

Sweden

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Early History



<http://>

[Upload.wikimedia.org/wikipedia/commons/a/a7/Vikings-Voyages.png](http://upload.wikimedia.org/wikipedia/commons/a/a7/Vikings-Voyages.png)

- Swedish historical documents first appear in 800 CE
- Coincides with the Viking Age
- The Vikings created many settlements, including what would become Russia
- The first king of Sweden was Eric the Victorious who became king in the late 10th century

Middle History



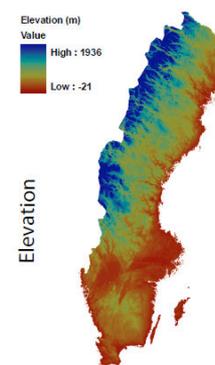
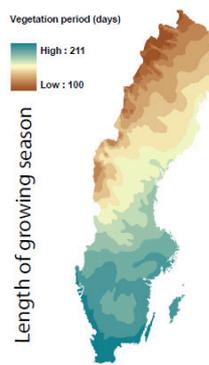
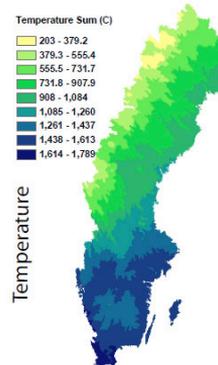
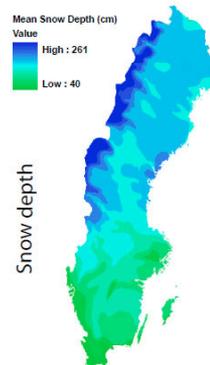
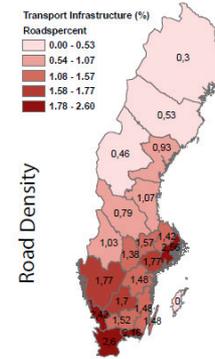
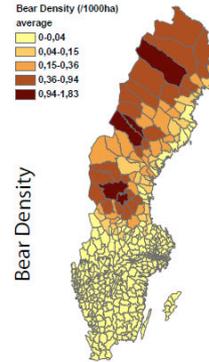
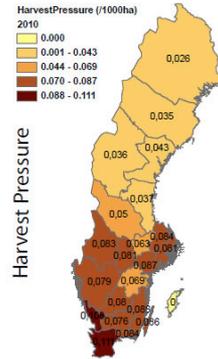
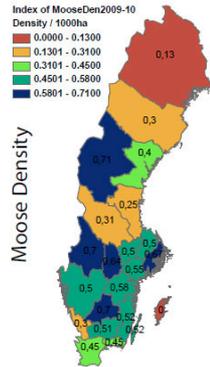
<http://www.kolbacksbygden.se/mobil/bilder/leva>

- Sweden was becoming Christian by the 11th century, and established the Church of Sweden in 1060
- In 1388 Denmark invaded Sweden, which was part of a Union with Denmark and Norway until 1434
- Gustav Vasa, a king of Sweden in the 16th century, made Sweden into a powerful and modern state for its time
- With a law passed in 1766 that established freedom of the press Sweden reached a period of enlightenment

Modern History

- Sweden fought its last war in 1814, invading Norway
- Sweden remained neutral during WWI and WWII, avoiding Norway's fate in the second world war while selling materials to both sides
- While not a member of NATO, Sweden sided with the US during the Cold War, allowing the US to operate Nuclear Subs off its coast
- In 1995 Sweden joined the EU

Geography & Climate



<http://esapubs.org/archive/appl/A022/108/appendix-A.htm>

Demographics

Population: **9.6 million “Swedes”**.

Language: **Swedish**. Area: **450,000 km²**

Religion: **Lutheran (Protestant Christian)**

Capital: **Stockholm**

Cities: **Göteborg & Malmö**



Population Challenge

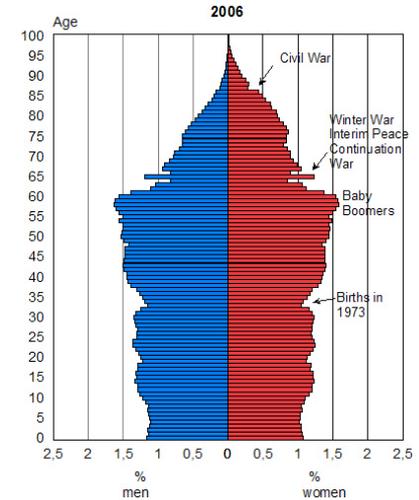
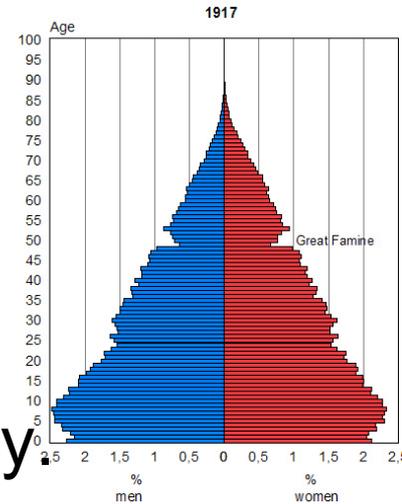
Birth Rate: **10.14 births/1000 pop.**

Death Rate: **10.2 deaths per 1000 pop.**

Life Expectancy: **81 years.**

Solution:

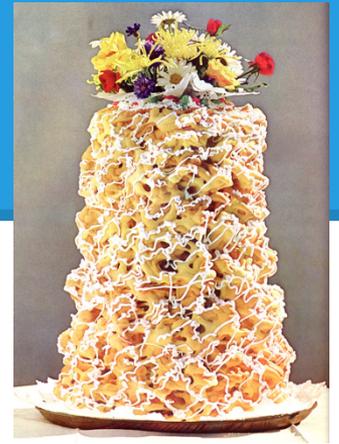
- Incentives to greater families.
- Open doors immigration policy.



