basis is also an important action from the strategic perspective. In addition, the social sectors that have not hitherto been the object of more significant initiatives for boosting the efficiency of energy use should be prioritised in the energy efficiency improvement work. This concerns *the transport sector* and *the industrial sector*. Furthermore, responsibility for coordinating State initiatives, monitoring and following up their effects and for the provision of information on energy efficiency improvement should be combined within a central body.

An important conclusion of the Commission of Inquiry work is that greater knowledge is a strategic action if the pursuit of more effective energy use is to be successful. This applies not least to information on

the economic benefits of improving the efficiency of energy use. Against this background, overall and coordinated information drives encompassing both general information and information aimed at individual groups of energy users should be undertaken at an early stage.

1 Introduction

1.1 Background and object

A growing proportion of the energy used within the EU is imported from countries outside the Union. According to the Commission's Green Paper entitled *A European Strategy for sustainable, competitive and secure energy,* the proportion of imported energy in Europe totalled approx. 50 per cent in 2006. Unless action is taken, this proportion will in 20–30 years rise to between 70 and 80 per cent, according to the Commission. The Green Paper also makes clear that energy prices have risen sharply and that the climate is changing as a result of greenhouse gas emissions. Against this background, the Commission specifies that European energy policy should encompass three main aims: sustainability, competitiveness and security of supply.

Increasing the efficiency of energy use is an important mechanism for achieving the aims of energy and climate policy. An overarching objective at EU level is for Member States, through energy efficiency improvement measures, to be able overall to save 20 per cent of the primary energy that can be expected to be consumed in 2020.[6] This is apparent from the Commission's Action Plan for Energy Efficiency, which was presented in October 2006.[7] In March 2007, the EU's heads of state and heads of government agreed to stress the need to boost energy efficiency in Europe in order to achieve the savings target of 20 per cent of the EU's calculated primary energy use in 2020, which the Commission has proposed. At the same time, the importance of Member States using their national action plans for energy efficiency for precisely this purpose is emphasised.[8] The

[6] 'Primary energy' should be understood to mean all energy consumed, from fuel source to end user. Primary energy therefore includes, besides the level of energy end use, the losses arising in energy production from extraction, transportation, conversion and transfer.
[7] COM (2006) 545 final. The final burden sharing between the Member States will be decided upon in future negotiations.
[8] The presidency's conclusions at the Council meeting of 8–9 March 2007 (7224/1/07 REV 1).

Council agreement should be viewed as a declaration of principle concerning a common approach and objective with regard to improving energy efficiency. The aim of a 20 per cent saving on primary energy is, on the other hand, not as yet legally binding on Member States. However, it was the Directive (2006/32/EC) on energy end-use efficiency and energy services (referred to below as *the Directive*) that was adopted by the European Parliament and the Council on 5 April 2006. The Directive is an instrument for achieving more efficient energy use in Europe and can therefore be seen as one of a number of ways of attaining the overarching savings target of a 20 per cent cut in the use of primary energy.

1.1.1 Object

The present document constitutes the first Swedish action plan for more efficient energy use pursuant to Article 14(2) of EC Directive 2006/32/EC. The plan describes, in short, the policy instruments already used, that have been decided upon or that are now proposed in the relevant social sector for achieving the savings target. To elucidate the specifically Swedish conditions with regard to energy supply and energy use, and which are important for the selection and design of policy instruments, brief background descriptions are also provided.

1.2 Main features of the Directive

The aim of the Directive is for Member States to take cost-effective, practicable and reasonable actions intended to help achieve the indicative target. Market imperfections which needlessly inhibit more effective end use of energy should be eliminated. The market for energy services should be promoted. Players within the energy sector are entrusted with new duties for reporting data to the authorities and concerning the provision of information to customers. The public sector is to act as a pioneer and set an example for other players with regard to boosting the efficiency of its energy use. Member States must ensure that there are effective energy inspection systems enabling the identification of possible energy efficiency improvement actions on the part of large and small energy customers, including in individual households.

A central provision of the Directive concerns the setting of a common savings target of at least 9 per cent. This target is to be achieved by Member States by 2016 at the latest. Member States are to submit national energy efficiency improvement plans to the Commission in which they describe how the savings target is to be achieved at national level.

The term *energy efficiency* should, in accordance with Article 3(b) of the Directive, be understood to mean the ratio between an output of performance, service or goods, e.g. a certain indoor temperature or a certain production volume of goods, and the input of energy required to achieve this. The term *energy savings* should, in accordance with point (d) of the same Article, be understood to mean the difference between the amounts of energy used measured or calculated before and after implementation of energy efficiency improvement measures.

1.2.1 National Energy Efficiency Action Plans (NEEAPs)

Member States are required, under Article 14(2) of the Directive, to submit national energy efficiency action plans to the Commission no later than 30 June 2007, 2011 and 2014.[9]

Under the terms of the same Article, the first action plan must describe the measures which the Member State plans in order to reach the targets set out in Articles 4(1) and 4(2), as well as to comply with the provisions on the exemplary role of the public sector. The plan must also set out how the Member State intends to meet the requirement concerning provision of information on the public sector's exemplary role as a pioneer in energy efficiency improvement in accordance with Article 5(1). The same applies to the requirement pursuant to Article 7(2) for Member States to establish appropriate conditions and incentives for market operators to provide more information and advice to final customers on effective energy end use. Later national action plans to be submitted to the Commission in 2011 and 2014 also lay down requirements concerning, among other things, the reporting of results, evaluation and analysis of measures taken.

[9] The Member States' action plans are posted up on the Commission's website, see www.ec.europa.eu/energy/demand/legislation/end_use_en.htm under the tab "National Energy Efficiency Action Plans".

1.2.2 Further details of the savings target

The National Energy Efficiency Action Plan is to concern the situation at the end of 2016. The savings target of at least 9 per cent is to relate to an absolute amount of energy and is to be expressed in TWh or some other suitable unit. The basis for the calculations is average energy use within the sectors covered by the Directive in the five years (the base years) preceding the Directive's entry into force, i.e. the period 2001–2005.

The savings target is purely indicative. On the other hand, Member States are required to plan and implement the measures they deem necessary for the target to be achievable or exceeded. The Swedish Parliament has endorsed the Swedish Government's view that an indicative national target of an energy efficiency improvement of *at least* 9 per cent by 2016 should be set.[10]

The indicative target is to be achieved by *energy services* and *other actions* leading to improved energy efficiency. Existing, planned or completely new policy instruments may be used to promote energy efficiency improvement measures. The impact of policy instruments that have been in effect since 1995 may be credited if the effects last until 2016. Where circumstances justify this, the impact of policy instruments that have been in effect over the period 1991–1994 may also be credited. A subgoal of the energy saving must be formulated for 2010.

1.3 Relationship between the two energy efficiency improvement targets

The target for energy saving according to the Directive (9 per cent of the base years' energy end use in 2016) is calculated in a different way from the target proposed in the Commission's action plan (20 per cent saving on calculated primary energy use in 2020). The Directive's targets do not concern all sectors of society. Enterprises covered by the emission rights trading system are exempt. The target is based on annual average use of energy for the period 2001–2005 and is to be achieved with national measures, some of which have their origin in EU-wide legislation.

The target of a 20 per cent saving on primary energy by the year 2020 must, for its part, be achieved with the aid of the measures

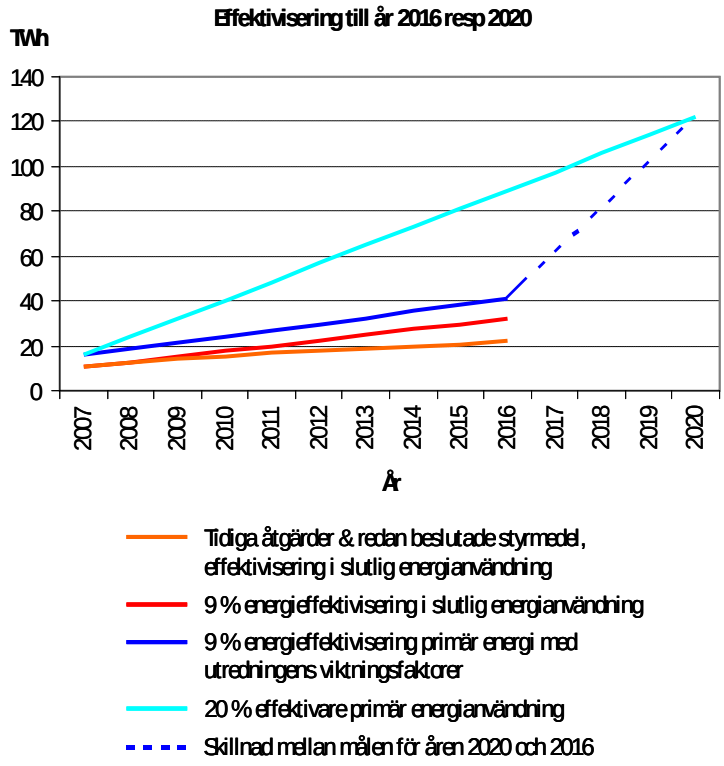
[10] Government Bill 2007/08:1, expenditure area 21, p. 44.

announced in the EU Commission's energy efficiency action plan. This target is based on a *calculation* of the Union's primary energy use in 2020 and, unlike the Directive's targets, encompasses all sectors of society.

Certain calculations show that the Directive's application means that EU Member States can achieve roughly one third of the target with a 20 per cent primary energy saving in 2020.[11] The reason why the application of the Directive is not considered to have a greater impact is, firstly, that it does not, from a European perspective, cover all energy end use owing to the trading sector being outside the Directive's scope. Secondly, the base for the energy saving is less in the Directive than applies to the 20 per cent target because the energy end use represents only part of the total amount of energy supplied. Lastly, it should be noted that the Directive covers a shorter period than applies for the 20 per cent target, namely the period 2008–2016. The relationship between the two energy efficiency improvement targets is shown in Figure 1.1.

[11] Energy Research Center of the Netherlands (ECN), see ECN's report (ECN-E-06-016) EC Energy saving target – Analysis of 20% cost-effective energy savings in the Green Paper on Energy Efficiency, September 2006.

Figur 1.1 **Förhållandet mellan direktivets vägledande mål om 9 procent effektivare slutlig energianvändning och 2020 års antagna mål om 20 procent effektivare primär energianvändning i Sverige**[12]



Translation of captions

Figur 1.1 … = Figure 1.1 Relationship between the Directive's indicative target of 9 per cent more efficient energy end use and the target of 20 per cent more efficient primary energy use in Sweden by 2020

Effekivisering till … = Increase in efficiency by 2016 and 2020

År = Year

[12] The Figure shows the estimated efficiency improvement in energy end use as a result of early measures and policy instruments already decided upon. In addition, the target for the year 2016, an efficiency improvement of 9 per cent, both with and without weighting factors for the individual forms of energy is illustrated. The Figure also illustrates an estimated level for 20 per cent more efficient primary energy use by the year 2020, and the difference between the 9 and 20 per cent targets. For the sake of simplicity, the trend is illustrated as a linear relation in the Figure.

Tidiga … = Early measures & policy instruments already decided upon, efficiency improvement in energy end use

9% energieffektivisering i slutlig energianvändning = 9% energy efficiency improvement in energy end use

9% energieffektivisering primär energi med utredningens viktningsfaktorer = 9% energy efficiency improvement with the Commission of Inquiry's weighting factors

20% effektivare … = 20% more effective primary energy use

Skillnad … = Difference between the targets for 2020 and 2016

Figure 1.1 shows that the application of the Directive in Sweden only contributes to a relatively small proportion of the savings target of 20 per cent primary energy assumed for illustrative purposes. The broken line shows the savings target for primary energy that remains for the period 2016–2020 if the target in the Energy Efficiency Improvement Directive is achieved, but not exceeded, and provided that no efficiency improvement measures are additionally taken, and

assuming that Sweden is assigned a saving target of 20 per cent primary energy. Besides being taken at the end-user stage, such measures can also be taken with regard to the supply of energy, e.g. through more efficient energy production. The ongoing expansion of combined heat and power will play an important role in boosting the efficiency of energy production in Sweden.

1.4 Work on the plan and the form of reporting

The action plan is based on extensive analysis work, not least in relating energy efficiency improvements at the end-user stage to more general systemic effects of such measures to boost energy efficiency. An explicit aim has also been to relate the impact of the EC Directive's application to the overarching target of a 20 per cent saving in primary energy. The action plan has been drafted by an independent commission of inquiry under the aegis of the Ministry of Enterprise, Energy and Communications (NM 2006:06). Some twenty experts, together representing a broad range of different interests and sectors of society, have assisted the commission of inquiry.

The results of the analysis work are described at length in the subreport *A more energy-efficient Sweden (SOU 2008-)*. References to the official report are consecutive in the action plan. The aim of this is to give the reader an opportunity to study the additional considerations that have led to the action plan's design.

In light of how the work on implementing the Energy Efficiency Improvement Directive has been organised in Sweden, supplementary policy instruments are described below in the form of *proposals* from the commission of inquiry.

During 2008, the commission of inquiry is, at the Swedish Government's instance, to continue work on implementing the EC Directive in Sweden. The commission of inquiry is, among other things, to analyse in greater detail how policy instruments and measures proposed in this plan can be implemented in a manner that is cost-effective from the socioeconomic perspective. The work will also, among other things, comprise a review of applicable statutory regulations, authority- and organisation-related issues pursuant to Articles 4(4) and 5(2), analysis and proposals concerning tariff structures pursuant to Article 10 and issues relating to statistics and follow-up of the results of the energy improvement measures. Issues concerning the funding of State or local authority spending on energy

efficiency improvement measures must also be analysed in greater detail. The commission of inquiry must issue a final report on its assignment by 31 October 2008.

1.5 General assumptions

1.5.1 Improvement of energy efficiency from a systemic perspective

As shown by Figure 1.1, a 9 per cent saving on energy end use means that only a small fraction of the saving target of 20 per cent primary energy that has been assumed is achievable. If the latter target is to be realistic, either a saving on energy end use that goes beyond 9 per cent is required or more extensive measures must be taken to boost the efficiency of energy production and the other parts of the value chain that precede end use. Measures of both kinds are probably required.

In the Budget Proposals for 2008, the Swedish Government has specified that the incentive for improving energy efficiency within both households and industry should be reviewed. The Government's objective is to break the link that has hitherto existed between economic growth and increased use of energy and raw materials. Boosting energy efficiency and making economical use of other limited resources is intended to reduce the burden on the climate and the environment. Different energy sources and different energy carriers have differing significance in this context. Saving 1 kWh of electricity from coal-fired condensing power must accordingly be valued more highly than saving 1 kWh of district heating from industrial waste heat or from a solar collector.[13]

Against this background, efficiency improvements in energy end use should, even at this stage, be viewed from a systemic perspective, with the impact on primary energy use also being made clear. Such an approach is dictated both by the climate targets and by the broacher view of energy efficiency improvement, from a primary energy perspective, which is expressed in the Commission's action plan (COM (2006) 545 final). In assessing efficiency improvement effects, Sweden has therefore chosen to use *weighting factors* which reflect primary energy use, not only for electricity but also for district heating, district cooling, oil products and biofuel.[14] The main

[13] Budget Proposals (Bill 2007/08:01), expenditure area 21, p. 65.
[14] See the official report, Chapter 4, section 4.3 and Annex 4.

objectives in other respects for such virtually comprehensive use of weighting factors are as follows:

1. To show the relationship between energy end use and energy supplied.
2. To show the *actual* effect of energy use from the resource perspective for the purpose of an efficiency improvement measure or increased energy use.[15]
3. To relate the savings targets for 2016 and 2020 to one another. Weighting factors underpin the appraisal of what kind of energy end use, e.g. electricity for heating purposes, should be prioritised in light of the overarching EU target of saving primary energy.

The weighting factors applied in the action plan are shown in Table 1.1.

Table 1.1 Weighting factors which reflect primary energy use, for different energy carriers for the base years and for future energy savings

Energy type/fuel	Weighting factor for the base years (mean)	Weighting factors for energy saving (margin)
Electricity	1.5	2.5
District heating	0.9[16]	1.0[17]
District cooling	0.4	0.4
Petroleum products	1.2	1.2
Biofuel	1.2	1.2

In the case of electricity and district heating, various weighting factors are used for the base and for energy saving. The reason for this is, as elaborated on in the subreport, that the basis for electricity production in the Nordic system comprises a proportion of hydroelectric power and combined heat and power which is high from a European perspective. Efficiency improvements, on the other hand, take place on the margin, which in the Nordic electricity system virtually always consists of fossil condensing power. This is less energy-efficient than average production of electricity during the base years. In relation to district heating, the weighting factor for the base reflects the average

[15] Energy purposes should be understood to mean, for example, heating a building, driving a vehicle or running a pump.
[16] The weighting factor for district heating may change during the period up to 2016, see subreport, Chapter 4 and Annex 4.
[17] See footnote 10.

efficiency of Swedish district heating during the base years. Marginal production of district heating consists in the short term chiefly of district heating produced with fuels. The relationship is different in the medium term because the new connection of district heating customers may lead to investments in biofuel-based combined heat and power.

