# SWEDEN

## Country at a glance

- Population: 9.38 million (2010) [1]
- Total area: 450,295 sq. km [2]
- Carbon emissions per capita: 5.07 metric tons (2010) [3]
- Energy consumption per capita: 63.5 MWh (2010) [4]
- Percentage of global carbon emissions: 0.16% (2010) [3]

*Erection of BioDME plant in w:Piteå, Sweden, May 2010 by Chemrec AB photographer. Permission from Chemrec via Patrik Löwnertz, VP Marketing & Sales. commons.wikimedia.org/wiki/File:Chemrec_5_-_small.JPG*

### *Building the world's first BioDME plant in Sweden*

*Dimethyl ether (DME) is a lower cost substitute for propane in LPG and is used as fuel in households and industry. DME also is a promising fuel for diesel and petrol engines, and also gas turbines.*

**Table 1 Breakdown of energy use, electricity and heat generation, 2010**

| | Primary energy sourced within country | | Energy imports minus exports | Primary energy used within the country[a] | | | Electricity Generation[b] | | Heat Generation[c] | |
|---|---|---|---|---|---|---|---|---|---|---|
| unit | ktoe | % | ktoe | ktoe | GWh | % | GWh | % | GWh | % |
| Coal, including brown coal & peat | 238 | 1 | 2,546 | 2,490 | 28,959 | 5 | 2,721 | 2 | 5,540 | 10 |
| Oil fuels | 0 | 0 | 15,500 | 13,894 | 161,584 | 27 | 1,774 | 1 | 4,160 | 7 |
| Natural gas | 0 | 0 | 1,457 | 1,457 | 16,941 | 3 | 2,877 | 2 | 5,220 | 9 |
| Nuclear | 15,070 | 45 | 0 | 15,070 | 175,268 | 30 | 57,828 | 39 | 0 | 0 |
| Hydroelectric | 5,710 | 17 | 0 | 5,710 | 66,410 | 11 | 66,398 | 45 | 0 | 0 |
| Biofuels and waste | 11,900 | 36 | 0 | 11,900 | 138,394 | 23 | 13,397 | 9 | 41,764 | 73 |
| Solar photovoltaics | 1 | 0 | 0 | 1 | 9 | 0 | 9 | 0 | 0 | 0 |
| Solar thermal | 10 | 0 | 0 | 10 | 120 | 0 | 0 | 0 | 0 | 0 |
| Tide, wave and ocean | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Wind | 301 | 1 | 0 | 301 | 3,503 | 1 | 3,502 | 2 | 0 | 0 |
| Geothermal | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Electricity (imported) | 0 | 0 | 179 | 179 | 2,078 | 0 | 0 | 0 | 469 | 1 |
| Sub total Renewables | 17,922 | 54 | 0 | 32,993 | 208,436 | 35 | 83,306 | 56 | 41,764 | 73 |
| **Totals** | **33,231** | **100** | **19,681** | **51,012** | **593,267** | **100** | **148,506** | **100** | **57,152** | **100** |

Source: Based on World Energy Statistics and Balances Database 2012, "World Energy Balances." © OECD/IEA, 2012.

Notes:

Standard conversion used is 1 ktoe = 11.63 GWh

(a) Sum of energy sourced within country, energy imports minus exports, international marine and aviation bunkers and stock change flows.

(b) Includes all electricity generation, including any exported.

(c) Does not include electrical heating. Includes waste heat recovery from electicity generation plants.

**Table 2 Breakdown of transport fuel use, 2010**

| (in ktoe) | Total transport mix | % | Domestic aviation | Road | % | Rail | Pipeline transport | Domestic navigation | Non-specified (transport) |
|---|---|---|---|---|---|---|---|---|---|
| Oil products | 7,177 | 92 | 154 | 6,835 | 94 | 1 | 0 | 187 | 0 |
| Natural gas | 27 | 0 | 0 | 27 | 0 | 0 | 0 | 0 | 0 |
| Biofuels and waste | 401 | 5 | 0 | 401 | 6 | 0 | 0 | 0 | 0 |
| Electricity | 207 | 3 | 0 | 0 | 0 | 207 | 0 | 0 | 0 |
| Sub total Renewables | 401 | 5 | 0 | 401 | 6 | 0 | 0 | 0 | 0 |
| **Total** | **7,813** | **100** | **154** | **7,264** | **100** | **208** | **0** | **187** | **0** |

Source: Based on World Energy Statistics and Balances Database 2012, "World Energy Balances." © OECD/IEA, 2012.

## Stand on climate change

Sweden signed the Kyoto Protocol as an Annex I member country on 29 April 1998. They ratified the protocol on 31 May 2002 and it was entered into force on 16 February 2005. Under the Kyoto Protocol, Sweden is obligated to reduce emissions by 0.4% from levels of 1990.