Culture

Food: Spettekaka (dessert)

Sports: Zlatan Ibrahimovic



Turism:
Northern
Lights &
Ice hotel



Government

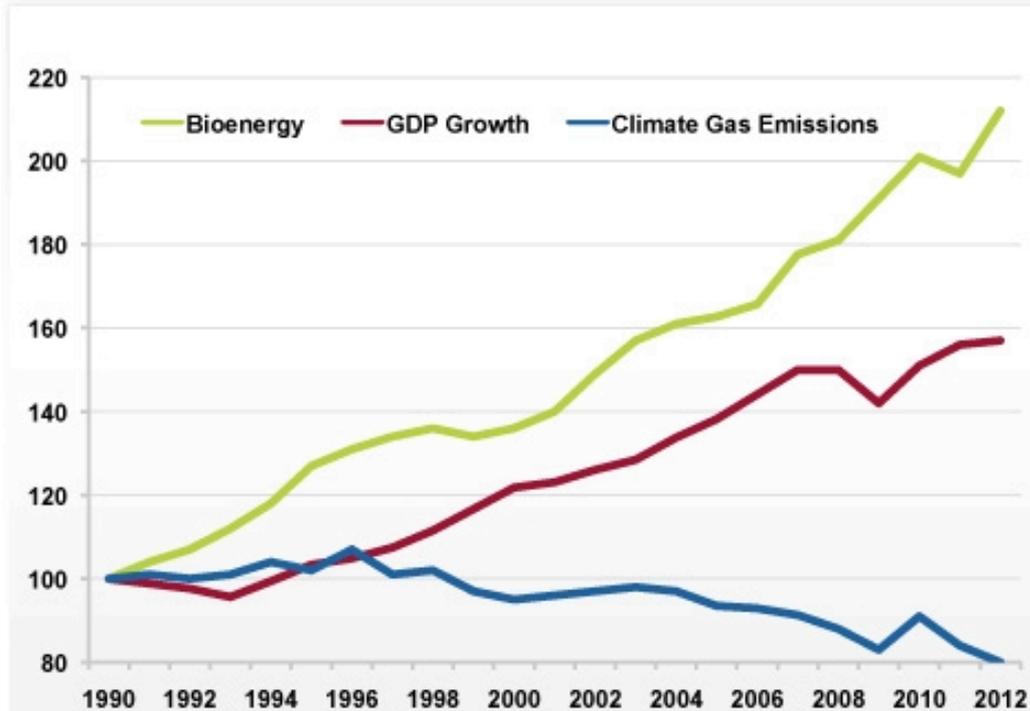
- Constitutional Monarchy
- The current government of Sweden was established on January 1st, 1975
- The Prime Minister and his cabinet, appointed by the Prime Minister, is collectively referred to as the government
- The Prime Minister himself is appointed by the Speaker of the Riksdag, Sweden's legislature
- The Riksdag has 349 seats and is controlled by the Greens and Social Democrats



Rosenbad, the seat of Swedish Government since 1981. Located in Stockholm.

http://upload.wikimedia.org/wikipedia/commons/thumb/3/38/Rosenbad_2006.jpg/250px-Rosenbad_2006.jpg

Economy

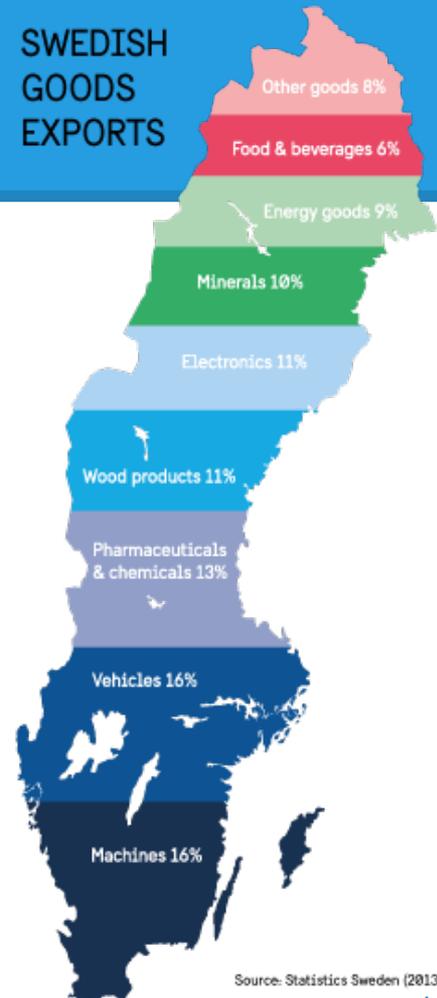


Sweden: reduced emissions and increased GDP.

Economy

- GDP = \$552 billion (as of 2013)
- Ranked 21st worldwide
- Economic Sectors:
 - Agriculture: 1.8%
 - Industry: 27.4%
 - Services: 70.8%

<http://data.worldbank.org/country/sweden>



Source: Statistics Sweden (2013)