1.5.2 Methods of calculation

Under the terms of the EC Directive, the indicative savings target must be calculated. In addition, Member States are required to use a harmonised method of calculation for ascertaining the impact of various policy instruments and actions on energy efficiency.[18]

This harmonised calculation model has so far been largely lacking. Such a model must, according to the Directive, be developed via the Commission. This work is to be carried out by a special regulatory committee appointed by the Commission. The committee has not started this work. This means that more detailed instructions on how certain necessary calculations and estimates should be conducted are not available, beyond what is set out concerning methodological issues in Annexes I and IV to the Directive. In this action plan, the effects of various measures have, for example, therefore been assessed in accordance with the current views of the Energy Efficiency Improvement Commission of Inquiry on how the methods, which are described in general terms in Annexes I and IV to the Directive, should be construed. How such effects have been assessed by the commission of inquiry is described at greater length in the subreport. The work on developing harmonised methods of calculation is to be developed by the regulatory committee over the new few years. This work may, where appropriate, end up modifying some of the proposals made by the commission of inquiry.

General principles for methods of calculation should, however, be that they must be transparent and practicable in various countries with differing conditions.

[18] Annex IV to the Directive, (point 1.1).

1.5.3 Restrictions

Under the Directive, certain restrictions apply concerning which operators and types of energy should be covered by energy efficiency improvements. For example, the Directive does not lay down requirements governing energy efficiency improvement in enterprises covered by quotas in the EU emission rights trading system. Air and marine transport is also exempted owing to the fact that aircraft and ship fuel stored in depots is not covered by the Directive. Lastly, there are exceptions for military activities in so far as energy efficiency improvement would conflict with the purposes of the activity.

The most important restriction for Sweden concerns enterprises covered by quota requirements under the EU emission rights trading system. Such enterprises account for a significant element of Swedish energy use. During the base years, enterprises within this sector accounted for approx. 70 per cent of industry's use of electricity and for approx. 80 per cent of its other energy use. Sweden considers that only *fossil fuel use* in facilities of the kinds listed in Annex I to the EC Directive (2003/87/EC) establishing a scheme for greenhouse gas emission allowance trading within the Community is to be exempted from the energy efficiency improvements arising from the application of the Energy End-Use Efficiency Directive in Sweden. This means that any other fossil fuel use in enterprises covered by quota requirements in the EU emission rights trading system, as well as all electricity, all biofuels and all district heating, are covered by the energy efficiency improvements that take place in Sweden by virtue of the Directive.

According to Article 3(a), the term 'energy' should be understood to mean all forms of commercially available energy, including transport fuel. However, the Directive is not to be applied to bunkered aircraft and ship fuel.[19] No distinction is made between national and international air and marine transport.

This means that commercial air and marine transport is exempted from the scope of the Directive. This may lead to distortions of competition between, for example, rail and marine transport. Such a demarcation is also difficult to justify from the environmental perspective. Against this background, and as there is no ban on

[19] Various definitions of the term 'bunker fuel' exist. The Swedish Energy Agency and Statistics Sweden (SCB) use *bunker fuel* for energy use for foreign navigation. This definition is employed in the action plan.

energy efficiency improvements in the modes of transport in question, energy use concerning aircraft and ship fuel was included in the calculation of energy use in the base years carried out by the Commission of Inquiry. Certain actions to improve energy efficiency which concern air and sea traffic are proposed for the same reason.

1.6 Strategy for a more energy-efficient Sweden

The Commission of Inquiry must, according to its instructions, subsequently devise an overall strategy for a more energy-efficient Sweden. As set out above, there are a number of close links between climate and energy policy, and energy efficiency improvement is an important tool in climate work. A general principle should therefore be that energy efficiency improvement should be viewed as central to overall work on climate and energy issues.

The strategy should therefore also cover issues of statistical data, analyses of the effects and interaction of the policy instruments, and concerning information and advice for various kinds of energy users. The Commission of Inquiry considers that the following points can serve as a platform for further discussion of such a strategy.

General principles for such a strategy have been described in the foregoing sections. This applies, for example, to the scope of the Directive and the central issue of energy efficiency improvements being viewed from a systemic perspective. The latter means that the actual energy efficiency effect throughout the energy system must, where possible, be calculated in preference to a unilateral focus on levels of energy end use. A strategic approach of this kind makes it easier to ensure that different energy carriers are used in the ways for which they are best suited. Thus, for example, electricity must first of all be used for, say, engine operation, IT systems, heat pump operation and lighting, but as little as possible for heating with electric boilers and direct-acting electroheating systems.

The demarcations described with regard to the trading sector and also aviation and shipping in part demonstrate an ambition to involve the largest possible areas of society in the work on boosting energy efficiency. This is indicated by the consideration of the environment, though also interest in avoiding distortions of competition, e.g. between different modes of transport. A benefit for industry is also that new data on energy use do not need to be collected and reported.

1.6.1 Prioritised areas of society

Sweden has for a long time, and on various occasions, undertaken ambitious measures to improve the efficiency of energy use in construction. This applies both to residential dwellings and to business premises. However, this does not mean that work on

improving efficiency has been completed in this sector. On the other hand, there are other sectors in which the action taken has not been as extensive, e.g. the industrial and transport sectors. The question of the environmental impact of greenhouse gases has also arisen recently, an issue which concerns not least of all the transport sector. As explained in Chapter 1 of the subreport, there are a number of close links between energy efficiency improvement and emissions of greenhouse gases. The EU's targets for the use of renewable energy also apply first of all to the transport sector. The only policy instrument within the industrial sector which, besides the environmental code, merits being highlighted is the programme for improving energy efficiency in industry (PFE). In this light, the transport sector and the industrial sector should in future constitute prioritised sectors for improving energy efficiency.

1.6.2 Role of the general public

The Directive makes clear that the public sector should lead the way in work on boosting the efficiency of energy use. The Commission of Inquiry considers that the State should act as a pioneer and set an example for other players in the public sector. In this light, State efforts within this area should be ambitious and implemented vigorously.

1.6.3 Overall responsibility for monitoring results, etc.

One principle should be that responsibility for the implementation of the Directive, the collection of statistics and the monitoring of results should be assigned to a central body.

1.6.4 Methods and supporting information

Despite the fact that the Directive is already applied with regard to, for example, national action plans, necessary assessment methods are lacking. This is not a problem only for Sweden. Methods must be developed via the Commission and with the aid of various working groups. The question of the formulation of national statistics and methods for their collection is, on the other hand, purely a matter for Sweden. It is crucially important that this can be improved if the

impact of the initiatives is to be evaluated and the development process monitored.

1.6.5 Complete package of measures

A national strategy for improving energy efficiency should encompass a *combination of policy instruments* as there are a number of criteria that must be taken into account when selecting policy instruments. An important task during the period of application of the Directive should be to put together combinations of policy instruments whose effects can interact to ensure that the best possible results can be achieved. The fragmented picture that now emerges for energy efficiency improvement measures within the context of the various authorities' respective sectoral responsibilities tends to hamper strategic considerations of this kind.

1.6.6 Dissemination of knowledge should be prioritised

A general impression of the Commission of Inquiry work is that understanding of not only how the efficiency of energy use can be improved but also the gains achievable through such measures is limited. This is true in all sectors of society. As shown in Chapter 3, the lack of knowledge is an actual obstacle to improvements in energy efficiency which are profitable for operators.

An important conclusion is thus that greater knowledge is strategically crucial if the pursuit of more effective energy use is to be successful. This applies not least to information on the economic benefits of improving the efficiency of energy use. In this light, combined and coordinated information drives should be conducted at an early stage, encompassing not only general information but also information targeted at individual categories of energy users and operators.

1.7 Guidance for the reader

The Swedish situation with regard to the supply and use of energy and the energy system's structure differ on a number of essential points from the European average. Given this, Chapter 2 sets out some key data concerning the input and use of energy in Sweden.

Chapter 3 provides a calculation of the indicative energy savings target and the impact of policy instruments that are already in use or that have been decided upon. This Chapter also provides an overview of the additional policy instruments needed, not only so that the indicative savings target is to be achieved but also so that a savings target of 20 per cent primary energy by the year 2000 that has been adopted by the Commission of Inquiry is to be realistically achievable in Sweden.

Chapters 4-6 deal at greater length with the various policy instruments in the housing, services, industrial and transport sectors. These chapters open with a brief account of structural conditions and energy use in the relevant sector.

Chapter 7 describes measures required pursuant to Articles 5(1) and 7(2) of the Directive, namely the public sector's role as a precursor and model with regard to improving energy efficiency and concerning information issues.

2 Input and use of energy in Sweden

2.1 Input

In total, an average of 630 TWh energy/year was supplied in Sweden over the period 2001–2005. The single greatest energy source was nuclear fuel with 210 TWh/year, followed by crude oil and petroleum products (203 TWh/year) and biofuels, peat, etc. (104 TWh/year).[20] Over the same period, the exchange of electricity with other countries varied between net imports of 13 TWh and net exports of 7 TWh. A breakdown of annual average inputs of energy by different energy types is provided in Table 2.1.

[20] Nuclear power is reported gross (i.e. including conversion and distribution losses) as nuclear fuel energy supplied in accordance with UN/ECE guidelines.

Table 2.1 Sweden's total annual energy inputs, annual average over the period 2001–2005, TWh and per cent

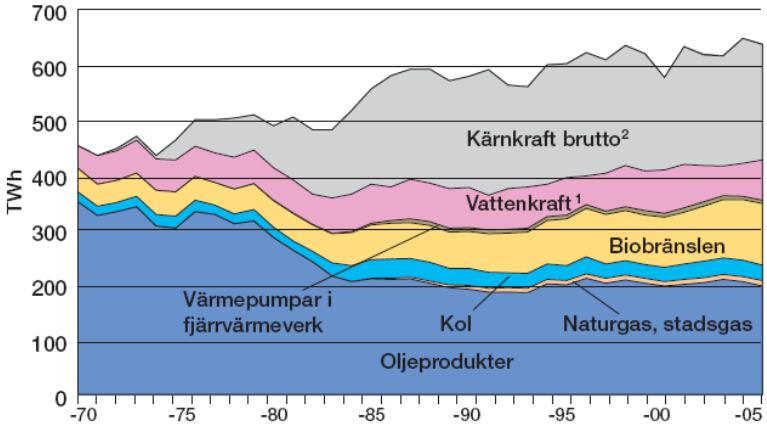
Total energy supplied	TWh	Proportion
Crude oil and petroleum products[21]	203	32.2%
Natural gas, town gas	9	1.4%
Coal and coke	29	4.6%
Biofuels, peat, etc.	104	16.5%
Heat pumps[22]	7	1.1%
Hydroelectric power	66	10.5%
Nuclear fuel	210	33.3%
Wind power	1	0.,2%
Import/export of electricity[23]	0.2	0.,0%
Total	630	100%

Source: The Swedish Energy Agency.

The use of fossil fuels has declined since the 1970s. At the same time, nuclear power's share within the energy system has grown. Biofuel use has increased since the beginning of the 1980s. Figure 2.1 illustrates how energy use in Sweden changed over the period 1970–2005.

[21] Crude oil and petroleum products include approx. 19 TWh oil for foreign navigation.
[22] 'Heat pumps' means large heat pumps in the district heating sector. Energy supplied to the heating system relates to heat produced, approx. 7 TWh. Heat absorbed from the surroundings was approx. 5 TWh, and operating energy from electricity was approx. 2 TWh. In the case of small houses, national statistics are lacking on heat absorbed, while production and distribution of the operating electricity for these are included in the statistics relating to energy sources converted to electricity. Estimates have been conducted by the consultants Nowab and Profu on the Swedish Energy Agency's behalf in "Heat pumps in energy statistics – suggestions" and "Action-based top-down analysis of conversions, etc.". These two estimates may, with due regard for deficiencies in available statistical information, be considered to be relatively unanimous. All in all, Nowab puts the utilised net energy at approx. 10 TWh in 2005, while Profu has put it at approx. 8 TWh for the same year. These estimates are based on the same basic data, but somewhat different assumptions about sizes and efficiency for the heat pumps and different demarcations for energy supplied and net energy requirements for heating.
[23] Net imports of electricity are counted as supplies.

Figure 2.1 Sweden's energy inputs 1970–2005, excluding net exports of electricity, TWh



Source: The Swedish Energy Agency: Note 1 in the Figure refers to the fact that wind power is included in hydroelectric power up to 1996. Note 2 in the Figure refers to the fact that the input of nuclear power is calculated by the FN/ECE method.

Translation of diagram captions

Kärnkraft = Nuclear power

Vattenkraft = Hydroelectric power

Biobränslen = Biofuels

Värmepumpar i fjärrvärmeverk = Heat pumps in district heating plants

Kol = Coal

Naturgas, stadsgas = Natural gas, town gas

Oljeprodukter = Petroleum products

2.2 National energy end use

Of the total 630 TWh input on an annual average, approx. 402 TWh reached end-users in the form of end-used energy, and 19 TWh/year was consumed in foreign navigation. Approx. 209 TWh/year was thus wasted in the form of losses or used for non-energy purposes.[24] This means that roughly two thirds of the energy supplied in the country could be utilised in final applications.

[24] Of this, 137 TWh was accounted for by conversion losses in nuclear power, while 47 TWh/year was accounted for by conversion and distribution losses for other energy carriers. Approx. 25 TWh/year went on non-energy purposes.

Petroleum products and electricity were the single greatest forms of energy used, accounting for 140 and 131 TWh/year respectively. Then came biofuels, peat, etc. with 63 TWh/year and district heating with 46 TWh/year.[25]

[25] The 63 TWh of biofuel concerns individual combustion plants. Beyond this, approx. 35 TWh of biofuel is included as part of district heating and electricity production. This means that the total share of biofuels, both for individual plants and in district heating and electricity production, is approx. 24 per cent.

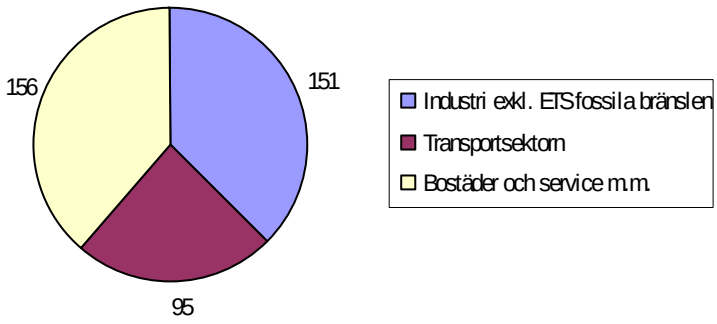
Table 2.2 Total energy end use in Sweden. Annual mean for the period 2001–2005, TWh and per cent

Energy carrier	TWh	Proportion
Petroleum products	140	34.7%
Natural and town gas	6	1.4%
Coal and coke	17	4.2%
Biofuels, peat	63	15.7%
Electricity	131	32.5%
District heating	46	11.4%
Total	402	100%

Source: The Swedish Energy Agency.

Of total energy end use, one third was accounted for by construction and industry each, while the transport sector accounted for approx. one quarter. The breakdown is shown in Figure 2.2.

Figure 2.2 Total energy end use in Sweden by sector, TWh



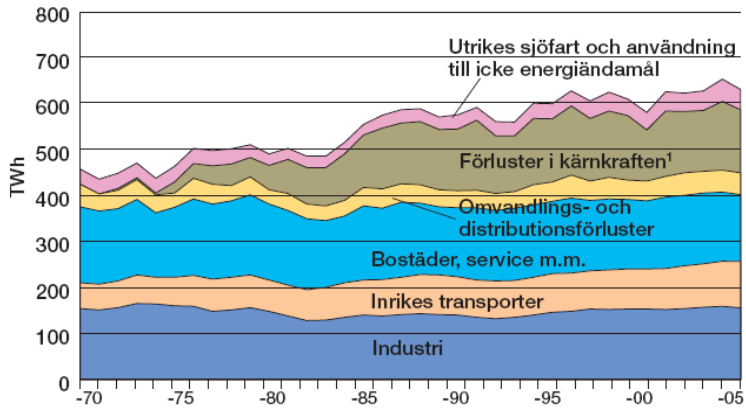
Source: The Swedish Energy Agency.

Translation of diagram captions
Industri … = Industry excluding ETS fossil fuels
Transportsektorn = The transport sector
Bostäder … = Housing and services, etc.

Figure 2.3 shows the change in total energy input and energy end use in the respective sector over the period 1970–2005. The Figure illustrates that energy end use in the industrial sector and in housing,

services, etc. has remained relatively constant. Energy end use in the transport sector has, on the other hand, risen over the past three decades. Over the period, the total area covered by buildings has grown by approx. 50 per cent, while total transport operations and industrial production have increased.

Figure 2.3 Sweden's total energy use, broken down by sector, 1970–2005. The energy conversion sector's losses are reported separately.



Source: The Swedish Energy Agency. Note 1 in the Figure refers to the fact that the input of nuclear power is calculated by the FN/ECE method.

