Annex to Government Decision

24 April 2014

N2013/5078/E
N2013/5984/E
N2014/2010/E

Sweden's Third National Energy Efficiency Action Plan

Adopted at the Cabinet meeting of 24 April 2014.

Summary

In accordance with Article 24(2) of Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency (hereinafter *Energy Efficiency Directive*), Member States shall submit National Energy Efficiency Action Plans in April 2014 and every three years thereafter. The Action Plans shall cover significant energy efficiency improvement measures and expected and/or achieved energy savings, including those in the supply, transmission and distribution of energy as well as energy end-use, in view of achieving the national energy efficiency targets referred to in Article 3(1) of the Energy Efficiency Directive.

The Swedish Parliament had previously, in accordance with Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC (hereinafter *Energy Services Directive*), adopted an overall national indicative energy savings target of 9 % by 2016 compared with the average energy end-use for the 2001-05 period (Bill 2008/09:163, report 2008/09:NU25, Parliamentary notification 2008/09:301). The percentage-based energy savings target has been converted into an energy saving in physical terms and corresponds to 33.2 TWh for 2016. This action plan shows that Sweden is meeting the savings target under the Energy Services Directive by a comfortable margin. Primarily through the use of the calculation methods recommended by the European Commission, the savings have been calculated as 48.7 TWh by 2016.

In addition to what is laid down in Article 24(2) of the Energy Efficiency Directive (2012/27/EU), this action plan also sets out a long-term strategy for investments in renovations to improve the energy efficiency of the national stock of residential and commercial buildings, both public and private, as required by Article 4 of the Energy Efficiency Directive.

Table of Contents

1 Introduction and conditions

1.1 Background

Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency (hereinafter *Energy Efficiency Directive* or *EED*) must be implemented in Sweden by June 2014[1]. That Directive replaces much of Directive 2006/32/EC of the European Parliament and of the Council of 5 April 2006 on energy end-use efficiency and energy services, as well as Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market. According to Article 24(2) of the EED, every Member State must submit a National Energy Efficiency Action Plan (NEEAP)[2] in April 2014 and every three years thereafter.

The action plan must cover significant energy efficiency improvement measures and expected and/or achieved energy savings, including those in the supply, transmission and distribution of energy as well as energy end-use, in view of achieving the national energy efficiency targets established under Article 3(1) of the Energy Efficiency Directive. The action plan must also contain estimates of overall primary energy consumption in 2020, as well as estimated levels of primary energy consumption in the sectors indicated in Part 1 of Annex XIV to the EED (industry, transport, households and services).

National Energy Efficiency Action Plans have previously been reported to the European Commission under Directive 2006/32/EC on energy end-use efficiency and energy services. Sweden's first national action plan[3] was submitted to the European Commission in March 2008, and the second in June 2011.

1.2 National conditions

Total energy consumption in Sweden consists of energy end-use in various sectors, energy loss, use for international shipping and aviation,

[1] Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC (OJ L 315, 14.11.2012, p.1, Celex 32012L0027).
[2] The Energy Efficiency Directive calls this action plan the first action plan, since it is the first action plan under that Directive. In some cases, however, it may be called the third action plan, so as to avoid confusion with the very first energy efficiency action plan, which was submitted to the European Commission in 2008.
[3] The first action plan corresponds to Chapter 11 of Swedish Government Bill 2008/09:163, *A cohesive energy and climate policy: Energy*, with supporting documents from the Committee on Energy Efficiency.

and use for non-energy purposes. Total energy consumption amounted to 577 TWh in 2011, of which energy end-use in industry, transport, households and services was 379 TWh.

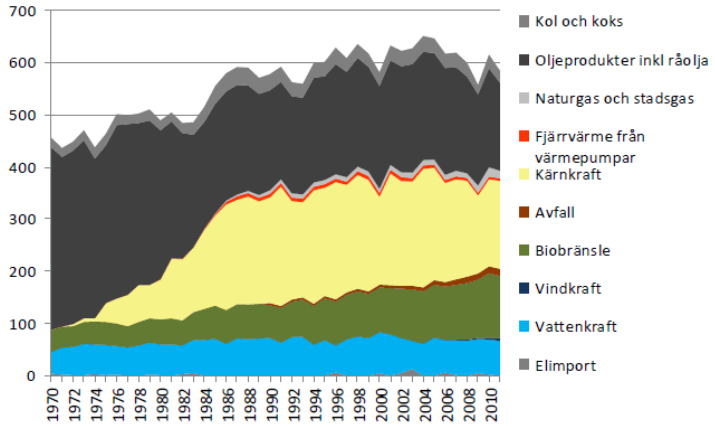
The remainder, 198 TWh, comprises losses, the use of oils for international transport[4] and use for non-energy purposes. Most of the losses consist of cooled energy from electricity production at nuclear power plants. There are also conversion losses at energy plants[5] and distribution losses associated with the delivery of electricity, district heating, natural and town gas, and gas released from blast furnaces. Use for non-energy purposes includes raw materials for the chemicals industry, lubricant oils, and oils for construction and installation work.

Figures 1 and 2 show Sweden's total energy consumption on the supply side and end-user side from 1970 to 2011. There has been an overall downward trend in energy consumption in recent years, but the trend varies between different energy carriers and sectors. Fossil-fuel consumption has fallen, while renewable-energy consumption has grown.

A total of 168 TWh of input nuclear fuel was consumed in 2011, which produced 58 TWh of electricity. Hydroelectric power production depends on the quantity of precipitation during the year. In 2012, some 78 TWh of electricity were produced from hydroelectric power, which may be compared to the mean annual hydroelectric power production during the 1985-2005 period, which has been calculated to be 67.5 TWh. Fuel-based heating production produced 15.1 TWh of electricity, and wind power produced 7.1 TWh. Input fuel for district heating production amounted to just under 56 TWh in 2011. The proportion of renewable energy sources in the total energy supply amounted to just over 36 % in 2011. Among other things, renewable energy sources include biofuels, hydroelectric power and wind power.

[4] Includes both international shipping and international aviation.
[5] In this context, energy plants comprise electricity and district heating production, refineries, gas and coke plants, and blast furnaces.

Figure 1. Total energy supply in Sweden (TWh) per energy carrier, 1970–2011



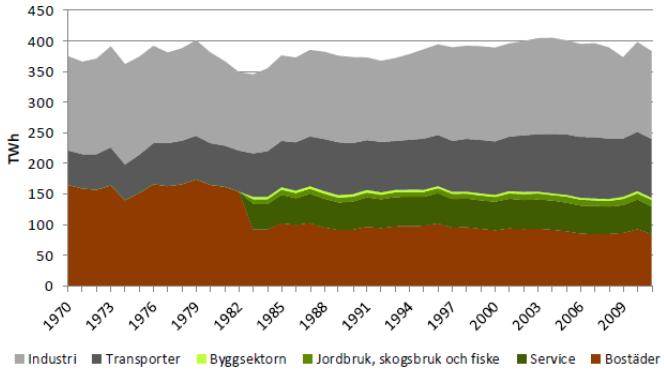
Source: Statistics Sweden and Swedish Energy Agency.

Swedish	English
Kol och koks	Coal and coke
Oljeprodukter inkl råolja	Oil products including crude oil
Naturgas och stadsgas	Natural gas and town gas
Fjärrvärme från värmepumpar	District heating from heat pumps
Kärnkraft	Nuclear power
Avfall	Waste
Biobränsle	Biofuels
Vindkraft	Wind power
Vattenkraft	Hydroelectric power
Elimport	Imported electricity

Energy end-use varied during the 2000s. In 2008 and particularly in 2009 there was a sharp fall in energy consumption, especially in industry, as a result of the economic downturn.

Over a longer period, industry consumes roughly the same amount of energy now as in 1970, despite the fact that industrial production is relatively high now. The households and services sectors have reduced their energy consumption since 1970 as a result of many different structural changes in those sectors. Among other things, the transition from oil to electricity has meant that some losses have moved over to the supply side of the energy system. Individual oil heating has largely been replaced by district heating. Figure 2 shows energy end-use per sector, excluding transport, losses, and consumption for non-energy purposes.

Figure 2. Final energy consumption (TWh) per sector, 1970–2011.



Source: Statistics Sweden and Swedish Energy Agency.

Swedish	English
Industri	Industry
Transporter	Transport
Byggsektorn	Construction sector
Jordbruk, skogsbruk och fiske	Agriculture, forestry and fisheries
Service	Services
Bostäder	Households

2 National targets

2.1 National energy efficiency targets

In 2009, the Swedish Parliament adopted a target of 20 % more efficient energy consumption by 2020. The target is expressed as an overall target for the sector of a 20 % reduction in energy intensity between 2008 and 2020, i.e. the input energy per unit of GDP in fixed prices must fall by 20 %. The reduced energy intensity target has been reported to the Commission as an indicative national energy efficiency target in accordance with Article 3(1).

In addition to this, the target in the Energy Services Directive (2006/32/EC) also applies. According to the requirements, Member States shall adopt an indicative savings target of at least 9 % on average annual energy end-use from 2001–05 to 2016. If converted into an energy saving in physical terms, this corresponds to 24.0 TWh by 2010 and 33.2 TWh by 2016. Average energy end-use does not include

consumption for international transport or fossil fuels that are included in the EU emissions trading scheme (hereinafter *ETS*). Electricity, heat and biofuel consumption at installations covered by the ETS are, however, included.

According to the guidelines for reporting national action plans, Member States with national targets expressed in terms of primary energy should, where possible, convert them into final energy consumption and also give the expected final energy consumption for 2020[6]. The difference between input and end-use energy consists of conversion and distribution losses and use for international transport and non-energy purposes (which have already been deducted in this case). According to the official statistics (1983–2011), there is a constant link between end-use and input energy (primary energy consumption). On the other hand, there is a link between final energy consumption and input energy adjusted for losses from nuclear power. The relationship between them is as good as it is constant[7]. Nuclear power production and consequently losses from it are assumed to be independent of the growth rate and final energy consumption.

$$(1)\ \frac{Slutlig\ energianvändning}{Primärenergianvändning\text{-}kärnkraftsförluster} = 0{,}90$$

Swedish	English
Slutlig energianvändning	Final energy consumption
Primärenergianvändning-kärnkraftsförluster	Primary energy consumption - nuclear power losses
0,90	0.90

In order to adjust the input energy for nuclear-power losses, three options have been assumed for these losses; please see Table 1. Options 1 and 3 are based on historical minimum and maximum growth of 97 TWh and 152 TWh respectively. Option 2 is a historical mean of 131 TWh over the 1986–2011 period.

[6] European Commission, *Guidance for National Energy Efficiency Action* Plans, C(2013)2882 final.
[7] Standard deviation = 0.0086.

Table 1. Final energy consumption (TWh) in 2020 with the target being met, for different mean GDP trend values per annum during the 2008-20 period, and for different nuclear-power loss scenarios.

Annual GDP growth	Nuclear power min	Nuclear power mean	Nuclear power max
0.0 %	297	267	248
1.0 %	346	316	297
2.0 %	401	370	351
3.0 %	461	431	412
4.0 %	529	498	479
5.0 %	604	573	554

Source: Swedish Energy Agency.

Table 1 shows energy consumption in 2020 with the target being met and various GDP trends. The table shows comprehensive scope for long-term GDP trends. In order to have an indication of how much energy consumption there will be when the target is met, assumptions may be made about future trends in GDP on the basis of the historical GDP trends. GDP increased by 1.4 % per annum on average over the 2008–12 period. On the assumption that the same annual growth rate also applies to the 2012–20 period, GDP will amount to SEK 3 855 billion (at 2009 prices) in 2020. Achieving the Swedish energy intensity target requires the indicative primary energy consumption to be 505 TWh or lower. Similarly, final energy consumption should be no more than 352 TWh, based on the historical mean nuclear-power losses.

Table 2 shows the estimated energy consumption in the usage sectors (industry, transport, households and services) according to the prognosis for input energy for electricity and district-heating production, spread across those sectors. The total for those sectors will not be as large as the total domestic energy consumption given in the table. The reason for this is that losses owing to electricity exports and various conversions (for example at refineries) cannot be divided among end-users, since there is no direct link to them.

Table 2. Prognosis for the supply and consumption of energy in 2020 (TWh)

Estimated energy consumption	**TWh**
Total domestic energy consumption (excl. non-energy purposes) in 2020	586
Input for conversion to electricity production (thermal)	0 (216*)
Electricity production (thermal)	0 (73*)
Input for conversion at CHP plants	61
CHP production (district heating)	35
CHP production (electricity)	22
Distribution losses (all energy carriers)	17
Total final energy consumption	398
Final energy consumption – industry	171
Final energy consumption – transport	86
Final energy consumption – households	83
Final energy consumption – services	59

* Excludes CHP. Figures in brackets relate to input fuel and nuclear-power production respectively.
Source: Swedish Energy Agency.

Table 3. Prognosis for energy consumption in 2020 where input energy for electricity and district heating production is divided among end-users (TWh)

Total domestic energy consumption (excl. non-energy purposes)	**586**
Industry	234
Transport	89
Households and services	217
Total: industry, transport, households and services	**539***

* Please note that the total domestic energy consumption will not be as large as total primary energy consumption. The reason for this is that electricity exports and various conversions (for example at refineries) cannot be divided among end-users, since there is no link to them.
Source: Swedish Energy Agency.

2.2 Other energy efficiency targets

Sweden must convert its vehicle fleet so that it is free of fossil fuels by 2030. In 2012, some 8.1 % of the fuel used for road traffic was renewable. There has not yet been any clear definition of exactly how the concept of a ‘fossil free vehicle fleet’ is to be understood.

3 Energy savings

3.1 Savings in primary energy

Since the savings in final energy consumption have been calculated using top-down methods, and it is not possible to separate out different types of energy using this calculation, it is not possible to provide a reliable estimate of savings in primary energy.

3.2 Savings in final energy consumption under the ESD

3.2.1 Calculation method and comparison with previous action plans

The methods recommended by the European Commission when the second energy efficiency action plan was reported (2011) have been used to calculated the expected energy savings for end-use by 2016 in accordance with Directive 2006/32/EC of the European Parliament and of the Council. For households and services, however, it has been decided to change the calculation method from bottom-up to top-down. This has been done to improve comparability between results and sectors and to facilitate comparison with the overall EU target.

A top-down calculation includes the impact of all market measures, even those that do not appear in any specific instrument. Among other things, this includes structural and cyclical effects. For this reason, and because the results depend on the assumptions and methods used, the figures should only be used to follow up the energy efficiency target.

The Directive distinguishes between ‘early’ and ‘late’ efficiency initiatives. Early efficiency initiatives are those that were implemented in 1995–2007, while late initiatives are those implemented after 2007. The calculations have therefore been performed according to this breakdown.

It should be noted that the top-down methods that have been recommended are designed so that activity at the end of 2016 is of great significance for the final saving. If usage becomes more efficient during this period, then the greater the activity is in 2016, the greater the saving will be. On the assumption that vehicles will consume less in the future

than they do now, for example, the saving for the period will be greater the more transport work there is in the future. The same applies to industry, where the saving partly depends on the amount of added value at the end of the year. It may, therefore, be interesting to follow the trend in the indicators, and not merely study the final saving.

The results of the prognosis for 2016 also depend on the assumptions made concerning economic development, taxes, prices, etc. This means that there is a relatively large amount of uncertainty in the prognosis.

3.2.2 Expected energy savings

Table 4 shows the calculation results and achievement of the target.

Table 4. Results of calculations for all sectors, and achievement of the target.

	2011 (TWh)	2016 (TWh)
Households and services – early action	10.4	10.4
Households and services – late action	6.4	12.4
Industry – early action	-	-
Industry – late action	13.7	9.3
Transport – early action	3.1	3.1
Transport – late action	4.8	13.5
Total	**34.3**	**48.7**
Target		**33.2**
Achievement of target		**147 %**

Source: Swedish Energy Agency.

3.2.3 Results of calculations for households and services

The households and services sector includes homes, holiday homes, private and public premises (excluding industrial premises), land industries and other services. No calculations have been done for land industries and other services in this action plan, since the lack of reliable, adequately detailed data makes it difficult to calculate according to the Commission's requirements. These subsidiary sectors do, however, only account for approximately 10 % of the sector's total energy consumption.

Please note that the change in calculation method means that the result differs somewhat from previous action plans. The total savings for

households and services amount to 16.8 TWh by 2011 and 22.8 TWh by 2016; please see Table 5. Early action amounts to 10.4 TWh by both 2011 and 2016. Late action is expected to yield a saving of 6.4 TWh by 2011 and 12.4 TWh by 2016.

There are several explanations for the savings in energy consumption for household heating and hot water, corrected for temperature. The rise in energy prices since the mid-1990s has prompted many households to take action to reduce energy consumption. The increasing used of heat pumps has led to a fall in the purchased energy reported in the statistics. Some have also switched from oil to heat pumps or district heating, which has meant that energy losses in the statistics have moved from end-use to the delivery and production of electricity and district heating.

Table 5. Results of calculations for households and services.

	2011 (TWh)	2016 (TWh)
Early action		
Energy consumption for household heating per square metre	6.2	6.2
Energy consumption for household hot water per inhabitant	4.2	4.2
Total early action	**10.4**	**10.4**
Late action		
Energy consumption for household heating per square metre	4.3	8.8
Energy consumption for household hot water per inhabitant	0.8	0.6
Electricity consumption per equipment type (kWh/year) (P4)	0.6	2.1
Electricity consumption for household lighting (P5)	1.4	1.6
Energy consumption in the service sector (not electricity) for each subsidiary sector per square metre (P6)	0.26	–0.26
Energy consumption in the service sector (only electricity) for each subsidiary sector per square metre (P7)	0.42	–0.42
Total late action	**6.4**	**12.4**
Total early and late action	**16.8**	**22.8**

Source: Swedish Energy Agency.

It is difficult in some cases to break down the statistics in the manner requested. This may mean that some of the subsidiary calculations could be uncertain. This should not, however, be a major problem for the total savings. Please see Annex 1, 'Basis for the calculation', for more information about the calculations for the households and services sector.

3.2.4 Results of calculations for the industry sector

The calculated saving for the industry sector since 2007 is 13.7 TWh by 2011 and 9.3 TWh by 2016; please see Table 6.

Table 6. Results of calculations for the industry sector.

	2011 (TWh)	2016 (TWh)
Late action		
Energy consumption per added value	13.7	9.3
Total	13.7	9.3

Source: Swedish Energy Agency.

The calculation of the 2011 saving is based on statistics, while the 2016 calculation is based on the Swedish Energy Agency's long-term prognosis for 2012. The result of 9.3 TWh is a somewhat lower saving by 2016 than the result of the previous follow-up. The primary cause is that economic development was adjusted downwards in that prognosis, which means that the added value has depreciated.

Among other things, the larger saving by 2011 is because statistics show that added value is generally greater and energy consumption lower than the prognoses indicated last time. This means a greater saving than in the second action plan. A saving of 9.3 TWh is equivalent to approximately 6 % of industrial energy consumption in 2007. The boom between 2007 and 2016 is equivalent to an improvement in efficiency of less than 1 % per annum. The calculation includes both technological efficiency improvements and structural effects.

Early action has not been calculated separately, but action that has still had an impact since 2007 is included in the top-down calculations for late action.

The long-term prognosis for 2012 takes 2007 as the base year and covers all approved action up until the end of 2011. The prognosis therefore does not consider developments after that point. The assumptions concerning economic development, price trends among energy carriers, and emission allowances are major uncertainty factors. In the long term, industrial energy consumption depends *inter alia* on economic growth in various sectors, how the link between added value and energy consumption develops, future product composition in Swedish industry,

and technological development. Please see Annex 1, 'Basis for the calculation', for more information about the calculations for the industrial sector.

3.2.5 Results of calculations for the transport sector

The calculated saving for the transport sector is 7.9 TWh by 2011 and 16.6 TWh by 2016; please see Table 6. Of the 16.6 TWh by 2016, early action accounts for 3.1 TWh. Some of the calculations in the transport sector show a negative saving, which means that there has been a fall in efficiency. This means, for example, that light goods vehicles used somewhat more energy per tonne-kilometre in 2007 than in 1994.

Table 7. Results of calculations for the transport sector.

	2011 (TWh)	2016 (TWh)
Early action		
Cars	3.33	3.33
Heavy goods vehicles	0.06	0.06
Light goods vehicles	–0.21	–0.21
Railways	0.19	0.19
Shipping	–0.31	–0.31
Total early action	**3.1**	**3.1**
Late action		
Cars	5.10	12.19
Heavy goods vehicles	–0.39	1.24
Light goods vehicles	–0.04	0.04
Railway passengers	–0.04	0.05
Railway freight	0.07	0.11
Shift in passenger transport from cars to public transport	0.13	–0.10
Total late action	**4.8**	**13.5**
Total early and late action	**7.9**	**16.6**

Source: Swedish Energy Agency.

The saving from early action has been calculated using the Commission's top-down methods. Since there are no statistics for certain kinds of transport, the simpler variants of the methods have been used for the subsidiary sectors of railways and shipping. The calculation for early action was performed using a mean value over three years.

Late action is expected to yield a saving of 13.5 TWh by 2016. The calculation is mainly based on the Swedish Transport Administration's prognosis for transport work, which forms the basis for the National Transport Plan 2014–25[8].

There are no prognoses for the subsidiary sector of shipping that could be used to calculate a saving in accordance with the Commission's methods.

[8] Swedish Transport Administration (2013), Proposed national transport plan 2014–25.