Economy

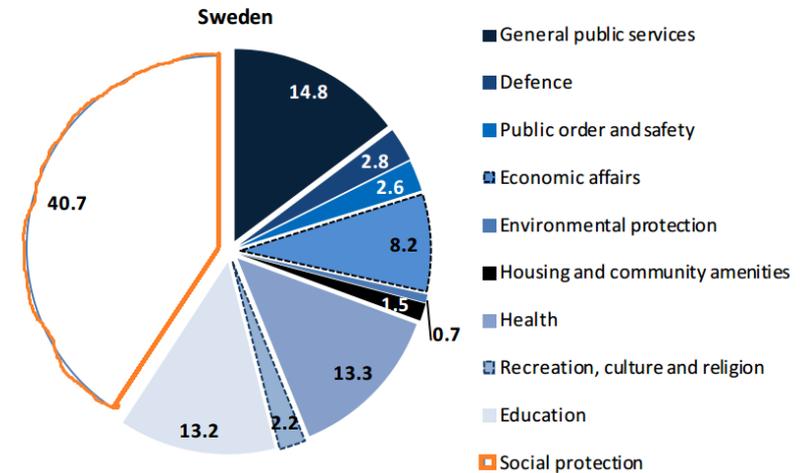
Gross Domestic Product:



<http://www.tradingeconomics.com/charts/og.png?url=/sweden/gdp-per-capita>

Distribution of Spending:

Structure of general government expenditures by function (2008)



<http://blogs-images.forbes.com/markadomanis/files/2012/08/Sweden-20082.png>

Economy

- Swedish Currency: Krona (SEK)
 - 1 USD = 8.6 SEK



Energy: The Past

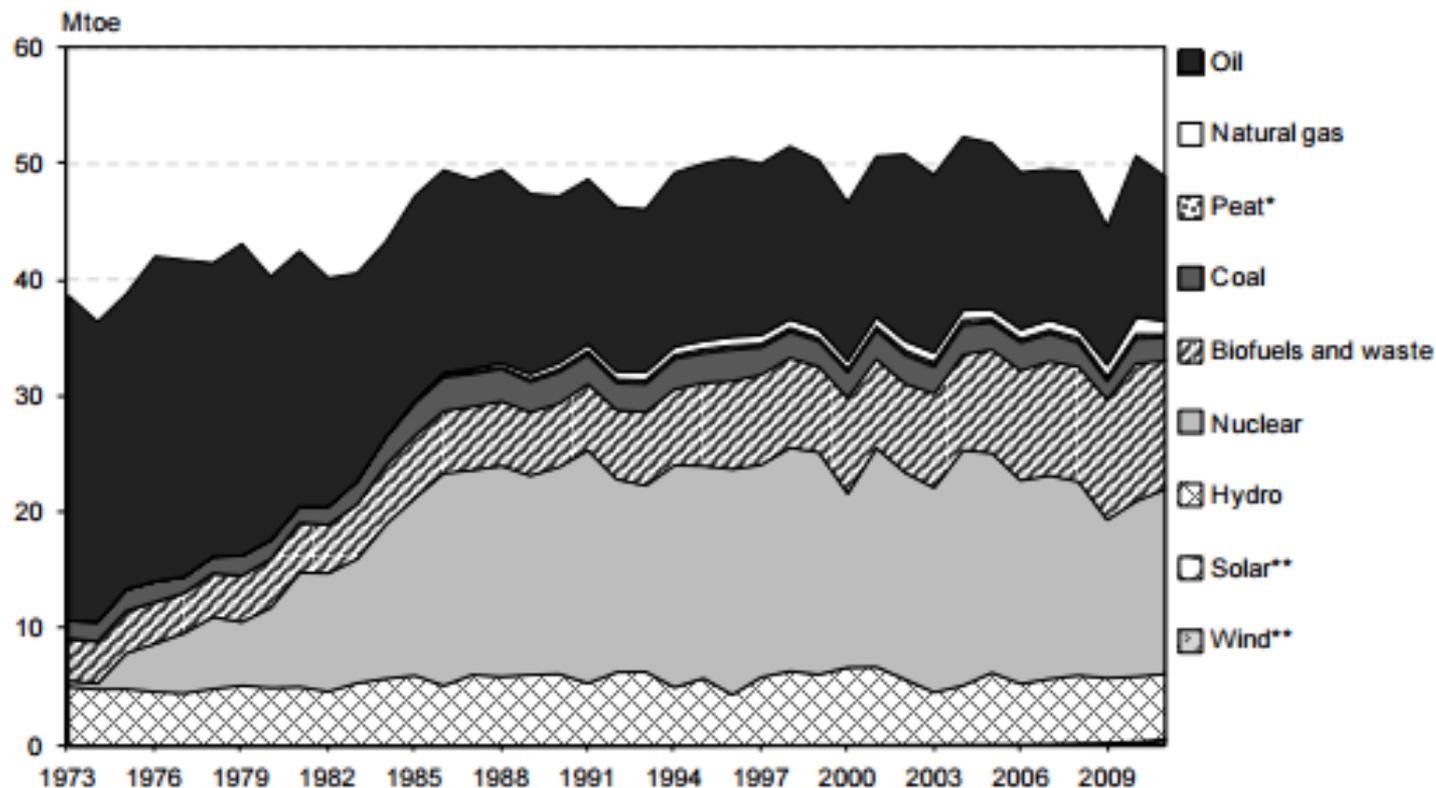
- Energy crisis of 1973 and dependence
- TMI and the 1980 Swedish Referendum
- Forbid new sites, reactors gone by 2010
- Riksdag cancellation and decision to build more



Forsmark Nuclear Power Plant

<http://media.treehugger.com/assets/images/2011/10/swedish-nuclear-01.jpg>

Figure 2. Total primary energy supply, 1973-2011*



* Provisional for 2011.