Translation of diagram captions

Utrikes … = Foreign navigation and use for non-energy purposes
Förluster … = Losses in nuclear power
Omvandlings- … = Conversion and distribution losses
Bostäder ... = Housing, services, etc.
Inrikes … = Domestic transport
Industri = Industry

2.2.1 Energy end use covered by the Directive

Total energy end use covered by the EC Directive is less than total Swedish energy end use. This is due mainly to the fact that industrial energy use, which requires emission rights, is exempt from the scope of the Directive. Other exceptions have only marginal importance. All in all, with the interpretation set out in Chapter 2 of the subreport, the Directive encompasses energy end use of 359 TWh in Sweden.

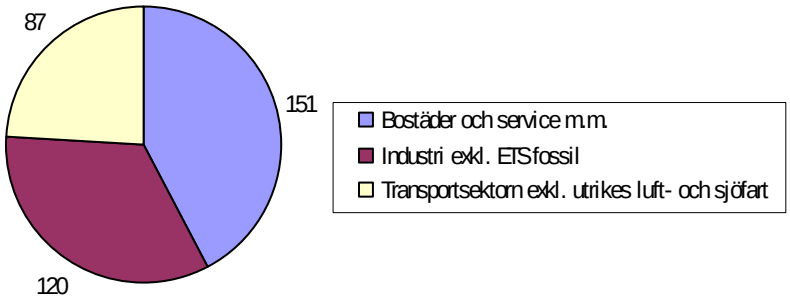
This equates to 456 TWh in primary energy use with the weighting factors used by the Commission of Inquiry.

Table 2.3 Calculation of the savings target of 9 per cent of the average for the base years 2001–2005, TWh

	Energy end use	Primary energy use
National energy end use[26]	402 TWh/year	509 TWh/year
Energy end use according to the Directive	359 TWh/year	456 TWh/year
Target of 9% efficiency improvement	32.3 TWh	41.1 TWh

Based on the Directive's scope, construction accounts for just over 40 per cent of energy end use. Industry's share is approx. one third, and the transport sector accounts for approx. one quarter of energy end use.

Figure 2.4 Energy end use under the scope of the EC Directive, broken down between various social sectors, TWh



Translation of diagram captions

Bostäder … = Housing and services, etc.

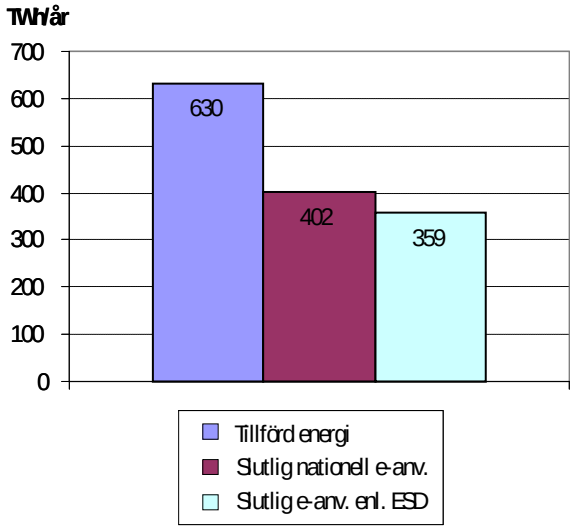
Industri … = Industry excluding ETS fossil fuels

Transportsektorn … = The transport sector excluding aviation and navigation

[26] Average for the base years 2001–2005.

In total, the EC Directive covers just under 90 per cent of national energy end use and nearly three fifths (57 per cent) of the total amount of input energy in Sweden.

Figur 2.5 **Förhållandet mellan total energitillförsel, total slutlig användning, slutlig energianvändning i enlighet med direktivet samt kvantifiering av 9 procent energieffektivisering för Sverige**



Translation of diagram captions

Figure 2.5 … = Figure 2.5 Relationship between total energy input, total end use, energy end use in accordance with the Directive and quantification of 9 per cent energy efficiency improvement for Sweden

Tillförd … = Energy input

Slutlig nationell e-anv. = National energy end-use

Slutlig e-anv. enl. ESD = End use in accordance with ESD

3 Savings targets and policy instruments

3.1 Quantification of the indicative target

There are, to begin with, grounds for recalling the general strategic principle set out in Chapter 1 whereby energy efficiency improvements should be viewed from a systemic perspective. Against this background, the basic aim of the Energy End-Use Efficiency Directive must be to cut the use of *primary energy* in order to meet society's needs for energy-dependent functions. The Directive addresses efficiency improvements in energy *end use* as a *means* of achieving this aim. We therefore calculate below the resulting effects, in the form of reduced consumption of *primary energy*, for various efficiency improvement actions taken by end users. As a logical consequence of this, energy end use in the sectors covered by the Directive has also, for the base years, been enumerated for the consumption of *primary energy* consumed when mainly conversion losses in the input system are taken into account.

As a result, the results are reported below in terms of *primary energy use*. The impact of the efficiency improvement initiatives on *energy end use* is also, by way of information, reported here, within brackets or in separate columns.

The starting point for the calculation of the indicative targets is energy use in the base years. The indicative savings targets are *at least 6.5 per cent in 2010* and *at least 9 per cent in 2016* of energy use in the base years. The subgoal for 2010 has been determined here based on an assessment of reasonableness and in consideration of the fact that this is in practice to be achieved by action taken during 2009.

Table 3.1 sets out all values in the unit of TWh primary energy use, which has been calculated using the weighting factors given in Chapter 1, Table 1.1 and, in parallel with this, energy end use in TWh.

Table 3.1 Quantification of the Directive's indicative targets

Average for the base years	Primary energy use (weighting factors according to Table 1.1)	Energy end use
Energy use in the base years	456	359
Subgoal, 6.5 per cent in 2010	30.0	23.3
Final aim, 9 per cent in 2016	41.1	32.3

The Commission of Inquiry has also related the Directive's indicative target for 2016 to the proposed target, in respect of which the burden has not yet been shared, of a 20 per cent cut by 2020 in relation to calculated primary energy use in the same year. As such a calculation has not yet been carried out, the Energy Efficiency Improvement Commission of Inquiry has estimated the scale of this target relative to the base year period's energy input. The calculations show that primary energy use in 2020, based on the said conditions, needs to fall by 126 TWh for the target to be achieved.

3.2 Effects of early actions and policy instruments already decided upon

The Directive enables the effects of what are known as *early actions*, which persist in 2016, to be credited when calculating whether the indicative target has been achieved. Such measures must have been conducted by 1995 at the earliest. In the case of general policy instruments, e.g. taxes, effects as from 1991 may be credited.

The work on improving energy efficiency has been going on in Sweden for several decades. A large number of actions have already been taken, helping to cut Swedish energy use. Chapters 5, 6 and 7 of the subreport describe actions relating to construction and industry, which were implemented as from 1991, and also actions relating to the transport sector, which were implemented as from 1995. These chapters also provide a detailed assessment of the energy efficiency effects expected to persist in 2016.

In spring 2007, at the request of the Swedish Government, the Swedish Energy Agency drew up an inventory of the policy instruments applied hitherto whose effects may be credited in accordance with the EC Directive. The Swedish Energy Agency has also calculated what level of savings effect the policy instruments in question yield relative to the savings target of at least 9 per cent. According to the EC Directive, an intermediate savings target for 2010 must be laid down. In this light, the Swedish Energy Agency has also calculated the effect of existing policy instruments for the year 2010. The Commission of Inquiry has quality-assessed, revised and supplemented the Swedish Energy Agency's calculations and assessments.

3.2.1 Early actions (1991–2005)

In the case of construction, it is considered that the effect of measures that have been implemented from 1991 and 1995 until 2005 totals approx. 17.9 (11.5) TWh.[27] For the transport sector, the residual effect of early actions is calculated to be at least 6.0 (5.0) TWh. No early actions with a residual effect have been identified in the industrial sector. In total, approx. 24 (16.5) TWh more efficient energy use is therefore considered to have been achieved with early actions.

The assessments are based on bottom-up methods, action-oriented top-down methods and econometric assessments. For a detailed account of the actions, and the calculations that have led to the results reported here, see Chapters 5–7 of the subreport.

3.2.2 Expected effect of policy instruments decided upon (2005-2016)

Besides the impact of the early actions on energy efficiency improvement, the effect of *policy instruments already decided upon* must also be assessed for actions expected to be implemented between 2005 and 2016.

In the case of construction, the assessed effect of such actions is 19.5 (8.9) TWh.[28] In the case of the industrial sector, actions as a

[27] Values in brackets in this and subsequent sections relate to energy end use.

[28] The assessed primary energy efficiency improvement by 2016 includes the element of the expansion of combined heat and power that can be attributed to the energy end users' decision to switch to district heating over the period 1991-2016. This action, which concerns energy input,

result of policy instruments hitherto decided upon are projected to have a residual effect of 1.8 (0.7) TWh in 2016. Actions as a result of policy instruments already decided upon for the transport sector over the same period are projected to have a residual effect in 2016 of at least 1.1 (0.9) TWh.

In total, this means that actions between 2005 and 2016, which are implemented by virtue of policy instruments already planned, are projected to lead to more efficient energy use of approx. 22 (10.5) TWh. The expected effect of the actions is set out in Table 3.2. These measures, and the calculations that have led to the results, are also set out in detail in Chapters 5-7 of the subreport.

leads to a significant reduction in national primary energy use, but no change in energy end use, beyond the losses incurred before conversion in connection with individual oil-fired heating in many of the buildings in question.

Table 3.2 Effects of early, existing and planned policy instruments by social sector in 2010 and 2016, TWh.

Sector	Policy instrument	2010		2016		
		End-use	Primary	End-use	Primary	Dev. model
Housing and services						
Early actions 1991/1995–2005	Conversions(1995–2004) including LIP/KLIMP, short programme, solar heat 2000–2005	11.2	17.1	11.2	17.1	Top down[29]
	White goods	0.3	0.8	0.3	0.8	Top down
Existing policy instruments, assessed effects 2005–2016	Future conversion actions in small houses, stock in 2005 (excluding solar heating)	1.1	3.2	2.4	7.1	Top down[30]
	Conversion to district heating in multiple-unit dwellings and premises	0.4	0.9	1.0	1.9	Top down[31]
	Conversion actions, solar heat, etc. 2000–2005	0.11	0.19	0.22	0.38	Top down
	KLIMP project	0.13	0.16	0.05	0.06	Bottom up
	Technology procurement, future expected	1.1	1.7	2.3	3.4	Bottom up

[29] This assessment also includes the effect of taxes on energy.
[30] See footnote 3.
[31] See footnote 3.

effects					
OFFROT	0.6	0.8	0.6	0.8	Bottom up
Support for energy-efficient windows	0.06	0.12	0.06	0.12	Bottom up
Combined heat and power expansion	0	0.4	0	1.8	Top down
New construction regulations. BBR06	0.03	0.05	2.3	2.5	Bottom up
District cooling	0	1.4	0	1.4	Bottom up

Sector	Policy instrument	2010		2016		
		End-use	Primary	End-use	Primary	Dev. model
Industrial sector						
Early actions 1991/1995–2005	No actions identified	-	-	-	-	
Existing policy instruments, assessed effects 2005–2016	PFE, effects in years 1 and 2	0.7	1.8	0.7	1.8	Bottom up
Transport sector						
Early actions 1991/1995–2005	Fuel tax and vehicle taxation	5.0	6.0	5.0	6.0	Top down
	LIP	0.03	0.04	0.03	0.04	Bottom up
Existing policy instruments, assessed effects 2005–2016	Fuel tax and vehicle taxation	0.20	0.24	0.30	0.36	Top down
	Preferential taxation	0.12	0.15	0.12	0.15	Bottom up
	Gentle driving, rail	0.01	0.01	0.01	0.01	Bottom up
	ATK, speed monitoring	0.10	0.12	0.17	0.20	Bottom up
	KLIMP project	0.26	0.31	0.26	0.31	Bottom up
	LIP project	0.03	0.04	0.03	0.04	Bottom up
Summation and calculation of targets	Total 1991-2005	16.5	23.9	16.5	23.9	
	Total 2005-2016	4.9	11.6	10.5	22.3	
	Total	21.5	35.5	27.0	46.3	

Of which percentage of energy use in the base years	6.0%	7.8%	7.5%	10.1 %

Source: The Swedish Energy Agency, Dargay and the Energy Efficiency Improvement Commission of Inquiry.[32]

[32] Joyce Dargay, Effects of taxation on energy efficiency. Report to Energieffektiviserings-utredningen. Institute of transport studies, University of Leeds. February 2008.

3.2.3 Summation of early actions and policy instruments already planned for the period 2005–2016

Table 3.2 shows that the effect of early actions and policy instruments already planned for the period 1991–2016 is projected to lead to primary energy efficiency improvements of approx. 35 TWh by 2010 and approx. 46 TWh by 2016. This equates, for 2016, to approx. 10 per cent of primary energy use. Expressed in terms of energy end use, the estimated effect is approx. 21 TWh for 2010 and 27 TWh for 2016. The saving corresponds to 7.5 per cent of average energy end use for the base years 2001–2005, which amounts to 359 TWh.

3.2.4 Potential for further improvements in energy efficiency

Based on available research findings and analysis, the Commission of Inquiry has assessed potential for energy efficiency improvement in construction, the industrial sector and the transport sector up to 2016.

The Commission of Inquiry's estimates of potential for efficiency improvements are based on data from a large number of recent studies and reports. It should be emphasised that these data have been obtained using different methods, assumptions and definitions. In the Commission of Inquiry's view, the quality of the material is also variable. This means that the levels of future efficiency improvement potential described below should be seen as *benchmarks* for how great this potential may be. It should also be borne in mind that there are estimates which lead to far greater efficiency improvement potentials than described here. Generally speaking, the results for construction are considered the most reliable, while the results for the transport and industrial sectors are subject to greater uncertainty.

Based on and subject to the general assumption of what has just been stated, the Commission of Inquiry has estimated total economic potential for energy efficiency improvements in construction, the industrial sector and the transport sector up to the year 2016 to be approx. 65 TWh of primary energy use, which is equivalent to 40 TWh of energy end use.[33] Of this approx. 65 (40) TWh, the Commission of Inquiry has estimated that approx. 41 (25) TWh of potential exists in construction, of which district heating and fuels account for approx. 16 (14) TWh and electricity for just over 25 (10)

[33] Over and above the approx. 15 (12) TWh of energy end use projected to be achieved by policy instruments already planned.

TWh respectively. In the industrial sector, with the exception of fossil fuel use which requires emission rights, the economic potential is put at approx. 11 (6) TWh, of which approx. 8 (3) TWh is accounted for by electricity. Lastly, economic potential within the transport sector is put at approx. 12 (10) TWh.

Table 9.3 Estimated economic potential for energy efficiency improvements in relevant sectors, TWh

	District heating and fuels [TWh]	Electricity [TWh]	Total potential, end [TWh]	Total potential, primary [TWh]
Construction				
Industrial sector excluding ETS fossil fuels				
Transport sector				

3.3 The need for supplementary policy instruments

In 2005, Sweden had achieved a primary energy efficiency improvement equivalent to approx. 21 TWh compared with energy use in the base years. This result is an effect of the early actions that have been touched upon above. Table 3.2 shows that, if the calculated effect of policy instruments decided upon is also taken into account, Sweden achieves in total approx. 46 TWh of primary energy use, i.e. more than a 10 per cent efficiency improvement by 2016. This should, in the Commission of Inquiry's view, be regarded as a reflection of the computed *actual* efficiency improvement in the Swedish energy system. Given this, the Commission of Inquiry's overall conclusion is that the efficiency improvement target is in practice already achieved by the accumulated effect of the early, existing and planned policy instruments set out above.

The Commission of Inquiry's conclusion in this part does *not*, however, mean that further improvements in energy efficiency would be unwarranted. On the contrary, there are strong reasons for

increasing the rate and for raising levels of ambition in efforts to boost efficiency.

The Commission of Inquiry has, as just described, identified potential for efficiency improvements of at least 65 TWh of primary energy use. This is a high level of energy, which it is considered profitable to save via measures to boost efficiency. The estimate has been conducted carefully. The potential for improvement may in fact be even more than 65 TWh. Given this, and with due regard for the aims of and background to the Energy End-Use Efficiency Directive, Sweden should at all events, and regardless of how the results of early, existing and planned policy instruments are calculated, seek to step up the rate of energy efficiency improvement. This also means that Sweden achieves the savings target by a wide margin and *regardless* of which method of calculation is used. There are also close links between climate issues and the improvement of energy efficiency. The need to take vigorous action to limit greenhouse gas emissions is therefore another strong reason for bolstering efforts to make Sweden more energy-efficient.

An energy saving, achieved via profitable actions, of approx. 65 TWh of primary energy, equivalent to 40 TWh of end-use energy, would lead to substantial economic savings for households and activities of all kinds. This should in all likelihood produce favourable socioeconomic effects.

As set out at greater length in Chapter 3 of the subreport, a number of studies have been presented over the last decade showing that many energy-saving measures are not implemented despite being profitable from the perspective of private economics and socioeconomically. This means that the energy markets are not functioning satisfactorily. The Commission's Green Paper "Doing More With Less" also specifies that the technical conditions pertaining on the energy markets mean that market-driven changes aimed at more efficient energy use need to be fostered and supported. Market forces cannot, owing to market imperfections, *independently* meet the need for a reduction in energy use of the scale now considered by many to be necessary within the EU on various grounds. Such deficiencies in the way in which the market works may be assumed also to impede the exploitation of the above-mentioned profitable potential for boosting energy efficiency.