## National climate change programmes

Sweden's fifth national communication to the UNFCCC is formulated in accordance with the guidelines adopted by the parties to the United Nations Framework Convention on Climate Change. The policy instruments introduced have had a significant effect, and emissions have fallen by around 9 per cent since 1990. At the same time, Sweden can point to relatively high economic growth. The report also contains projections for emissions up to 2020. According to these projections, emissions will continue to decrease, but additional measures are needed to meet Sweden's national targets for 2020. The Government has announced measures to achieve the national target of 40 per cent reduction by the year 2020. The national communication describes Sweden's vulnerability and what the country is doing to adapt to climate change. Sweden's international efforts in relation to development assistance with relevance to climate change are presented, as are research and development [5].

In March 2009 the Swedish Government presented a coherent climate and energy policy which lay the foundation for the future efforts that need to be made in order to contribute to a stabilization of the greenhouse gas concentration at a level that enables the $2^{o}$ Celsius target to be reached. Sweden's targets for climate and energy policy by 2020 are [6]:

- 40% reduction in aggregate greenhouse gas emissions
- At least 50% renewable energy in total primary energy supply
- 20% increased efficient energy use
- At least 10% renewable energy in the transport sector

## Some of the notable sectoral approaches are:

**Energy sector:**

As well as being included in the EU ETS since 2005, combustion installations for electricity and district heating are covered by carbon dioxide and energy taxes, an electricity certificate system, the provisions of the Environmental Code and special support for wind power. It is estimated that emissions from the electricity and district heating sector would have been around 15 million tons higher in 2007 if economic policy instruments applicable in 1990 had been retained in the sector instead of being further developed and tightened. In particular, coal would have been profitable to use more widely if the policy instruments had not been tightened. The decrease in emissions from the residential and service sector in 2007 in comparison with 1990 was nearly 7 million tonnes. As well as energy and carbon dioxide taxes, energy use has also been affected by grants (for example for the expansion of and connection to district heating), energy

efficiency requirements for new and existing buildings and EC Directives, for example the Energy Performance of Buildings Directive, the Ecodesign Directive and the Energy Labelling Directive [7].

**Industrial sector:**

Policy instruments influencing emissions from the industrial sector were already in place before 1990. Policy instruments introduced later are not deemed to have had any significant guiding effect. However, EU ETS is expected to have a major impact on the industrial sector as a policy instrument in the longer term. Emissions of fluorinated gases are governed by the EU regulation and directive on emissions of certain fluorinated greenhouse gases. Carbon dioxide and energy taxes are due to be raised in 2011 and 2015 for industry not covered by the EU ETS.

**Transport sector:**

Taxes on vehicle fuels have been raised in several stages since 1990. Tax increases, together with rises in fuel prices, have curbed growth in transport, encouraged more energy-efficient vehicles and eased the introduction of biofuels. The taxes are supplemented by targeted policy instruments for the introduction of renewable energy into the road transport sector and for more energy-efficient vehicles the strategy for vehicle biofuels contains a temporary exemption from energy and carbon dioxide taxes for all vehicle biofuels until 2013.

To increase the availability of biofuels, all larger filling stations are required by law to sell at least one renewable fuel. A government green-car rebate has been paid since 2007 on the purchase of vehicles capable of running on E85 or biogas, electric and electric hybrid cars and particularly fuel-efficient vehicles that do not emit more than 120 grams $CO_2$/km. Since 2006, Sweden also has a differentiated annual vehicle tax for passenger cars according to the vehicle's $CO_2$ emissions. As well as the Swedish policy instruments, from 2012 car-makers selling cars within the EU will have to comply with the directive on maximum average carbon dioxide emissions from new cars of 130 grams $CO_2$/km by 2015. The rises in vehicle fuel taxes since 1990 are estimated to lead to 1.9 million tonnes $CO_2$/year lower emissions in 2010 and 2.4 million tonnes $CO_2$/year lower emissions in 2020 than if the nominal tax level in 1990 had been retained. The encouragement of vehicle biofuels has led to the use of biofuels in 2008 totalling 4.3 TWh, which is equivalent to 1.1 million tonnes $CO_2$ in emissions if petrol and diesel had been used instead. The energy efficiency of the Swedish car fleet has improved from a relatively low level in recent years. Part of the explanation is that the proportion of diesel-engine cars, which are more energy-efficient than cars running on petrol, has risen sharply [8].

**Waste sector:**

Requirements for municipal waste plans, the introduction of producer responsibility for various product groups in the 1990s, the introduction of tax on waste sent to landfill (2000) and subsequent bans on the landfilling of separated combustible (2002) and organic material (2005) have substantially reduced emissions from landfills. Only 4 per cent of the total volume of household waste was landfilled in 2007. The combined effect is estimated as 1.4 million tonnes less $CO_2$ equivalent emissions in 2010 than with 1990 policy instruments. The difference is estimated to be 1.9 tonnes of $CO_2$ equivalent in 2020. At the same time as emissions from landfills have decreased, the combustion of waste in the electricity and district heating sector has increased by around 6 TWh in comparison with 1990 levels, leading to further mitigation, in addition to the decrease in methane emissions at landfills, if waste is assumed to replace fossil fuels [9].