** Negligible.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2012.

Energy: The Present

- Transportation

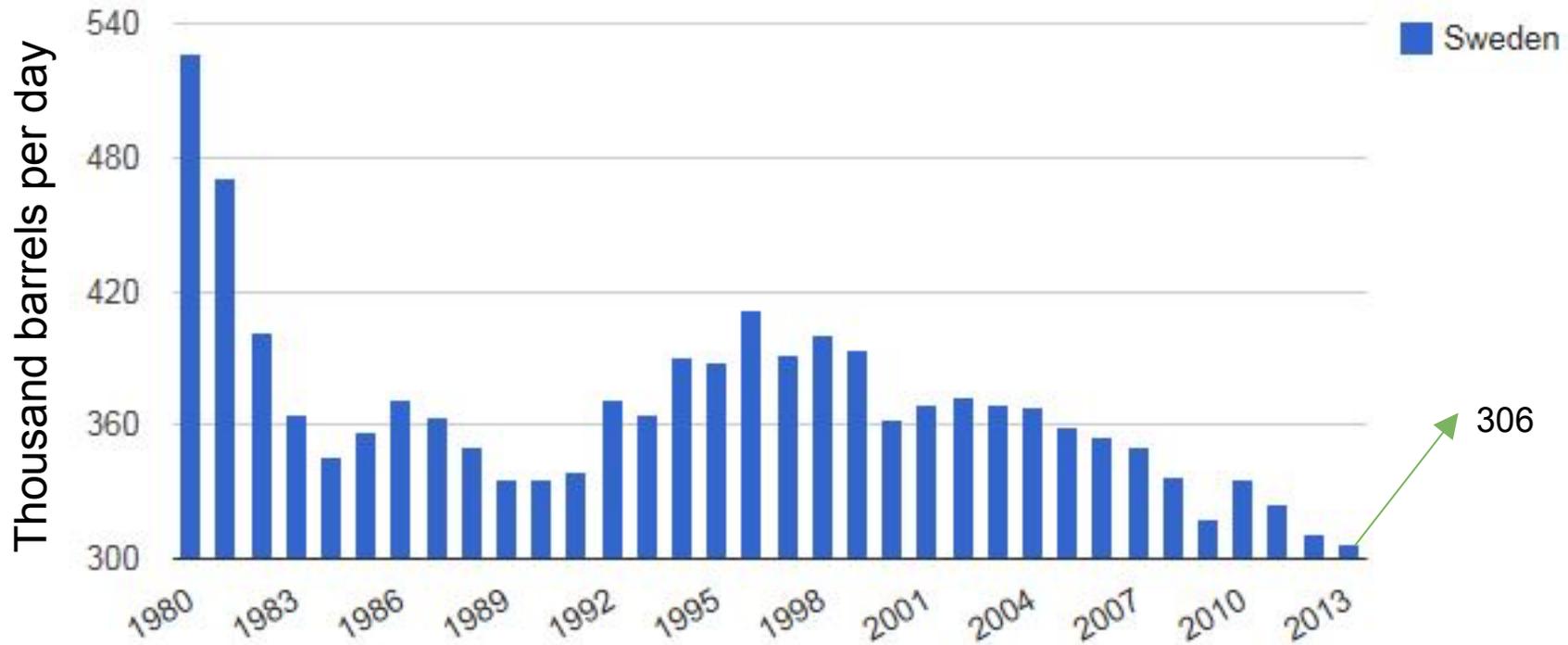
- Electricity

- Policy, Taxes, and Initiatives

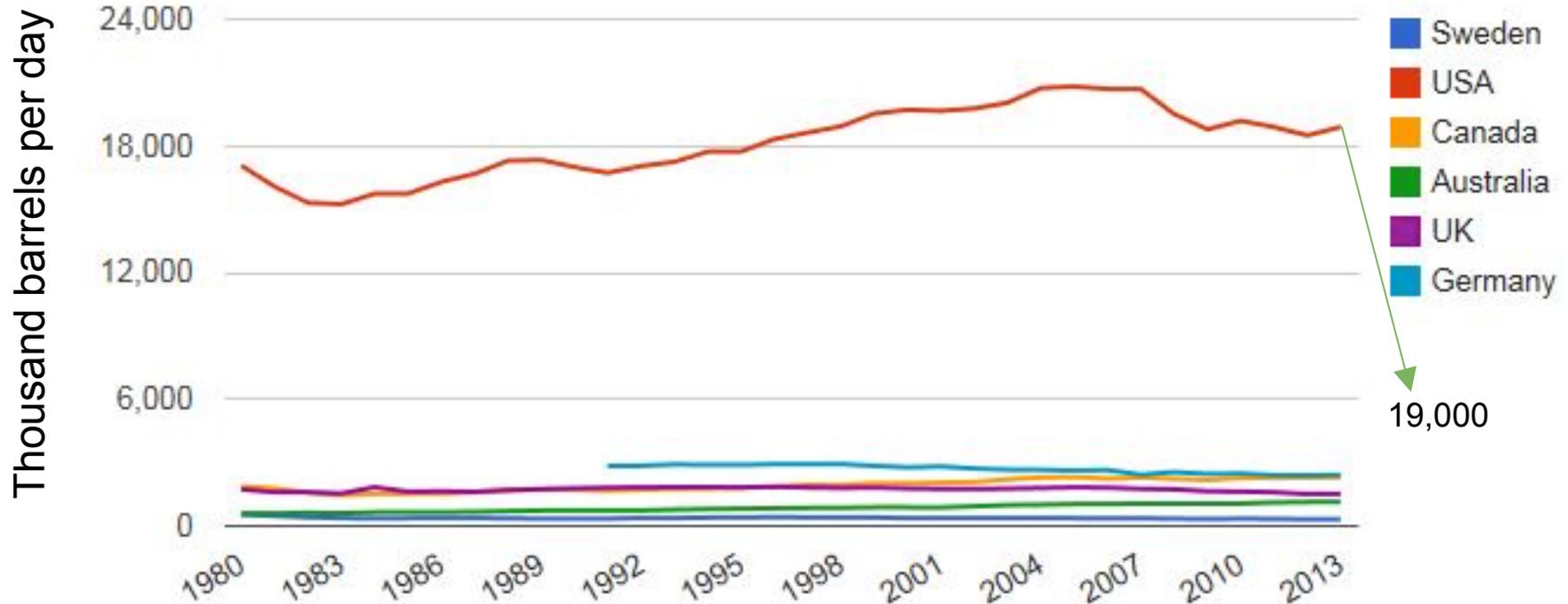
Transportation

- 23% of total energy consumption
- 22.4 million metric tons of CO₂.
- Fossil-fuel-independent fleet by 2030