One of the main market imperfections is, according to the Green Paper, a lack of knowledge on the part of the operators regarding new technology for boosting energy efficiency, its costs and availability

and also regarding the costs of their own energy use.[34] An important conclusion is that more significant improvements in energy efficiency, over and above those already assessed as being achievable, will not arise of their own accord. Progress beyond this thus calls for policy instruments of various kinds. Such policy instruments entail costs for the general public that must be taken into consideration. The actions must be justified from a socioeconomic perspective.

All in all, the Commission of Inquiry considers there to be a need for new or bolstered policy instruments to make Sweden more energy-efficient.

3.4 Potential future policy instruments

The Commission of Inquiry has identified thirty potential future policy instruments. These instruments are enumerated in the list below. A more detailed description of these potential future policy instruments is provided in Chapters 4–7. Application of these policy instruments means that Sweden will, by a wide margin and regardless of the method of calculation adopted, exceed the indicative savings targets in the Energy End-Use Efficiency Directive, though also that much of the calculated potential for improving energy efficiency will be exploited.

- **The public sector as a pioneer**
  - Programme for improving energy efficiency in State activities
  - Energy efficiency improvement agreements with local authorities and county councils

- **Housing and services, etc.**
  - Energy certificates for buildings, continuous development
  - Energy classification of buildings
  - Energy conservation requirements associated with renovation
  - Evaluation and announced gradual tightening-up of the new-build requirements
  - Programme for more efficient electricity use
  - Continued promotion of energy services
  - Technology procurement
  - Increased local authority energy advice

[34] Commission Green Paper 'Doing More With Less' (COM 2005 265 final) of 22 June 2005. See in particular section A1-2.

  - Programme for more efficient energy use in land-based industries
  - Research, development and demonstration projects

- **Industrial sector**
  - New programming period for the Programme for Improving Energy Efficiency in Energy-Intensive Industrial Enterprises (PFE)
  - Expanded scope for PFE
  - Contributions/tax rebates for energy efficiency-boosting investments for *non-energy-intensive enterprises* via appropriation to energy saving funds or equivalent

- **Transport sector**
  - Binding emissions requirements for automotive manufacturers
  - Increased fuel taxes
  - Carbon dioxide-differentiated vehicle tax
  - Heavier preferential taxation
  - Modified definition of environmentally friendly vehicles
  - Lower speeds
  - Improved logistics
  - Economical driving
  - Social planning
  - Public-sector initiatives in respect of research, development and demonstration
  - Consumer information on vehicle fuel consumption

- **Information drives**
  - Forum energy efficiency improvement

4 Housing and services, etc.

The account provided in this chapter is based on a detailed description and analysis of the housing and service sectors set out in Chapter 5 of the subreport.

Structural aspects

The *housing and services, etc.* sector encompasses construction in its entirety, land-based industries and also certain service functions with a close link to construction. Construction encompasses housing, premises for activities of various kinds, non-commercial activities and public sector premises. On the other hand, buildings classed as industrial units are not covered. In official statistics, these are classified in the industrial sector.

The housing and services, etc. sector covers:

- Housing (small houses and multiple-unit dwellings)
- Premises (broken down in accordance with SCB into 11 categories of buildings) excluding industrial premises
- Land-based industries (agriculture, forestry, fisheries, etc.)
- Weekend residences
- Other services encompassing the building sector, road and street lighting, sewage and treatment plants, power stations and waterworks

In all, the housing and services sector encompasses approx. 590 million square metres of buildings, breaking down between approx. 260 million square metres of small houses (1.7 million small houses including agriculture and permanently occupied weekend

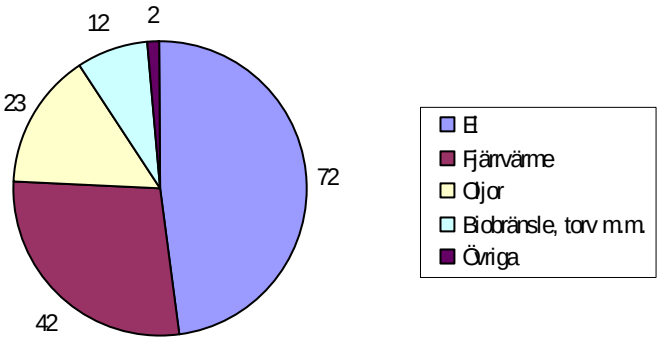
residences[35]), 165 million square metres of multiple-unit dwellings (approx. 135 000 multiple-unit dwellings with a total of 2.4 million apartments) and 165 million square metres of premises broken down between approx. 60 000 properties with predominantly commercial activities and approx. 120 000 buildings in the public sector[36]. Besides this, there are approx. 124 million square metres of heated space in buildings on plots classified as industrial units. Of these industrial-classified buildings, around one third (44 million m^2) are considered to be normally heated and used as offices and for similar purposes.

4.1 Energy use in the housing and services, etc. sector

The housing and services, etc. sector accounts for just under 40 per cent of energy end use in Sweden and for approx. 42 per cent of national energy end use covered by the EC Directive. Over the period 2001–2005, average total end use of energy in the housing and services, etc. sector was 151 TWh of energy end use and 190 TWh of primary end use.

[35] The term 'permanently occupied weekend residences' should be understood to mean buildings which are classified for property purposes as weekend residences but which are used as housing for permanent occupation.
[36] See the official report 'Energy certificate of buildings' (SOU 2004:109).

Figure 4.1 Average annual energy end use in the housing and services sector during the base years 2001–2005[37], TWh



Source: The Swedish Energy Agency.

Translation of diagram captions
El = Electricity
Fjärrvärme = District heating
Ojlor = Oils
Biobränsle, torv m.m. = Biofuel, peat, etc.
Övriga = Other

Table 4.1 Total end use broken down by energy carriers in the housing, services, etc. sector. Average for the period 2001–2005, TWh[38]

Energy carrier	TWh
Electricity	72.3
District heating	41.5
Oil products	23.2
Biofuel, peat, etc.[39]	12.2

[37] Electricity for the operation of heat pumps is included as electricity. Utilised energy from the surroundings for heat pumps in construction is not included in the official energy statistics relating to energy supplied (purchased). As mentioned in Chapter 3, there are no reliable statistical data for these heat pumps' utilised energy, although estimates have been carried out by the consultancies Nowab and Profu. These two estimates may, with due regard for deficiencies in the available statistical data, be considered to be relatively unanimous. All in all, Nowab puts utilised net energy at approx. 10 TWh in 2005, while Profu has put it at approx. 8 TWh for the same year. These estimates are underpinned by the same basic data, but to some extent differing assumptions about sizes and efficiency for the heat pumps and differing demarcations for supplied energy and net energy requirements for heating. The effect of the conversions that have taken place after 1995 and that are still considered to persist in 2016 is included in the estimates of effects of early measures and effects of measures conducted over the period 2005–2016 as a result of policy instruments already decided upon.
[38] See footnote 3.

Other[40]	2.2
Total	151.3

4.1.1 Small houses

There are approx. 1.7 million small houses in Sweden. Average energy end use over the period 2001–2005 totalled approx. 38 TWh in respect of heating and hot running water in small houses. Besides energy use on heating and hot running water, there is approx. 11 TWh in property and household electricity.

The commonest form of heating for small houses in Sweden is electroheating. In 2005, nearly one third of small houses (542 000) were heated with electricity. In the same year, a good fifth of small houses (369 000) used a combination of electric and biofuel heating. Roughly one in ten small houses (188 000) were heated exclusively with biofuel. Just under 10 per cent of small houses (120 000) were connected to district heating systems.

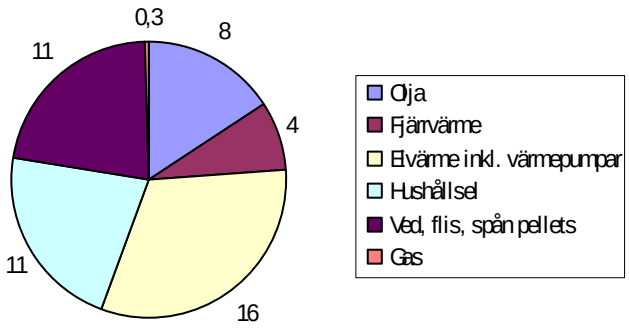
The proportion of small houses with individual oil-fired heating fell over the past decade. Over the period 1998–2005, the proportion of small houses with individual oil-fired heating fell from just under 30 per cent to just over 10 per cent.

The national energy statistics are inadequate in terms of providing information on numbers of installed heat pumps. They indicate that 120 000 small houses, approx. 7 per cent, were mainly heated by heat pumps in 2005. A more accurate assessment, based on sales data, is considered to be that around 200 000 small houses were mainly heated by heat pumps in 2005. The rate of increase for the installation of heat pumps buried in rock, soil or the sea is also strong, with an estimated 40 000 - 50 000 installations per annum at the present time. In all, SCB considers that 444 000 small houses, i.e. more than a quarter of small houses, had some kind of heat pump in 2005.[41] This relatively high proportion includes all kinds of heat pumps, including discharge air heat pumps and other kinds of heat pumps not used as primary heat sources for the home.[42] It should be noted that heat pumps' utilised energy from the surroundings is counted as net

[39] Biofuels are also included as part of district heating and electricity production.
[40] Electroheating also includes electricity for the operation of heat pumps.
[41] Heat pumps buried in rock, soil and the sea, air heat pumps and combinations.
[42] In national statistics, the term 'primary heat source' denotes the heat source that accounts for most of the heating.

energy, and is thus not included in the national energy statistics relating to energy end use.

Figure 4.2 **Breakdown between types of energy for heating and hot running water for small houses during 2001–2005, average end use, TWh**



Source: Energy statistics for small houses 2005, Statistical communications EN 16 SM 0601, SCB.

Translation of diagram captions
Olja = Oil
Fjärrvärme = District heating
Elvärme inkl. värmepumpar = Electroheating including heat pumps
Hushållsel = Household electricity
Ved, flis, spån pellets = Timber, wood chips, chip pellets

4.1.2 Multiple-unit dwellings

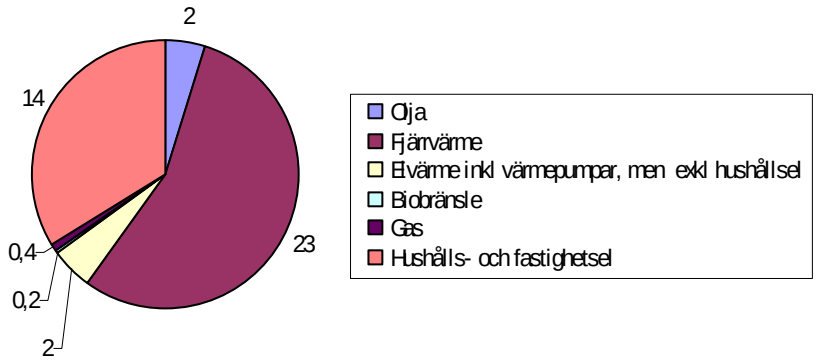
Sweden has approx. 2.4 million residential apartments in multiple-unit dwellings covering a total heated area of approx. 178 million square metres. Over the period 2001–2005, approx. 28 TWh was expended on heating and hot running water in multiple-unit dwellings. This is supplemented by approx. 8 TWh of property electricity and approx. 6 TWh of household electricity. The use of property and household electricity has increased sharply in this segment over the last few decades.

The stock of multiple-unit dwellings has a smaller surrounding area per square metre of residential area and a greater area of district heating than the stock of small houses in Sweden.[43] Despite this, energy end use per square metre, so-called specific energy use, for

[43] A higher proportion of district heating means that specific energy end use falls compared with, for example, individual oil- and biofuel-fired heating because the conversion losses are moved from the individual building to district heating production.

multiple-unit dwellings is on average approx. 8 per cent higher for heating and hot running water purposes in multiple-unit dwellings than in small houses.

Figure 4.3 Breakdown between energy types for heating and hot running water for multiple-unit dwellings, average energy end use 2001–2005, TWh



Source: Energy statistics for multiple-unit dwellings 2005, Statistical communications EN 16 SM 0602, SCB.

Translation of diagram captions
Olja = Oil
Fjärrvärme = District heating
Elvärme … = Electroheating including heat pumps, but excluding household electricity
Biobränsle = Biofuel
Hushålls- … = Household and property electricity

The commonest form of heating in multiple-unit dwellings is district heating. More than three quarters of multiple-unit dwellings are entirely heated by district heating, with an additional approx. 11 per cent of multiple-unit dwellings being partially heated by district heating. Two per cent of multiple-unit dwellings are entirely heated using oil, and three per cent are partially heated using oil. Three per cent of multiple-unit dwellings are heated using electricity, and around ten per cent are heated by heat pumps in combination with other types of energy. According to SCB's statistics, around nine per cent of multiple-unit dwellings have "other heating". This includes, for example, gas and primary heating by heat pumps.

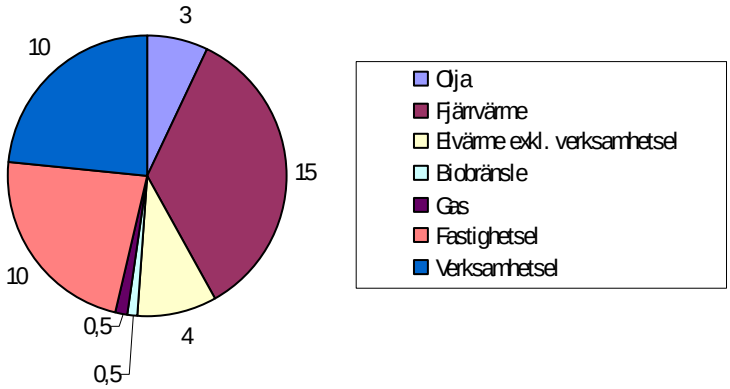
4.1.3 Premises

In the official statistics, premises are classified into eleven different categories, including offices, hotels and restaurants, schools, churches, nursing and other care establishments, assembly halls and other premises.

According to SCB's statistics, the total area covered by premises was 144 million square metres in 2005, broken down between approx. 53 000 properties.[44] Offices and schools are the two largest categories of premises, each with a quarter of the total area covered by premises. The biggest owners of premises are limited liability companies (41 per cent) and local authorities (27 per cent). In all, the public sector (State, local authorities and county councils) owns approx. two fifths of the total area covered by premises.

Average energy end use for heating and hot running water in premises totalled approx. 23 TWh over the period 2001–2005. Besides energy use for heating and hot running water, an additional approx. 10 TWh electricity is consumed on property operation and approx. 9.5 TWh on activities. Electricity consumption in the premises sector has risen sharply in the last few decades. District heating is the dominant form of heating in premises. Nearly three fifths of all Swedish premises are heated by remote heating. After this comes electroheating with just under 7 per cent, and oil heating with just under 4 per cent.

Figure 4.4 Breakdown of energy end use for the premises sector, including electricity consumed in respect of property and activities. (Average values for 2001 - 2005.) TWh



[44] Many properties comprise more than one building.

Source: Energy statistics for premises 2005, Statistical communications EN 16 SM 0603, SCB

4.1.4 Land-based industries and other services

Land-based industries comprise agriculture, forestry and fisheries. Energy end use in this category averaged approx. 9 TWh over the period 2001–2005. Petroleum products are the dominant energy type within land-based industries, accounting for around 7 TWh/year. Of this, approx. 5 TWh/year was accounted for by diesel oil. Electricity consumption in land-based industries totals approx. 1.5 TWh/year.

The 'other services' category includes the building sector, road and street lighting, sewage and treatment plants, power stations and waterworks. Energy end use in this category averaged approx. 7 TWh over the period 2001–2005.

4.2 Potential future policy instruments in the housing and services sector

4.2.1 Energy certificates for buildings, continuous development

The Buildings Energy Certificate Act came into force in October 2006. The entire stock of multiple-unit dwellings and premises will in the short term be covered by the energy certificates requirement. Energy certificates must be submitted for small houses as well, but here the rate of implementation for the declarations is considered to be slower than for multiple-unit dwellings and premises because requirements governing energy certificates come into force only as from 1 January 2009 and exist only in connection with the sale or renting out of a building. The energy certificate provides a unique opportunity to formulate *individual action proposals for each house and each property owner*. Energy certificates are therefore an important tool in achieving more effective energy use in the building.

The Commission of Inquiry for building energy certificates found that there are few relevant studies investigating the potential for energy efficiency improvement that may be identified by the energy certificates.[45] The introduction of the system of energy certificates

[45] Building energy certificates (SOU 2004:109) This official report states that there are few relevant studies investigating scope for improving the efficiency of energy use in Swedish

has, however, proceeded slowly and the level of requirements applicable to property owners has been discussed. There may therefore be a risk that the potential for economic energy efficiency improvement is not exploited.