Since energy consumption by shipping is irregular, it is difficult to make any reliable prognoses in this area. Prognosis results depend on the assumptions made concerning economic development, taxes, prices, etc. In order to illustrate how the calculated saving by 2016 is affected by changes to the assumptions made, a couple of different sensitivity analyses have been carried out. These are discussed in Annex 1, 'Basis for the calculation'.

3.3 Comparison with previous energy efficiency action plans

The 2011 energy efficiency action plan calculated households and services using bottom-up methods, industry mainly using top-down methods, and transport using top-down methods. The bottom-up calculations for households and premises included savings for energy-efficient windows and insulation, conversions, solar panels, solar heating, energy-efficient white goods and energy-efficient lighting. The impact of these measures will not be rendered as visible as where top-down methods are used.

The bottom-up methods used in the second action plan are based on statistics at the building level. Since there are no statistics at this level, the statistics that do exist have been supplemented by estimates and assumptions. This creates uncertainties for using such detailed methods to calculate improvements to efficiency at the national level, so the method was changed for this action plan. Some of the other reasons for changing the calculation methodology are to facilitate comparison of savings between sectors and with the EU target for 2020, and to give a truer picture of the amount of the savings.

The target for 2010 was 24 TWh of energy savings, and for 2016 it is 33.2 TWh. According to the second action plan, savings of 34.3 TWh were achieved by 2010 and the prognosis for 2016 was of savings equivalent to 55 TWh.

According to the calculations in this third action plan, the margin is not quite as large by 2016, although it is still considerable. Table 8 below shows that the predicted saving has been adjusted downwards from 55 TWh to 48.7 TWh for 2016, which means that the margin for achievement of the target has been revised from 166 % to 147 %. The main reason for these differences lies in the impact on the end result of changes to the basis for the calculations, new prognoses and statistics, and also changes to the assumptions concerning economic development, price trends among energy carriers, and prices for emission allowances. The differences in results between different action plans for households and services are mainly due to the change in calculation method.

The reduction in the calculated saving for industry compared to the second action plan is mainly due to the relationship between energy consumption and added value, and how the recession affects it. Added

value up until 2016 has depreciated considerably in the prognosis, which largely explains the difference in the results. The larger saving up to 2010 compared to the last follow-up (2011) was, among other things, because statistics for 2007 and 2011 show that the added value is generally higher and energy consumption lower than the prognoses indicated last time. This means that we have a much larger saving than the calculation for 2010 gave in the second action plan, since both energy consumption and added value increased marginally. New prognoses have been used for the transport sector; in other words, output data have changed somewhat in relation to the second action plan. This has meant that late action for the transport sector has appreciated by 3.5 TWh.

Table 8. Results of calculations for all sectors, and achievement of the target.

	Second action plan (2011)		Third action plan (2014)	
	2010 (TWh)	2016 (TWh)	2011 (TWh)	2016 (TWh)
Households and services – early action	20.7	16.3	10.4	10.4
Households and services – late action	2.5	8.2	6.4	12.4
Industry – early action	0.4	0.4		
Industry – late action	4.6	17.0	13.7	9.3
Transport – early action	3.1	3.1	3.1	3.1
Transport – late action	3.0	10.0	4.8	13.5
Total	**34.3**	**55.0**	**34.3**	**48.7**
Target	**24.0**	**33.2**	**–**	**33.2**
Achievement of target	**143 %**	**166 %**	**–**	**147 %**

Source: Swedish Energy Agency.

4 Instruments and measures for energy efficiency

4.1 Horizontal instruments

4.1.1 Article 7: Obligation scheme or alternative instruments

Article 7 states that Member States may choose to set up an energy efficiency obligation scheme or adopt other policy measures (i.e. instruments) to achieve end-use energy savings. The Swedish Government is of the view that alternative instruments should be selected in accordance with Article 7(9), as the basis for achieving the energy savings target referred to in Article 7(1).

In accordance with the requirements of the Directive, Sweden notified a plan for implementing Article 7 to the Commission on 5 December 2013. The plan specifies how much the cumulative energy saving is deemed to be, what policy measures are intended to be used to achieve the cumulative energy saving, and assessments concerning the extent of the impact of various policy measures. In this context, it is relevant to note that Member States may add and/or remove policy measures until the end of 2020. The final assessment of whether Member States are fulfilling the provisions of that Article is made on the basis of their reports on the cumulative energy saving for the entire period, and will take place in April 2022. Sweden's report to the Commission states that the preliminary estimate of the accumulated energy saving that Sweden intends to achieve during the period from 1 January 2014 to 31 December 2020 inclusive is 106 TWh.

The report states that Sweden intends to apply the method specified in Article 7(2)(c), namely to apply a value of 1 % for 2014 and 2015, 1.25 % for 2016 and 2017, and 1.5 % for 2018, 2019 and 2020 when calculating the accumulated energy saving. This means reducing the saving by 20.8 %, which is less than the 25 % permitted by the Directive. Sweden also intends to divide the 2014–20 period into two intermediate periods, the first being 2014–16 and the second 2017–20. The accumulated energy saving for the first interim period should be 35 TWh, and the remaining 71 TWh should therefore be achieved during the 2017–20 period.

In order to completely avoid the risk of a duplicate calculation of energy savings from supplementary instruments, Sweden intends to study and calculate the effects of various instruments as a package. Since the basis for Swedish energy efficiency policy is the impact on price signalling through the application of general economic instruments, the overall impact of the instruments used in Sweden will be calculated in accordance with the methodology laid down in the Directive for calculating the impact of energy and carbon dioxide taxes.

The energy savings are calculated in a counterfactual way, i.e. by comparing the actual tax levels to an alternative scenario where the opportunity to lower the tax levels to the EU's minimum tax levels is used. Differences in VAT levels are included in the calculation, with the exception of the households and services sector[9].

Existing instruments refer to the implementation plan reported to the Commission for the 2009 Energy Bill (Bill 2008/09:163, report 2008/09:NU25, Parliamentary notification 2008/09:301), in which the Swedish Government stated that Swedish energy efficiency policy was based on the principles that:

- instruments should be general and not tied to specific technologies;
- prices must give correct (or desired) information;
- search costs are reduced by developing and disseminating information; and
- barriers can be removed, for example by adapting existing rules.

National measures are aimed both at the use and supply of energy and at supporting the efficiency improvements that are taking place spontaneously in society and as a result of instruments that have been adapted to market mechanisms. The role of the State is thus deemed to be to identify and prevent market failure, primarily external effects and a lack of information.

The current portfolio of instruments for energy efficiency is very broad and includes general economic instruments, such as energy and carbon dioxide taxes and emissions trading, as well as more targeted administrative instruments such as, for example, a requirement to hold a licence for carrying out environmentally hazardous activities and an energy performance and energy labelling requirement for energy-related products and buildings. In addition to this, various kinds of supplementary action are being used that are designed to rectify a lack of information in the market in various ways, as well as to raise awareness and knowledge of, and improve the legitimacy of, various energy-efficiency and energy-saving measures (related to technology and/or behaviour). State aid for municipal energy and climate advice, State aid for energy audits at small enterprises, regional climate and energy strategies, network activities, technology procurement, and other measures for early introduction to the market could be mentioned as examples of such measures. The combination of economic, market-based instruments and supplementary, targeted information initiatives is considered to provide good conditions for achieving an improvement in energy efficiency that is effective in socio-economic terms.

[9] For more information about the calculations, please see Sweden's plan for implementing Article 7 of the EED, 5 December 2013, file no N/2013/5035/E.

According to Article 7(12), Member States shall ensure that when the impact of instruments (policy measures) or individual actions overlaps, no double counting of energy savings is made. The Swedish Government intends to apply a wide range of instruments that complement each other. The actual measures adopted to make energy consumption more efficient will result from the interaction of these instruments.

Energy and carbon dioxide taxes increase energy prices. Through the control signal that they give, taxes provide an incentive for energy consumers to adopt energy-saving measures to reduce their energy consumption or make it more efficient. In some cases, the measures may be easy to introduce and adopt, but sometimes there is a lack of detailed knowledge about which measures could be adopted and which measures are relevant to the given case. Information about possible and relevant measures is often asymmetrical, which means that energy end-users, and thus those who have to implement (purchase) the measures, are at an information disadvantage in comparison with those who sell energy-efficient technologies or other solutions for improving energy efficiency. In such cases, the control signal given by the energy price does not suffice. Energy users who react to price signals are also affected by other instruments. Through support for energy audits, end-users can acquire better knowledge of whether measures should be taken. Impartial advice about relevant measures may be obtained from a municipal energy and climate adviser.

Both support for energy audits and municipal energy and climate advice are followed up continuously through reporting requirements and investigations. This gives a good picture of which measures and energy-saving effects result from these initiatives. The Swedish Energy Agency has calculated that aid for improving energy efficiency at local authorities and county councils could result in an accumulated energy saving of 10 TWh over the 2014–20 period.[10] The Swedish Energy Agency has also estimated that the contribution to the accumulated energy saving during the 2014–20 period will amount to 0.5 TWh from support for energy audits and just under 14 TWh from municipal energy and climate advice. On the other hand, the possibility of double counting of the effects cannot be excluded if the reported effects of the various instruments have to be added up. The risk of double counting becomes greater if the effects of taxes, which are calculated on a top-down basis, are added to the effects of other instruments, which are calculated on a bottom-up basis.

In order to completely avoid the risk of double counting of energy savings from supplementary instruments, the Swedish Government has calculated the impact of existing instruments as a package. Since the starting point for Swedish energy efficiency policy is that the impact on price signalling through the application of general economic instruments

[10] Swedish Energy Agency (2013), Implementation of Article 7 of the Energy Efficiency Directive – Swedish Energy Agency's calculations and proposals, ER 2013:04.

is fundamental, the overall impact of the instruments applied in Sweden has been calculated in accordance with the methodology laid down in the Directive for calculating the impact of energy and carbon dioxide taxes. The effects of other, supplementary instruments will therefore not be followed up or calculated separately in relation to follow-up of Article 7. Their impact is included in the assessment of the impact of the taxes. They will, however, be followed up for other purposes.

The total quantity of accumulated energy savings resulting from the taxes, in combination with other supplementary instruments, over the 2014–20 period is assessed as 134 TWh.

Table 9. Annual and cumulative energy savings resulting from measures.

		2014	2015	2016	2017	2018	2019	2020
Households and services	TWh/year	2.2	3.4	4.5	5.5	6.5	7.3	8.1
	TWh cum.	2.2	5.6	10.1	15.6	22.1	29.4	37.5
Land industries	TWh/year	0.08	0.15	0.23	0.31	0.38	0.46	0.54
	TWh cum.	0.08	0.23	0.46	0.77	1.2	1.6	2.2
Transport	TWh/year	8.8	10.2	11.4	12.1	12.5	12.8	12.9
	TWh cum.	8.8	19.0	30.4	42.5	55.1	67.8	80.8
Industry	TWh/year	0.48	0.95	1.43	1.91	2.39	2.86	3.34
	TWh cum.	0.48	1.4	2.9	4.8	7.2	10.0	13.4
Total	TWh/year	**11.6**	**14.7**	**17.6**	**19.8**	**21.8**	**23.4**	**24.9**
	TWh cum.	**11.6**	**26.2**	**43.9**	**63.7**	**85.6**	**108.8**	**133.9**

Source: Ministry of Enterprise, Energy and Communications (2013), Plan for implementing Article 7 of the Energy Efficiency Directive.

Please see Sweden's plan for implementing Article 7 (file no N2013/5035/E) for a more detailed description of the methodology and basis for the calculation.

4.1.2 Article 8: Energy audits and energy management systems

In Bill 2013/14:174, *Implementation of the Energy Efficiency Directive*, the Swedish Government proposes the introduction of a new Act on energy audits for large enterprises, in order to fulfil Articles 8(4)–8(7). The Swedish Parliament will debate the Bill in spring 2014. The Bill means that energy audits must be carried out at large enterprises by 5 December 2015 and at least every four years thereafter. If the enterprise has an environmental management system or an energy management system, an energy audit need not be carried out if the system has been certified in accordance with the regulations issued in connection with the Act on energy audits for large enterprises, and if the system requires an energy audit to be carried out that satisfies the requirements of the Act and associated regulations.

'Large enterprises' means enterprises that employ at least 250 people and have an annual turnover in excess of EUR 50 million or a balance-sheet total in excess of EUR 43 million per annum. Enterprises must be defined in accordance with Part I of the Annex to Commission Recommendation 2003/361/EC of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises.

'Energy audit' means a systematic procedure with the aim of acquiring knowledge about the existing energy consumption of a building or group of buildings, an industrial process, a commercial activity, an industrial installation or a commercial installation, or private or public services, in order to establish cost-effective measures and report the results.

On the basis of the definition of large enterprises in the Directive, there are approximately 1 500 enterprises in Sweden that have more than 250 employees and which could be affected by the requirement to carry out an energy audit. A lucid analysis of the target group shows that just under 30 % of large enterprises are in the manufacturing industry and other large enterprises dominate in terms of numbers.

Access to high-quality, cost-effective energy audits that are carried out independently by qualified and/or accredited experts (Article 8(1)) is ensured by the fact that the Swedish Energy Agency makes information available on its website.

Article 8(2) is fulfilled through the existence of aid for energy audits at small and medium-sized enterprises in the form of what are known as energy audit checks. This aid may be granted to enterprises with energy consumption in excess of 500 MWh per annum or for farms with at least 100 animal units, even if the energy consumption is lower. The relevant Ordinance entered into force on 1 January 2010, and the aid amounts to

no more than SEK 30 000, which covers no more than half the costs of an energy audit. According to the assessment, the main impact of energy audit checks has been greater knowledge of specific issues concerning energy efficiency among enterprises, which in turn forms the basis for the measures. A network has also been created with the participation of trade organisations and individual enterprises, which has resulted in the effective dissemination of information about energy management systems. In February 2014, just over 800 enterprises had been granted aid for energy audits[11], of which 40 were large enterprises.

As part of its Focus on Nutrients aid programme, the Swedish Board of Agriculture also offers advice about improving energy efficiency to farms that are smaller than the minimum size for energy audit checks. As part of the ENIG project, the Swedish Energy Agency has developed a simplified, web-based energy management system.

The implementation of Article 8(3) is based on the existing municipal energy and climate advisers, who are a well-established instrument for information and advice services for households and small enterprises. Most of the measures that may need to be implemented in order to raise awareness can probably be carried out through a targeted initiative involving the advisers, reinforced by press releases and information through developed channels.

There are various kinds of vocational training programme for energy experts in the public and private sectors. There may be reason to audit and analyse access to such programmes, and the number of people trained. In its 2010 report, the Technology Delegation also stated *inter alia* that there is a gap between what society needs and what society delivers through the education system. Fewer and fewer pupils are dedicating themselves to the natural sciences and technical subjects, which in turn means that the basis for recruitment with specialist skills will become too small, according to the Delegation. In the long term, therefore, there is reason to link up the initiatives to meet the requirements of Article 8 by means of other initiatives so as to increase interest in the natural sciences, technology, energy and climate issues among children and young people. The Swedish Energy Agency has had such a mandate since 2008.

4.1.3 Articles 9–11: Metering and billing

In some cases, the Directive requires metering of electricity, natural gas, heating, cooling and hot tap water at a level corresponding to the Swedish concept of a home. In Bill 2013/14:174, *Implementation of the Energy Efficiency Directive*, the Swedish Government proposes that a

[11] The figures relate to the number of energy audit aid decisions made since the aid was introduced in 2010.

new Act on energy metering in buildings be introduced. The Swedish Parliament will debate the Bill in spring 2014.

The Act proposes that the obligation to carry out metering lies with either the person having a new building erected or the person making substantial changes to existing installations in the context of a conversion. The requirement also applies to those who own an existing building if the measures are technologically possible to implement and cost-effective. The Swedish Government has given the Swedish National Board of Housing, Building and Planning a mandate to investigate the types of buildings in which metering systems for heating, cooling and hot tap water should be installed[12].

Since electricity or natural gas is installed when a new building is erected or when an existing building is comprehensively refurbished, the owner must ensure that users can take out a contract with the local electricity company or natural-gas distributor. Similarly, a homeowner must be able to take out a network contract when an existing meter is replaced. Since an electricity company with a concession for a given area does not automatically have access to a building's internal electricity network, the requirement should not be aimed at the electricity company. Instead, the requirement in the text of the Act should be aimed at the person who erects the building. In practice, this means that the developer or owner of the property must contact the electricity company when erecting or modifying the building and ensure that the electricity company's electricity meters are installed so that usage by the relevant home can be metered.

If there is an opportunity for individual metering, the payment for energy consumption for a tenant or other person with the right of residence must be calculated on the basis of the metered consumption.

Monitoring to ensure that metering systems are installed at the home level is the responsibility of the municipal board(s) acting in the area of planning and construction (hereinafter *building committee*). The building committee may issue the orders required so that the obligations following from the Act are fulfilled, and it has the option of combining orders with a fine. Local authorities may also deduct monitoring expenses. The Swedish Government also proposes that the Swedish Board for Accreditation and Conformity Assessment (Swedac) be given a mandate to develop regulations for meters used for distribution and for charging costs within a building, in respect of heating, cooling, electricity and hot water.

Network concession holders must ensure that electricity consumers are given appropriate information when new meters are installed. Both electricity and natural gas must be charged for in relation to metered

[12] Mandate to the Swedish National Board of Housing, Building and Planning, file no N2014/1317/E.

amounts where possible. Bills from electricity and natural-gas suppliers must be clear and contain information about the metered consumption and the current energy prices on which the bill is based. If the energy consumer has concluded a supply agreement that requires metering in hours, such information may be made available online. In such cases, the bill must refer to that information. Billing must take place at least every quarter.

Electricity suppliers, network concession holders, natural-gas suppliers and enterprises transmitting natural gas that conclude agreements with consumers must, in addition to what already applies, provide information on their websites or by other means concerning independent consumer organisations from which their customers may seek advice concerning the energy-efficiency measures available and comparison profiles for energy consumption. District-heating enterprises must provide similar information on their websites and refer to it in their agreements and bills. Network concession holders and enterprises transmitting natural gas must report metering results and calculations *inter alia* to the authority responsible for the system, consumers, producers, balance responsible parties and suppliers.

Electricity-trading enterprises, gas-trading enterprises and district-heating enterprises are prohibited from levying any charges for providing bills and billing information regarding energy consumption.

4.1.4 Articles 12 and 17: Consumer information and training

Municipal climate and energy advice fulfils the provisions of Articles 12(1) and 17(4) on promoting efficient energy consumption by small energy consumers, including household customers. The types of initiative that Member States may choose for implementing Article 12(1) include municipal energy and climate advice, which is regarded as a way of disseminating information. The Swedish Energy Agency is also working to disseminate information and raise awareness. The Swedish Government has decided to continue funding energy and climate advisers up to and including 2017.

It is also important to note that there have been energy taxes in Sweden for a long time. They are an important financial incentive for households, among others, to use energy efficiently. Sweden therefore also applies a tax incentive for fulfilling the requirements laid down in Article 12(1).

In addition to this, there are various kinds of conferences and meetings that are organised on the initiative of public-sector players, where stakeholders, including market players, are given an opportunity to provide information.

In addition to the activities mentioned above, information about energy-efficiency measures is also available from relevant players now, for example via the Swedish Energy Agency website, various networks of

market players (BELOK, BEBO, BELIVS, HYLOK, ENIG, etc.), public-sector players (the Sustainable Municipalities project, energy-efficient authorities, etc.) and municipal energy and climate advisers.

4.1.5 Article 16: Certification

In Bill 2013/14:174, *Implementation of the Energy Efficiency Directive*, the Swedish Government proposes that a voluntary certification system be established. It is proposed that the new rules be inserted into the Act (2012:838) on the certification of certain fitters, and an opportunity introduced for personal certification of the person who is to perform the service.

Article 16(3) is fulfilled through the requirement that accessible information concerning the opportunities for certifying such energy services should be available on the Swedish Energy Agency website, where there are also references to the current rules in which the requirements appear.

4.1.6 Article 18: Energy services

Article 18 is deemed to be fulfilled by the work that is already being done now, for example in disseminating information. The Swedish Energy Agency is currently working to promote the creation of a trade organisation for the energy-services sector. One of its duties should be to ensure in practice that lists of all energy-service areas be compiled and published in order to fulfil Article 18(1)(c).

Member States must also support the public sector in relation to the procurement of energy services. This is also being fulfilled through the Swedish Energy Agency's existing work.

The Swedish Energy Agency has investigated whether there are any barriers to competition in the energy services market in Sweden in its report *Are there any barriers to competition in the market for energy services?* (ER 2012:26). Approximately one-third of the enterprises surveyed felt that there were barriers, while the majority felt that this was not the case. The main barrier was felt to be the rules for procurement procedures and legislation relating to the activities of municipal energy companies. This barrier was mainly cited by municipally owned enterprises. This barrier is not, however, regarded as being of such a nature that any additional measures are regarded as justified. The overall assessment, based on the requirements of the Directive, is therefore that there are no legislative barriers and that the market works well. There is, however, reason to continue monitoring the trend, not least in view of the fact that the market is expanding. The Swedish Energy Agency has a mandate to this effect.

An independent ombudsman for handling complaints (Article 18(2)(c)) and extrajudicial disputes concerning energy-service agreements is not regarded as appropriate. No problems have emerged in relation to energy services that would justify the introduction of extrajudicial dispute-resolution mechanisms. Our assessment is that no measures are necessary over and above the existing consumer legislation and regulations in the field of contract law.