Oil Consumption



Oil Consumption



Biofuels: Ethanol

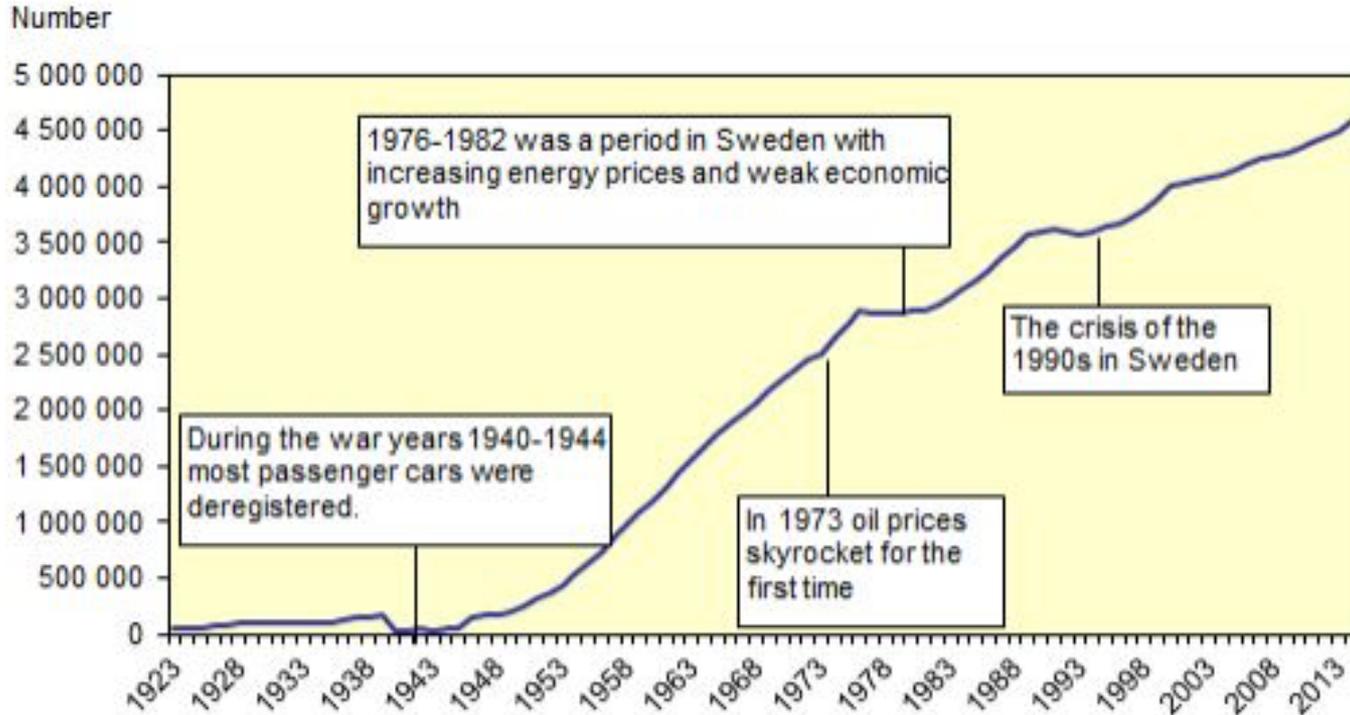
196,000 vehicles on E85.
-1,200 fueling
stations.

Mostly imported

Heavily subsidized



Passenger Cars



1 car for every 2 people.

2% are flexi-fuel vehicles.

Why does it work?

Incentives:

- 30 % cheaper than gasoline at pump.
- US \$1300 bonus.
- Free parking spaces
- 20% discount auto insurance

Alternatives

Black liquor to biofuel.

Ethanol from African Sugarcane.