Energy certificates are a strategic instrument for identifying economically motivated efficiency improvement measures in individual buildings. Given this, there are grounds for continuously reviewing and improving the general advice on how the system of energy certificates should be applied. This applies, for example, to reference values, inspection routines, presentations of actions, reporting, registers of certificates, etc. The Commission of Inquiry proposes that an independent evaluation of energy certificates be conducted during 2010. The evaluation is intended to clarify in a balanced way not only the experiences of consumers (both property owners and users) but also how energy certificates function as a policy instrument. It should also include an overview of what kinds of cost-effective actions are proposed in connection with the certificates. The evaluation should also investigate whether household electricity is to be included in the energy certificates.

The Commission of Inquiry further recommends that the National Board of Housing, Building and Planning be commissioned by 2008 to evaluate whether the routines that have been introduced function as intended from a consumer perspective and in administrative terms. The National Board of Housing, Building and Planning should also be commissioned, in consultation with the Swedish Energy Agency, to

buildings. The Energy Certificate Commission of Inquiry asserts that this fact hampers a qualified quantitative assessment of costs and income and also what resource contributions are optimal when energy certificates are to be drawn up, but points out that practical experience indicates a savings potential from profitable actions amounting to 10–30 per cent of energy use on average. The economic impact assessment conducted by the Energy Certificate Commission of Inquiry discusses three scenarios based on different economic depreciation periods. The first scenario consists of actions that pay for themselves within a year, but which on the other hand are considered to have a duration not exceeding ten years. Examples of types of actions cited include adjustments of control systems, simple adjustments of air flows and heat, correction of errors, etc. A number of studies show that extensive efficiency improvements can be achieved by very simple measures, particularly in premises. This may entail adjustment of air flows, operating times and supply air temperatures. In the second scenario, the Energy certificate Commission of Inquiry puts the potential at around 15 per cent, equivalent to annual energy use of approx. 25 TWh (pp. 243–244, section 12.2.1 Assumptions of costs for energy certificates and potential for efficiency improvements). This second step consists of future actions with a pay-off period of up to 8 years. This group of actions includes extensive adjustment operations, replacement or new installation of control equipment, exchanges of pump systems, replacement of fans, etc. This group of actions also includes additional costs for further insulation or better windows and when façades and windows need to be renovated or replaced. The third scenario comprises additional future actions. These are principally actions that can only be justified in connection with renovation and which may be the same actions as in step 2, but which are here taken further.

continuously improve and refine routines and data for the energy certificates. Any revisions should be in conformity with CEN standards devised for energy certificates.

4.2.2 Energy classification of buildings

The energy classification of buildings is a simple and effective way of clarifying a building's energy performance for users and owners. It enables the energy characteristics of buildings to be made clear to market operators, e.g. buyers, vendors and tenants. In the event of changes in owner, classification can be a simple way of communicating a building's energy efficiency to the players concerned. As part of the 'ByggaBo model', research has been conducted for a number of years on devising a model for the classification of buildings.[46] Research and development focusing on a number of other classification models, e.g. Green Buildings and Minergie, is also being conducted.

The Commission of Inquiry proposes that the National Board of Housing, Building and Planning and the Swedish Energy Agency be commissioned to devise a system for the energy classification of buildings. Such a classification system must take account of primary energy use, and the classification should be linked to the system of energy certificates. The work should be conducted in close consultation with affected authorities and business organisations. As part of this work, account must be taken of ongoing standardisation activities within this area, and aim to achieve *one* generally accepted classification system. The ByggaBo dialogue proposals concerning what benefits may arise from the energy classification of buildings in terms of credit conditions, insurance premiums, building classification charges, etc. are an important factor underpinning the work.

4.2.3 Energy conservation requirements associated with conversion

According to the assessments that Chalmers EnergiCentrum has conducted on behalf of the Commission of Inquiry, potential for economic energy efficiency improvements in existing buildings in

[46] Like the energy certificate for buildings, the 'ByggaBo dialogue' is administered by the National Board of Housing, Building and Planning.

relation to district heating and fuels are approx. 19 TWh and 14 TWh of electricity in 2016.[47] There is currently an extensive need for renovation and upgrading in buildings.[48] This applies, for example, to residential housing covered by the 'environmental programme' and multiple-unit dwellings built in the 1940s and 1950s. Around 60 per cent of the existing stock of multiple-unit dwellings in Sweden needs renovation over a ten-year period.[49] It is therefore important that scope for improving energy efficiency be capitalised upon because profitability for efficiency improvement measures in general is considerably more favourable in connection with renovation than as individual actions. If this does not happen, much of the scope for implementing actions that are currently cost-effective will be lost until the next time that the buildings need renovation. It may take 30–50 years before equivalent scope for cost-effective energy efficiency improvements arises again.

[47] This potential includes approx. 9 TWh more efficient energy end use which is considered to be achieved by actions arising from policy instruments already decided upon.
[48] Under the terminology adopted by the National Board of Housing, Building and Planning, the term "modification" is used, not renovation or conversion.
[49] The approx. 60 per cent of multiple-unit dwellings include the approx. 750 000 apartments erected in the 1960s and 1970s under the 'environmental programme' and the approx. 800 000 apartments built in the two previous decades.

According to the Directive on the energy performance of buildings, Member States must ensure that when buildings with an area of over 1 000 m^2 undergo renovation, they must meet certain minimum requirements in respect of energy performance.[50] In Denmark, Germany and France, there are rules governing energy efficiency improvements in connection with conversion. The said rules define in which cases the minimum requirements must be met and what they are designed to achieve at an overall level or in relation to individual components. In Denmark and Germany, equally radical energy efficiency requirements are in principle laid down for conversion as for new construction.

The National Board of Housing, Building and Planning has recently, on the Swedish Government's behalf, investigated what actions are appropriate for boosting the efficiency of energy use in existing buildings.[51] The Board's terms of reference for this assignment concern actions that can be implemented in connection with *modification of buildings* under the Order (1994:1215) concerning technical characteristic requirements for structures, etc. (Swedish abbreviation: BVF). Proposals regarding what modification actions should require building notification are also to be submitted. In undertaking this assignment, it is to be ensured that the energy efficiency improvement aims to cut consumption of the planet's primary energy resources and thus reduce the burden on the climate and the environment. The terms of reference also entail analysing any need for amendment of regulations in effect with reference to the actions proposed and describing proposals for such actions.

The National Board of Housing, Building and Planning proposes in its report that amending regulations governing more efficient energy use should be drawn up and submitted to the EU for notification during 2009, and that the work should be conducted in close collaboration with other affected authorities and the sector's players. Furthermore, the National Board of Housing, Building and Planning proposes that the legislative term "considerably extended working life" should be replaced by a new concept for extensive conversion. It also suggests that it be clarified what criteria should apply so that extensive conversion is considered to exist and what requirements may be laid down in such a situation. The National Board of Housing, Building and Planning further proposes that the Swedish Energy Agency be instructed, in collaboration with the National Board of

[50] The Directive on the energy performance of buildings, Article 6.
[51] The assignment is conducted after consulting the Swedish Energy Agency.

Housing, Building and Planning, to identify relevant building products with a major impact on the energy use of buildings and to work to ensure that these products are declared and labelled in accordance with voluntary sectoral agreements or via compulsory labelling. Lastly, the National Board of Housing, Building and Planning proposes in its account of the assignment that requirements be drawn up concerning individual metering of hot water in connection with modification and new construction. The Commission of Inquiry supports all these proposals.

4.2.4 Evaluation and announced gradual tightening-up of the new construction requirements

The energy conservation requirements in the building regulations of the National Board of Housing, Building and Planning were revised on 1 July 2006. Certain transitional rules applied initially; since 1 July 2007, however, the transitional rules have ceased to apply and the requirements are now fully applicable. It is thought that clearer and more verifiable functional requirements will lead to cuts in energy use in new buildings.

The Commission of Inquiry considers that further gradual tightening-up of the energy requirements in the new construction rules is a suitable way of achieving the Energy End-Use Efficiency Directive's savings targets. Such tightening-up should be announced so that operators in the building sector are given an opportunity to plan for the rule changes. In this way, the operators' desire for predictability in terms of energy requirements can be fulfilled. A gradual tightening-up of the new-build rules on this point is in line with the requirement for review of the energy performance rules set out in the EC Directive on the energy performance of buildings. Proposals concerning tightened-up energy requirements for new construction have previously been presented in, among other things, Government Bill 2005/06:145.

The Commission of Inquiry proposes that the National Board of Housing, Building and Planning be instructed to review and, where necessary, tighten up current requirements governing energy conservation for new construction in accordance with proposals in Government Bill 2005/06:145, sections 6.4.3 and 6.4.4.

4.2.5 Reduced electricity consumption in housing and premises

High levels of electricity are used in buildings. This is the case not only in relation to heating in small houses in particular but also in respect of electricity for property operation throughout the buildings and in relation to household and business electricity. There is substantial potential for improving efficiency for these applications. In addition, boosting electricity efficiency has a major impact on the use of primary energy. As a result, the Commission of Inquiry has considered that limiting the use of electricity for heating and more effective use of operating electricity, household electricity and business electricity to be desirable from society's point of view. In terms of heating, the conversion of small houses with direct-acting electroheating or with electrical boilers to district heating, biofuel or heat pump operation is an important measure.[52]

Despite the fact that a large number of buildings, principally small houses, have in recent years been converted from direct-acting or waterborne electroheat to mainly heat pumps and district heating, more than 20 TWh of electroheat remains in the Swedish building stock. To this should be added 'hidden electroheat' in the form of electroheating coils in bathrooms, towel rails, etc. which are often recorded for statistical purposes as household electricity.[53] The State has for a number of years provided financial support for conversion initiatives of the kind just described. Currently, however, the majority of all new multiple-unit dwellings are built with electroheating coils in the bathroom. This is not in line with the general effort to counter the use of electricity for heating purposes. If ordinary heating requirements and bathroom electroheating are added together, the result may be that such multiple-unit dwellings do not meet the requirements of the National Board of Housing, Building and Planning concerning maximum permitted energy use per square metre.

To contribute to the fulfilment of the Directive, the Commission of Inquiry proposes a *Programme for efficient electricity use*.

[52] When converting to biofuel heating, however, emissions of air contaminants such as VOCs and particulates should be taken into account.

[53] Measurements at Hammarby Sjöstad show that such electroheating coils in bathroom floors account for 15–20 kWh per m^2 of total building area/year. This should be set against the heating requirements of the new-build rules.

Programme for efficient electricity use

The Commission of Inquiry proposes that a national programme for efficient electricity use be implemented. This programme should comprise greater State aid for conversion initiatives, information drives and advice and also measures to promote more efficient use of electricity for the operation of buildings, household electricity and business electricity.

It may be appropriate to extend and boost existing support for electroheating conversion. The aim of the programme for efficient electricity use is to contribute to the adjustment of the Swedish electricity system. The programme for efficient electricity use is intended to make it easier for the approx. 600 000 owners of small houses who currently have electroheating to convert their heating systems to renewable energy sources, district heating or heat pump operation. Particular importance should be attached to the problems associated with the conversion of directly electroheated buildings. It should be considered whether small houses that are mainly heated by electric boilers in waterborne heating systems should, unlike at the present time, also be eligible for State aid. This may be an important measure because the marginal production of electricity takes place mainly in fossil fuel-fired power stations. This also means that conversion from electroheat, regardless of whether this is direct-acting or waterborne, contributes to a significant cut in carbon dioxide emissions.

The programme for more efficient electricity use in housing and premises must exploit market forces. Possible working methods may include joint procurement, technology procurement and other methods that may contribute to new attractive and profitable package solutions being designed for owners of houses heated by electricity. Interest-free loans, for example, may be considered as an alternative to contributions to individual property owners.

Scope for making contributions to energy suppliers or other operators who undertake area-based electroheat conversion instead of individual small house owners should also be considered. In this context, the successful working method adopted by the Electricity Savings Fund in Denmark may be worth studying. The Commission of Inquiry intends, in connection with its final report, to deal at greater length with issues concerning the impact assessment of organisational, dimensioning and funding matters relating to support for more efficient electricity use, and also how this should be funded.

4.2.6 Continued promotion of energy services

Energy services can make a significant contribution to exploiting the profitable potential for efficiency improvements that exist within buildings. The consultancy WSP has surveyed the energy services market at the request of the Energy Efficiency Improvement Commission of Inquiry. This survey has been undertaken partly via interviews with representatives of energy services companies and customers.

The commonest services are currently Energy Performance Contracting (EPC) and various functional services, e.g. climate agreements. An evaluation of EPC projects implemented in the public sector since the beginning of the new millennium shows that an average saving of 22 per cent has been achieved for heating and hot water. The agreement models for energy services are based on a commitment in which the energy services company assumes full responsibility for investigation and analysis, implementation and follow-up of the energy efficiency improvement projects. The agreement includes guarantees concerning energy saving and performance. The services are offered to customers within, in particular, the property sector and industry, although such projects have also been implemented in the multiple-unit dwelling sector.

The study conducted by the consultancy WSP on behalf of the Commission of Inquiry shows that there is a high level of consensus among market operators that the energy services market will grow significantly in the short and medium term. The result of the interview work also shows that there is a great need to raise levels of expertise. A lack of competent personnel is consistently highlighted as a limiting factor for the expansion of the energy services market. Against this background, the Commission of Inquiry proposes an investment in interdisciplinary courses within this area that are relevant for energy services.

The market survey also reveals a need for disseminating information among customers. The survey proposes that greater support for energy services be provided via the Swedish Energy Agency's *Forum for Energy Services.* The Commission of Inquiry therefore proposes that the Forum for Energy Services be instructed to work on raising levels of expertise, procurement support and the dissemination of information about energy services.

4.2.7 Technology procurement

Technology procurement contributes to the development and dissemination of new energy-efficient technology and to the speeding-up of the introduction of such technology. Technology procurement has been used successfully used since the beginning of the 1990s for the development and market launching of new energy-efficient components, products and systems in Sweden. The Swedish Energy Agency currently coordinates and supports four customers groups in the housing and services sector. Potential for continued development of energy-efficient products and systems within the housing and services, etc. sector is considered to be good.

The Commission of Inquiry proposes that the Swedish Government entrust the Swedish Energy Agency with expanding the technology procurement programme. As part of this programme, the Swedish Energy Agency must seek to ensure that more groups of customers come into being. The expanded technology procurement programme should encompass the dissemination of information on the products developed. In addition, the Swedish Energy Agency should be instructed to create the necessary conditions so that the technology procurement concept can be further developed with regard to, among other things, dissemination and evaluation of the impact of the projects.

4.2.8 Local authority advice

There is considerable potential for improving efficiency both in the stock of small houses and in local authority stocks of buildings. Particular problems also exist with securing acceptance for measures from owners of small houses. To increase the implementation of energy efficiency improvement actions and electroheat conversion in small houses, individual owners of small houses are required to have access to objective and impartial information and advice. Energy advice is a particularly important tool in efficiency improvement work in terms of reaching the target group of small house owners not affected by energy certificates to the same extent as larger property owners.

The Commission of Inquiry proposes that, unlike at the present time, local authority energy advisers should also be allowed to work with more efficient energy use for transport.

4.2.9 Programme for more efficient energy use in land-based industries

Great potential for improving efficiency also exists within land-based industries. In a study conducted on behalf of the Swedish Environmental Protection Agency, the Swedish Institute of Agricultural and Environmental Engineering (JTI) at the Swedish University of Agricultural Sciences in Uppsala found that there is significant potential for improving efficiency in agriculture.[54] Examples of actions referred to in the report include more efficient heating and cereal drying, fuel switching, training, better maintenance of machinery and tools, gentle driving and plant-adapted cultivation. There ought also to be attractive opportunities for improving energy efficiency in forestry and fisheries.

The Commission of Inquiry is considering proposing the implementation of a national programme for efficiency energy use within land-based industries. The programme should, among other things, encompass increased State information drives and advice on actions aimed at more efficient energy use.

4.2.10 Research, development and demonstration

Research, development and demonstration (RDD) are needed for the efficiency improvement desired by society to come about. These policy instruments work primarily in the longer term, while the Directive's aims must be achieved in only nine years. Despite the differing time perspectives, the Commission of Inquiry considers it important to invest in RDD. The reasoning for this is to mobilise society for more efficient energy use through continued technology development, the acquisition of understanding about obstacles and driving forces, behaviour-related issues, modified attitudes and preferences and other factors pertaining to the outside world.

The Commission of Inquiry would point out that investments in RDD are important to be able to achieve a more general transformation in energy use in the housing and services, etc. sector. It is also important that investments in RDD harmonise with other policy instruments adopted with a view to achieving changes in energy use in buildings. A long-term investment in research and

[54] Energy saving in agriculture in 2020, JTI – The Swedish Institute of Agriculture and Environmental Engineering, 2007

development is therefore required. The Commission of Inquiry would also point out that it is important to develop analytical capacity concerning scope for and the impact of various policy instruments. The Commission of Inquiry will also return to this question in its final official report.

As a sectoral authority, the Swedish Energy Agency bears the principal and coordinating responsibility for energy-related building research which is now funded by the State. Besides the Swedish Energy Agency, the State Swedish Research Council FORMAS funds research projects in the energy arena. The Swedish Consumer Agency, the National Board of Housing, Building and Planning and the Swedish Environmental Protection Agency also fund certain energy-related research projects.