With regard to enabling independent intermediaries to play a role in stimulating market development on the demand and supply sides (Article 18(2)(d)), such players already have great opportunities for promoting development of the market for energy services. For example, several regional energy offices have worked on this matter in conjunction with the Swedish Energy Agency. The European energy services campaign launched by the EU is being managed in Sweden by one of the regional energy offices. There is not considered to be any need to implement any additional measures over and above the activities already being carried out by the Swedish Energy Agency.

Member States must ensure that energy distributors, distribution system managers and enterprises that sell energy in the retail sector refrain from activities that could impede demand for and the supply of energy services. It may be stated that the Swedish Competition Authority already has the task of detecting barriers to effective competition in public-sector and private-sector activities. This is stipulated in the Ordinance (2007:1117) containing instructions for the Swedish Competition Authority.

The Directive states that Member States must support the energy services market so that it works well. On this point, the Swedish Energy Agency acts as a point of contact for end-users and relevant information is made available on its website. The provisions concerning monitoring of trends in the energy services market are also fulfilled now, through existing activities under the auspices of the Swedish Energy Agency. These activities do, however, have scope for development, for example in relation to how data are gathered and statistics compiled. It would be desirable, for instance, to make it easier to separate out the energy services portion of the public procurement processes that have been carried out.

There is also currently a lack of knowledge concerning exactly how large the market is. It is known that the volume of energy services procured in the public sector more than trebled over the 2006–11 period, and that on average energy services were procured to an amount of SEK 40 million per annum over that period. This estimate is, however, most likely a gross underestimate of the actual volume. Property was the most common object of energy services in the public sector; three out of four procurement procedures for energy services related to property, 15 % were in the field of transport, and 8 % were in organisations.

The number of new Energy Performance Contracts (EPCs) has generally been fewer than ten in recent years, whereas the total number since 2000 may be approximately a hundred. The business model for EPCs in Sweden has developed over the last seven or eight years, and it has shifted from being a solution with a focus on technology to a model focussed more on property economics. The focus has shifted from short repayment periods to longer collaboration and greater flexibility in the solutions.

4.1.7 Article 19: Other horizontal instruments

Measures to reconcile particular barriers to energy efficiency and divided incentives

The presence of regulatory and non-regulatory barriers to improving energy efficiency has been analysed in accordance with the requirements of Article 19(1) of the Energy Efficiency Directive.

In 2013, the Swedish Government commissioned the Swedish National Board of Housing, Building and Planning and the Swedish Energy Agency to analyse any barriers to investments for improving the energy performance of existing buildings following from the division of incentives between property owners and tenants, or between owners of shared-ownership property. This mandate also included analysing any barriers to investments for improving the energy performance of new buildings as a result of the division of incentives between developers and property owners if properties are built for management or sale. The authorities submitted their report[13] to the Government Offices of Sweden (Ministry of Enterprise, Energy and Communications) in December 2013 (file no N2013/5794/E).

'Divided incentive' means a market failure associated with asymmetrical information between parties and which may result in investments not being made on the grounds that one of the parties is liable for the investment costs while the other party benefits from the cost savings. Divided incentives of this kind are referred to as 'investment problems' in the report, which also discusses divided incentives in the form of 'consumption problems'. These are a consequence of users not having an incentive to economise on energy in their ongoing energy consumption. The presence of consumption problems may have a restrictive effect on investments, and this report mainly focuses on this effect.

A general conclusion from the authorities' analysis is that divided incentives are deemed to be a relatively minor problem in comparison with other barriers such as financing problems and knowledge-related barriers. The study also provides evidence showing that, in terms of

[13] Analysis of divided incentives for improving energy efficiency, Swedish National Board of Housing, Building and Planning report 2013:32.

international comparison, divided incentives are a limited problem in the Swedish market. A decisive explanation for this ought to be that tenancy agreements based on rent including heating are predominant in Sweden. 'Rent including heating' means that energy costs are set on the basis of a model and are included in the rent. On the other hand, 'cold rent' is based on charging for actual consumption. Cold rent gives the user an incentive to economise on energy consumption, but it has the disadvantage that the property owner's incentive to improve energy efficiency is undermined. Investments to improve energy performance may therefore not be made, which gives rise to divided incentives of the 'investment problem' type. On the other hand, with rent including heating, it is the user's incentive that is undermined, which creates 'consumption problems'. The authorities are of the view that it is primarily consumption problems that occur in Sweden, and that these are generally a smaller barrier to improving energy efficiency than investment problems are. The authorities do not propose any specific measures for dealing with the presence of divided incentives, but they note that a general solution for divided incentives could be to increase collaboration among the stakeholders who negotiate and sign agreements on investments to improve energy efficiency and on ongoing energy costs specifically, or as part of broader negotiations.

A large number of existing instruments could help to reduce the problems posed by divided incentives. First and foremost, there are various kinds of information programme and regulatory minimum requirements to reduce barriers that could be linked to asymmetrical information. Some instrument that have the stated aim of dealing with divided incentives are networks in the construction sector, projects involving green agreements and certain research initiatives.

Against the background of the authorities' analysis, the Swedish Government's assessment in Bill 2013/14:174, *Implementation of the Energy Efficiency Directive*, is that no measures need to be adopted to reconcile the presence of divided incentives.

In 2013, the Swedish Government commissioned the Swedish Energy Agency to audit the public sector and analyse the presence of any barriers to improving energy efficiency at public bodies. Any barriers resulting from regulations in Acts and other statutes, as well as administrative practices, relating to public procurement, annual budgets and reporting in particular had to be analysed. The mandate included explaining the initiatives that have been adopted to counteract the barriers identified. The mandate was reported on[14] to the Government Offices of Sweden (Ministry of Enterprise, Energy and Communications) in February 2014 (file no N2014/1122/E).

[14] Audit and analysis of barriers to improving energy efficiency at public bodies, with a focus on public procurement, annual budgets and reporting, Swedish Energy Agency, report ER 2014:06.

The authorities' audit shows that there are many different kinds of barrier to improving energy efficiency in the public sector.

The greatest barrier to improving energy efficiency at local authorities and county councils covers organisation, such as failure to engage in collaboration between administrative bodies, failure to produce steering documents for energy requirements in connection with procurement procedures, or failure to give sufficient priority to such work in terms of time. Another major barrier is a lack of skills, for example in relation to how energy requirements may be imposed in the context of procurement and in financial management, where budgeting methods may constitute a barrier. An assessment of the barriers faced by stakeholders themselves shows that finances, organisation and structure are the greatest barriers.

With regard to public procurement, one in four local authorities have said that they do not have steering documents for energy requirements in procurement procedures, and more than three in four local authorities and county councils said that they do not have the skills for imposing energy requirements in the context of procurement procedures. Approximately half of the local authorities and county councils rarely or never follow up the energy requirements that are imposed in the context of procurement and purchasing.

Nearly half of the local authorities that responded to the survey felt that their budgeting methods were a barrier to energy-efficient measures. The budgets are too focussed on short-term rather than long-term measures, and there is often a centralised budget with a high level of detail. This means that all of the decision-making processes for a major investment, for example a water park, also apply to smaller energy measures. Other barriers in the area of finances relate to the selection of calculation methods, which may benefit or be detrimental to energy measures to varying extents.

Barriers within municipal housing companies include several financial aspects such as financial risk-taking, tenants' ability to pay, and interpretation of the concept of profitability, as well as barriers in procurement and legislation and any future requirements for individual metering and charging for heating.

Energy requirements in the context of procurement and follow-up of such requirements are more common among housing companies than among local authorities and county councils. There are, however, similar barriers for housing companies as for the local authority and county council sector.

The barriers that companies have highlighted as being considerable include a lack of willingness or ability among tenants to pay for increases in rent, which is a great challenge for renovating homes in areas where environmental programmes are carried out. They also highlight the possibility of future requirements for individual metering and charging for heating that run the risk of reducing stimuli and incentives for

energy-efficient measures among housing companies, while tenants who pay for heating in that case have limited opportunities for implementing measures at the property.

There are also examples of housing companies that perceive a contradition between the legislative requirement for a business-like attitude and the requirement for social responsibility. The general perception, however, is that the Act permits the long-term administration and implementation of energy measures.

Barriers within national authorities include failure to prioritise strategic energy work and barriers in knowledge and follow-up, for example imposing and following up procurement requirements. They also include a lack of clear energy requirements in national framework agreements and failings with regard to how subordering authorities perceive their roles and responsibilities in the event of a suborder under the framework agreement. There is also a lack of financial resources for implementing profitable measures for subsidised properties at the National Property Board of Sweden.

In the area of procurement, many national authorities suborder under the Legal, Financial and Administrative Services Agency's framework agreement, and the majority of subsidiary authorities believe that energy aspects have already been considered in the agreement. The Legal, Financial and Administrative Services Agency often works with catalogues of requirements, whereby the subordering authority has an extensive opportunity to impose additional requirements in the event of a suborder, for example in terms of energy requirements. On this point, information about the imposition of requirements and responsibility needs to be exchanged.

Barriers that are directly linked to legislation and practice in the area of public-sector procurement and financial management are limited. The legislation may, however, be interpreted in different ways at different organisations, which may lead to energy-efficient measures being prevented. The organisation may also abandon measures to improve energy efficiency on grounds of uncertainty as to how the legislation is to be interpreted, which in turn may often be attributed to a lack of skills at the organisation. This primarily applies to imposing energy requirements in the context of procurement. The Act on Public-Sector Procurement is perceived to be complex, difficult and time-consuming. There are currently also some problems concerning the accounting of costs at local authorities and county councils where high maintenance costs must be entered in the accounts directly as costs, and this may result in organisations reporting a deficit. This barrier will, however, probably be eliminated by the forthcoming rules on component depreciation, which are estimated to enter into force in 2015.

A large number of existing instruments and initiatives may be regarded as helping to reduce the problems caused by barriers to improving energy efficiency at public bodies. It may be mentioned, for example, that the

Swedish Environmental Management Council is working on a broad portfolio of information initiatives aimed at energy-efficient procurement, and that the Swedish Environmental Protection Agency has support in the form of various networks for national authorities. Among other things, the authorities are working on a benchmarking network for authorities with a focus on measures to reduce their own energy consumption.

Since 2008, the County Administrative Boards have had the task of working on regional energy and climate strategies, and they have received a contribution for this work since 2010. There has been an Ordinance on State aid for improving energy efficiency at local authorities and county councils since 2010. This is partly financial aid, but as part of the programme the Swedish Energy Agency, together with the County Administrative Boards, also provides support and advice on improving energy efficiency in the form of training courses, networks and regional projects. The Sustainable Municipalities project is a programme that has taken place in three stages since 2003. The programme is about exchanging experience and network partnerships in many different types of energy project, including everything from business development and social planning to energy-efficient street lighting and renewal of the environmental programme. The Energy Efficiency Council has been established by the Swedish Government to reinforce collaboration and facilitate coordination among authorities and organisations in improving energy efficiency. A large number of authorities are also continuously developing information materials about energy consumption and improving energy efficiency at public bodies.

Against the background of the authorities' analysis, the Swedish Government's assessment is that no additional measures need to be adopted to reconcile the barriers associated with legislation and practice in the areas of public procurement, annual budgets and annual accounts. The analysis does, however, provide a valuable basis for establishing how the Swedish Competition Authority's support for national authorities, local authorities and county councils for the procurement of energy-efficient goods and services could be developed.

Energy and carbon dioxide tax

In historical terms, energy tax has been fiscal in nature, but has gradually become more like a means of controlling resources. With fiscal taxation, a tax base that is robust, i.e. does not change, should be taxed more heavily than a tax base that is sensitive to variation. The aim of fiscal taxation is to generate tax revenues at the lowest possible socio-economic cost.

Bill 2009/10:41[15] states *inter alia* that it is desirable for energy tax to become more like a means of controlling resources so that the targets for renewable energy and more efficient energy consumption can be achieved at the lowest possible socio-economic cost. It also states that, if energy taxes are to promote the aim of more efficient energy consumption, energy taxes should in principle be levied on all energy equally.

It should be noted that carbon dioxide tax also aims for the objective of more efficient energy consumption and renewable energy. Unlike energy taxes on fuel, which are based on energy content, carbon dioxide taxes are based on the fuel's fossilised coal content.

The European Union's provisions have been adapted since Sweden's accession. The Energy Taxes Directive[16] lays down the framework of EU law with regard to how Member States must design their national taxation of fuels and electricity. At the holistic level, it may be said that Swedish tax rates tend to be considerably higher than the minimum levels laid down in the Energy Taxes Directive.

The taxes vary depending on whether the fuel is used for heating or as a propellant. There is also some variation depending on whether it is used by households, industry or the energy-conversion sector. The energy tax on electricity varies depending on what the electricity is used for and where it is used.

Energy tax and carbon dioxide tax have been subject to several amendments. An example of this is the amendments made following the aforementioned Bill 2009/10:41, which proposed staggered increases in both energy and carbon dioxide tax, as well as changes in the efforts to reduce exemption from the energy-tax system.

The Swedish Tax Agency is the authority responsible for energy and carbon dioxide tax[17].

The Environmental Code

The Environmental Code (1998:808) is a mandatory, all-embracing instrument in the area of the environment that covers all activities and initiatives that have an impact on the environment. The basic provisions

[15] Bill 2009/10:41, *Some questions concerning excise duties resulting from the Budget Bill for 2010*.
[16] Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity, OJ L 283, 31.10.2003, p. 51, Celex 32003L0096.
[17] The tax rates appear in the provisions of the Act on Energy Tax (1994:1776). With the exception of unleaded aviation fuel, the tax rates for which appear in the Act (2013:1004) amending the Act (1994:1776) on Energy Tax, the current tax rates for 2014 appear in the Ordinance (2013:859) Laying Down Converted Amounts for Energy Tax and Carbon Dioxide Tax for 2014.

of the Environmental Code (Chapter 1) aim to promote sustainable development and are to be applied so as to promote *inter alia* economising on energy and raw materials.

The general rules of consideration in the Environmental Code state that anyone who carries out an activity or implements a measure must be economical with raw materials and energy, and use renewable fuels in the first instance (Section 5 of Chapter 2 of the Environmental Code).

The Swedish Environmental Protection Agency has overall responsibility for enforcement of the Environmental Code. The Swedish Energy Agency must provide guidance for local authorities and the County Administrative Boards concerning self-monitoring by operators with regard to energy management and the use of renewable energy sources.

Monitoring the markets for electricity, natural gas and district heating

The Swedish Energy Markets Inspectorate is responsible for monitoring the energy markets, and it has the task of reinforcing the position of energy customers and ensuring that the markets for electricity, district heating and natural gas work in the best possible way. This is designed to make it easier for customers to make well-informed decisions. Its activities include checking that the regulations in the Electricity, Natural Gas and District Heating Acts are complied with, assessing and issuing licences under those Acts, monitoring energy markets, and submitting proposals for amendments to the regulations, or other initiatives to facilitate the functioning and development of these markets.

Ecodesign and energy labelling

The aim of ecodesign is to lay down requirements for environmental performance, usually energy efficiency, for the lifecycle of a product. Products that consume large amounts of energy will be phased out of the market through these requirements imposed on manufacturers. The requirement is regulated by the Ecodesign Directive (2009/125/EC). The Directive can cover all energy-related products, with the exception of products for the transport sector. The product groups are usually regulated in the form of EU Regulations, although self-regulation can also occur.

Implementation of the Energy Labelling Directive is regulated in Sweden by the Act on the Labelling of Energy-Related Products (2011:723). The Swedish Energy Agency is the authority responsible.

Research

Research and development initiatives are a significant component of the work being done by Sweden to improve energy efficiency. The Swedish Energy Agency is involved with every link in the chain, from research to development, demonstration and marketing. The Swedish Energy Agency is an important source of finance for research to improve energy efficiency, primarily in buildings, industry and transport, but also of far-reaching initiatives relating to energy systems and energy consumption. In addition to the Swedish Energy Agency, there are also a number of other players that carry out research and investigatory activities on improving energy efficiency.

The most important research programmes that are not specific to a particular sector are enumerated below (sector-specific programmes are listed under the relevant sector: buildings, industry or transport).

The Energy, IT and Design project started in 2009, and its aim is to influence people's habits, views and behaviour in everyday life in relation to improving energy efficiency, with a focus on improving the efficiency of electricity consumption using both IT and design. The programme is to result in a number of specific prototypes and demonstrations.

The Energy Systems programme started in 1997, and has been funded in full by the Swedish Energy Agency since 2001. The programme comprises a research school and a research programme where engineers and social scientists work together to study energy issues from a broad perspective and with different approaches. The research programme is being run by three consortia: Buildings as an Energy System, Industrial Energy Systems, and Local and Regional Energy Systems. Of the 74 people enrolled, 45 hold a PhD and 11 hold a Masters degree, which in most cases is part of a PhD.

The aim of the General Energy Systems Studies programme (hereinafter *AES programme*) is to develop systemic, holistic thinking in relation to the conversion of energy systems. The need for research into energy-policy instruments has increased with the deregulation of the energy markets and the introduction of market-based instruments. The Internationalisation of the energy markets and efforts in pursuit of an internal market for energy within the EU have also increased the need for knowledge about the behaviour of producers, suppliers and consumers in the energy markets. The AES programme therefore has two main areas of research, one of which is energy policy and energy-policy instruments, with a focus on how cost-effective and appropriate these instruments are. The other main area is research into energy markets and energy-market players, as well as technological changes.

The aim of the Coordinated Urban Development research programme was to support and promote interdisciplinary research and development projects on urban areas and urban development that are aimed at systems

and practitioners, and thus to reinforce knowledge creation and the skills base in relation to sustainable urban areas. On of the aims of the research programme was to create better coordination between a number of sources of research funding.

4.1.8 Article 20: Financing

Funds have not traditionally been used to finance Swedish policies to improve energy efficiency. Instead, the State contributes in various ways, with support to make it easier for various stakeholders to implement measures to improve energy efficiency; please see section 4.1.2, for example. Another example is the State aid for technology procurement and the market entry of new, energy-efficient technologies in homes and on premises, and in food shops, the manufacturing industry and the transport sector. The 'RCE' allowance provides an opportunity for private individuals to receive a tax reduction of 50 % of the costs of work to repair, maintain, convert or extend a home (houses, condominiums and privately owned flats). The State also provides support for the installation of solar-panel systems connected to the grid and solar electricity/solar heating hybrid systems.

There are various EU programmes that can provide support for improving energy efficiency. A new programming period for the Structural Funds will last from 2014 to 2020. It is worth noting that improving energy efficiency is one of the areas that will be prioritised under the Structural Funds.

There is not currently any information or other initiatives aimed specifically at banks or financial institutions. Since they are an important target group and have been specially designated, the Swedish Energy Agency will design information initiatives that can help banks and other financial institutions to increase their commitment to increased energy efficiency.

It is worth noting that, in the Budget Bill for 2014, the Swedish Government announced that it intends to establish a green investment fund to improve the conditions for financing ideas that could clearly help to reduce carbon dioxide emissions and achieve sustainable energy consumption.

4.2 Instruments for improving energy efficiency in buildings and on premises

4.2.1 Energy Performance of Buildings Directive (2010/31/EU) (EPBD)

Sweden has selected the advisory option under Articles 14 and 15 of the Energy Performance of Buildings Directive (hereinafter *EPBD*). Work is

currently ongoing with regard to how these Articles are to be reported on, so they will be reported on separately by no later than 30 June 2014.

According to Article 10(2) of the EPBD, Member States shall draw up a list of existing and proposed measures including those of a financial nature, other than those expressly required by the Directive, which promote the objectives of the Directive. The various instruments and initiatives used in Sweden and which provide an incentive for measures to improve the energy efficiency of buildings are described in section 4.2.3 as well as in this section.

Article 5(2) has already been reported on to the European Commission.

In 2012, when the EPBD was transposed into Swedish law, a new Act on Energy Declarations was also adopted. It is the owner of a building, for example a housing cooperative, that is responsible for ensuring that the energy declaration is made. The energy declaration system has been developed since the last action plan. Among other things, centralised monitoring has been introduced, and the Swedish National Board of Housing, Building and Planning is responsible for it. The requirement for an accredited control body has also been abolished and replaced by a requirement for energy declarations to be made by certified energy experts. Since 1 January 2013, a building's energy class has been clarified by a label that is familiar to consumers. The aim is to achieve a stronger link between the building's energy performance and its value.

4.2.2 Directive (2012/27/EU) on energy efficiency (EED), Article 4: National building renovation strategy

Energy for heating, cooling, operations and lighting in homes and on premises accounts for approximately one-third of final energy consumption in Sweden, according to the energy statistics. Measures for increasing the energy efficiency of existing buildings is crucial for making energy consumption more efficient in the sector as a whole. It is also important for being able to achieve the Swedish Government's vision of Sweden having a sustainable, resource-efficient energy supply and no net emissions of greenhouse gases into the atmosphere by 2050. The requirement in the Energy Efficiency Directive for a long-term building renovation strategy therefore supplements the provisions of the Directive (2010/31/EU) on the energy performance of buildings.

Following a mandate from the Swedish Government, the Swedish National Board of Housing, Building and Planning and the Swedish Energy Agency have produced a proposed national strategy for renovations to improve energy efficiency (file no N2013/5078/E)[18]. The authorities' proposal is based on the assumption that there is an obvious

[18] Swedish National Board of Housing, Building and Planning and Swedish Energy Agency (2014), Proposed national strategy for building renovations to improve energy efficiency.

opportunity to increase the energy efficiency of buildings during future renovations. Effective improvements to energy efficiency are made by achieving a market that works well. The strategy is based on the instruments that are already in place and which are important for continuing to head towards more efficient energy consumption. According to the authorities' proposal, energy prices have a key role to play, but instruments that affect pricing, such as energy and carbon dioxide taxes, need to be supplemented by information instruments.