Biogas

Biogas

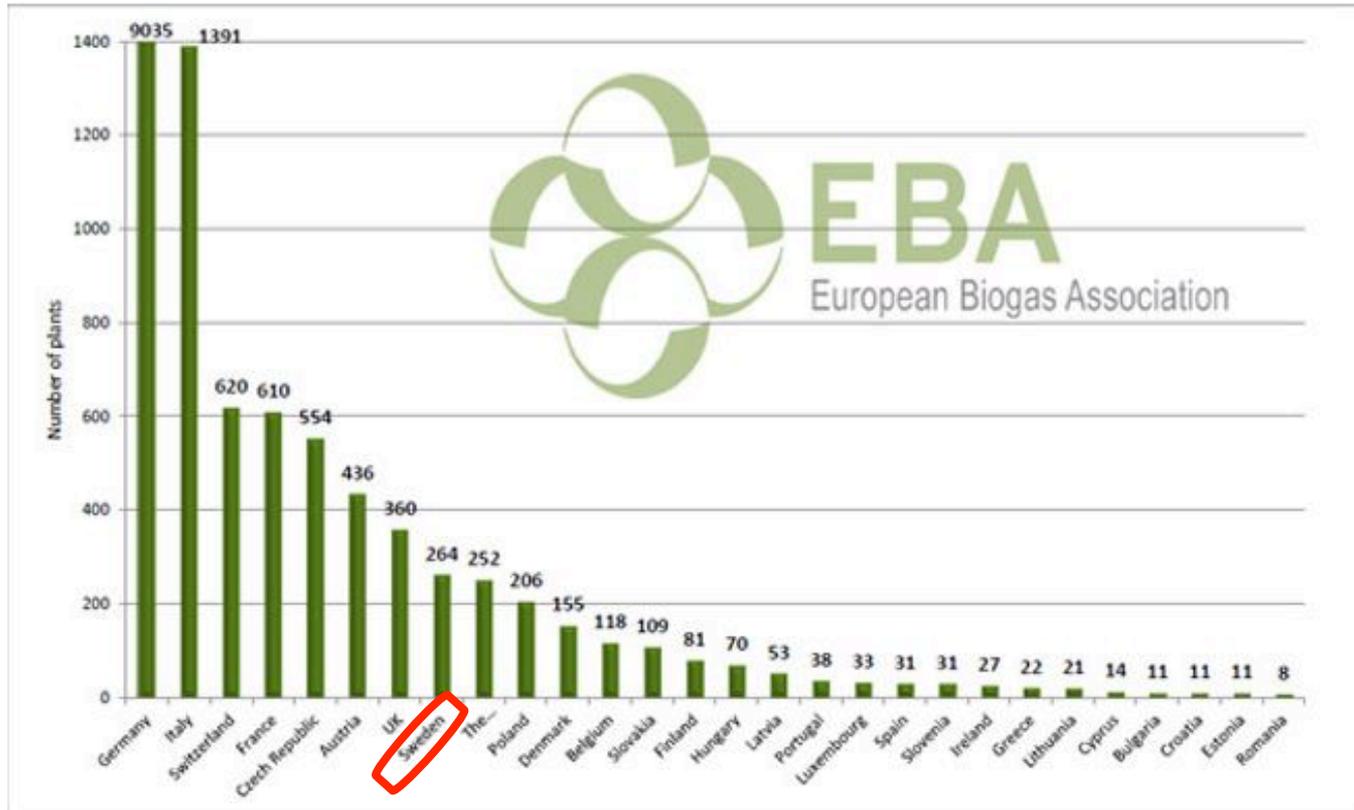
65% CH₄ - 30 % CO₂ - 5% other
gases

Feedstock: Sewage, Manure, Food Wastes, Landfill.

In 2013, 14,500 biogas plants in Europe
-Installed capacity of 7,857 MW.

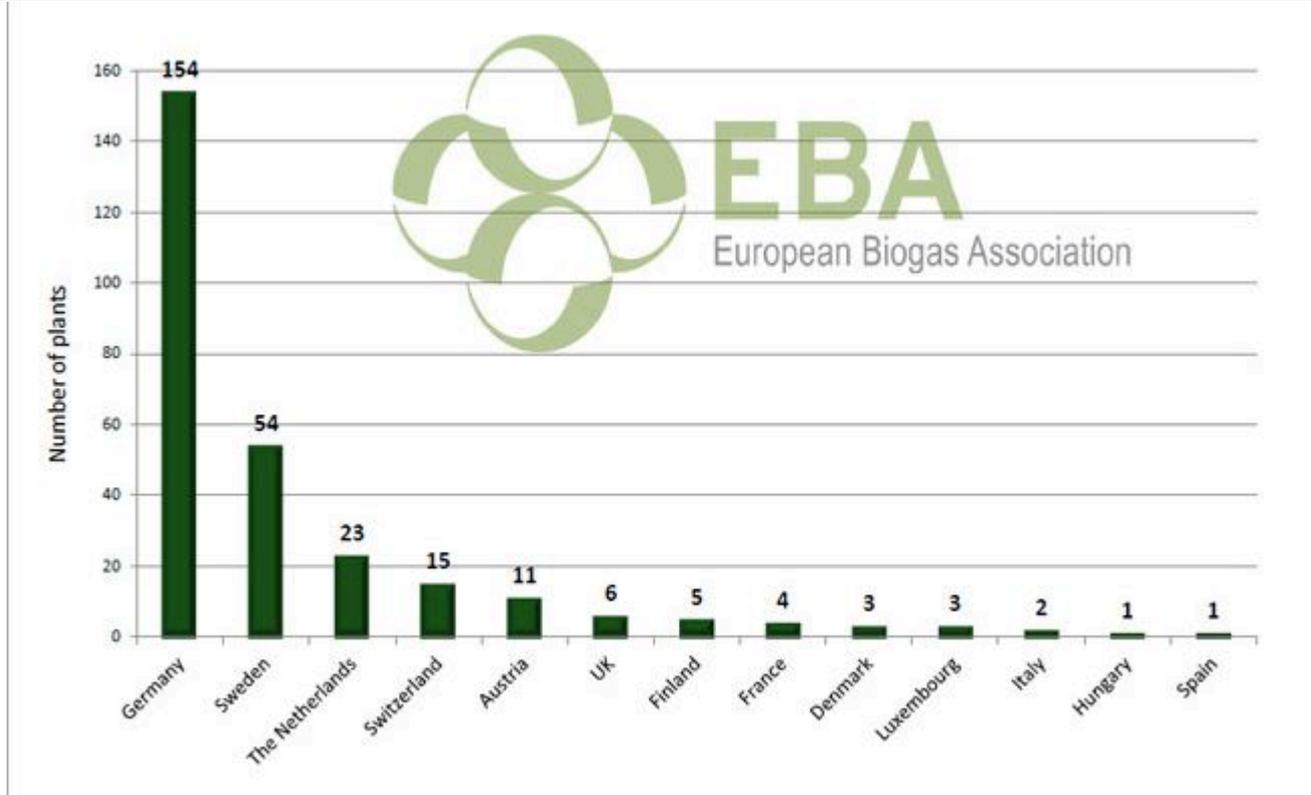
Biogas in Europe

Number of plants



Biomethane in Europe

Number of plants



343 billion gallons

Electricity Overview

- Sweden is making a concerted effort to reduce carbon emissions
- The country is an exporter of electricity
- Close to Poland, Norway, Finland, Denmark

Table 9. Largest utilities and their assets in Sweden (in MW)

Company	Hydro power	Nuclear power	Wind power	Other thermal power	Total
Vattenfall AB	7 941	4 682	261	668	13 552
E.ON Sverige AB	1 788	2 668	18	2 078	6 552
Fortum Power and Heat AB	3 135	1 690	0	994	5 819
Statkraft Sverige AB	1 261	0	0	0	1 261
Total	14 125	9 040	279	3 740	27 185

Source: SEA, 2011.