Via the Swedish Energy Agency, the State funds the building research programme CERBOF, the Centre for Energy and Resource Efficiency in Building and Administration. The work within this programme is conducted in close collaboration with other authorities, operators in the building and administration sector, colleges and research institutes. The programme is being run over the period 2007–2009 with a budget of SEK 130 million.

Via the Swedish Energy Agency, the State also funds, together with affected industry, an applied research programme for more efficient cooling and heat pump systems, EFFSYS2. The research programme, which is being conducted from July 2006 to June 2010, is supported by the Swedish Energy Agency via a contribution of SEK 28 million.

5 The industrial sector

The account provided in this Chapter is based on a detailed description and analysis of the Swedish industrial sector provided in Chapter 6 of the subreport.

5.1 Structural situation

The industrial sector is taken to include activities relating to the extraction and preparation of raw materials and products. Examples include mining and mineral extraction, engineering, the chemicals industry and the production of timber products, food and textile products. The industrial sector covers SNI codes 10–37 in accordance with the SNI classification from 2002.[55]

The Swedish industrial sector has traditionally been founded on basic industries, i.e. chiefly the extraction and refining of domestic raw materials such as iron ore and forestry. Since the 1970s, the traditional branches of industry, ore mining, the steel industry and the pulp industry, have declined in importance in the Swedish economy. In the first half of the 1990s, traditional manufacturing industry underwent a radical structural transformation. Over this period, the number of people employed in industry fell, as did total production. In the second half of the 1990s, production increased substantially, while the number of people employed rose moderately. Industry has recently become more knowledge-intensive. Roughly one fifth of private-sector employees work in industry. The industrial sector accounts for just over a quarter of Swedish GNP.

[55] Energy use in parts of the business community which are not classed as industry are included in the category of premises in the housing, services, etc. sector.

Table 5.1 The main branches of Swedish industry, 2005

SNI code	Branch of industry	Number of enterprises	Number of employees	Turnover Billions of SEK	Production value Billions of SEK
34	Automotive industry		79 000	252	242
29	Engineering industry		92 900	213	191
15–16	Food industry		55 100	138	124
24	Chemicals industry		35 700	136	134
27	Steel and metalwork		36 000	113	106
21	Pulp and paper industry		35 800	111	113

Source: Statistics Sweden.

Vehicle and machinery manufacture are currently the branches of industry with the greatest turnover and value added. The food and chemical industries are other branches of industry that account for large elements of Swedish industrial production. The chemicals industry, in which the pharmaceutical industry assumes a leading role, has grown strongly in recent years.

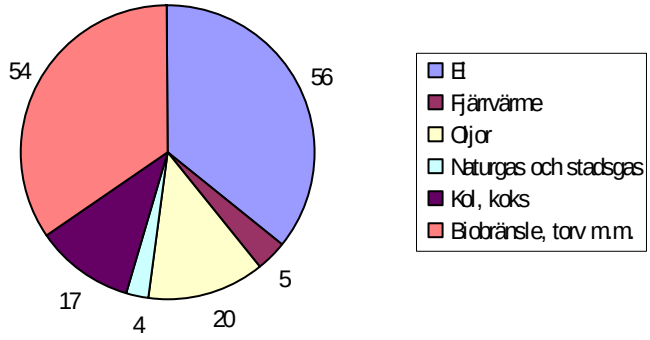
5.2 Energy use in industry

Average annual energy use in industry during the base years 2001–2005 was 155 TWh energy end use, which equates to approx. 265 TWh of primary energy use. Within energy end use, electricity accounted for 60 TWh, biofuel for 54 TWh, oils for 20 TWh and coal and coke for 17 TWh.[56] The use of district heating averaged just

[56] Fossil energy use in industry which is covered by the emission rights trading system has, for the period 2008–2012, been put at a total of approx. 57 TWh. Of this, approx. 35 TWh is included in the Swedish Energy Agency's statistics of the industrial sector's energy use as part of total national energy use. The other 21 TWh is accounted for by industrial by-products of fossil origin such as coke oven gas and blast furnace gas, which are included in statistics of energy use specific to the industrial sector.

under 5 TWh/year. Just over 4 TWh of natural and town gas was used on average in industry during the base years.

Figure 5.1 Distribution of energy end use in Swedish industry, average for the years 2001–2005, TWh



Source: The Swedish Energy Authority.

Translation of diagram captions
El = Electricity
Fjärrvärme = District heating
Oljor = Oils
Naturgas och stadsgas = Natural and town gas
Kol, koks = Coal, coke
Biobränsle, torv m.m. = Biofuel, peat, etc.

The pulp and paper industry accounts for nearly half of industry's energy use, and the iron and steel industry for approx. 15 per cent. The chemicals industry and the engineering industry account for roughly equal proportions of industrial energy use, 8 and 7 per cent respectively. As is apparent from the foregoing, vehicle and machinery manufacturing, which form part of the engineering industry, are the two largest branches of industry in Sweden in terms of turnover, numbers of employees and production value. Total energy use in the engineering industry totals approx. 7 TWh/year. The individual enterprises in the engineering industry are, however, as a rule not energy-intensive.

The pulp and paper industry also account for the highest proportion of *electricity use* in industry, just over 40 per cent. From a national perspective, electricity-intensive industry, in which the pulp and paper industry is dominant, accounts for roughly one quarter of total levels of electricity end use in Sweden.

5.2.1 Exempted energy use in industry

Under the terms of Article 2(b) of the EC Directive, undertakings subject to quota requirements in the EU emission rights trading system are not covered by the Directive's scope. For the current trading period, i.e. 2008–2012, when the number of combustion plants subject to licensing will be increased substantially, it is estimated that approx. 80 per cent of industry's *fossil* fuel use requires emission rights. This means that between 10 and 15 TWh of industry's total fossil fuel use of approx. 70 TWh/year could, theoretically, be the subject of energy efficiency improvements by virtue of the Directive. This is equivalent to approx. 7 per cent of expected total use of energy of all kinds in industry over the period 2008–2012.

5.3 Potential future policy instruments in the industrial sector

5.3.1 New programme period for PFE

A special programme for improving electricity efficiency in energy-intensive industry (PFE) exists in Sweden. A programme period of 5 years has so far been approved by the EU Commission. The Commission of Inquiry proposes that a new programme period of a further five years be implemented. Energy-intensive enterprises will thus be able to apply to take part in a new program with effect from 2009 up to 2014. This means that actions within PFE may be implemented up to 2019. This yields further energy efficiency improvements that can be taken into account when calculating to what extent the savings target pursuant to the Directive has been met.

5.3.2 Extended scope for PFE

The Swedish Energy Authority has been commissioned by the Swedish Government, following consultation with the Swedish Environmental Protection Agency, to propose amendments to the Act (2004:1196) concerning Programmes for Energy Efficiency Improvement (2004:1196) and consequential amendments of the Environmental Code with the objective of introducing uniform and

appropriate regulations for energy efficiency improvement measures in industry.[57]

The point of departure for the proposals is to be that PFE is modified so that enterprises that meet the requirements pursuant to PFE can at the same time be deemed to meet the requirements governing energy conservation that are laid down in the Environmental Code having regard not only to business finance aspects but also to the protection interests and socioeconomic considerations behind the Environmental Code. A specific issue that must be considered is whether PFE should also apply to types of energy other than electricity.

[57] Government decision 24/05/2007 with ref. no. N2007/5101/E.

The terms of reference do not, however, encompass investigating an extension of the scope of PFE to enterprises outside energy-intensive industry. As described above, there is also significant and achievable energy savings potential in non-energy-intensive industry. The Commission of Inquiry considers that enterprises in these parts of industry should also be invited to take part in voluntary energy efficiency improvement programmes that can be adapted to the enterprises on the basis of the latter's size and energy usage patterns.

5.3.3 State aid for energy efficiency improvement in non-energy-intensive enterprises

A new energy efficiency improvement programme for small and medium-sized enterprises outside energy-intensive industry should be established. This programme should be aimed at, and adapted for, enterprises unable to take part in PFE, i.e. enterprises that are not energy-intensive. The programme is intended for a very broad target group, comprising just over 57 000 enterprises or approx. 98 per cent of all enterprises in the industrial sector. Together, the enterprises in the target group account for more than half of manufacturing industry's energy use.

Certain financial incentives should, as in the case of PFE, be offered to participating enterprises. Besides a discount on or exemption from energy tax, it may, for example, be considered whether participating enterprises should be given an opportunity to set aside funds in an *energy saving fund* in the enterprise. Funding reserved is to be usable for investments in the enterprises that boost energy efficiency.

The Energy Efficiency Improvement Commission of Inquiry has conducted an overall inventory of conceivable models for how a policy instrument as referred to here can be designed. The focus has been on how the incentives for the individual enterprises to take part in the programme should be devised. The terms of reference also entailed assessing what energy efficiency improvement potential can be achieved and elucidating the State finance impact and the consequences for enterprises. The results principally reveal the following.

Incentives linked to the use of energy are generally the form that is not only simplest to implement administratively but also the easiest to understand in information terms. An increased energy tax is an

example of such a policy instrument. As the energy cost in the enterprises in question is relatively low compared to turnover, high levels of tax would probably be required for substantial effects to be achievable. Another option, related to the business, is to link various incentives to reduced energy use or to various targets for improving energy efficiency. This may, however, be administratively complicated. It may also be called into question whether such a solution is compatible with EU State aid rules. In this light, incentives linked to investments are to be preferred.

There are two main financial models for lowering the cost in enterprises and thereby increasing the incentive for industrial investments in energy-efficient technology; *contributions* and *deductions in tax* (including fund appropriations).

Contributions are a relatively simple and tested support model. As the target group is large, comprising just over 57 000 enterprises, a simple administrative process is needed for the support to be manageable. As energy use accounts for a small fraction of activities for the groups studied, the contributions should be so evident that they are noticed and sought out while at the same time remaining within the State aid rules which provide maximum investment contributions of 40 per cent on the investment.

Tax deductions are also a tested support model. Deductions via appropriations to investment funds ought to meet the requirements of simplicity both for enterprises and for Skatteverket. A conceivable design entails Skatteverket checking that the investments concern a predefined category of products which are classified as energy-efficient. The deductions must be designed so that they do not conflict with the State aid rules.

Initially, the Commission of Inquiry considers that the deduction model yields better effects than the contribution model. The deduction model is simpler and less expensive to operate for enterprises and authorities. A disadvantage is, however, that deductions are dependent on results and the economic situation.

The two variants of deductions, *direct deductions* and *appropriations to investment funds*, are essentially equivalent. Direct deductions can be conceived of as easier for smaller enterprises and for smaller investments.

Support without liability to repayment must be recorded as income, while support with liability to repayment may only be recorded as income if, with a high degree of probability, it cannot be considered that the support will be reclaimed. Support provided in the form of

investment contributions must reduce the purchase value of the asset. Operating contributions must be set against the costs that the support is intended to cover. The tax handling of State contributions follows the same principles as apply for accounting.

In the light of what has been stated, the following principles can be set out:

- The same support is granted to enterprises in the target group
- The support is based on investments in improving energy efficiency
- The support is granted in the form of tax deductions, where appropriate with appropriations to investment funds

The maximum energy efficiency improvement may be assumed to be 3.3 TWh, which equates to approx. 6 TWh of primary end use. This yields a cost for the State of SEK 0.20 per kWh. The cost per kWh of saved energy in existing PFE programmes is considered to be max. SEK 0.80 per kWh. Realistic potential for the new programme can perhaps be put at approx. 1.5 TWh, equivalent to approx. 3 TWh of primary energy use. This means an energy saving of roughly the same order of magnitude as the effect of existing PFE programmes for electricity-intensive industry.

A possible explanation as to why the illustration yields a lower cost than in PFE is that in energy-intensive industries, where the cost of energy is high, there is a greater focus on exploiting energy-efficient technology than in the rest of industry. Potential for further energy efficiency improvements for really low investments may therefore be greater within enterprises that are not energy-intensive.

It can be noted that a portion of the energy-saving investments should come about even without State aid. The cost per kWh is therefore slightly underestimated.

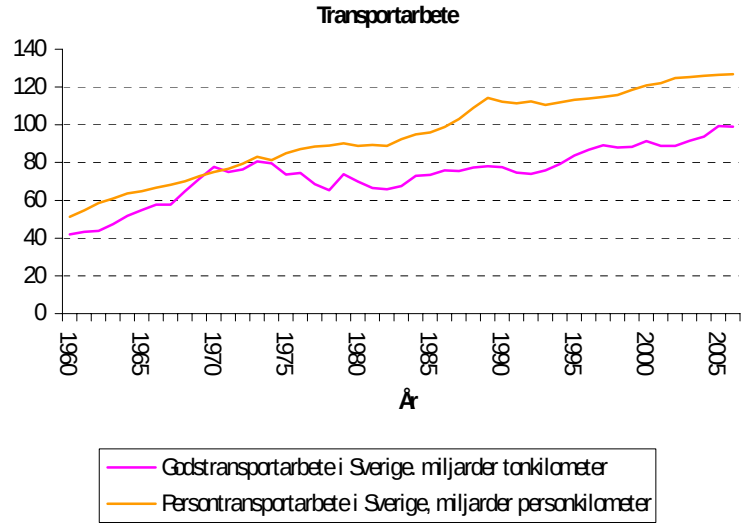
6 The transport sector

The presentation in this chapter is based on a detailed description and analysis of the Swedish transport sector, which is set out in Chapter 7 of the subreport.

6.1 Structural situation

The transport sector is still entirely dependent on fossil fuels. Road transport is the dominant mode of transport. Since 1990, carbon dioxide emissions from road transport have risen by 11 per cent as a result of growth in lorry traffic. As shown by Table 6.1, passenger and goods transport has increased since 1990.

Figure 6.1 Trend for passenger and goods transport in Sweden over the period 1960–2006



Source: SIKA.

Translation of diagram captions

Transportarbete = Transport work

Godstransportarbete … = Goods transport work in Sweden, billions of tonne kilometres

Persontransportarbete … = Passenger transport work in Sweden, billions of passenger kilometres

Energy use for domestic transport is set out in Table 6.1.

Table 6.1 Energy use for domestic transport (2001–2005), per mode of transport, TWh[58]

Mode of transport	2001	2002	2003	2004	2005
Road transport	74,3	78,7	80,3	82,7	84,3
Rail transport	2,9	2,9	2,8	3,0	2,8
Domestic navigation	1, 7	1,6	1,8	1,6	1,5
Domestic flights	2,6	2,5	2,4	2,7	2,7
Total	81,4	85,7	87,4	90,0	91,3

Source: The Swedish Energy Agency.

6.1.1 Passenger transport

Over the past 10 years, passenger transport work has increased by 9 per cent by road, 8 per cent by air, 32 per cent by rail and 33 per cent by sea.[59]

Domestic passenger transport work (road transport, rail and domestic flights) has increased by 14 per cent since 1990, totalling approx. 123 billion passenger kilometres in 2005. Over the same period, economic growth measured in terms of GNP (fixed prices) has risen by 25 per cent. Trips abroad have increased in number and length. Measured in terms of passenger kilometres, they have increased by 80 per cent since 1995. Leisure trips, which account for

[58] Information from the Swedish Energy Agency.
[59] The Swedish Energy Agency: the Energy Situation in 2006.

a quarter of trips abroad, account for the largest increase. The trends now reported are expected to continue, at least in the medium term.

Road traffic dominates passenger transport and in 2005 accounted for 88 per cent of passenger transport work in Sweden, while rail transport accounted for approx. 9 per cent and air transport for just under 3 per cent. Of long-haul passenger transport work (trips over 100 kilometres), the proportion of vehicle journeys was 71 per cent. In the case of short-haul passenger transport work, the proportion of vehicle journeys was just under 80 per cent.[60]

Trips to work and school and to various leisure activities dominate. According to the latest published survey of travel habits, Swedes made 13.4 million trips on an average day, equivalent to just under 5 billion trips in one year. The total distance covered was 363 million km during an average day. The commonest mode of transport was the car, which was used for 64 per cent of the total trip length. In total, the population travelled 4 times as far by car as by public transport. On an average day, 53 per cent used the car, 14 per cent used public transport and 5 per cent used both public transport and the car. Half the number of trips were journeys to or from work or school or for official business. For these, the car was used in 61 per cent of cases.[61]

Increased economic prosperity enables more people to own a car and travel more. The total number of passenger cars on the road has risen from approx. 2.8 million in 1975 to just over 4 million in 2004. Over the same period, car ownership has increased from 300 to just over 450 cars per 1 000 inhabitants. By European standards, this is a low figure. The average in the EU-15 was 495 cars per 1 000 inhabitants in 2002.

The prime reason why carbon dioxide emissions from cars in Sweden are high is that they are heavier and have higher-capacity engines than the average for Europe. Carbon dioxide emissions from diesel engine technology are approx. 20 per cent lower than from petrol engines. The diesel proportion of new car sales in Sweden was approx. 5 per cent at the beginning of the new millennium, and thereafter rose to 10 per cent in 2005, 20 per cent in 2006 and 35 per cent in 2007. Over the same period, sales of ethanol cars rose from approx. 1 per cent to 4 per cent in 2005, just over 10 per cent in 2006 and 11.5 per cent in 2007. Over the corresponding period, the proportion of electric hybrid cars was approx. 1 per cent.