In their report, the assessment of the Swedish National Board of Housing, Building and Planning and the Swedish Energy Agency is that energy consumption per square metre will fall by 20–30 % by 2050 in comparison with 1995 if the current instruments are maintained.

The Swedish Government is aware that the Directive imposes a requirement for the first version of the national strategy to have been adopted and published by no later than 30 April 2014, but it also understands that the time provided by the Directive for producing the national strategy is very short, particularly in view of its scope and significance. The Swedish Government emphasises the importance of having a solid basis for a long-term national strategy, and it intends to continue working to develop a forward-looking national strategy for renovations to improve energy efficiency. The Swedish Government's proposed first national strategy for renovations to improve energy efficiency appears in Annex 3.

4.2.3 Other instruments for improving energy efficiency in buildings

The Planning and Construction Act (PCA), including energy requirements for buildings (Building Code)

A new Planning and Construction Act, which was introduced in 2010, lays down minimum requirements for buildings *inter alia* with regard to energy management. Among other things, the energy requirements were made 20 % more stringent on average.

On 1 January 2012, binding regulations were introduced for modifications to buildings. The basis for this is that the energy-performance requirements are the same as for the construction of a new building. On 1 January 2012, the energy requirements were also made more stringent for new buildings not heated by electricity. The energy requirements were made approximately 20 % more stringent on average.

The Swedish National Board of Housing, Building and Planning has the task of reviewing and increasing the stringency of the energy-management levels in its regulations. The Swedish National Board of Housing, Building and Planning must produce a report on this mandate, containing an analysis and proposed energy-management levels. The aim

must be for the new provisions to enter into force on 1 January 2015. The mandate is part of Sweden's strategy to come closer to a nearly-zero energy requirement and gradually increase the energy-management requirements.

At the start of 2014, the Swedish Government gave the Swedish National Board of Housing, Building and Planning a mandate to propose quantitative guidelines for energy-management requirements for nearly-zero energy buildings by no later than 15 June 2015.

Online portal

Since 2011, the Swedish National Board of Housing, Building and Planning, the Swedish Energy Agency and the Swedish Board of Agriculture have had a common online portal (www.energiaktiv.se) on improving energy efficiency. It is aimed at homeowners, other property owners and managers, and provides support for improving energy efficiency in relation to both buildings and the organisation's transport. The support covers the whole chain from planning to follow-up of the measures.

Repairs, maintenance, conversion or extension, RCE

Since 2008, there has been an opportunity to receive a tax reduction of 50 % of the costs of work to repair, maintain, convert or extend the property that one owns, to a maximum amount of SEK 50 000 per annum. Some of these measures contribute to more efficient energy consumption.

Solar panel aid

Since 2009, there has been an opportunity to apply for contributions for the installation of solar panels. This contribution may be applied for by both private individuals and enterprises and organisations. The amount of this aid amounts to 35 % of the investment costs but no more than SEK 1.2 million. Some SEK 280 million has been paid out up to and including February 2014, while SEK 210 million has been set aside for the 2013–16 period.

Technology procurement and networks

Technology is mainly procured in order to disseminate new technologies for heating, hot water, ventilation, etc. The last action plan explained the networks that act as procurement groups for such technology. There is BELOK, which is a procurement group for premises, BEBO, which is a procurement group for homeowners and residential property managers, and HYLOK, which is a procurement group for tenants of commercial

premises, including national authorities. BeLivs has subsequently been added for the food sector. These networks also work actively on other initiatives such as methodology development to reduce the energy consumption of the building stock.

Low-Energy Buildings Programme (LÅGAN)

In 2010, the Swedish Construction Federation received five years' aid for stimulating energy-efficient new buildings and conversions. The projects that receive aid must achieve at least 50 % better energy performance than the Building Code (BBR) in the case of new buildings. For conversions, the energy consumption must fall by at least 50 % whilst achieving energy consumption that is 40 % lower than the requirement in the BBR. The project is also required to have a high demonstrative value.

Energy and climate advice

State aid for municipal energy and climate advice was originally introduced in 1977–78. Municipal energy and climate advice has existed in its current form since 1998. The advice is both general and specific, and can be given to both private individuals and enterprises, and it includes advice concerning buildings, among other things. The energy and climate advisers have a key role to play *inter alia* in fulfilling Articles 14 and 15 of the EPBD.

Sustainable Municipalities

The Sustainable Municipalities programme has been running since 2003 to support the work done by local authorities in Sweden in relation to energy conversion and reducing the impact on the climate. Among other things, this work is aimed at influencing the energy consumption of local authorities. There are, for example, eight local authorities that are participating in a project aimed at halving energy consumption.

Research

A specific research programme for making the energy consumption of buildings more efficient has been ongoing since 2007, and it deals with improving the energy efficiency of buildings of cultural and historical importance using measures that can be implemented whilst preserving the cultural value of those buildings. There is another research programme dealing with how IT and design can be used to visualise an individual's/household's electricity consumption in real time and thus influence individuals' everyday habits. A third programme provides support for research in the area of lighting, with a focus on the impact of the paradigm shift that is taking place through LED technology, which is undergoing a rapid rise.

Tests and information

The Swedish Energy Agency carries out comprehensive activities to identify and provide information about products that help to reduce a building's energy consumption. Among other things, white goods, home electronics, heating, ventilation and lighting are tested.

Demonstration initiatives for nearly-zero energy buildings (NZE)

At the start of 2014, the Swedish Government gave the Swedish National Board of Housing, Building and Planning and the Swedish Energy Agency a mandate to work together to produce a framework for nearly-zero energy buildings on the basis of Communication 2011/12:131, *The road to nearly-zero energy buildings*, and the provisions of Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings. The mandate includes assessing existing and new low-energy buildings and explaining how other Nordic countries are working on nearly-zero energy buildings.

The Swedish Government has also given the Swedish National Board of Housing, Building and Planning a mandate to analyse and propose a definition of energy performance to be applied to energy-management requirements relating to nearly-zero energy buildings, and to propose quantitative guidelines for energy-management requirements relating to nearly-zero energy buildings.

Before the introduction of legislation from 2018 and 2020 inclusive and respectively, when standards for nearly-zero energy buildings are to be enforced, a demonstration project will start in 2014 for public buildings, premises, blocks of flats and houses.

Requirement to investigate alternative energy-supply systems

Enforcement rules for investigating alternative energy-supply systems were introduced on 12 July 2013.

Requirement for certification of certain fitters

The rules on certification of certain fitters were introduced in March 2013. The aim of the certification system is to extend fitters' knowledge. Fitters must have the ability to decide which installations are the most advantageous on the basis of the building in question, and they must be able to provide information and guidance to consumers on their choice of installation. Certified fitters must contribute to highly efficient, environmentally friendly and good-quality installations.

4.3 Instruments in the public sector

4.3.1 Article 5: State authorities' buildings

The requirement in Article 5 in Sweden covers buildings that are owned by the administrative authorities under the Swedish Government and by the courts. The Swedish Government is of the view that the alternative strategy should be selected for implementing Article 5. Ownership of the kind of properties in question is unequally distributed. Two authorities own approximately 95 % of the buildings, with a total floor area of 1.59 million square metres and total energy consumption of 270 GWh. These authorities are the National Property Board of Sweden and the Swedish Fortifications Agency; please see Table 10.

In order to promote cost-effective measures and low administrative costs, an energy-saving target is planned, which is calculated using all authorities' buildings, to be divided between these two property owners.

The annual savings target for State-owned buildings is calculated as 3 % of the difference between the total current energy consumption of the buildings in question and the total of what their energy consumption would be if the minimum requirements in the Swedish National Board of Housing, Building and Planning's Building Code (BBR) were to be met. The average energy performance of buildings owned by State authorities is 172 kWh/m^2/year. The average energy performance of these buildings if they had met the requirement for new buildings in accordance with the BBR is 108 kWh/m^2/year, which gives a difference of approximately 64 kWh/m^2/year.

This means that, by the end of 2020, the National Property Board of Sweden and the Swedish Fortifications Agency must have implemented measures that reduce the buildings' energy consumption by at least 21 GWh; please see Table 11.

Table 10. State authorities' buildings, area and energy consumption.

Authority	Number of buildings	Total floor area Atemp (m^2)	Total energy consumption (kWh/year)
Swedish Fortifications Agency	264	696 770	130 817 790
Civil Aviation Administration	11	68 067	15 195 047
Swedish Environmental Protection Agency	2	1 197	221 271
Swedish Maritime Administration	8	3 763	914 314
National Property Board of Sweden	433	897 683	139 570 376
Swedish University of Agricultural Sciences	7	2 580	529 075
Swedish Transport Administration	6	8 619	1 555 361
Total Swedish Fortifications Agency and National Property Board of Sweden	**697**	**1 594 453**	**270 388 166**
Total for all authorities	**731**	**1 678 679**	**288 803 234**

Source: Swedish National Board of Housing, Building and Planning.

Table 11. Energy savings for buildings owned by State authorities.

Year	Accumulated saving (MWh)
2014	3 219
2015	6 342
2016	9 371
2017	12 309
2018	15 160
2019	17 924
2020	20 606

Source: Swedish National Board of Housing, Building and Planning.

4.3.2 Article 5: Buildings of other public bodies

In order to coordinate the work to improve energy efficiency, a special Energy Efficiency Council has been established at the Swedish Energy Agency. The Council includes ten or so public bodies. The Council is an arena where issues of strategic importance are raised in order to strengthen cooperation among the authorities and to increase transparency in the area of improving energy efficiency, among other things in procurement by State authorities and measures to increase energy efficiency at State authorities.

The public sector in Sweden comprises a total of 180 State authorities, 290 local authorities and 21 county councils.

Since 2009, the Ordinance (2009:893) on Energy-Efficient Initiatives for Authorities has regulated what measures State authorities must adopt to increase their energy efficiency. This Ordinance was designed on the basis of the provisions of the Energy Services Directive. A total of 180 State authorities are covered by the Ordinance. The measures must be implemented continuously, for example as part of the authority's environmental management system for which there are provisions in the Ordinance (2009:907) on Environmental Management at State Authorities. Authorities must also report their work on energy-efficient measures to the Swedish Energy Agency every year.

The Swedish provisions on measures for improving energy efficiency at State authorities will be developed on the basis of the provisions of the Energy Efficiency Directive. In Bill 2013/14:174, *Implementation of the Energy Efficiency Directive*, the Swedish Government's assessment is that, as part of their environmental management work, State authorities should adopt a strategy with targets and an energy-efficiency action plan, and report on their progress every year. The Swedish Government therefore intends to clarify the requirement to improve energy efficiency in Ordinance (2009:907) on Environmental Management at State Authorities. Approximately 180 State authorities are required to have an environmental management system.[19]

The main aim is that the regulations that apply to State authorities must also apply to other public bodies. This requires instruments and stimulus initiatives on the part of the State.

Since 2010, there has been State aid for local authorities and county councils for their strategic work on improving the energy efficiency of their own activities. This aid has been designed on the basis of the provisions of the Energy Services Directive, and it is regulated by the Ordinance (2009:1533) on State Aid for Improving Energy Efficiency at Local Authorities and County Councils. The local authorities and county councils that receive aid commit themselves to (i) establishing a strategy

[19] A list of State authorities that are required to have an environmental management system is given in Annex 4.

for improving energy efficiency; (ii) working actively to implement the strategy; and (iii) implementing at least two of the six measures laid down in the Ordinance (2009:893) on Energy-Efficient Initiatives for Authorities, which were designed on the basis of the provisions of the Energy Services Directive.

On the whole, all 290 local authorities and 21 county councils have been granted aid for improving energy efficiency for the 2010–14 period. Since 2011, most local authorities and county councils also have plans for improving energy efficiency that contain targets and action plans[20].

This aid scheme is largely deemed to meet the requirements of the Directive concerning the obligation for Member States to invite public bodies at the local and regional level to adopt a plan for improving energy efficiency. The work done by local authorities and county councils is also affected by the aid given by the County Administrative Boards in the context of work on climate and energy strategies. Since 2009, the County Administrative Boards have had the task of working together with regional stakeholders and local authorities to produce and implement regional energy and climate strategies. The work done by the County Administrative Boards includes supporting local authorities, working on methodology development, and implementing networking initiatives to disseminate knowledge and experience.

Some State authorities, local authorities and county councils will be covered by the requirement for large enterprises to carry out energy audits.

Up until 2011, some 16 million square metres of building surface were subject to Energy Performance Contracting (EPC). To date, public-sector buildings have been the main target group. The Swedish Energy Agency has developed a model for categorising energy services, and it will publish an annual report describing trends in the energy services market.

4.3.3 Article 6: Purchasing by public bodies

According to the Ordinance on Energy-Efficient Authorities (2009:983), the courts and administrative authorities under the Swedish Government must implement at least two out of six different measures for making their energy consumption more efficient. This may include purchasing energy-efficient equipment. The provisions have been designed on the basis of the Energy Services Directive and need to be amended on the basis of the Energy Services Directive. In Bill 2013/14:174, *Implementation of the Energy Efficiency Directive*, the assessment of the Swedish Government is that it is the courts and administrative authorities under the Swedish Government that are covered by the requirements in

[20] A list of local authorities and county councils with plans for improving energy efficiency is given in Annex 4.

Article 6. The intention is for these requirements to be introduced in the form of a special Ordinance on the Procurement of Energy-Efficient Goods, Services and Buildings by the Authorities.

The Ordinance (2009:1) on Environmental and Traffic-Safety Requirements for Authorities' Cars and Car Journeys applies to the procurement of vehicles.

The vast majority of State authorities are tenants. The energy-performance requirements for State authorities' tenancy agreements for premises follow from the provisions of Article 6 of the EED. These will not come into force until State authorities renegotiate their tenancy agreements.

4.4 Other instruments for improving energy efficiency, including instruments for industry and the transport sector

4.4.1 Industry

Programme for improving energy efficiency, PFE

The programme for improving energy efficiency in energy-intensive industry (PFE) was introduced in 2004 and is a voluntary agreement between individual enterprises and the Swedish Energy Agency. The agreement means that an enterprise may, if it meets the requirements of the PFE, receive a five-year exemption from energy tax on electricity (SEK 0.005/kWh), which was introduced on 1 July 2004 following adaptation to the EU's Energy Taxes Directive[21]. Through the PFE, enterprises gain greater knowledge of their energy consumption which, together with the initiatives that are implemented, leads to lower energy costs.

Among other things, enterprises that participate in the PFE must carry out an energy audit and introduce an energy management system and routines with regard to energy considerations when procuring electrical equipment and when re-designing, modifying or renovating as part of their activities. An energy audit and analysis must be carried out from the systemic perspective, be long-term and short-term, and result in initiatives to improve energy efficiency. Initiatives with a shorter repayment period than three years must be implemented by the enterprises during the programming period.

[21] The requirements to be met by the PFE and which thus form the basis for the tax reduction are regulated by the Act and Ordinance on the Programme for Improving Energy Efficiency.

There have been many initiatives relating to needs management (for example regulating the speed of electric motors or managing the timings of lighting) and optimisation. These initiatives often have a short repayment period, and some of them do not require any investment. It is customary to switch to more energy-efficient products. Several of the reported initiatives are in the area of pumping; this may be explained in part by the fact that the majority of participating enterprises are in the pulp and paper industry. Initiatives involving compressors and compressed-air systems are also a large item for improving efficiency. The results from the first five-year programming period show that the enterprises have reported implementing measures that have been estimated to give an improvement in electricity efficiency of 1.45 TWh per annum.

The guidelines on State aid for environmental protection, which were issued in 2008, have resulted in more limited opportunities for granting tax exemptions to enterprises. Consequently, the Act (2004:1196) on a Programme for Improving Energy Efficiency was repealed at the end of 2012. This means that enterprises may no longer sign up to the programme.

For transitional purposes, however, the provisions of the repealed Act will apply to the enterprises that signed up in 2012. Most of the programme participants will be ending the PFE on 30 June 2014, but the programming period for the last enterprises to sign up will expire in 2017.

Energy audit checks

Enterprises may apply for aid for energy audits if they have final energy consumption of more than 0.5 GWh per annum, or if they are active in the primary production of agricultural products and cover at least 100 animal units. Energy audit checks are also included in the fulfilment of Article 8; please see the description in section 4.1.2 for further information.

Networks

In order to reconcile any asymmetrical information in the area of improving energy efficiency, network initiatives may be a good platform for disseminating information.

The network for the mining and steel industries intends to increase awareness and make tools available for making energy consumption more efficient at all levels of industrial enterprises through three subsidiary projects. They relate to training, an online energy handbook and a network.

The network for improving energy efficiency, ENIG, comprises a network of experts, industries, energy offices and energy and climate advisers for improving energy efficiency. The focus is on casting, surface treatment, heat treatment, plate forming and plastics. The network started in June 2009.

The aim of Energy-Efficient Sawmills, EESI, is to demonstrate that specific energy consumption in the sawmill industry can be reduced by 20 % by 2020. This result must be achieved through a programme to improve energy efficiency to include, above all, an audit of energy consumption (using energy audit checks; please see above) for modelling opportunities to improve efficiency and a plan for demonstrations at selected sawmills. The network started in January 2010.

Both ENIG and EESI are now in stage 2, which is more operational in nature and focuses on implementation whilst gradually increasing the extent to which the results are used.

The GeniAL project stands for Common Energy Networks in the Aluminium Industry. The aim of the project is to increase knowledge, identify and implement measures, and make tools available for long-term improvements to the efficiency of energy consumption in the aluminium industry, through cooperation in sector-specific councils and networks.

The Swedish Steel Producers' Association (the trade organisation for the Swedish steel industry) carries out network-related work with its member enterprises in the energy sector, but without any financial support from the Swedish Energy Agency. Between 2006 and 2011, the Swedish Steel Producers' Association ran a research programme called the Swedish Steel Producers' Associations Energy Programme 2006–10 with aid from the Swedish Energy Agency. The research initiatives carried out as part of the programme have been calculated to result in improvements to efficiency corresponding to 894 GWh/year over a ten-year period. Most of the potential for improving efficiency is thought to be realised within five years from the end of the programme. Some of the results from certain projects have already been implemented in production, so it is already possible to point to some improvements in efficiency.

4.4.2 Transport

Increased energy efficiency is about releasing availability for passengers and freight in society at the same time as reducing energy consumption for transport. This can be achieved by making the vehicles and infrastructure more energy-efficient, but also through reducing the need for journeys and transport.

Requirements for vehicles and tyres in the EU

In 2009, new provisions[22] on carbon dioxide emissions from new cars were adopted. The Regulation must result in a reduction in average carbon dioxide emissions from new cars to 130 grams per kilometre by 2015. In 2009, the European Community adopted Regulation (EC) No 661/2009, which contained rules for vehicles and tyres. That Regulation introduced requirements for monitoring systems for tyre pressure, grip, maximum rolling resistance and rolling noise from 1 November 2012 onwards. Later that year, requirements for tyre labelling were also decided upon[23]. As of 1 November 2012, tyres must be labelled with regard to their rolling resistance, rolling noise and grip in wet conditions.

Road tax

In 2006, Sweden introduced a road tax for cars that was differentiated according to carbon dioxide, in the Road Traffic Taxation Act[24]. Road tax for light goods vehicles, light buses and private cars has also been differentiated according to carbon dioxide for vehicles registered after 2010. Green vehicles have been exempt from road tax for the first five years as of 1 July 2009. In 2013, this tax exemption was extended so that it also includes private cars, light goods vehicles and light buses. The emission level was lowered at that time from 120 grams of carbon dioxide per kilometre to 117 grams of carbon dioxide per kilometre. Tax based on carbon dioxide is therefore paid for each gram in excess of 117 grams of carbon dioxide per kilometre[25]. In the spring Budget Bill for 2014, the Swedish Government announced that it intends to propose an increase in road tax for light goods vehicles in the Budget Bill for 2015.

Ordinance on the Procurement and Leasing of Green Vehicles by the Authorities

Since 2005, environmental requirements have been imposed on the procurement and leasing of cars by State authorities in the Ordinance (2004:1364) on the Procurement and Leasing of Green Vehicles by the Authorities. These requirements have since been supplemented by

[22] Regulation (EC) No 443/2009 of the European Parliament and of the Council setting emission performance standards for new passenger cars as part of the Community's integrated approach to reduce CO_2 emissions from light-duty vehicles.
[23] Regulation (EC) No 1222/2009 of the European Parliament and of the Council on the labelling of tyres with respect to fuel efficiency and other essential parameters.
[24] Road Traffic Tax Act (2006:227).
[25] In the system based on carbon dioxide, road tax is a basic amount of SEK 360 plus an amount for carbon dioxide, and since 2011 it has been SEK 20 per gramme of carbon dioxide over and above 117 grammes emitted by the vehicle per kilometre for mixed-use driving. For vehicles that can run on alcohol or gas (other than LPG), the amount for carbon dioxide is SEK 10 per gramme of carbon dioxide.

traffic-safety requirements while the proportion of green vehicles was increased from 85 % to 100 % by the Ordinance (2009:1) on Environmental and Traffic Safety Requirements for Authorities' Cars and Car Journeys (amended by SFS 2011:351).[26]

Procurement by other authorities (local authorities, county councils, State-owned enterprises, etc.) is regulated by the EU Directive on the promotion of clean and energy-efficient road transport vehicles. The Directive has been implemented in Sweden by the Act (2011:846) on Environmental Requirements for the Procurement of Vehicles and Certain Public Transport Services.