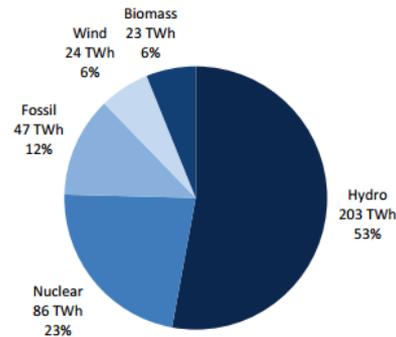
The Nordic Electricity Market

- Finland, Denmark, Norway, Sweden
- A system that allows these nations to share electricity across borders
- Fights monopolies by bringing in 3rd parties



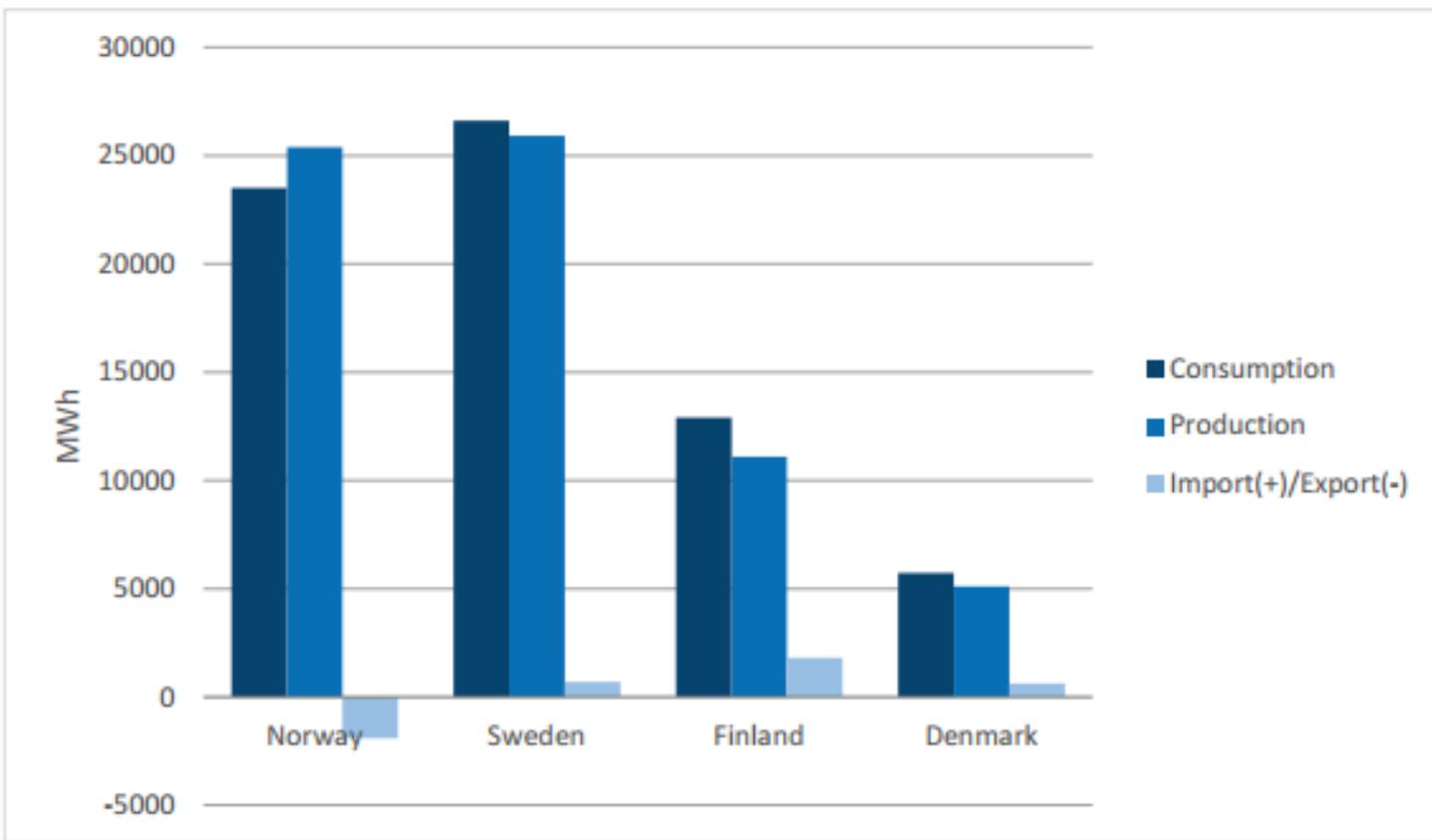
<http://www.nordicenergyregulators.org/>

Figure 2. Power generation by power source in the Nordic region in 2013



Source: ENTSO-E

Figure 7. Consumption, generation and exchange in the Nordic region, January 25th, hour 9



Source: Nord Pool Spot

Key data (2011 provisional)