[60] The Swedish Energy Authority: the Energy Situation in 2006.
[61] RES 2005-2006 The national survey of travel habits SIKA 2007:19.

In Sweden, around half of new car purchases relate to company cars and preferential cars purchased by legal entities. The rules in force governing preferential cars mean that it is financially more advantageous to use preferential cares than to purchase and own equivalent cars.

6.1.2 Goods transport

Domestic goods transport work has increased by 27 per cent since 1990, and in 2005 totalled 98.7 billion tonne kilometres. This is the highest level ever and means an increase of over 5 billion tonne kilometres since 2004. Around half this increase is accounted for by the transportation of hurricane-felled timber by rail and lorry which took place in the aftermath of hurricane Gudrun in 2005.

Goods transport work is split more evenly between various modes of transport than is passenger transport work. Goods transport by road accounts for approx. 40 per cent, while rail transport and navigation account for 22 and 38 per cent respectively of total domestic goods transport work. Goods transport work by road has increased by 35 per cent since 1990. Goods transport by sea and rail has also increased, by 29 and 14 per cent respectively.

6.2 Energy use in the transport sector

Annual energy use in the transport sector, excluding fuel for foreign aviation and shipping, averaged approx. 87.2 TWh over the period 2001–2005. In terms of primary energy use, this is equivalent to approx. 108 TWh. This represents just over 20 per cent of Sweden's total energy end use. Energy use for domestic transport consists in large part of oil products, principally petrol and diesel oil. The breakdown between various fuels is set out in Table 6.2.

Petrol use, excluding lean ethanol, has held steady at roughly the same level over the past ten years. Over the period 2000–2005, diesel use has risen every year. In 2005, the use of renewable fuel (ethanol, FAME and biogas) accounted for approx. 2 per cent of the transport sector's energy use (excluding foreign shipping). As a proportion of the use of petrol and diesel, renewable fuel accounted for approx. 2.3 per cent.

Table 6.2 Energy use in the transport sector (including domestic shipping and aviation), unweighted (all energy carriers 1.0), TWh

Fuel	2001	2002	2003	2004	2005	Mean
Petrol	48.4	48.9	48.6	47.1	46.5	47.9
Diesel/Eo 1	26.6	30.2	31.5	34.4	36.4	31.8
Eo 2–5	0.5	0.5	0.8	0.8	0.8	0.7
Pure ethanol	0.2	0.5	0.9	1.5	1.7	1.0
Aviation fuel	2.6	2.5	2.4	2.7	2.7	2.6
Electricity	2.9	2.9	2.8	3.0	2.8	2.9
Natural gas & biogas	0.2	0.4	0.3	0.3	0.4	0.3
Pure FAME	0.0	0.0	0.1	0.1	0.1	0.1
Total	81.4	85.7	87.4	90	91.3	87.2

Source: The Swedish Energy Agency.

Energy use in the transport sector is to a large degree dependent on economic development and technology development. Total energy use for goods transport is increasing. Since the beginning of the 1970s, goods transport work in Sweden has grown by approx. 30 per cent. Over the same period of time, goods transport journeys of more than 100 kilometres by rail increased by 10 per cent, and those by lorry increased by 30 per cent. Rail is thus losing market share to road transport.

6.3 Potential future policy instruments in the transport sector

6.3.1 Binding emissions requirements for automotive manufacturers

In December 2007, the EC Commission submitted a proposal to introduce a binding average emissions limit of 130 grams of carbon dioxide per kilometre for new cars in 2012. In addition, the Commission proposed that certain additional measures be introduced that can help cut emissions by a further 10 grams of carbon dioxide per kilometre and thus reduce emissions from new car production sufficient to meet the EU's target of 120 grams/kilometre. Such additional measures include energy efficiency improvements in car components with the greatest impact on fuel use, such as tyres and air conditioning. The Commission plans to come back with such energy efficiency improvement proposals. The Commission's proposals concerning a "limit value" can be viewed as part of a European programme for boosting energy efficiency in an area where the market has failed to achieve set targets (140 grams of carbon dioxide per kilometre in 2008), despite the fact that technology has been available.

Testing Stations 2008 recommended that the Swedish Government seek to ensure that the proposal concerning the limit value of 130 grams of carbon dioxide per kilometre be implemented and at the same time strive to ensure that the rules allow certain flexibility in meeting the requirements.[62] Furthermore, Testing Stations 2008 proposes that the Swedish Government seek to ensure that the binding

[62] The Swedish Energy Agency and the Swedish Environmental Protection Agency: The development of Swedish climate strategy. A summary of the Swedish Energy Agency's and the Swedish Environmental Protection Agency's data for Testing Stations 2008, ET2007:29

emissions requirements are gradually tightened up after 2012 and that the requirements will also cover light lorries.

6.3.2 General policy instruments in the transport sector

Tax on fossil motor fuels is currently the general policy instrument used within the transport sector. Fuel taxation is a cost-effective way of cutting fuel consumption. An increase in fuel tax provides an incentive for a number of adaptation measures. This may encompass cycling instead of driving, using public transport more, investing in an effective logistics solution, purchasing a more energy-efficient car or driving in a more energy-efficient way.

Within the EU, Directives apply which lay down requirements for minimum taxation on fuels. Petrol and diesel for transport operations are subject to energy and carbon dioxide tax which together exceeds the minimum level. Carbon dioxide tax for fuels is, with effect from 1 January 2008, 101 öre per kg of carbon dioxide emitted. The energy tax is differentiated according to the environmental class to which the fuel belongs.

Table 6.3 Energy tax and carbon dioxide tax on fuel with effect from 1 Jan. 2008 (SEK per litre)

	Energy tax	Carbon dioxide tax	Total
Petrol (ec 1)[63]	2.95	2.34	5.29
Diesel (ec 1)	1.28	2.88	4.16

Source: Skatteverket.

Since the end of the 1990s, energy and carbon dioxide tax rates have been revised annually in line with inflation (CPI). The increase in carbon dioxide tax that has taken place since 2000, besides index adjustment in line with CPI, has largely taken place at the same time as energy tax has been reduced.

Until 1995, Sweden had very low energy tax on diesel fuel as all diesel-operated cars were subject to tax based on distance driven. In

[63] ec stands for environmental class

connection with Sweden's accession to the EU, the tax based on distance driven was abolished and replaced by an increased energy tax, and total diesel fuel tax came into line with that in effect in other EU Member States. Since 1995, energy and carbon dioxide tax on diesel fuel has largely tracked growth in GNP.

As taxes on fuel place a direct burden on fuel use and leave it up to the consumer to decide on measures to cut use, fuel taxes provide an incentive for the most cost-effective measures to be implemented. However, the lower energy tax on diesel compared with petrol has an adverse impact on cost-effectiveness. A technology-neutral tax on petrol and diesel oil would mean that energy tax on diesel would be raised by just over SEK 2 per litre. Testing Stations 2008 proposed that the energy tax on diesel fuel be gradually raised to a level of taxation equivalent to that for petrol in terms of energy content at the same time as the increased vehicle tax is removed. The possibility of refunding elements of energy tax paid on diesel fuel to haulage contractors in compensation for an increase in energy tax on diesel should be investigated, according to Testing Stations 2008. The level of energy and carbon dioxide tax in Sweden is roughly on a par with the average in Europe and slightly lower than in Sweden's nearest neighbours. Taxes on diesel are also in line with the average in Europe but slightly above those in Sweden's nearest neighbours.

The Commission of Inquiry notes that aviation and shipping are generally low-taxed compared with road traffic. Fuel within both sectors is untaxed and there is a general lack of effective policy instruments for emissions in these sectors. Aviation is to a limited extent subject to environmentally regulating taxes. The lack of policy instruments for these modes of transport is to a large extent dictated by the fact that these industries operate on international markets. National rules and policy instruments have a limited effect, and rigorous Swedish requirements may, among other things, lead to the reregistration of ships to flags of convenience.

In the light of what has been stated above, a combined package of policy instruments for boosting the energy efficiency of the transport sector should, according to the Commission of Inquiry, include an increase in tax on fossil fuels. The level of this increase should, according to the Commission of Inquiry, be laid down after an overall impact assessment and coordination of existing and proposed policy instruments within the environmental and energy arenas has been conducted. Based on such an evaluation, the question of a suitable level for fuel taxes can be decided upon.

6.3.3 Carbon dioxide-differentiated vehicle tax

Vehicle tax has primarily a fiscal purpose, but has since autumn 2006 been changed so as to encourage a switch to more energy-efficient vehicles and vehicles than run on alternative fuel. The tax was previously based on vehicle weight. The tax is nowadays based on vehicle carbon dioxide emissions.

Annual vehicle tax for new passenger cars from model year 2006 and for cars in environmental class 2005, and electric and hybrid vehicles has, since 1 October 2006, been determined by three components:

- a fiscal basic tax of SEK 360 for all passenger cars,
- a carbon dioxide component of SEK 15 per gram of carbon dioxide emissions per kilometre exceeding 100 gram/km,
- an environmental and fuel factor totalling 3.3 for diesel cars that is to be multiplied by components 1 and 2. The environmental factor is a supplement for diesel cars' higher emissions of particulates and nitrogen oxides compared with petrol cars. The fuel factor is a supplement for the lower energy tax on diesel compared with petrol.

An extra reduction applies to cars that can run on alternative fuels. The tax system in question for preferential cars means that a carbon dioxide-based vehicle tax has a positive but limited impact on demand for fuel-efficient cars. Control Stations 2008 proposes that the fiscal basic tax be replaced by greater carbon dioxide differentiation through the removal of a higher carbon dioxide component for emissions above 120 grams of carbon dioxide per kilometre.

A differentiated carbon dioxide tax complements binding emission requirements for automotive manufacturers. The current format has been projected to yield a limited impact for the energy efficiency of new cars. One way of boosting the incentive to choose an energy-efficient car is to give the fuel and environmental factors currently applied in calculating vehicle tax a stronger carbon dioxide differentiation.

6.3.4 Change in existing policy instruments

A number of the taxes on Swedish passenger cars are currently designed so that they directly or indirectly counteract adaptation of the Swedish fleet of vehicles to fuel consumption and emissions at average European level.

Preferential taxation

The preferential taxation of free cars for private use counteracts adaptation to the European level. The current design of the preferential value, which does not take account of the car's specific fuel consumption, provides an annual tax discount of up to SEK 8 000 for cars that can run on E85 and up to SEK 16 000 for hybrid cars and cars that can use biogas.

If free fuel is included in the car benefit, this benefit is currently estimated to be the market value of the quantity of fuel used multiplied by 1.2. This means that the fuel costs for people with this benefit is only 60 per cent of the fuel costs for motorists who do not have this benefit. The current tax discounts for preferential cars help, in relative terms, to make it less attractive to choose an energy-efficient car. The limited taxation of the fuel benefit leads to increased driving distances. The impact is significant because approx. 50 per cent of new cars are purchased by legal entities, of which more than one half are preferential cars.

Clearer differentiation of preferential taxation on the basis of the vehicle's fuel consumption makes it more attractive in relative terms to choose an energy-efficient car.

Subsidies for the purchase of environmentally friendly cars

The number of cars that run wholly or partly on electricity, gas or ethanol has grown in recent years. In 2006, the number of cars that could run on biofuel accounted for just over 10 per cent of new car sales. This increase is the result of the policy instruments that have been introduced to promote the use of environmentally friendly cars. The State subsidises new environmentally friendly cars to the tune of SEK 10 000 and requires 75 per cent of all new passenger cars purchased or leased by State authorities to be environmentally friendly

cars.[64] The benefit value for free cars has been reduced by up to 40 per cent for Flexible Fuel Vehicles (FFVs). Biofuels are exempt from energy and carbon dioxide tax. According to the State definition of an environmentally friendly car, vehicles which release up to 218 grams of carbon dioxide per kilometre are accepted if they can use a biofuel. If the car is fitted with an automatic gearbox (which usually increases fuel consumption by 5–10 per cent), it is in this context still counted as if it were fitted with a manual gearbox. This means that cars even with up to 240 grams of carbon dioxide per km are in practice accepted as environmentally friendly cars and granted extensive subsidies.

According to the Commission of Inquiry, the Swedish definition of an environmental car should be changed if Sweden is to be able to contribute to the EU achieving the target of max. 120 grams per km by 2012. With the retention of current Swedish policy instruments, a risk exists that the gulf with the rest of the world will widen instead of narrowing. Mean fuel consumption in new E85 cars has increased sharply over the past two years.

One option might, according to the Commission of Inquiry, be to gradually raise the requirements concerning how high the fuel consumption of "environmentally friendly cars" may be. The requirement should be technology-neutral and fuel-neutral. There is therefore no reason, from an emissions perspective, to carry on rewarding electric hybrids in preference to other solutions that yield equally low fuel consumption. The Commission of Inquiry proposes that the Swedish National Road Administration's definition should apply to all State incentives that promote greater numbers of environmentally friendly cars. This means that highly fuel-efficient petrol and diesel vehicles are included. Furthermore, a tightening-up of the requirement concerning the energy efficiency of vehicles that can run on biofuel should be investigated, according to the Commission of Inquiry.

6.3.5 Lower speed

Table 1.4 Average link between speed and fuel consumption at constant speed in the case of petrol-driven passenger cars, 2000–2001 models

[64] Order (2004:1364) concerning public-sector purchasing and leasing of environmentally friendly cars. This means that 35 per cent of all State cars are to be environmentally friendly cars.

Km/hour	30	50	70	90	110	130
litre/100 km	7.30	5.96	6.13	6.90	7.98	9.70

Source: The Swedish National Road Administration.

The maximum speed limit for heavy lorries in Sweden is 80 km per hour. Despite this, speed limiters, which are mandatory for heavy vehicles, are factory-set at 89 km per hour. A number of haulage contractors have themselves decided to convert their vehicles to 80 km/hour because they reckon that the loss of time that would arise from the lower speed will be outweighed by lower costs for fuel, vehicle wear, etc. One possibility may be, via procurement requirements, to promote a general switch to no more than 80 km per hour. Another possibility is to stipulate that commercially operated heavy lorries registered in Sweden have the speed limit set at max. 80 km per hour.

Intelligent Support for Adaptation (ISA) of speed may assume great importance for speed adaptation and road safety by providing the driver with instantaneous information on whether he or she is exceeding the maximum speed limit. The system can be designed so that it continuously records and stores information on what speed the vehicle is doing relative to the maximum speed limit. This makes it possible for those ordering goods and passenger transport to impose requirements so that people carrying out the work check that drivers do not break the speed regulations. The system can also be used for individual monitoring of the training of drivers in Eco-driving.

According to a British study, the mandatory introduction of ISA would cut fuel consumption by 8 per cent in built-up areas and 3 per cent on other roads.

The transport industry may, over the next few years, introduce ISA and use the technology to ensure that drivers observe the speed limit displayed. If this does not happen, the Swedish Government should, according to the Commission of Inquiry, consider making ISA equipment mandatory for vehicles used for commercial transport. This would entail equipment which stores information and which can be read off both by hauliers and by the police. The use of ISA in commercially operated vehicles may be expected to have a mitigating effect on the speed of other vehicles as well.

6.3.6 Improved logistics

There is significant technical potential for improving energy efficiency in logistics and the distribution of goods. Although many haulage contractors who undertake goods transport operations under their own management already use modern electronically based route planning systems, significant potential probably remains nevertheless.

Certain local authorities (e.g. Falun and Stockholm) have developed systems for co-distribution of goods supplies to, for example, schools and old people's homes. The potential for improving energy efficiency appears to be significant. Schenker talks about cutting the number of supplies in Stockholm by 70 per cent. Energy consumption will not fall by as much, but perhaps by 30–40 per cent. Similar scope exists in relation to supplies of certain types of goods for the consumer non-durables trade. Trials have previously been conducted, including in Majorna in Gothenburg and in Stockholm Old Town, but it seems difficult to win over the trade.

A likely effect of the introduction of a tax based on distance driven for heavy vehicles is an increase in the average fullness factor, and a marginal increase in the competitiveness of rail and shipping. After tax based on distance driven was introduced in Germany, a spot market was established for empty space on long-haul lorries. Nothing similar is yet available in Sweden.

The Commission of Inquiry proposes that the Swedish National Road Administration be instructed to work on the dissemination of information on energy services in the transport sector so as to try to exploit the socioeconomic potential for energy efficiency improvements that exists in connection with goods transport.

6.3.7 Energy-efficient driving

Training in energy-efficient driving (Eco-driving) may permanently cut fuel consumption by 5–15 per cent depending on drivers' habits before they undergo the training and how well it is followed up. The impact of training in energy-efficient driving is considered to wane over time. This is due not only to the fact that the impact does not become permanent without repeated training or positive incentives but also to the fact that the braking energy in an electric hybrid can be recovered only in part.

The Commission of Inquiry proposes that the Swedish National Road Administration, in consultation with affected authorities, develop a joint concept for energy-efficient driving of machinery and supplements this basic concept with tailored applications in the various sectors.

6.3.8 Social planning

Transport demand depends to a large extent on how society is organised spatially. Social planning at local and regional level therefore indirectly constitutes a central policy instrument for improving energy efficiency even if the development of society also depends to a great extent on other factors such as structural change within the business community. The planning process has a number of often conflicting objectives and has therefore not led to a society that is more economical from the transport perspective. Neighbouring local authorities compete with one another for customers for external shopping centres or for the establishment of new enterprises, where work income and tax income may be given a higher priority than transport work.