Super-green vehicle premium

In December 2001, the Swedish Government decided to introduce a super-green vehicle premium. The aim was to try and increase the sales and use of new cars with a low impact on the climate.[27] The premium covers private cars with very low greenhouse-gas emissions, at a maximum of 50 grams of carbon dioxide per kilometre, which mainly relates to plug-in hybrids and purely electric cars. The premium amounts to SEK 40 000 per vehicle for private individuals and 35 % of the difference between the price of the new car and the nearest comparable car for enterprises, the public sector and associations.

Vehicle power tax

Power tax is a permanent reduction for green vehicles. On 1 January 2002, these rules were supplemented by a time-barred opportunity for a further reduction in the power value for certain types of environmentally adapted car (cars equipped with technology for running on electricity or a gas other than LPG). The reduction covers electric cars, gas cars (not LPG) and plug-in hybrid cars, and it is valid up to and including 2016.

Congestion charges and other local initiatives

Congestion charges were permanently introduced to Stockholm on 1 August 2007. The charge was also introduced to Gothenburg in 2013, and it follows the same principle as in Stockholm. The primary aim of the congestion charges in Stockholm and Gothenburg is to increase accessibility and improve the local environment as well as finance

[26] 'Green vehicle' means a vehicle that can run on ethanol, vehicle gas or electricity, as well as vehicles powered by fossil fuels that have maximum carbon ioxide emissions of 120 g/km. Energy requirements are also imposed on vehicles powered by ethanol, gas and electricity.
[27] Ordinance (2011:1590) on the Super-Green Vehicle Premium.

investment in infrastructure, although they are also of indirect importance for energy consumption and carbon dioxide emissions.

At the local level, local authorities may also influence car use without applying congestion charges, for example through parking charges, parking standards and parking policies.

Lower speeds and eco-driving

There are currently over 1 000 traffic safety cameras throughout the Swedish road network. In 2010–11, many local authorities in Sweden introduced new, lower speed limits, with 30 or 40 km/h the norm in urban areas. There is a clear link between speed and fuel consumption, with increased fuel consumption from approximately 50 km/h upwards.

Since 2007, eco-driving requirements have been included in driver training and driving tests for a type-B driving licence (private cars). Since then, the requirements have been extended to all licences. The requirements include both practical and theoretical components. The concept of eco-driving is also considered to have potential for railway traffic. The installation of energy meters and the use of the Drive Style Manager are reducing energy consumption in both new and old rolling stock.

Green corridors

Green corridors are a Swedish initiative that was launched by the European Commission in 2007. National and international goods traffic must be concentrated on long routes with eliminated bottlenecks and coordination rules. The Transport Act must be used to the maximum by means of logistical solutions and strategically placed terminals for unloading, with an adapted support infrastructure. Green corridors must also be a platform for innovative logistical solutions and demonstrating good examples. The work is characterised by close collaboration between society, business and research. In total, there are over 190 separate projects in the area of green corridors.

Improving the energy efficiency of transport infrastructure

In addition to the energy consumption caused by road and railway traffic, energy is also used for the construction, operation and maintenance of transport infrastructure. A rough estimate is that this amounts to approximately 10 % of energy consumption by road traffic, which amounts to a total of just over 80 TWh. The Swedish Transport Administration has introduced the area of improving energy efficiency as a focal area for its own activities. The aim of this work is to find measures to improve the energy efficiency of investment projects that can be calculated and disseminated, both internally to the project

managers and also externally to design consultants and entrepreneurs, among others. The Swedish Transport Administration will encourage its suppliers to propose more energy-efficient methods for building roads and railways in Sweden.

For several years, the Swedish Transport Administration has worked with a lighting strategy that urged the use of more energy-efficient fittings, turning off unnecessary lights and also moving lighting from railways to cycle paths and pedestrian walkways.

Even in railway traffic, there are opportunities for improving the efficiency of energy consumption in the infrastructure. The Swedish Transport Administration estimates that, as part of a national project, it will be able to make 59 major station areas and sidings more energy-efficient with regard to lighting in sidings and on platforms, in station buildings, at electrically heated points, and in technical buildings. A pilot project at Östersund Central, which was reported on in 2013, saw the Swedish Transport Administration collaborating with Östersund Municipality and Jernhusen AB in the largest full-scale test of LED lighting in Scandinavia. The most important conclusion from the project is that the installation of new points-heating controls yields an energy saving of 50 %. Applied to the whole of Sweden, this could give an energy saving of 74 GWh per annum if it is assumed that 75 % of the existing control equipment for heating the points is bypassed.

Work is also being done on more energy-efficient lighting in the area of shipping. In order to reduce energy consumption and increase the life expectancy of waterway markings, LED technology is being used for more and more applications, for example on lighting buoys, which has also resulted in the procurement of fewer batteries despite the increase in the number of lighting buoys, and there is also less of a need for maintenance transport.

Information initiatives

There are many different kinds of information initiative that affect energy consumption in the transport sector.

The car index of new cars' impact on the climate is the result of collaboration between the Swedish Transport Administration and the Swedish Consumer Agency which started in 2007. The aim of the report is to shed light on purchases of new cars by Swedes and what climate consequences are involved. The report is produced twice a year, and it provides statistics about carbon dioxide emissions from new cars according to the EU method, as well as the estimated climate impact for all local authorities, all counties, and nationally.

The Swedish Consumer Agency and the Swedish Energy Agency are working together to develop and administer a portal of information and facts about cars, called Bilsvar.se, with consumers as the target group.

The work is being done in collaboration with the Swedish Transport Administration, which is providing expertise on various specialist matters where needed. The aim of Bilsvar.se is to provide consumers with easily accessible, reliable information about new and used car models and thus reinforce their opportunities to be well-informed and active in the market. Before any purchase decision is made, there must be adequate information in hand for selecting a model based on needs, financial conditions and the environmental perspective.

For green vehicles there is the website www.miljofordon.se, which has been co-financed by the Swedish Energy Agency since 2011. It contains information to supplement the New Car Guide.

Technology procurement

The Swedish Energy Agency has financed the programme on Technology Procurement and Introducing Energy-Efficiency Improvements to the Transport Market. The programme took place between 2010 and 2013, and had a budget of SEK 35 million. The aim was to develop, verify and give practical demonstrations of new technologies and technical solutions prior to their introduction to the market in the areas of logistics, integration into modes of transport, planning, organisation, IT, and impact on behaviour. This programme was run in parallel with the more research-focussed programme on Improving Energy Efficiency in the Transport Sector. The projects that received support under the programme could, for example, facilitate the transition to more energy-efficient types of transport, improve usage through higher filling levels, or contribute to more energy-efficient journey patterns by reducing the need to travel and changing travel behaviour.

Collaboration with public-sector stakeholders and business

Since the end of the 1990s, far-ranging work has been done to limit the impact of transport on the climate. An important part of this is carrying out initiatives together with public-sector stakeholders and business. This involves information, coordination, and financial support for projects. Some of the initiatives that have been involved include social planning to reduce car use, the selection of energy-efficient modes of transport or travel, the selection of energy-efficient vehicles, car pooling, improved logistics for passenger and freight transport, eco-driving, better compliance with speed limits, and less use of studded tyres.

Sweden is collaborating with Finland to make ice-breaking more efficient. Ice-breaking is an energy-intensive service that is offered to shipping. Better coordination between the ice-breaking operations of these states could lead to a reduction in energy consumption for this level of service. A formal partnership agreement for 20 years was signed in 2012.

Research

The Swedish Energy Agency and several other authorities and organisations finance research in the transport sector. The Swedish Transport Administration finances research that covers all aspects of impact on the climate and energy consumption on roads and railways. Research by the Swedish Maritime Administration relates to the vessel, its physical design, power sources, fuel and emissions, as well as questions relating to improving the efficiency of the whole transport chain. The Swedish Energy Agency's research is done *inter alia* in the areas of alternative fuels and energy-efficient vehicles.

LETS 2050 (Governing Transitions Towards Low-Carbon Energy and Transport Systems) was an interdisciplinary programme that analysed how Sweden can work towards carbon-neutral and sustainable energy and transport systems. The programme was led by Lund University and employed approximately 25 researchers from ten different institutions. The research was based on the fact that it is both technologically possible and financially feasible to switch to being a carbon-neutral society, and that it is now time to find the way there. It was co-financed by the Swedish Environmental Protection Agency, the Swedish Energy Agency, the Swedish Governmental Agency for Innovation Systems (Vinnova) and the Swedish Transport Administration. The programme ended in 2013.

Research and Innovation (FFI) is a collaboration between the State and the vehicle industry on co-financing research, innovation and development activities with a focus on the areas of climate and the environment, as well as safety. The initiative, which started in 2009, involves research and development activities amounting to approximately SEK 1 billion per annum, of which public-sector resources account for half. There are currently five areas of collaboration, including energy and the environment, and transport efficiency.

Energy Systems in Railway Vehicles is another research programme that brings together research projects relating to more energy-efficient railway vehicles. As part of the various subsidiary projects, research is being done on cheaper lithium ion batteries, different kinds of hybrid system, and methods for converting diesel into hydrogen. It also includes more long-term research into the management, regulation and development of combustion engines.

The Swedish Energy Agency finances the research programme on Improving Energy Efficiency in the Transport Sector, which has been running since 2010. The programme's vision is to support research that helps to realise the potential for improving energy efficiency in the transport sector through new solutions for moving transport to more energy-efficient types of transport, logistics, planning, behaviour and physical initiatives in various environments. One of the main aims is to find energy-efficient freight and passenger transport through the use of advanced IT solutions and initiatives aimed at changing behaviour.

4.5 Instruments for efficient heating and cooling

4.5.1 Article 14: Comprehensive assessment

District heating is widespread in Sweden. It is the most common type of energy used in blocks of flats, with approximately 90 % of heating for such buildings being provided by district heating. In addition to this, nearly 80 % of commercial premises are heated by district heating. Total consumption of district heating amounts to over 50 TWh. Since the use of district heating is comprehensive, there is relatively little scope for it to develop further.

In 2013, the Swedish Energy Agency reported[28] the potential for extending CHP, district heating and district cooling based on cost/benefit calculations from a number of different reports. The assessment of that potential assumes that existing instruments internalise external costs in principle. Given this assumption, the market will implement the projects that are profitable, including with consideration to any external factors. Stakeholders may thus be said to act in a manner that is efficient from the socio-economic perspective. The Swedish Energy Agency is of the view that existing instruments are sufficient in that no new instruments are needed to develop the district-heating market, since it is already fully developed in principle.

The need for heating and cooling is broken down into sectors (blocks of flats and commercial premises, houses, industry and other), but not geographically. Nonetheless, the calculations are based on Sweden as a geographical boundary, but they also consider imports and exports.

Some 55 TWh of district heating was produced in 2011. The analysis shows that there is still potential to expand district heating, district cooling and CHP. This potential is restricted by the fact that it is already well developed, with the exception of district cooling. The potential for future district heating has been estimated at 4 TWh by 2020 and 8 TWh by 2030.

Remote cooling production currently amounts to nearly 1 TWh. The potential for district cooling has been estimated at an additional 1 TWh by 2020 and 2 TWh by 2030. Electricity produced by CHP amounted to 10.5 TWh in the district heating network in 2011 and 6 TWh in industry. The potential for CHP comprises both CHP in the district-heating system and CHP in industry, known as industrial counter-pressure. The future potential for electricity production from CHP will amount to 5 TWh by 2020. It is then estimated that there will only be marginal increases until 2030.

[28] Swedish Energy Agency, Comprehensive assessment of the potential for using highly efficient CHP, district heating and district cooling, ER 2013:24.

The total primary-energy savings from the potential expansion of CHP, district heating and district cooling are estimated to amount to 14 TWh by 2020 and a maximum of 16 TWh by 2030. The Swedish Energy Agency has found that many measures are required for this calculation and that they have great consequences for the results and for the conclusions drawn. It is therefore inappropriate to design instruments on the basis of these calculations.

4.5.2 Other instruments for efficient heating and cooling

According to the requirements in the Directive, profitable measures must be proposed that emerged through the cost/benefit analysis carried out and which form the basis for assessing the expansion of district heating, CHP and district cooling. Market players take care of this expansion in Sweden, and the State lays down a framework that the players must respect. When expansion is profitable, it is thus carried out through market forces. Since the district-heating market in Sweden is already well developed, there is little or no scope for any State initiatives to extend it further. In addition to this, it would probably have involved a distortion of competition in the heating market. On the other hand, the district-heating market may be developed, and some of the tasks that have been reported on are listed below:

- Principles for reporting residual heating potential when designing new district-heating production. (Swedish Energy Agency, ER 2013:09);
- Assessing price changes and the principle of equal treatment (Swedish Energy Markets Inspectorate, EI R2013:07);
- Regulated access to the district-heating network (Swedish Energy Markets Inspectorate, EI R2013:04);
- Overview of the Swedish National Board of Housing, Building and Planning's building regulations and analysis of their technical neutrality (Mandate for the Swedish National Board of Housing, Building and Planning, N2014/75/E).

4.6 Instruments for the conversion, transmission and distribution of energy

4.6.1 Article 15: Criteria for improving energy efficiency for network tariffs and network regulations

The Swedish electricity legislation in force does not contain any explicit prohibition of tariffs that have a detrimental impact on total efficiency. The intention is therefore to introduce the provisions to safeguard the Energy Efficiency Directive in this section. In Bill 2013/14:174, *Implementation of the Energy Efficiency Directive*, the Swedish

Government proposes that it must be possible for the network authority (the Swedish Energy Markets Inspectorate) to consider the extent to which the network concession holder carries out its activities in a manner that promotes improvements to energy efficiency. The network authority must then be able to decide whether to reduce the revenue framework for a network enterprise that carries out its activities in a manner incompatible with efficient use of the electricity network. An enterprise that instead contributes to improving energy efficiency, on the other hand, should be allocated a greater dividend on the capital base. The Swedish Parliament will debate the Bill in spring 2014.

Article 15 of the Directive may be implemented by stipulating in the Electricity Act that network tariffs must be designed in a manner compatible with efficient use of the electricity network and with efficient production and consumption of electricity. This will ensure that tariffs do not constitute a barrier to such system services or contain any incentives that could hinder participation in load management in conjunction with balancing services and the procurement of ancillary services. Such a provision could be inserted into the Electricity Act.

There is also some doubt as to whether the Swedish regulations provide a direct incentive for network enterprises to make system services available to network users. Provisions regarding such an incentive may therefore be introduced. This would make it possible for network users to implement measures for improved energy efficiency in conjunction with the continued commissioning of intelligent networks.

4.6.2 Facilitate and support load management and energy efficiency in relation to network design and regulation

The Swedish Energy Agency and the Swedish Energy Markets Inspectorate currently have a mandate from the Swedish Government to investigate the total potential for making the infrastructure for electricity and gas more efficient. This mandate is to be reported on to the Government Offices of Sweden in June 2014.

Annex 1 Basis for the calculation

Annex 1 describes statistics and assumptions that have been used for the calculations. The methods recommended by the Commission[29] have been used wherever possible, and any deviations from those methods are explained in Annex 2. The methods recommended by the Commission include what are known as P, A and M methods. The P (preferred) methods are those that the Commission regards as better for use than the A (alternative) methods and M (minimum) methods. The choice of method to be used depends on access to statistics.

Homes

Savings for homes are calculated using five indicators:

1. P1 – Energy consumption for household heating per square metre;
2. P2 – Energy consumption for household cooling per square metre;
3. P3 – Energy consumption for household hot water per inhabitant;
4. P4 – Electricity consumption per equipment type (kWh/year)
5. P5 – Electricity consumption for lighting per household (kWh/year).

The official energy statistics show energy consumption for heating and hot water together, since they are most often not separated. This is because, in most homes, heating and hot water are not metered separately. As part of this work, the Swedish Energy Agency has chosen to use a model of 80 % heating and 20 % hot water. Cooling is not used to a particularly great extent in Sweden, even though it is on the rise. There are no reliable statistics, however, that provide a special account of energy consumption for cooling, separately from energy consumption for heating, hot water and electricity. For this reason, indicator P2 is deemed to be irrelevant for Sweden. For 2016, the Swedish Energy Agency has obtained results from the authority's long-term prognosis of 2012. Table 12 sets out the basis used for the calculations.

[29] European Commission, Preliminary draft excerpt – Recommendations on measurement and verification methods in the framework of Directive 2006/32/EC on energy end-use efficiency and energy services.

The calculations for indicators P4 and P5 are based on sales statistics.[30] Only late action has been included, owing to a lack of statistical quality for previous years.

P1- Energy consumption for household heating per square metre

Early savings (2007–1995) are calculated as follows:

$$Besp._{1} = \left[\left(\frac{Eh_{2007}}{F_{2007}} * \frac{MDD_{20}}{ADD_{2007}}\right) - \left(\frac{Eh_{1995}}{F_{1995}} * \frac{MDD_{20}}{ADD_{1995}}\right)\right] * F_{2007}$$

Swedish	English
Besp.	Saving

Later savings (2007–11 and 2007–16) are calculated in a similar way.

Table 12. Statistical basis for indicator P1.

Authority	1995	2007	2011	2016
Heating cons. (TWh) actual (Eh)	60.4	46.0	44.2	47.2
Hot water cons. (TWh) (Ew)	15.1	11.5	11.0	11.8
Areas in homes (F)	446	426	450	456
Inhabitants in Sweden (P)	8.8	9.2	9.5	9.9
Degree-days (ADD)	3 782	3 283	3 241	3 740
Degree-days (normal year) (MDD)	3 841	3 740	3 740	3 740

Source: Swedish Energy Agency.

Table 13. Calculation results for indicator P1.

Indicator P1	2011	2016
Early savings (TWh)	6.2	6.2
Late savings (TWh)	4.3	8.8
Total savings P1	**10.5**	**15.0**

Source: Swedish Energy Agency.

Since the calculations are based on final purchased energy consumption, the large-scale installation of heat pumps and the shift away from oil mean that final energy consumption has fallen considerably and has resulted in large savings. This is on the basis that energy recovered from heat pumps is not included and that the shift away from oil has meant that the losses arising from the combustion of oil have disappeared from households and have shifted to the electricity and district-heating sector.

[30] The calculations are based on data from IT Energy ApS and the Danish Energy Agency.

P2- Energy consumption for household cooling per square metre

Not relevant for Sweden, owing to minor consumption of cooling and the difficulties of separating energy consumption from heating and hot water.

P3- Energy consumption for household hot water per inhabitant

Early savings (2007-1995) are calculated as follows:

$$Besp. = \left[\frac{BW_{2007}}{P_{2007}} - \frac{BW_{1995}}{P_{1995}}\right] * P_{2007}$$

Swedish	English
Besp.	Saving

Later savings (2007–11 and 2007–16) are calculated in a similar way.

Table 14. Calculation results for indicator P1.

Indicator P3	2011	2016
Early savings (TWh)	4.2	4.2
Late savings (TWh)	0.8	0.6
Total savings P3	**5.0**	**4.8**

Source: Swedish Energy Agency.

In the same way as for heating, the large-scale installation of heat pumps and the conversion from oil mean that final energy consumption for hot water has fallen considerably and has resulted in large savings.

P4- Energy consumption for household appliances

$$(UEC^{x}_{2015} - UEC^{x}_{2007}) * stock^{x}_{2016}$$

Where UEC^{x} is electricity consumption per equipment type (x) and stock is the total number of pieces of equipment for each type.

Table 15. Mean energy consumption per equipment type (kWh/year).

(UEC)	2007	2011	2016
Fridge	249	212	177
Freezer	322	275	225
Washing machine	233	218	204
Dishwasher	330	306	282
Tumble-dryer	500	471	438
TV	398	364	230

Source: Swedish Energy Agency.

Table 16. Number of pieces of equipment in stock.

(stock)	2007	2011	2016
Fridge	3 669 985	4 094 359	4 501 883
Freezer	1 707 413	1 858 915	2 015 920
Washing machine	2 333 394	2 708 257	3 098 886
Dishwasher	2 117 525	2 537 268	2 978 001
Tumble-dryer	932 004	1 095 787	1 324 612
TV	2 547 145	5 787 869	7 486 721

Source: Swedish Energy Agency.

Late savings (2007–16) are calculated by taking the difference between the key figure (mean energy consumption per annum and per equipment type) for 2016 and 2007 and multiplying it by the total number of pieces of equipment (per type) in 2016. A similar calculation has been performed for 2011.

Table 17. Savings for pieces of equipment (GWh).

Indicator P4	2011	2016
Fridge	150	322
Freezer	87	196
Washing machine	40	91
Dishwasher	61	143
Tumble-dryer	31	82
TV	193	1 254
Total	562	2 088

Source: Swedish Energy Agency.

P5 – Energy consumption for lighting

$$Besp. = \left(\frac{E^{H,li}_{2016}}{D_{2016}} - \frac{E^{H,li}_{2007}}{D_{2007}}\right) * D_{2016}$$

Swedish	English
Besp.	Saving

Where $E^{H,li}$ is electricity consumption for household lighting and D is the number of households.

Table 18. Estimated energy consumption for household lighting.

Indicator P4	2007	2011	2016
Energy consumption for lighting (kWh/year and household), [EH,li]	797	494	464
Number of households (1000s), [D]	4 477	4 656	4 656

Source: Swedish Energy Agency.