**Agriculture sector**

There are a few policy instruments to date that are directly aimed at limiting greenhouse gas emissions in the agricultural sector. However, the Swedish Government has taken a number of initiatives in recent years to limit the use of fossil fuels in agriculture, to increase knowledge and encourage measures leading to reduced greenhouse gas emissions from manure management and land use. The Swedish Board of Agriculture has been asked to draw up a combined action programme to reduce plant nutrient losses and greenhouse gas emissions from agriculture. In the framework of the on-going reform of EU agricultural policy, more resources will be set aside for measures that limit the climate impact of the agricultural sector. The level of energy and $CO_2$ taxes for heating fuels and vehicle fuels used in the land-based industries will also be raised [10].

Besides sectoral approaches, the Swedish Government through the Swedish Environment Protection Agency and the Swedish Energy Agency have adopted the following instruments [11]:

- **Carbon dioxide tax instrument**

In Sweden, there are so far three different taxes levied on energy products (mainly fossil fuels): energy tax, sulphur tax and $CO_2$ tax. Energy taxation has been used as a policy instrument ever since the oil crisis of the 1970s to support renewable energy and nuclear power. The Energy tax was reduced by half in 1991 during the tax reform, simultaneously with the introduction of a $CO_2$ tax on fossil fuels, with exceptions on ethanol, methanol, other biofuels, peat and wastes.

- **Renewable energy certificate system**

As one part of the Government's long-term energy policy to reduce GHG emissions, the Swedish government introduced a voluntary international system for trading "green certificates", i.e. the renewable energy certificate system (RECS). With effect from 1 May 2003, RECS intends to encourage and increase the proportion of electricity produced from renewable energy sources. This will be done by payment of a levy in proportion to a certain fraction of their electricity during the year. For example, during the first year (2003), users will be required to buy 7.4 per cent of the electricity generated from renewable sources.

- **Renewable energy subsidies and continuous investment on R&D**

Since 1991, Sweden started many programmes to encourage the use of renewable energy and new technology development, e.g. Energy Policy programme (Long and short term programmes that focus on ways to increase the supply of renewable electricity, to reduce electricity consumption, and to promote energy efficiency), Green Certificate Scheme (Generators using solar, wind, biomass, geothermal, wave or small hydro are awarded one certificate for each MWh produced, and all consumers are obliged to buy enough certificates to cover a set proportion of their use).

- **International collaboration and carbon trading systems**

Sweden also shows its leadership in international cooperation and competence on the climate change issues. Sweden actively took part in some international climate policy programmes, such as Prototype Carbon Funds (PCF) and Activities Implemented Jointly (AIJ).

- **Public consultation and participation**

Public participation is quite important in addressing climate change and its effects and developing adequate responses. Without the support of the public, it is impossible to implement a new policy instrument successfully. For example, one cannot anticipate that bioethanol and biodiesel could be widely consumed without support and understanding from the general population. Therefore, information to raise the level of knowledge concerning the climate issue is necessary.

**Ministries involved in climate change/energy policy making:**

| Ministries involved | Web links |
|---|---|
| Ministry of Foreign Affairs | www.government.se/sb/d/2059 |
| Ministry of Education and Research | www.government.se/sb/d/2063 |
| Ministry of Enterprise, Energy and Communications | www.government.se/sb/d/2067 |
| Ministry of the Environment | www.government.se/sb/d/2066 |
| Ministry of Rural Affairs | www.government.se/sb/d/2064 |

**Education institutes involved in climate change/energy policy making:**

| Education Institutes involved | Web links |
|---|---|
| Stockholm Environment Institute | www.sei-international.org/ |
| Swedish Meteorological and Hydrological Institute | www.smhi.se/en |
| Center for Climate Science and Policy Research | www.cspr.se/?l=en |
| Center for Environmental and Climate Research – Lunds Universistet | www4.lu.se/o.o.i.s/24746 |

## References


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[2] "CIA - The World Factbook." Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/th.html. [Accessed: 12-Mar-2013].

[3] $CO_2$ Emissions from Fuel Combustion Statistics database 2012, "Indicators for $CO_2$ emissions." © OECD/IEA, 2012.

[4] World Energy Statistics and Balances database 2012, "World Energy Balances." © OECD/IEA, 2012.

[5] Fifth National Communication on Climate Change – Government of Sweden. Available at: http://unfccc.int/resource/docs/natc/swe_nc5.pdf

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[10] Swedish Common Agriculture Policy – Swedish Agricultural Board. Government of Sweden. Available at: http://www.un.org/esa/agenda21/natlinfo/countr/sweden/agriculture.pdf

[11] Policies and Measures - Fifth National Communication on Climate Change. Government of Sweden. Available at: http://unfccc.int/resource/docs/natc/swe_nc5.pdf (Page 34-58)



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