The structure of society and investment in infrastructure are important factors in reducing the environmental burden from traffic over the long term. Technology improvements and alternative fuels need to be supplemented by other measures to eliminate the burden of traffic on the environment. Infrastructure may need to be supplemented to meet the needs and promote the use of energy-efficient modes of transport. Under the EET strategy, specific proposals are presented for town planning and infrastructure which are effective in transport terms, but it has not been possible to account separately for quantifications of the impact of each individual proposal.

The proposals concern, among other things, investments which bolster rail capacity. Through higher levels of maintenance, improved integration of transport operations and the expansion of alternative routes that afford greater flexibility and speed, rail can effectively support both Sweden’s competitiveness and development towards a sustainable transport system. The Swedish Rail Administration’s view is that rail can accept 50 per cent more goods until 2020, chiefly in the form of increased combined transport and thus help cut total carbon dioxide emissions from the transport sector.

Another proposal is that public transport needs to be developed both in major towns and local authorities and on routes between them. Investment required concerns, among other things, attractive and safe travel centres, stations and stops, improved punctuality and reliability for regional trains, public transport lanes and signal prioritisation, good link roads for pedestrians and cyclists, effective modern information systems and good facilities for parking bicycles or cars.

Over the long term, structural measures such as social planning offer great potential in creating a social structure with lower transport intensity and better interaction between different modes of transport. This has been stressed by the IPCC and by a number of authorities in Sweden, although there is at the same time a lack of data for assessing costs and technical potential. [65]

The aim of transport is usually to gain access to goods and services rather than the mobility in itself. If society can be organised so that such access is gained with less frequent and long physical movements, the same access can be achieved with less transport work. Remote working and home shopping are two examples that can lead to reduced demand for physical transport. This may also entail a modified structure for goods through a reduction in materials content and altering the composition of consumption in favour of a greater proportion of services or less transport-intensive goods.

The Environmental Protection Working Party has identified town planning as a key area and considers that, at local level, a number of important approaches are needed to rectify in the short and medium term, and to eliminate in the long term, the structures that contribute to increased dependence on transport: [66]

- well-planned building structure for large towns (decentralised concentration/multiple centres/star-shaped towns) and for other built-up areas;
- compression of land already exploited, particularly around public transport nodes;
- good local public transport provision;
- decentralised services, such as consumer non-durable stores, schools and day-care centres;

[65] Intergovernmental Panel on Climate Change (a UN body).
[66] The Environmental Protection Working Party, Strategy for Reduced Transport Dependence, Memorandum 2006:2.

- restriction of parking areas and better access that is efficient for vehicles.

The Commission of Inquiry considers that social planning at regional and local level needs to a greater extent to encourage a social structure that promotes transport which is sparing on resources. Conscious management of the development of construction is, according to Inspection Stations 2008, of great importance for future transport dependence as construction changes slowly and transport-generating construction patterns have long-term consequences. Regional coordination of planning is considered to be required.

6.3.9 Public investments in research, development and demonstration

There are grounds for thinking about what transport systems may end up looking like and what obstacles have so far been identified that could prevent the desirable efficiency improvement coming about and how this affects the assessment of future needs for research, development and demonstration (RDD). The driving forces behind technical trends relating to vehicles are of differing kinds. Such trends are driven by economic policy instruments, legal requirements, information, etc. There may also be other driving forces that are not as predictable. Modified attitudes and preferences are examples of such factors pertaining to the outside world. Although engines have steadily become more efficient, this improvement has primarily been capitalised upon not by lower fuel consumption but by increased demand for larger cars with more powerful engines. It is difficult to foresee whether this kind of preference will continue into the future. The future will in part depend on what approach is chosen for RDD, one of whose aims is to try to make the transport system more energy-efficient.

The Commission of Inquiry would emphasise that investments in RDD are a very important step in ensuring that a more radical transformation of the transport system is achievable. It is also important that investments in RDD harmonise with other policy instruments adopted with a view to achieving changes in the transport system.

Internal-combustion engine development and electrical drive systems must in the long run lead to technology that can materially

reduce fuel consumption in passenger cars and heavier vehicles. It is considered that public-sector efforts aimed at future efficiency improvements in vehicles must continue to entail mainly support for RDD. Based on increased RDD activities, a strategic plan should, according to the Commission of Inquiry, be urgently drawn up concerning priorities for continued investments in the most promising concepts in relation to electricity and electric hybrid vehicles and fuel cell engines.

6.3.10 Consumer information on vehicle fuel consumption

An important complement to changes in fuel taxes, vehicle taxes, rules governing preferential cars, etc. is information for consumers on vehicle fuel consumption. The Commission of Inquiry proposes greater consumer information for new car buyers with a focus on the comparability of fuel consumption. In addition, support for buyers of heavy vehicles and work machinery should be provided so that fuel consumption can be taken into account more easily.

6.3.11 The transport sector in the EU emission rights trading system

The above proposals concerning policy instruments are based on the assumption that the transport sector is not incorporated in the EU emission rights trading system. The issue of the inclusion of the transport sector in the trading system is currently being considered. As emission rights trading ought to be relevant for the transport sector only in the relatively long term, a number of other measures need to be taken to boost energy efficiency in the transport sector. Such measures have been described above. If a decision is taken to include the trading sector in the trading system, scope for the Commission of Inquiry's proposals concerning policy instruments will be affected.

7 Specific reporting requirements under the Directive

Under the terms of Article 14(2), Member States must, besides the energy efficiency improvement policy instruments and measures required to reach the savings target, also describe the measures planned for the public sector to set an example to other players with regard to energy efficiency improvement. Furthermore, under the terms of Article 14(2), cf. Article 5(1), it should be described how Member States intend to disseminate information on the public sector's specific responsibility. The same applies to general information and advice to final customers of all kinds pursuant to Article 7(2) concerning energy efficiency improvement.

7.1 The public sector's specific responsibility

7.1.1 Structural observations

The public sector in Sweden consists of the State, local authorities and the county council regions. State organisation has both a central and regional level. At central level, there is the Swedish Government with 13 ministerial departments, the EU representation and the Cabinet Office. The departments are relatively small by international standards. In Sweden, much of the work which in many countries is carried out by departments or ministries is undertaken by the central State administrative agencies and the authorities. There are approx. 250 such authorities of varying size, ranging from several employees to several thousand.

The regional State organisation consists of the county administrative boards, one in each of the 21 counties. The county administrative boards have a number of overarching and coordinating tasks in the county within a large number of specialist areas such as transport, construction, regional planning, employment, agriculture and the environment.

In recent years, a number of authorities or elements of authorities have, on regional policy grounds, relocated to parts of Sweden other than Sweden. The State administrative authorities are managed via spending authorisations from the Swedish Government. Results are monitored via annual reports. The authorities are relatively independent of the Government and have great freedom in determining how activities are to be organised and how assignments are to be carried out.

The local authorities are autonomous legal subjects and independent of the State organisation. Sweden's local authorities are self-governing, and their activities are regulated in the Local Authority Act. The latter makes clear, among other things, that the local authority must be managed by town councillors, a policy-making assembly chosen by general election. Town councillors must appoint a municipal executive board and the committees otherwise needed for the local authority to be able to discharge its duties vis-à-vis the general public. Important duties for the local authority include road management, snow clearance, waste management and similar municipal services. The local authorities are also responsible for schools and kindergartens, care and nursing of the elderly and disabled, and social services in the local authority. There are currently 290 local authorities in Sweden. Activities are funded by local authority tax, the level of which is set by the local authorities themselves.

In addition, there are 20 county council regions. These are responsible in all essentials for nursing and local transport within an area generally following county boundaries. The county council is, like the local authorities, managed by a politically appointed town councillor, the county council deputy. Elections to the county council take the form of general elections. Activities are funded by the county council tax, and each county council decides itself how the tax revenue is to be used.

7.1.2 Specific requirements governing the public sector

Under the Energy End Use Efficiency Directive, Member States must ensure that measures aimed at improved energy efficiency are adopted in the public sector. The measures must be taken at a suitable national, regional or local level. Legislation and voluntary agreements are mentioned as conceivable policy instruments. In addition, there are specific rules governing public procurement. Annex IV to the Directive sets out six measures, linked to public procurement, at least two of which must be implemented in accordance with Article 5(1). The measures listed in Annex VI to the Directive are as follows:

a) Use procurement models with guaranteed energy savings

b) Purchase the most energy-efficient equipment and vehicles based on lists of energy-efficient product specifications

c) For procurement, also apply energy requirements in the standby mode

d) Lay down requirements to replace or retrofit existing equipment and vehicles in order to meet energy efficiency requirements listed in points b) and c)

e) Require the use of energy audits and implement the resulting cost-effective recommendations

f) Lay down requirements concerning the modification of buildings owned or rented by the public sector in order to render them energy-efficient

Member States must instruct one or more authorities to take charge of the administration, management and implementation of energy efficiency improvement measures in the public sector. Nothing prevents the authority which is to be responsible for overall supervision and monitoring of the Directive's implementation from also being responsible for monitoring and supervision in the public sector.

7.1.3 Energy efficiency improvement programme in State activities

The State must adopt a pioneering role

The State authorities must provide a lead for other bodies, including local authorities and county councils, with regard to actual measures. Partly given the independent position of local authorities in Sweden, it is strategically important whether the targets are achievable. The Energy Efficiency Improvement Commission of Inquiry will return in its final report to the question of implementation and management approaches in relation to introducing an energy efficiency improvement programme in State administration.

Programme for energy efficiency improvement in State activities

There is considerable untapped potential for cost-effective energy efficiency improvement measures in the public sector as well. The State can contribute to improved energy efficiency in various ways. This may be done by the selection of equipment and installations in the State's own buildings. It can also be achieved by setting requirements, for example as tenants when leases are concluded. The efficiency of energy use within the State's own activities can also be improved, e.g. through the purchase of energy-efficient computers and the choice of transport.

The Commission of Inquiry has put the total economic potential of boosting the energy efficiency of the State's stock of property at approx. 0.8 TWh primary energy use, which corresponds to approx. 0.5 TWh/year in energy end use. This should be supplemented by the efficiency improvement potential in buildings leased by State operators. This assessment is based on calculations of the potential for the existing approx. 15 million square metres of State-owned properties.[67] Around 25 per cent of the saving concerns electricity and the remaining three quarters relates to district heating and fuel. The estimated potential of 0.8 (0.5) TWh covers only the direct effects to which energy efficiency improvement measures in the State sector contribute. This must be supplemented by the indirect effects, or 'knock-on effects', that arise in other parts of the construction sector as a result of the State sector setting a good example, and as a result of

[67] www.samverkansforum.nu

State procurement creating markets and bringing about the development of new energy-efficient products.

The Commission of Inquiry proposes a combined programme for improving energy efficiency in the State sector in order to meet the Directive's requirements, here called PFE_{state}. It should be compulsory for State authorities to take part in the programme. State corporations should also, where possible and applicable, be covered by the programme. This may, for example, be carried out via owner instructions to State-owned enterprises. The requirements concerning participation can be adapted to the activity carried out within the respective organisation.

The requirements in PFE_{state} should cover the following:

- Energy management
- Building projects/administration (for State developers and administrators)
- Procurement of products (including transport)
- Leases
- Business trips

The programme should be coordinated with other activities concerning energy efficiency improvement so that the maximum possible joint impact is achieved. The requirements should also be harmonised with those in the agreements to be concluded with local authorities and county councils. A number of support functions must be established to support the organisations taking part in PFE_{state}. Examples of such support functions are tools for procurement and advice on building projects. The Commission of Inquiry proposes that the Swedish Government instruct the Swedish Energy Agency to design the energy efficiency improvement programme for State activities.

7.1.4 Energy efficiency improvement agreements with local authorities and county councils

Local authorities and county councils are responsible for a large proportion of Swedish public-sector activity. The Commission of Inquiry proposes that agreements concerning more efficient energy use be concluded between the State and individual local authorities and county councils.

The Commission of Inquiry has put the total economic energy efficiency improvement potential offered by buildings owned by local authorities and county council regions at approx. 3 TWh of primary energy use, which is equivalent to approx. 2 TWh/year in energy end use. To this should be added the efficiency improvement potential in buildings leased by local authorities and county councils. This assessment is based on calculations of the potential for the existing approx. 56 million square metres of buildings owned by local authorities and county council regions.[68] Around 25 per cent of the saving concerns electricity and the remaining three quarters concerns district heating and fuel. The estimated potential of 3 (2) TWh covers only the direct effects to which energy efficiency improvement measures in local authorities and county councils contribute. This must be supplemented by the indirect effects, or 'knock-on effects', that arise in other parts of the construction sector as a result of the public sector setting a good example, and as a result of public procurement creating markets and bringing about the development of new energy-efficient products.

The aim of the agreements is for local authorities and county councils to implement such extensive and coordinated energy efficiency improvement programmes that they set an example and lead the way on energy efficiency improvement. This means that the socioeconomically profitable energy efficiency improvement potential that exists is to be exploited. Local authorities and county councils can contribute to increased energy efficiency improvement both by the selection of equipment and installations in their own properties and by laying down requirement in lease conditions concerning energy efficiency in leased premises. Energy use within their own activities can also be improved. An important measure is also to lay down requirements concerning energy efficiency when procuring equipment and choosing transport. The agreements are to encompass at least two of the above-mentioned measures.

To obtain the greatest possible impact for efficiency improvement measures, the Commission of Inquiry proposes that agreements be signed individually with individual local authorities and county councils. In certain cases, a group of local authorities may be party to a joint energy efficiency improvement programme. The level of the requirements in the agreements should be harmonised with the requirements in the PFE_{state}. The Commission of Inquiry intends, in

[68] SCB and the Swedish Energy Authority, STIL2.

collaboration with the Swedish Association of Local Authorities and Regions (SKL), to draw up a proposal in 2008 regarding how local authority agreements to improve energy efficiency can be designed.

7.1.5 Monitoring and supervision

As mentioned above, one or more authorities are to be instructed to monitor and supervise compliance with regulations governing the public sector's role in energy efficiency improvement work. This entails, among other things, taking responsibility for the introduction and follow-up of the energy efficiency improvement programme in the State sector. Another relevant task entails representing the State as a party vis-à-vis the local authorities when local authority improvement agreements are concluded.

It is unnecessary, but may be appropriate, for one and the same authority to be responsible for all monitoring and inspection of energy efficiency improvement work in the public sector. The Commission of Inquiry intends addressing this issue at greater length in its final report.

7.2 Dissemination of information

As stated in Chapter 3, a lack of knowledge and information is a major factor behind why energy efficiency improvements that are intrinsically profitable in terms of both private and social economics do not come about. In this light, a combined information drive as part of the package of measures arising from the EC Directive is important. Such drives should be coordinated at State level, but also involve representatives of various kinds of energy users such as property owners, industrial concerns and local authorities. The drives consist principally of a combined information campaign aimed at more efficient energy use and a web-based information centre called the Forum for Energy Efficiency Improvement.

7.2.1 Forum for Energy Efficiency Improvement

Information provision and the dissemination of knowledge are targeted in a combined *Forum for Energy Efficiency Improvement*. The internet represents the main medium for information provision via

an energy forum of this kind. It is strategically important that representatives of users also take part in designing the service.

It must be possible to integrate a number of types of information in the service, which is thus intended for various kinds of user. An overarching objective is also for the provision of information on improving energy efficiency to the general public to be targeted and coordinated via this forum. There is nothing to preclude the use of channels other than the internet if deemed necessary for a specific target group, or a specific context.

Conceivable applications include the following:

- Dissemination of general information on energy efficiency improvement that is tailored to the relevant target group, apartment-type households, property owners of all kinds, industry, small businesses, local authorities, etc.
- Dissemination of information on life-cycle cost calculation for actions.
- Dissemination of target group-adapted information covering computational programs for energy efficiency improvement for various categories of energy user.
- Dissemination of target group-adapted information on contributions, tax reliefs and other public support.
- Dissemination of information on good examples and, not least, what economic savings can be achieved by improving energy efficiency.
- Provision of a platform for the public sector, principally the State, to demonstrate how the State authorities are leading the way on improving energy efficiency. The authorities can in this context also be graded and classified with regard to targets achieved. The same applies to local authorities. Within the framework of "Your local authority", citizens can acquaint themselves with their own and other local authorities' results on improving energy efficiency. A strategically important issue to clarify concerns which local authorities have concluded energy efficiency improvement agreements with the State and which have not.

A system for benchmarking is therefore introduced within the Forum for Improving Energy Efficiency: this system gives the general public an opportunity to compare different authorities, municipalities and other public organisations with one another. The issue of improving

energy efficiency is currently of general interest. This is due not least to the current climate debate and the central importance that climate issues have assumed recently. As a result, inhabitants of municipalities, for example, may be expected to make demands of their politicians, if their own local authority does not perform as well as others, in an effort to improve the efficiency of energy use. The media may be expected to play an important part in disseminating knowledge and information concerning the performance of various local authorities and State authorities and differences between them.