Late savings (2007–16) are calculated by taking the difference between the key figure (electricity consumption for lighting per household) for 2016 and 2007 and multiplying it by the total number of households in 2016. A similar calculation has been performed for 2011.

Table 19. Savings for lighting (GWh).

Indicator P5	2011	2016
Lighting	1 407	1 550

Source: Swedish Energy Agency.

Service sector

The following indicators are used for the service sector:

1. P6 – Energy consumption (not electricity) in the relevant subsidiary sector per square metre;
2. P7 – Energy consumption (only electricity) in the relevant subsidiary sector per square metre.

The subsidiary sectors that the Swedish Energy Agency has chosen to divide up are the following:

- Public services (public administration and government services);

- Office premises (Offices);
- Healthcare (Hospitals);
- Trade (Wholesale and retail trade services);
- Hotels and catering (Hotels and restaurants);
- Miscellaneous (Other).

It is important to note that the statistics broken down at this level may be uncertain and vary between years in some cases. This is because it is problematic to do breakdowns of this kind. The 'Other' category is a residual item and is a large proportion of total energy consumption in the sector. No early savings (1995–2007) have been calculated, since it is difficult to find comparable statistics broken down into different sectors for 1995. For 2016, it is assumed that the energy consumption and area, corrected for a normal year, will be the same as in 2011. This is because it is difficult to break down these figures from the long-term prognosis made by the Swedish Energy Agency in 2012, and such a breakdown would be of limited value.

There are three tables below that contain basic statistics for the calculations. The first table shows energy consumption excluding electricity for various sectors. The second relates to electricity consumption and the third to area.

Table 20. Energy consumption (not electricity) broken down into different subsidiary sectors [Enonel] (TWh).

	2007	2011	2016
Public services (public administration and government services)	0.38	0.64	0.74
Office premises (Offices)	2.36	2.07	2.39
Healthcare (Hospitals)	2.26	1.92	2.21
Trade (Wholesale and retail trade services)	1.04	1.12	1.29
Hotels and catering (Hotels and restaurants)	0.55	0.69	0.79
Miscellaneous (Other)	13.86	13.09	15.10
Degree-days [ADD]	3 283	3 241	3 740
Degree-days (normal year) [MDD]	3 740	3 740	3 740

Source: Swedish Energy Agency.

Table 21. Energy consumption in TWh broken down into different subsidiary sectors [Eel].

	2007	2011	2016
Public services (public administration and government services)	1.56	1.41	1.41
Office premises (Offices)	3.82	3.75	3.75
Healthcare (Hospitals)	3.27	2.69	2.69
Trade (Wholesale and retail trade services)	5.89	5.80	5.80
Hotels and catering (Hotels and restaurants)	1.48	1.64	1.64
Miscellaneous (Other)	10.32	10.04	10.04

Source: Swedish Energy Agency.

Table 22. Area in million square metres, broken down into different subsidiary sectors [I].

	2007	2011	2016
Public services (public administration and government services)	4.6	6.9	6.9
Office premises (Offices)	28.6	22.4	22.4
Healthcare (Hospitals)	22.5	18.6	18.6
Trade (Wholesale and retail trade services)	16.3	15.8	15.8
Hotels and catering (Hotels and restaurants)	7.3	7.3	7.3
Miscellaneous (Other)	79.4	81.1	81.1

Source: Swedish Energy Agency.

P6 – Energy consumption (not electricity) in relevant subsidiary sectors per square metre

The formula for savings for the relevant subsidiary sectors by 2016 is as follows:

$$Besp. = \left[\left(\frac{E^{Energi-el}_{2008}}{IA_{2008}} * \frac{MDD_{20}}{ADD_{2008}}\right) - \left(\frac{E^{Energi-el}_{2016}}{IA_{2016}} * \frac{MDD_{20}}{ADD_{2016}}\right)\right]$$

Swedish	English
Besp.	Saving

Table 23. Calculation results for indicator P6.

	2011	2016
Public services (public administration and government services)	0.09	0.09
Office premises (Offices)	0.29	0.29
Healthcare (Hospitals)	0.09	0.09
Trade (Wholesale and retail trade services)	0.14	0.14
Hotels and catering (Hotels and restaurants)	0.16	0.16
Miscellaneous (Other)	-1.02	-1.02
Total savings P6	**-0.26**	**-0.26**

Source: Swedish Energy Agency.

On the whole, there are no savings, but instead there is a clear increase for this indicator between 2007 and 2016.

P7- Electricity consumption in relevant subsidiary sectors per square metre

The formula for savings for the relevant subsidiary sectors by 2016 is as follows:

$$Besp. = \left[\frac{Bel_{2016}}{I_{2016}} - \frac{Bel_{2007}}{I_{2007}}\right] * I_{2016}$$

Swedish	English
Besp.	Saving

Table 24. Calculation results for indicator P7.

Indicator P7 in TWh	2011	2016
Public services (public administration and government services)	-0.93	-0.93
Office premises (Offices)	0.77	0.77
Healthcare (Hospitals)	-0.01	-0.01
Trade (Wholesale and retail trade services)	0.09	0.09
Hotels and catering (Hotels and restaurants)	0.16	0.16
Miscellaneous (Other)	-0.50	-0.50
Total savings P7	**-0.42**	**-0.42**

Source: Swedish Energy Agency.

On the whole, there are no savings, but instead there is a slight increase for this indicator in respect of electricity consumption between 2007 and

2016. In total, there are no savings on premises, but rather there is an increase of 0.68 TWh.

Table 25. Calculation results for the service sector.

Indicators P6 and P7	2011	2016
Savings P6 (TWh)	-0.26	-0.26
Savings P7 (TWh)	-0.42	-0.42
Total savings	**-0.68**	**-0.68**

Sources: Swedish Energy Agency.

Industry

The Directive only includes energy consumption by industry outside emission allowance trading. Energy consumption from fossil fuels in the trading sector has therefore been excluded. This has been done by calculating the trading sector's share of energy consumption for each energy carrier in the relevant sector. These shares have been used to exclude energy consumption by different energy carriers that are covered by emission allowance trading. The same proportions have been used for 2007 and 2016.

Early action

No early action has been calculated.

Late action

The M8 method has been used to calculate the saving for 2007–16. The calculation is performed for each energy carrier and sector with the same distribution as in the Swedish Energy Agency's prognoses, i.e. on 16 energy carriers[31] and 13 sectors[32]. The sector and fuel breakdown selected will affect the result of the calculations.

In order to reduce the impact of structural effects, the calculations have been performed at the smallest possible sector level. Owing to the structure of the method (M8) and the prognosis, however, it has not been possible completely to exclude the effects of fuel substitution, for example, or all structural effects.

[31] The energy carriers are coal, coke, petroleum coke, biofuel, LPG, petrol, light oils, diesel, fuel oil 1, fuel oil 2-5, natural gas, town gas, coke-oven gas, blast-furnace gas, district heating and electricity.

[32] The sectors are the mining industry (05–09 in SNI 2007), the food industry (10–12), the textiles industry (13–15), the timber industry (16), the pulp and paper industry (17), the publishing industry (18), refineries (19), the chemicals industry (20-21), plastics and rubber (22), the earth-moving and quarrying industry (23), the iron and steel industry (241–243), metallurgy (244–245), and the workshop industry (25–30).

Early action

Early action savings have been calculated using the Commission's top-down methods. Since there are no statistics from the mid-1990s, the minimum methods have been used to perform the calculations for railways and shipping. The following methods are used to calculate improvements to efficiency for early action:[33]

- Cars (P8);
- Heavy goods vehicles (P9);
- Light goods vehicles (P9 A2);
- Railways (M6);
- Shipping (M7).

Table 26. Calculated saving of early action in the transport sector.

	2011	2016
Early action		
Cars (P8)	3.33	3.33
Heavy goods vehicles (P9)	0.06	0.06
Light goods vehicles (P9 A2)	-0.21	-0.21
Railways (M6)	0.19	0.19
Shipping (M7)	-0.31	-0.31
Total improvement in efficiency for early action	3.1	3.1

Source: Swedish Energy Agency.

In simplified terms, the saving has been calculated using the following method:

$$Besparing = \left(\frac{E_0}{A_0} - \frac{E_t}{A_t} \right) * A_t$$

Swedish	English
Besparing	Saving

E = energy consumption; A = activity; 0 = start year; t = end year.

[33] Some adjustments have been made to the Commission's indicators. These are specified in Annex 2, 'Calculation methods'.

The saving is the difference in energy consumption per activity between the start and end year, multiplied by activity for the end year. The saving thus depends on the situation in the start year and end year. In order to reduce the effects of individual years, the saving for early action has been made by using the mean over three years instead of merely working on the basis of statistics for the start and end year.

Late action

Prognosis for transport work

The 'Prognosis for Goods Transport by 2030' and the 'Prognosis for passenger transport' have been used as the basis for transport work.[34] These prognoses were produced in 2012 as the basis for the Swedish Transport Administration's action planning[35]. Both statistics and the prognosis for transport work have been revised, and they have fallen since the second action plan. For 2011 onwards, the growth rate according to the Swedish Transport Administration's prognosis has been used. The Swedish Transport Administration's prognosis applies until 2030 and, with the exception of the downturn in 2012, the trend is assumed to be almost linear over the prognosis period.

Table 27. Statistics for goods-transport work in 2007 and predicted trend for 2011 and 2016 (millions of tonne-kilometres).

	2007	2011	2016
Road	40 525	38 333	44 301
Railway	23 250	22 864	23 585
Shipping	7 246	7 508	7 780

Source: Swedish Energy Agency.

Table 28. Statistics for passenger-transport work in 2007 and predicted trend for 2011 and 2016 (millions of person-kilometres).

	2007	2011	2016
Cars	99 315	103 194	112 678
Railway	10 261	11 378	12 063
Rail traffic	2 204	2 340	2 592
Bus	8 655	8 766	8 786

Source: Swedish Energy Agency.

[34] Swedish Transport Administration, Report on a National Plan for the Transport System 2014-25, preliminary version.
[35] The reference scenario has been used for this work (in the Swedish Transport Administration's prognoses, this scenario is called Basic Prognosis 2030).

Energy consumption for cars and goods vehicles

The results from the Swedish Transport Administration's basis for climate reports are used for energy consumption, albeit adjusted somewhat so as to be consistent with the transport work set out in Table 28. Improved efficiency of 0.4 % per annum over the 2007–13 period has been included in the energy prognosis for heavy goods vehicles. It has also been assumed that cars will achieve 120–130 g/km by 2020 at the EU level, being introduced gradually over the 2012–15 period, and Sweden is assumed to have the same relative reduction as the EU average. After 2015, improved efficiency of 1 % per year is assumed.

Table 29. Energy consumption for passenger and goods transport by road. Statistics for 2007 and prognosis for 2011 and 2016.

	2007 (TWh)	2011 (TWh)	2016 (TWh)
Cars	49.3	47.6	46.9
Light goods vehicles	7.5	7.9	8.0
Heavy goods vehicles	17.9	17.9	19.7

Source: Swedish Energy Agency.

Energy consumption for passenger and goods traffic by railway

Energy consumption between 2012 and 2016 has been predicted on the basis of historical trends for the kWh/transport work ratio between 2000 and 2011. The reason for this period being used as the basis is that energy consumption for passenger and goods traffic was not broken down for previous years. The calculation is based on statistics from Transport Analysis for transport work and energy consumption, and comparing them gives the trend in energy consumption for each type of transport work in Table 30.

Table 30. Energy consumption for each type of transport work (kWh/person-km and kWh/tonne-km).

	2000	2007	Trend*
Passenger (railway)	0.12	0.11	0.99
Passenger (other rail traffic)	0.14	0.12	0.98
Goods	0.04	0.04	10.99

*This column shows the mean annual trend in energy consumption for each type of transport work.
Source: Swedish Energy Agency.

Energy consumption for each type of transport work for goods transport has been relatively constant in recent years, whereas passenger transport has seen an increase in efficiency of approximately 2 % per annum. The same growth rate is assumed for the 2007–16 period.

Table 31. Energy consumption for each type of transport work.

	2007	2011	2016
kWh/person-km (railway)	0.12	0.11	0.10
kWh/person-km (other rail traffic)	0.14	0.11	0.11
kWh/tonne-km	0.04	0.04	0.04

Source: Swedish Energy Agency.

Transition to passenger transport

The saving for the P12 method is calculated using the formula:

$$\text{Besparing} = (PT_t - PT_{2007}) * T_t * (UECA_t - UEPT_t)$$ where:

Swedish	English
Besparing	Saving

PT = proportion of public transport (calculated in person-kilometres);

T = total transport work (person-kilometres);

UECA = energy consumption for cars (kWh/person-km);

UEPT = energy consumption for public transport (kWh/person-km).

Public transport includes buses, underground railways, trams and trains. Energy consumption for buses has been taken from Artemis. Energy consumption for rail traffic has been taken from calculations performed for the P10 method; please see Annex 2. The transport work has been obtained from the passenger-transport prognosis described above.

Table 32. Conditions for calculating savings for indicator P12.

	2007	2011	2016
Proportion of public transport	17.5 %	17.9 %	17.2 %
Total transport work (person-km)	120 435	125 678	136 120
Energy consumption for cars (kWh/person-km)	0.52	0.47	0.41
Energy consumption for public transport (kWh/person-km)	0.19	0.18	0.17

Source: Swedish Energy Agency.

The saving by 2016 will be negative, at -0.1 TWh, which means that the proportion of public transport will fall.

Saving for late action

The P8, P9, A2, P10, P11 and P12 methods in Annex 2 have been used. The saving calculated for late action in the transport sector is shown in Table 33.

Table 33. Calculated saving for late action in the transport sector.

	2011 (TWh)	**2016 (TWh)**
Late action		
Cars (P8)	5.10	12.19
Heavy goods vehicles (P9)	-0.39	1.24
Light goods vehicles (P9 A2)	-0.04	0.04
Railway passengers (P10)	-0.04	0.05
Railway goods (P11)	0.07	0.11
Transition of passenger transport from cars to public transport (P12)	0.13	-0.10
Total late action	**4.8**	**13.5**

Source: Swedish Energy Agency.

Sensitivity analyses

The parameters used in the prognosis are energy consumption for each type of transport work carried out in the start year and transport work in the end year. The saving methods recommended by the Commission mean that the amount of transport work in the end year will be of relatively great importance. A source of uncertainty is thus whether transport work will increase as predicted. A lower level of transport work in 2016 would mean a smaller saving, even if energy consumption for each type of transport work carried out develops as predicted. A sensitivity analysis has been performed to explain this uncertainty, whereby transport work is assumed to remain constant throughout the period covered by the prognosis. If transport work remains constant, the calculated saving for late action by 2016 will be 12.3 TWh, i.e. a saving of 1.2 TWh less than in the basic scenario.

Shipping has not been included in the assessment of savings in the transport sector, but it should be included in subsequent analyses of savings in the transport sector, since there will be more statistics available, and possibly also prognoses. The inclusion of shipping at a later stage could affect the total saving, but the significance of shipping for the national target is expected to be marginal. This is because the saving from shipping is high, but there is a low level of transport work. A sensitivity analysis has been performed to shed light on the marginal impact of shipping, whereby the energy consumption per tonne-kilometre is assumed to halve between 2007 and 2016 while transport work is assumed to remain constant during that period. The saving from shipping in 2016 would therefore amount to 0.1 TWh. With this trend, the total saving for the transport sector would amount to 13.6 TWh.

Annex 2 Calculation methods

Households and services

P1- Energy consumption for household heating per square kilometre

$$Besp. = \left[\left(\frac{Eh_{2007}}{F_{2007}} * \frac{MDD_{30}}{ADD_{2007}}\right) - \left(\frac{Eh_{1995}}{F_{1995}} * \frac{MDD_{30}}{ADD_{1995}}\right)\right] * F_{2007}$$

Swedish	English
Besp.	Saving

Where E_h: heating consumption, E_w: hot-water consumption, F: area of homes, P: inhabitants of Sweden, ADD: degree-days in Sweden, and MDD_{30}: degree-days (normal year for the last 30 years).

P3- Energy consumption for household hot water per inhabitant

$$Besp. = \left[\frac{Ew_{2007}}{P_{2007}} - \frac{Ew_{1995}}{P_{1995}}\right] * P_{2007}$$

Swedish	English
Besp.	Saving

Where E_w: hot-water consumption and P: inhabitants of Sweden.

P4 – Energy consumption for household appliances

$$Besp. = \left[\frac{Ew_{2007}}{P_{2007}} - \frac{Ew_{1995}}{P_{1995}}\right] * P_{2007}$$

Swedish	English
Besp.	Saving

Where UEC^x is electricity consumption for each type of equipment (x) and stock is the total number of pieces of equipment per type.

P5 – Energy consumption for lighting

$$Besp. = \left(\frac{E_{2016}^{H,li}}{D_{2016}} - \frac{E_{2007}^{H,li}}{D_{2007}}\right) * D_{2016}$$

Swedish	English
Besp.	Saving

Where $E^{H,li}$ is electricity consumption for household lighting and D is the number of households.

P6 – Energy consumption (not electricity) in relevant subsidiary sectors per square kilometre

$$Besp. = \left(\frac{E_{2016}^{H,li}}{D_{2016}} - \frac{E_{2007}^{H,li}}{D_{2007}}\right) * D_{2016}$$

Swedish	English
Besp.	Saving

Where $E^{non\text{-}el}$: energy consumption that is not electricity, IA: area, MDD_{30}: degree-days (normal year for the last 30 years) and ADD: degree-days in Sweden.

P7- Electricity consumption in relevant subsidiary sectors per square kilometre

$$Besp. = \left(\frac{E_{2016}^{H,li}}{D_{2016}} - \frac{E_{2007}^{H,li}}{D_{2007}}\right) * D_{2016}$$

Swedish	English
Besp.	Saving

Where E^{el}: electricity consumption and I: area.

Industry

M8

$$Indikator \frac{E^{I^X}}{VA^{I^X}};$$

Swedish	English
Indikator	Indicator

$$M8 = \left(\frac{E_{2007}{}^{I^X}}{VA_{2007}{}^{I^X}} - \frac{E_t{}^{I^X}}{VA_t{}^{I^X}}\right) \cdot VA_t^{I^X} \cdot K_{2007}^{I^X}$$

E^{Ix}_{2007}, E^{Ix}_{2007} = energy consumption in subsidiary sector x in 2007 and year t;
K^{Ix}_{2007} = proportion of energy consumption in subsidiary sector x appearing in the Directive;
VA^{Ix}_{2007}, VA^{Ix}_{2007} = added value in fixed costs in subsidiary sector x in 2007 and year t.

Transport

All calculations for the transport sector have been performed in kWh instead of in oil equivalents. In order to reduce the impact of individual years, the saving for early action has been made by using the mean over three years instead of merely working on the basis of statistics for the start year and end year.

P8 Cars

$$Indikator\ \frac{E^{CA}}{T^{CA}}; \qquad P8 = \left(\frac{E_{2007}^{\ CA}}{T_{2007}^{TLV}} - \frac{E_t^{\ CA}}{T_t^{CA}} \right) \cdot T_t^{CA}$$

Swedish	English
Indikator	Indicator

E^{CA} = energy consumption for cars (kWh);
T^{CA} = passenger transport work (person-kilometres).

P9 Heavy goods vehicles

$$Indikator\ \frac{E^{TLV}}{T^{TLV}}; \qquad P9 = \left(\frac{E_{2007}^{TLV}}{T_{2007}^{TLV}} - \frac{E_t^{\ TLV}}{T_t^{TLV}} \right) \cdot T_t^{TLV}$$

Swedish	English
Indikator	Indicator

E^{TLV} = energy consumption for light goods vehicles (kWh);
T^{TLV} = goods transport work (tonne- kilometres)

P9 A2 Light goods vehicles

$$Indikator\ \frac{E^{TLV}}{S^{TLV}}; \qquad P9A2 = \left(\frac{E_{2007}^{TLV}}{S_{2007}^{TLV}} - \frac{E_t^{\ TLV}}{S_t^{\ TLV}} \right) \cdot S_t^{TLV}$$

Swedish	English
Indikator	Indicator

E^{TLV} = energy consumption for light goods vehicles (kWh);
S^{TLV} = vehicle fleet of light goods vehicles.

The reason for using different indicators for heavy and light goods vehicles is that statistics of goods transport work are only available for

heavy goods vehicles. In order to obtain the trend for light goods vehicles, another indicator has been used for light goods vehicles, this being a modified version of the Commission's P9 A2 indicator. This method shows the actual energy consumption per goods vehicle, as in the formula above. On the other hand, Sweden does have statistics on the distance covered by this group of vehicles. Using existing statistics on the distances covered and calculating the indicator as energy consumption per km should be a more reliable way of calculating the saving for light goods vehicles than merely considering the number of vehicles.

P10 Railway passengers

$$Indikator\ \frac{E^{RPa}}{T^{RPA}};\ P10 = \left(\frac{E_{2007}^{RPa}}{T_{2007}^{RPa}} - \frac{E_t^{RPa}}{T_t^{RPa}}\right)\cdot T_t^{RPa}$$

Swedish	English
Indikator	Indicator

E^{RPa} = energy consumption (kWh);
T^{RPa} = passenger transport work (person-kilometres)

P11 Railway goods

$$Indikator\ \frac{E^{RFa}}{T^{RFr}};\qquad P11 = \left(\frac{E_{2007}^{RFr}}{T_{2007}^{RFr}} - \frac{E_t^{RFr}}{T_t^{RFr}}\right)\cdot T_t^{RFr}$$

Swedish	English
Indikator	Indicator

E^{RFr} = energy consumption (kWh);
T^{RFr} = goods transport work (tonne-kilometres).

P12 Transition of passenger transport from cars to public transport

$$Indikator\ \frac{T_{Public}^{Pa}}{T^{Pa}};$$

$$P12 = (PT_t - PT_{2007})\cdot T_t^{Pa}\cdot (UE_t^{CA} - UE_t^{PT})$$

Swedish	English
Indikator	Indicator

PT = proportion of public transport (calculated in person-kilometres);
T = total transport work (person-kilometres);

UECA = energy consumption for cars (kWh/person-kilometre);
UEPT = energy consumption for public transport (kWh/person-kilometre).

M7 Shipping

$$Indikator\ \frac{E^W}{T^W}; \qquad M7 = \left(\frac{E^W_{2007}}{T^W_{2007}} - \frac{E_t{}^W}{T_t{}^W} \right) \cdot T_t^W$$

Swedish	English
Indikator	Indicator

E^W = energy consumption for shipping (kWh);
T^R = transport work (tonne-kilometres).

Annex 3 National strategy for renovations to improve the energy efficiency of buildings

Article 4 of the Energy Efficiency Directive, 2012/27/EU (hereinafter *EED*), states that Member States shall establish a long-term strategy for mobilising investment in the renovation of the national stock of residential and commercial buildings, both public and private. The strategy must include:

a) an overview of the national building stock based, as appropriate, on statistical sampling;

b) identification of cost-effective approaches to renovations relevant to the building type and climatic zone;

c) policies and measures to stimulate cost-effective deep renovations of buildings, including staged deep renovations;

d) a forward-looking perspective to guide investment decisions of individuals, the construction industry and financial institutions;

e) an evidence-based estimate of expected energy savings and wider benefits.

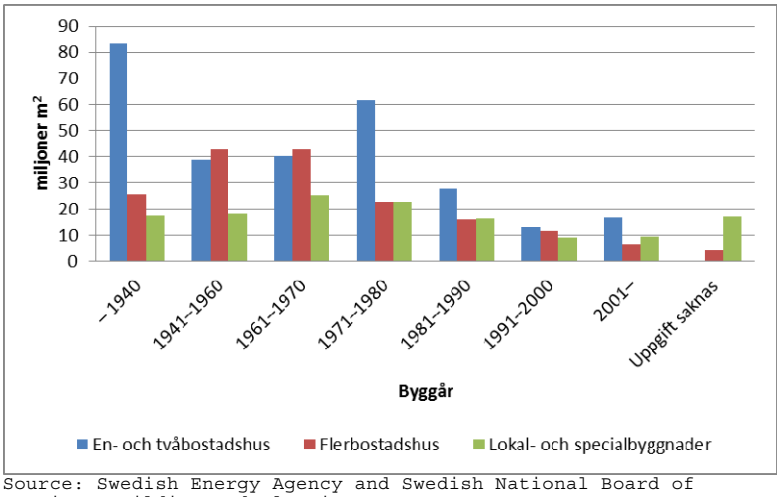
In order to satisfy these requirements, the Swedish Government gave the Swedish National Board of Housing, Building and Planning and the Swedish Energy Agency a mandate to work together to propose a national strategy for investment in renovations to improve the energy performance of the national stock. On the basis of the authorities' proposal, the Swedish Government has developed the first national strategy for renovations to improve the energy efficiency of buildings. The strategy must be published by no later than 30 April 2014 and it must be updated every three years thereafter.

The Swedish Government may state that the authorities found that existing instruments have had an impact over the years and have contributed to a reduction in average energy consumption of 11 % between 1995 and 2011, and that, from the European perspective, Sweden has an energy-efficient building stock. The present national strategy for investment in renovations to improve the energy performance of the national stock contains a report on the energy performance of the national building stock, the instruments that influence the pace of renovation, and measures to improve energy efficiency in the context of renovations and the expected energy savings from such measures.

Overview of the national building stock

The national building stock has been divided up into detached and semi-detached houses, blocks of flats, and buildings for commercial premises and special purposes. Three-quarters of the heated area of the Swedish building stock is more than 30 years old. From an international perspective, Sweden has a young building stock dominated by buildings erected in the 1945–1980 period.

Figure 3. Heated area of homes and premises in 2011, by year of construction and building category.



Source: Swedish Energy Agency and Swedish National Board of Housing, Building and Planning.

Swedish	English
miljoner m^2	million m^2
Uppgift saknas	No data
Byggår	Year of construction
En- och tvåbostadshus	Detached and semi-detached houses
Flerbostadshus	Blocks of flats
Lokal- och specialbyggnader	Buildings for commercial premises and special purposes

Blocks of flats built between 1941 and 1970 represent nearly half of the heated surface of the stock of blocks of flats and 15 % of the total building stock. Blocks of flats from before 1930 are no more than those erected in the 1970s. A large proportion of detached and semi-detached houses were erected before 1940. There are, however, more detached and

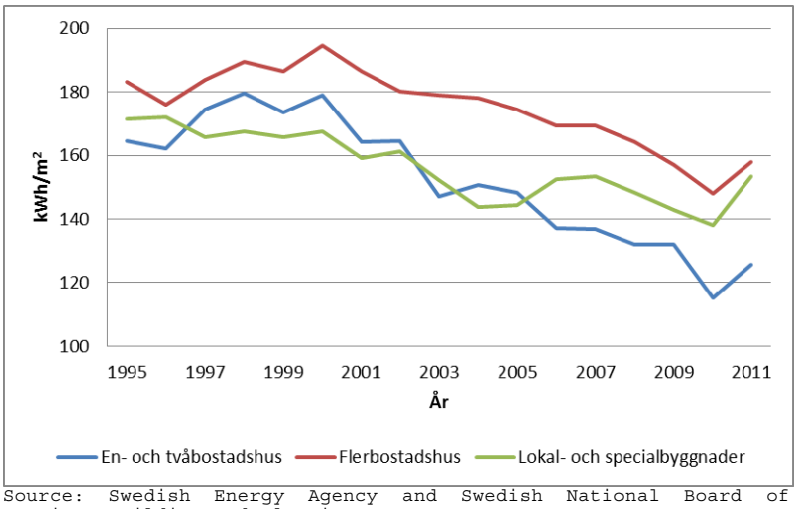
semi-detached houses from the two decades 1961–1980 than from the whole period before 1940.

With regard to commercial premises, there is no equally clear predominance of construction in bumper years. Just over 60 % of the heated surface for commercial premises was built before 1981. This is equivalent to 14 % of the total building stock.

Energy performance of the building stock

The amount of energy purchased for heating and hot water per unit of area for all building types, corrected for a normal year, fell between 1995 and 2011. There are several reasons for this. The report does not cover the heating contributed by heat pumps and losses arising from the production and distribution of electricity and district heating. This means that the increased use of heat pumps and conversion to district heating have resulted in a fall in the amount of energy purchased. High energy prices in the 2000s have probably encouraged many property owners to take action to reduce energy consumption. Even more stringent requirements for better energy performance in new-build houses will lead to lower average consumption.

Figure 4. Energy consumption per square kilometre for heating and hot water, 1995-2001.



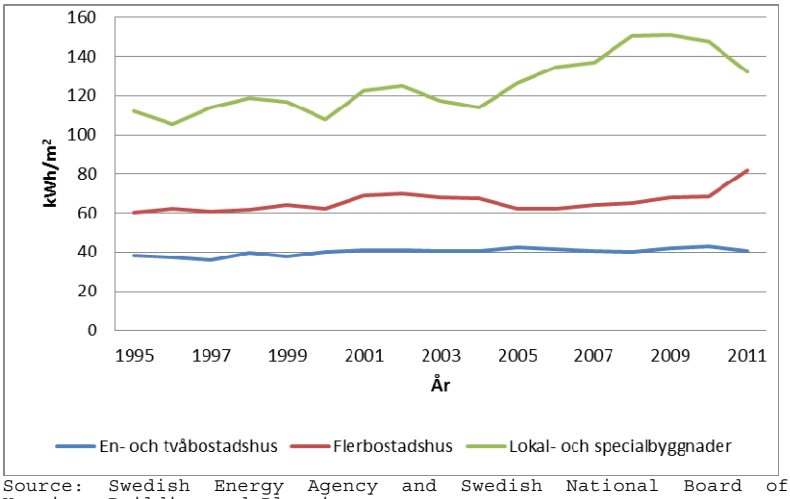
Source: Swedish Energy Agency and Swedish National Board of Housing, Building and Planning.

Swedish	English
År	Year
En- och tvåbostadshus	Detached and semi-detached houses

Flerbostadshus	Blocks of flats
Lokal- och specialbyggnader	Buildings for commercial premises and special purposes

Electricity consumption has been relatively stable for blocks of flats and houses, while it has increased for commercial premises. Since 2010, it has fallen for commercial premises but increased for blocks of flats. Two opposite trends are affecting consumption of household, property and commercial electricity. Under the Ecodesign Directive, the trend is heading towards more electricity-efficient installations and equipment, but the number of pieces of equipment per household is increasing. The reasons for the increase in electric power on commercial premises include increased heat recovery, more stringent requirements for indoor environments and better ventilation, more lighting points and more equipment.

Figure 5. Electricity consumption per square kilometre, 1995-2011.



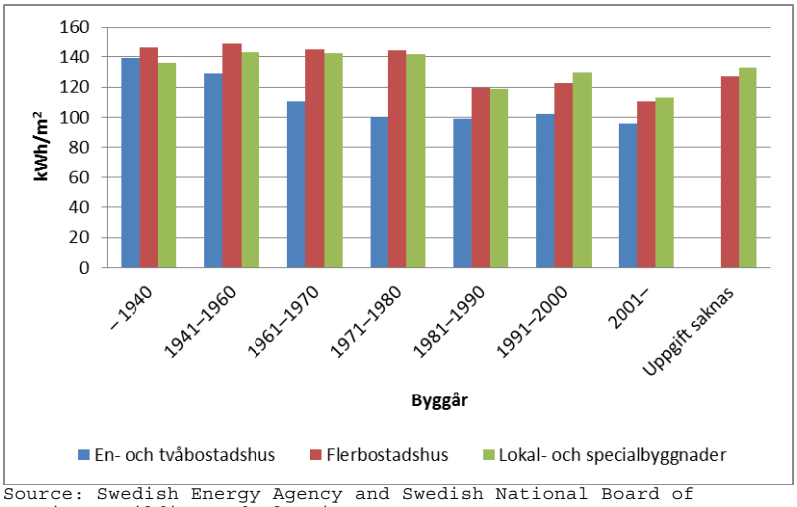
Source: Swedish Energy Agency and Swedish National Board of Housing, Building and Planning.

Swedish	English
År	Year
En- och tvåbostadshus	Detached and semi-detached houses
Flerbostadshus	Blocks of flats
Lokal- och specialbyggnader	Buildings for commercial premises and special purposes

The oldest group of detached and semi-detached houses has the poorest energy performance. The energy performance is better for buildings with a more recent year of construction up until 1980, since when it remained

at approximately the same level until 2000. A certain improvement can be seen after that point. It is difficult to explain certain aspects of this trend using reasons relating to construction technology, but for annual volumes originally heated using a large proportion of direct-acting electricity the energy performance for purchased energy may be assumed to have improved through the installation of heat pumps.

Figure 6. Energy performance for various types of house and age bracket, 2011.



Source: Swedish Energy Agency and Swedish National Board of Housing, Building and Planning.

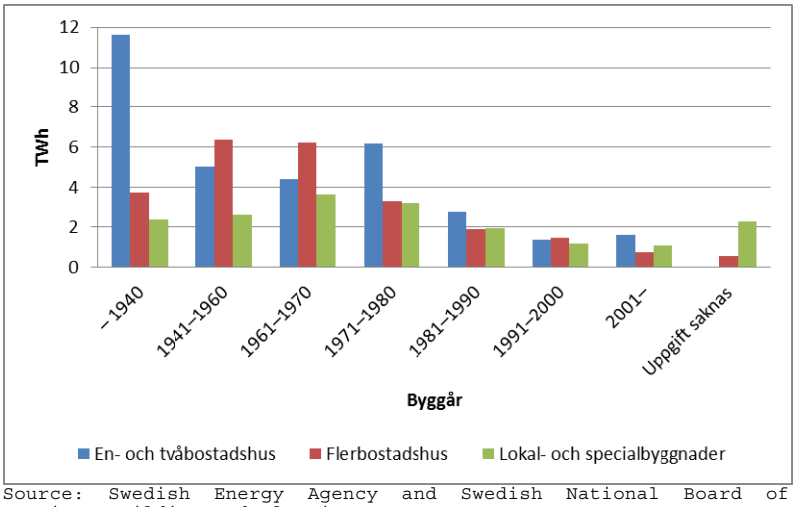
Swedish	English
Uppgift saknas	No data
Byggår	Year of construction
En- och tvåbostadshus	Detached and semi-detached houses
Flerbostadshus	Blocks of flats
Lokal- och specialbyggnader	Buildings for commercial premises and special purposes

Total energy consumption in various age brackets

The official energy statistics can be used to calculated the total energy consumption for various age brackets. Buildings erected prior to 1941, predominantly detached and semi-detached houses, represent a quarter of the total energy consumption.

The building stock up to and including 1980 accounts for 78 % of energy consumption. As may be seen in Figure 3, older detached and semi-detached houses cover a large surface area, and this is one of the reasons for the high level of total energy consumption. Another reason is that they are more likely than blocks of flats and commercial premises to have their own heating system, which means that there are conversion losses within the boundaries of the system.

Figure 7. Energy consumption in TWh for heating and hot water in 2011 (not corrected for a normal year).



Source: Swedish Energy Agency and Swedish National Board of Housing, Building and Planning.

Swedish	English
Uppgift saknas	No data
Byggår	Year of construction
En- och tvåbostadshus	Detached and semi-detached houses
Flerbostadshus	Blocks of flats
Lokal- och specialbyggnader	Buildings for commercial premises and special purposes

Without exception, detached and semi-detached houses have a better energy performance than multi-storey dwellings, irrespectively of whether a regional division or a division into age categories is used, but the worst houses are just as bad as the worst blocks of flats. Figure 6 shows that detached and semi-detached houses have a very great spread of energy performance up until 1970, when the gap shrinks due to a fall in the proportion with high energy consumption at that time. The difference in average energy performance in relation to blocks of flats is that the proportion of buildings with low energy consumption in the

detached and semi-detached houses group is relatively large. Up until the 2000 construction year, 20 % of the stock had energy performance in the range 60–80 kWh/m^2 per annum or lower, which then fell further. On the other hand, the 20 % of detached and semi-detached houses with the highest energy consumption are at the same levels as the worst blocks of flats. The reasons behind these figures have not been analysed.

Blocks of flats are the most homogeneous group, but they also display great variation. Up until 1930, some 20 % of the stock had an energy performance in the range 100–110 kWh/km^2 per annum or better, while 20 % had an energy performance in the range 180–190 kWh/km^2 per annum or worse. It is striking that the stock of blocks of flats up until 1930 is better than many of the subsequent decades with regard to both the proportion with low consumption and the proportion with high consumption. In these respects, blocks of flats built during the 1971–80 period are the worst, but from the 1990 construction year onwards there is a clear improvement in both high and low consumption.

The group that varies the most is buildings for commercial premises. The 20 % with the lowest energy performance follow the curve for blocks of flats fairly well. There is also great variation in the 20 % with the poorest energy performance. It is interesting to note that 20 % of buildings for commercial premises from 1961 to 1970 consume 230 kWh/m^2 or more. The types of buildings for commercial premises that are responsible for the very high energy consumption have not been analysed[36]. In the age bracket up to 1930, some of these buildings may be assumed to be various institutional buildings with very high roof heights. The age range that particularly sticks out is 1961–70, where it may be assumed that there is a relatively large proportion of sports facilities, but also schools.

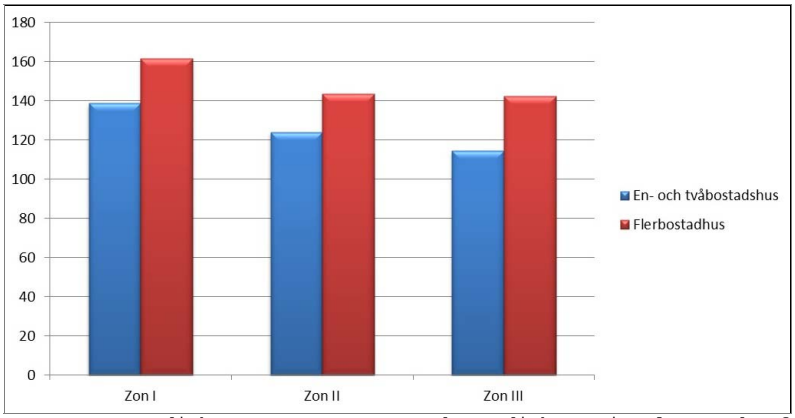
The importance of location

The Swedish National Board of Housing, Building and Planning's Building Code (BBR) divides Sweden into three climatic zones. On the basis of the differences in the climate conditions, the energy-performance requirements vary by 20 kWh/m^2 per annum for each climatic zone. If the building stock had been divided equally among these climatic zones and were comparable in all other respects, a similar relationship could have been expected in the actual energy performance. Such a difference may be seen by comparing climatic zone I (Jämtland, Västerbotten and Norrbotten counties) and climatic zone II (Västernorrland, Gävleborg, Dalarna and Värmland counties). By comparing zones II and III (other counties), a certain difference in energy performance may be discerned with regard to detached and semi-detached houses, but only 9 kWh/m^2 per annum. With regard to blocks of flats, the difference in energy

[36] An explanation for individual buildings for commercial premises may be that it has been difficult over the years to distinguish between electricity used for commercial purposes and electricity used for the property in such buildings, and this may result in large values.

performance between these climatic zones is negligible, despite the different climate conditions. It is worth noting that detached and semi-detached houses in the northern climatic zone display better energy performance than multi-storey dwellings in the southernmost climatic zone.

Figure 8. Average energy consumption in kWh/m^2 per annum (A_{temp}), with figures corrected for a normal year.



Source: Swedish Energy Agency and Swedish National Board of Housing, Building and Planning.

Swedish	English
En- och tvåbostadshus	Detached and semi-detached houses
Flerbostadshus	Blocks of flats
Zon I	Zone I
Zon II	Zone II
Zon III	Zone III

Cost-effective renovation methods

When a building is renovated, there is an automatic improvement in energy efficiency, since components are replaced with more energy-efficient ones. There is also the opportunity to implement additional measures to improve energy efficiency. If the property owner misses this opportunity, it can be a very long time before another such opportunity arises.

Renovations include various things, for example total renovation, where the aim may be to upgrade an entire residential area for technical and social reasons. Such an upgrade may be on the grounds that renovations had been postponed for a long time, or that the property owner needs to

choose whether to demolish, dispose of or improve the property. A more limited renovation could be on the grounds that components have reached the end of their life cycle, that damage has occurred, that the indoor environment must be improved, or that the operating surplus is to be improved by investments in improving energy efficiency.

Renovations for climate reasons usually include roof insulation, sealing, and the replacement of windows. A general rule of the Building Code is that where renovations are carried out for climate reasons they must be carried out to the standards that apply for new builds, but there are some exceptions to this rule, including with regard to preserving cultural value and cost-effectiveness. Renovations for climate reasons also often include an upgrade of installations, e.g. replacing radiator valves, installing control and regulation equipment, and naturally adjustments to the heating and ventilation systems.

Instruments and measures

Sweden has a large number of instruments that affect the incidence of building renovations and provide an incentive for implementing measures to improve energy efficiency in the context of renovations. These are described below.

The Planning and Construction Act (PCA), including energy requirements for buildings (Building Code)

A new Planning and Construction Act, which was introduced in 2010, lays down minimum requirements for buildings *inter alia* with regard to energy management. Among other things, the energy requirements were made 20 % more stringent on average.

On 1 January 2012, binding regulations were introduced for modifications to buildings. The basis for this is that the energy-performance requirements are the same as for the construction of a new building. On 1 January 2012, the energy requirements were also made more stringent for new buildings not heated by electricity. The energy requirements were made approximately 20 % more stringent on average.

The Swedish National Board of Housing, Building and Planning has the task of reviewing and increasing the stringency of the energy-management levels in its regulations. The Swedish National Board of Housing, Building and Planning must produce a report on this mandate, containing an analysis and proposed energy-management levels. The aim must be for the new provisions to enter into force on 1 January 2015. The mandate is part of Sweden’s strategy to come closer to a nearly-zero energy requirement and gradually increase the energy-management requirements.

Online portal

Since 2011, the Swedish National Board of Housing, Building and Planning, the Swedish Energy Agency and the Swedish Board of Agriculture have had a common online portal (www.energiaktiv.se) on improving energy efficiency. It is aimed at homeowners, other property owners and managers, and provides support for improving energy efficiency in relation to both buildings and the organisation's transport. The support covers the whole chain from planning to follow-up of the measures.

Repairs, maintenance, conversion or extension, RCE

Since 2008, there has been an opportunity to receive a tax reduction of 50 % of the costs of work to repair, maintain, convert or extend the property that one owns, to a maximum amount of SEK 50 000 per annum. Some of these measures contribute to more efficient energy consumption.

Solar panel aid

Since 2009, there has been an opportunity to apply for contributions for the installation of solar panels. This contribution may be applied for by both private individuals and enterprises and organisations. The amount of this aid amounts to 35 % of the investment costs but no more than SEK 1.2 million. Some SEK 280 million has been paid out up to and including February 2014, while SEK 210 million has been set aside for the 2013–16 period.

Technology procurement and networks

Technology is mainly procured in order to disseminate new technologies for heating, hot water, ventilation, etc. The last action plan explained the networks that act as procurement groups for such technology. There is BELOK, which is a procurement group for premises, BEBO, which is a procurement group for homeowners and residential property managers, and HYLOK, which is a procurement group for tenants of commercial premises, including national authorities. BeLivs has subsequently been added for the food sector. These networks also work actively on other initiatives such as methodology development to reduce the energy consumption of the building stock.

Low-Energy Buildings Programme (LÅGAN)

In 2010, the Swedish Construction Federation received five years' aid for stimulating energy-efficient new buildings and conversions. The projects

that receive aid must achieve at least 50 % better energy performance than the Building Code (BBR) in the case of new buildings. For conversions, the energy consumption must fall by at least 50 % whilst achieving energy consumption that is 40 % lower than the requirement in the BBR. The project is also required to have a high demonstrative value.

Energy and climate advice

State aid for municipal energy and climate advice was originally introduced in 1977–78. Municipal energy and climate advice has existed in its current form since 1998. The advice is both general and specific, and can be given to both private individuals and enterprises, and it includes advice concerning buildings, among other things. The energy and climate advisers have a key role to play *inter alia* in fulfilling Articles 14 and 15 of the EPBD.

Sustainable Municipalities

The Sustainable Municipalities programme has been running since 2003 to support the work done by local authorities in Sweden in relation to energy conversion and reducing the impact on the climate. Among other things, this work is aimed at influencing the energy consumption of local authorities. There are, for example, eight local authorities that are participating in a project aimed at halving energy consumption.

Research

A specific research programme for making the energy consumption of buildings more efficient has been ongoing since 2007, and it deals with how the energy efficiency of buildings of cultural and historical importance can be improved whilst preserving the cultural value of those buildings. There is another research programme dealing with how IT and design can be used to visualise an individual's/household's electricity consumption in real time and thus influence individuals' everyday habits. A third programme provides support for research in the area of lighting, with a focus on the impact of the paradigm shift that is taking place through LED technology, which is undergoing a rapid rise.

Tests and information

The Swedish Energy Agency carries out comprehensive activities to identify and provide information about products that help to reduce a building's energy consumption. Among other things, white goods, home electronics, heating, ventilation and lighting are tested.

Demonstration initiatives for nearly-zero energy buildings (NZE)

At the start of 2014, the Swedish Government gave the Swedish National Board of Housing, Building and Planning and the Swedish Energy Agency a mandate to work together to produce a framework for nearly-zero energy buildings on the basis of Communication 2011/12:131, *The road to nearly-zero energy buildings*, and the provisions of Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings. The mandate includes assessing existing and new low-energy buildings and explaining how other Nordic countries are working on nearly-zero energy buildings.

The Swedish Government has also given the Swedish National Board of Housing, Building and Planning a mandate to analyse and propose a definition of energy performance to be applied to energy-management requirements relating to nearly-zero energy buildings, and to propose quantitative guidelines for energy-management requirements relating to nearly-zero energy buildings.

Before the introduction of legislation from 2018 and 2020 respectively, when standards for nearly-zero energy buildings are to be enforced, a demonstration project will start in 2014 for public buildings, premises, blocks of flats and houses.

Requirement to investigate alternative energy-supply systems

Enforcement rules for investigating alternative energy-supply systems were introduced on 12 July 2013.

Requirement for certification of certain fitters

The rules on certification of certain fitters were introduced in March 2013. The aim of the certification system is to extend fitters' knowledge. Fitters must have the ability to decide which installations are the most advantageous on the basis of the building in question, and they must be able to provide information and guidance to consumers on their choice of installation. Certified fitters must contribute to highly efficient, environmentally friendly and good-quality installations.

In their proposed national strategy, the Swedish National Board of Housing, Building and Planning and the Swedish Energy Agency propose that an information centre for energy-efficient renovations be established with the aim of having a coordinated grasp of the gathering and dissemination of information to promote development and raise

awareness. The authorities are of the view that this measure could help to rectify the market failures that have been identified[37].

Reference option and energy savings

Assumptions concerning the measures implemented

The following section describes in summary form how and to what extent measures are assumed to have been implemented in the reference option set out in the report by the Swedish National Board of Housing, Building and Planning and the Swedish Energy Agency. The starting point is that measures are implemented where components or systems are worn out, i.e. measures are not governed by profitability calculations but by an acute need for replacements or renovation.

Table 34 shows the measures, their expected impact per square kilometre (Atemp), and the extent to which they are assumed to have been implemented in blocks of flats and houses in the reference option. Coverage for roof insulation has been selected using a cautious approach. For floor structures, it has been assumed that individually implemented measures have already been carried out, while wall insulation is less profitable and has not been carried out to the same extent. For houses, renovations have been assumed to a greater extent than for blocks of flats, since they more often have three stages and are therefore easier to carry out, often with a good financial outcome.

According to the national statistics, insulation measures for walls or roofs were implemented for 11.7 % of the stock over the 2001–11 period. Window-related measures are common, but there are various kinds of measure, such as replacing a glazing unit instead of replacing the whole window.

[37] Please see Swedish National Board of Housing, Building and Planning and Swedish Energy Agency, *Proposed national strategy for renovations to improve the energy efficiency of buildings*, ET 2013:24.

Table 34. Measures, saving achieved per kWh per square kilometre A_{temp} and extent to which they are assumed to have been implemented in blocks of flats and houses in the reference option.

	Houses		Blocks of flats	
Measure	Expected saving kWh/m^2 Atemp	Extent of reference option	Expected saving kWh/m^2 Atemp	Extent of reference option
100 mm insulation phased -1960	12	12.5 %	15	5 %
100 mm insulation phased 1961-1975	6	12.5 %	9	4 %
300 mm insulation wind -1960	16	12.5 %	6	5 %
300 mm insulation wind 1961-1975	10	12.5 %	3	4 %
Window replacement U 2.8—0.9	25	15 %	22	15 %
Window replacement U 1.7—0.9	10	10 %	9	10 %
Double-glazed unit replacement U 1.7—1.2	7	10 %	5	10 %
Inner glazed unit replacement U 2.8—1.8	13	15 %	12	15 %
Ventilation recovery or heat pump in houses	19	20 %	25	5 %
Ventilation recovery or heat pump in blocks of flats	16	10 %	25	30 %
New ventilation recovery in houses or blocks of flats with ventilation recovery	10	6 %	16	5 %
Ventilation recovery in blocks of flats	27	1 %	14	10 %
Circulation	2	50 %	…	

pump replacement				
Water-conservation measures	.		9	75 %
Hot-water recovery from waste water	..		5	30 %
Controls and regulators	...		15	30 %

. The opportunities for improving efficiency are marginal, for example the current level of hot-water consumption is close to the hot-water consumption adopted by SVEBY where efficiency improvements have been carried out.
.. Efficiency improvements are under development, with no outcome assumed for houses.
... Measures have been limited for this category of building, or have been included under another measure.
.... This measure is included in the saving for control and regulator measures in blocks of flats.
Source: Swedish Energy Agency and Swedish National Board of Housing, Building and Planning.

Expected energy savings

The reference option describes what the trend in energy consumption is expected to be if all existing instruments are maintained until 2050. Please note that some of the existing instruments need to be extended before 2050.

In the reference option, the energy purchased for all buildings per square kilometre for heating and hot water is estimated to fall by 12–25 %, while the buildings' energy needs for heating and hot water are estimated to fall by 2–17 % per square kilometre between 2011 and 2050.

It is difficult to assess and specify how and at what rate improvements are made, for example, to the building envelope, various system solutions, adjustments and time management, particularly from the long-term perspective. For this reason, the results of the calculations are characterised by great uncertainty.

Table 35. Expected trend in the reference option.

	2011*	2020	2050
Total energy consumption, TWh	122	121-123	112-124
Energy consumption for heating and hot water, TWh	80	79-80	69-82
Energy purchased for heating and hot water, kWh/m^2 Atemp	126	120-122	94-111
Building's energy needs for heating and hot water, kWh/m^2 Atemp	129	126-128	107-126
Total energy purchased, kWh/m^2 Atemp	193	185-187	151-168
Total energy needs for the building, kWh/m^2 Atemp	196	191-193	164-184

*The data represent a mean over the 2009–11 period.
Source: Swedish Energy Agency and Swedish National Board of Housing, Building and Planning.

Energy savings for ventilation in blocks of flats are expected to be made by installing heat pumps or ventilation systems with heat recovery (FTX). Energy savings are made in blocks of flats by replacing windows and using water fittings that consume small amounts of water. These measures have the greatest impact in terms of improving energy efficiency. The same measures are the most efficient for houses and for blocks of flats. It is currently more expensive to install an FTX system than heat pumps, and it is therefore more common for heat recovery from ventilation to take place through the installation of heat pumps, but the proportion of FTX systems may increase if costs fall and more consideration is given to improving the indoor climate. Commercial premises require mechanical ventilation, so there is considerably greater scope for implementing FTX systems right from the outset. In addition to this, commercial premises now often have cooling equipment too, so heat-pump solutions could be a viable solution in combination for both heating and cooling.

Targets and ambitions for the future

As part of the system of environmental targets, Sweden has an environmental quality target of a Well-Built Environment, which has been formulated such that urban areas, densely populated areas and other built environments must constitute a good, healthy living environment and contribute to a good regional and global environment. Natural and cultural assets must be looked after and developed. Buildings and installations must be located and designed in a way that is adapted to the environment and so that good long-term management of land, water and other resources is promoted.

As part of the system of environmental targets and the target of a Well-Built Environment, there was previously a target for improving the energy efficiency of the building stock. The target was expressed in units of heated area in homes and on commercial premises, and it was formulated such that energy consumption should fall by 20 % by 2020 and by 50 % by 2050 in relation to the consumption levels in 1995.

In 2010, the Swedish Parliament decided on a new structure of targets for the environmental target system. An important aim of the amendments that were made to the environmental target system was to achieve a more efficient system and a sharper focus on action so as to achieve the conversion of society required in order to reach the environmental quality target. At the start of 2014, the Swedish Government gave the Swedish National Board of Housing, Building and Planning a mandate to investigate how the environmental quality target of a Well-Built Environment is to be achieved. This mandate must be reported on by no later than 1 December 2014.

Annex 4 List of public-sector organisations with energy-efficiency plans

Table 36. Organisations with plans for improving energy efficiency.

Municipality	**Municipality**	**Municipality**	**County council**
Ale	Lindesberg	Katrineholm	Stockholm
Alingsås	Linköping	Kil	Uppsala
Alvesta	Ljungby	Kinda	Östergötland
Aneby	Ljusdal	Klippan	Jönköping
Arboga	Ljusnarsberg	Knivsta	Kronoberg
Arjeplog	Lomma	Kramfors	Kalmar
Arvidsjaur	Ludvika	Kristianstad	Blekinge
Arvika	Luleå	Kristinehamn	Skåne
Askersund	Lund	Krokom	Halland
Avesta	Lycksele	Kumla	Västra Götaland
Bengtsfors	Lysekil	Kungsbacka	Värmland
Berg	Malmö	Kungsör	Örebro
Bjurholm	Malung	Kungälv	Västmanland
Bjuv	Malå	Kävlinge	Dalarna
Boden	Mariestad	Köping	
Bollebygd	Mark	Laholm	
Bollnäs	Markaryd	Landskrona	**County Administrative Board**
Borgholm	Mellerud	Laxå	Stockholm
Borlänge	Mjölby	Lekeberg	Uppsala
Borås	Mora	Leksand	Södermanland
Botkyrka	Motala	Lerum	Östergötland
Boxholm	Mullsjö	Lessebo	Jönköping
Bromölla	Munkedal	Lidingö	Kronoberg
Bräcke	Munkfors	Lidköping	Kalmar
Burlöv	Mölndal	Lilla Edet	Blekinge
Båstad	Mönsterås	Tingsryd	Skåne
Dals-Ed	Mörbylånga	Tjörn	Halland
Danderyd	Nacka	Tomelilla	Västra Götaland
Degerfors	Nora	Torsby	Värmland
Dorotea	Norberg	Torsås	Örebro
Eda	Nordanstig	Tranemo	Västmanland
Ekerö	Nordmaling	Tranås	
Eksjö	Norrköping	Trelleborg	

Emmaboda	Norrtälje	Trollhättan	
Enköping	Norsjö	Trosa	
Eskilstuna	Nybro	Tyresö	
Eslöv	Nykvarn	Täby	
Essunga	Nyköping	Töreboda	
Fagersta	Nynäshamn	Uddevalla	
Falkenberg	Nässjö	Ulricehamn	
Falköping	Ockelbo	Umeå	
Falun	Olofström	Upplands Väs	
Filipstad	Orsa	Upplands-Bro	

Municipality	**Municipality**	**Municipality**	
Finspång	Orust	Uppsala	
Flen	Osby	Uppvidinge	
Forshaga	Oskarshamn	Vadstena	
Färgelanda	Ovanåker	Vaggeryd	
Gagnef	Oxelösund	Valdemarsvik	
Gislaved	Pajala	Vansbro	
Gnesta	Piteå	Vara	
Gotland	Ragunda	Karlskoga	
Grums	Robertsfors	Karlskrona	
Grästorp	Ronneby	Karlstad	
Gullspång	Rättvik	Tidaholm	
Gällivare	Sala	Tierp	
Gävle	Salem	Timrå	
Gothenburg	Sandviken	Vaxholm	
Götene	Sigtuna	Vellinge	
Habo	Simrishamn	Vetlanda	
Hagfors	Skara	Vilhelmina	
Hallsberg	Skellefteå	Vimmerby	
Hallstahammar	Skinnskatteberg	Vindeln	
Halmstad	Skurup	Vingåker	
Hammarö	Skövde	Vårgårda	
Haninge	Smedjebacken	Vänersborg	
Haparanda	Sollefteå	Vännäs	
Heby	Sollentuna	Värmdö	
Hedemora	Sorsele	Värnamo	
Helsingborg	Sotenäs	Västervik	
Herrljunga	Staffanstorp	Västerås	
Hjo	Stenungsund	Växjö	
Hofors	Stockholm	Ydre	
Hudiksvall	Storfors	Ystad	
Hultsfred	Storuman	Åmål	
Hylte	Strängnäs	Ånge	
Håbo	Strömstad	Åre	

Hällefors	Strömsund	Årjäng	
Härjedalen	Sundbyberg	Åsele	
Härnösand	Sundsvall	Åtvidaberg	
Härryda	Sunne	Älmhult	
Hässleholm	Surahammar	Älvdalen	
Höganäs	Svalöv	Älvkarleby	
Högsby	Svenljunga	Älvsbyn	
Hörby	Säffle	Ängelholm	
Höör	Säter	Öckerö	
Jokkmokk	Sävsjö	Örnsköldsvik	
Järfälla	Söderhamn	Östersund	
Jönköping	Söderköping	Österåker	
Kalix	Södertälje	Östhammar	
Kalmar	Sölvesborg	Östra Göinge	
Karlsborg	Tanum	Överkalix	
Karlshamn	Tibro	Övertorneå	

Source: Swedish Energy Agency.

Table 37. State authorities with environmental management systems.

Swedish National Grid business network	International Programme Office for Education and Training	County Administrative Board, Örebro county	Swedish Geotechnical Institute
National Board for Consumer Disputes	Chancellor of Justice	County Administrative Board, Östergötland county	Swedish Accident Investigation Authority
Swedish Labour Court	Legal, Financial and Administrative Services Agency	Malmö University	National Historical Museums
Swedish Public Employment Service	Karlstad University	Swedish Migration Board	Swedish National Board of Institutional Care
Swedish Agency for Government Employers	Karolinska Institute	Mid-Sweden University	Swedish Board of Agriculture
Swedish Work Environment Authority	Swedish Chemicals Agency	Museum of Modern Art	Public Art Agency Sweden
Swedish Museum of Architecture	National Board of Trade	Swedish Disability Policy Coordination Authority	Swedish Arts Council
Ombudsman for Children	National Institute of Economic Research	Swedish Intercountry Adoptions Authority	National Maritime Museums
Blekinge	Swedish	Swedish	Swedish Media

Institute of Technology	Competition Authority	Broadcasting Authority	Council
Swedish Companies Registration Office	University College of Arts, Crafts and Design	Swedish Civil Contingencies Agency	National Museums of World Culture
Swedish National Board of Housing, Building and Planning	Swedish Arts Grants Committee	Swedish Growth Policy Investigation and Analysis Authority	Music Development and Heritage Sweden
Swedish National Council for Crime Prevention	Swedish Consumer Agency	Invest Sweden	Swedish Schools Inspectorate
Swedish Crime Victim Compensation and Support Authority	Swedish Prison and Probation Service	Swedish National Agency for Higher Vocational Education	Swedish National Agency for Education
National Board of Student Aid	Swedish Enforcement Authority	Mälardalen University	National Government Employee Pensions Board
University of Dance and Circus	Royal Institute of Art	National Museum and Prince Eugen's Waldemarsudde	Swedish Water Supply and Sewage Tribunal
Data Inspection Board	Royal College of Music, Stockholm	Swedish Museum of Natural History	National Veterinary Institute
Equality Ombudsman	Royal Institute of Technology	Swedish Environmental Protection Agency	Swedish National Road and Transport Research Institute
Swedish National Courts Administration	National Library of Sweden	Nordic Africa Institute	Statistics Sweden
Swedish Economic Crime Authority	Swedish Coast Guard	University College of Opera, Stockholm	Swedish Agency for Public Management
Swedish National Financial Management Authority	Swedish Mapping, Cadastral and Land Registration Authority	Swedish Patent and Registration Office	Nordic Museum Foundation
National Electrical Safety Board	Linköping District Court	Swedish Pensions Agency	Skansen Museum Foundation
Swedish Energy Markets Inspectorate	Linköping University	Swedish Polar Research Secretariat	Stockholm Academy of Dramatic Arts
National Export	Linnaeus	Swedish Post and	Stockholm

Credits Guarantee Board	University	Telecom Authority	University
Swedish Financial Supervisory Authority	Royal Armoury, Skokloster Castle and Hallwyl Museum Foundation	Supervisory Board of Public Accountants	Swedish Radiation Safety Authority
Swedish Academy for Peace, Security and Development	National Food Agency	Swedish National Heritage Board	Swedish Board for Accreditation and Conformity Assessment
Swedish Research Council for Health, Working Life and Welfare (Forte)	Swedish Gambling Authority	Swedish National Archives	Swedish International Development Cooperation Agency (Sida)
Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas)	Civil Aviation Administration	Swedish National Debt Office	Swedish Institute
Swedish Fortifications Agency	Luleå University of Technology	National Police Board	Geological Survey of Sweden
Defence Materiel Administration (FMV)	Lund University	Swedish Exhibition Agency	Swedish University of Agricultural Sciences
National Defence Radio Establishment	Medical Products Agency	Swedish National Space Board	Swedish Meteorological and Hydrological Institute
Swedish National Defence College	County Administrative Board, Blekinge county	Swedish European Social Fund Council	Södertörn University College
Swedish Social Insurance Agency	County Administrative Board, Dalarna county	National Board of Forensic Medicine	Swedish Talking and Braille Book Library
Swedish School of Sport and Health Sciences	County Administrative Board, Gotland county	Sami Schools Board	Dental and Pharmaceutical Benefits Agency
University of Gothenburg	County Administrative Board, Gävleborg county	Sami Parliament of Sweden	Swedish National Museum of Science and Technology
Swedish Agency for Marine and	County Administrative	Swedish Maritime	Swedish Agency for Economic and

Water Management	Board, Halland county	Administration	Regional Growth
Dalarna University	County Administrative Board, Jämtland county	Swedish Tax Agency	Swedish Defence Research Agency
University of Borås	County Administrative Board, Jönköping county	Swedish Forest Agency	Swedish Defence Recruitment Agency
University of Gävle	County Administrative Board, Kalmar county	Swedish Institute for Communicable Disease Control	Transport Analysis

Halmstad University	County Administrative Board, Kronoberg county	National Board of Health and Welfare	Swedish Transport Administration
University of Skövde	County Administrative Board, Norrbotten county	National Agency for Special Needs Education and Schools	Swedish Transport Agency
Kristianstad University	County Administrative Board, Skåne county	Swedish Council on Health Technology Assessment	Swedish Customs
Uppsala University, Gotland Campus	County Administrative Board, Stockholm county	Swedish Energy Agency	Umeå University
University West	County Administrative Board, Södermanland county	National Property Board of Sweden	National Board for Youth Affairs
Swedish Council for Higher Education	County Administrative Board, Uppsala county	Swedish National Institute of Public Health	Uppsala University
Swedish Agency for Non-Proliferation and Export Controls	County Administrative Board, Värmland county	National Swedish Museums of Military History	Election Authority
Institute for Evaluation of Labour Market and Education Policy	County Administrative Board, Västerbotten county		Swedish Agency for Higher Education Services

Swedish Institute of Space Physics	County Administrative Board, Västernorrland county		Swedish Governmental Agency for Innovation Systems
Institute for Language and Folklore	County Administrative Board, Västmanland county		Swedish Research Council
Institute for International Development Work Assessment	County Administrative Board, Västra Götaland county		Swedish Prosecution Authority
Örebro University	National Board of Appeal for Student Aid		

Source: Swedish Environmental Protection Agency.