Installed capacity: 36.5 GW

Total gross electricity generation: 150.5 TWh, 3.6% increase from 2000

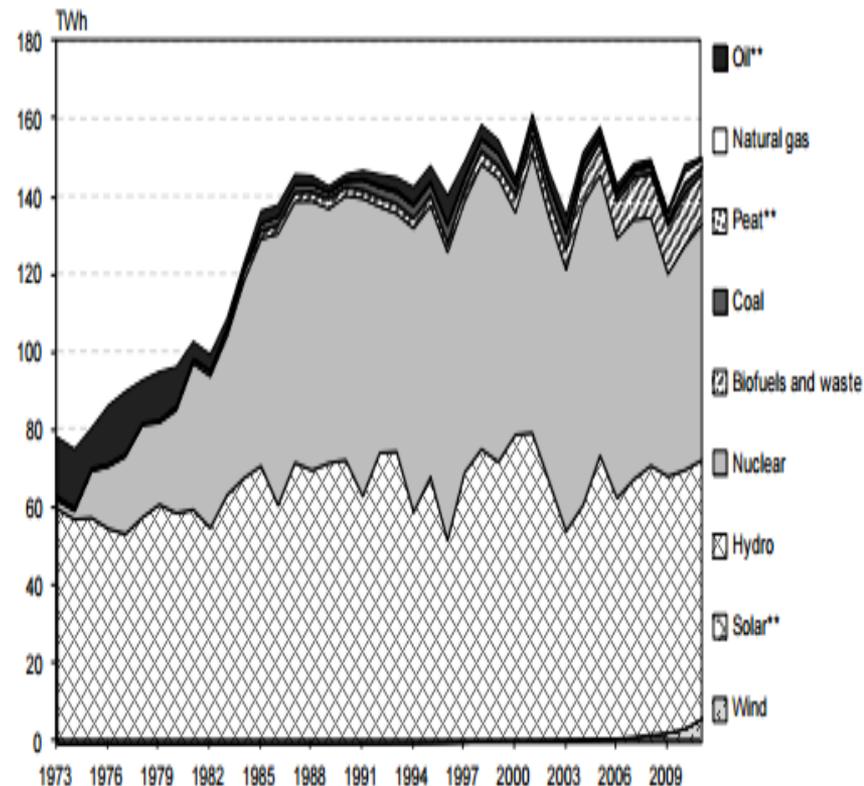
Electricity generation mix: hydro 44.1%, nuclear 40.5%, biofuels and waste 8.5%, wind 4%, natural gas 1.2%, coal 0.8%, oil 0.5%, peat 0.4%

Peak demand: 26 GW

Inland consumption: 10.8 Mtoe (industry 42.3%, residential 34.3%, services and other 21%, transport 2.4%)

- Currently heavily vested in Hydro and Nuclear
- Jump in Nuclear after 1973

Figure 32. Electricity generation by source, 1973-2011*



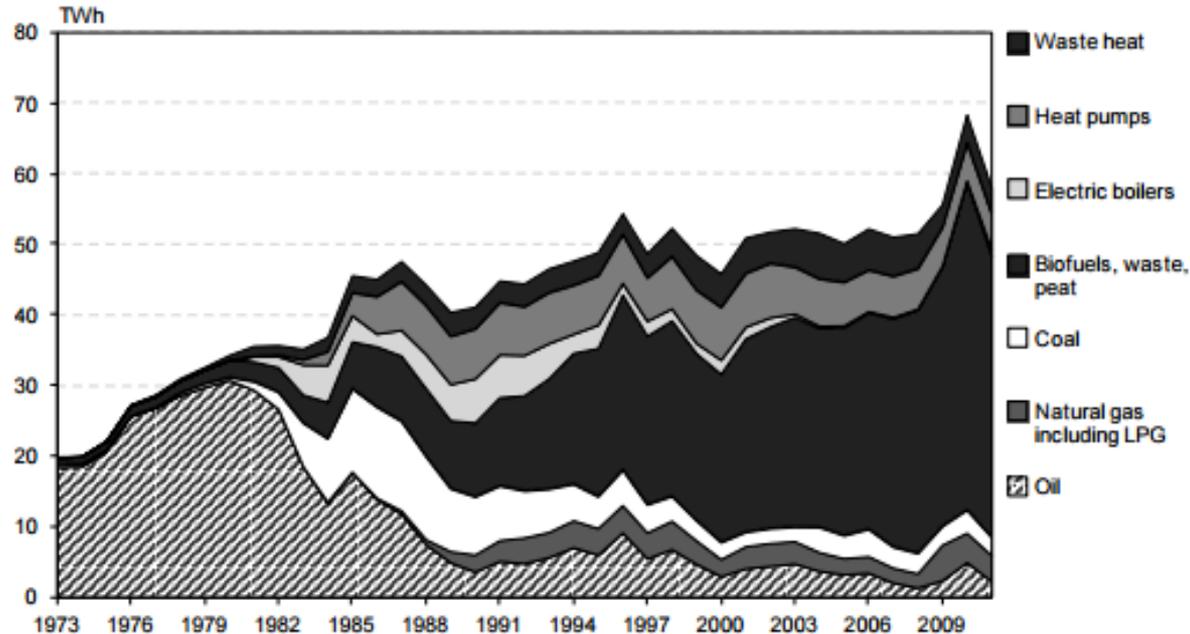
* Provisional for 2011.

** Negligible.

Source: *Energy Balances of OECD Countries*, IEA/OECD Paris, 2012.

Where does the residential electricity go?

Figure 42. Energy input for district heating, 1970-2011



Note: the sharp increase in district heat production in 2010 is primarily due to an extremely cold winter.

Source: submission by the Swedish government to the IEA.

IEA Sweden
Review 2011

Nuclear

- 40% of Sweden's electricity comes from nuclear generation
- Riksdag voted to not decommission all reactors in February, 2009
- Still only have 10 reactors, the Riksdag voted to replace the old reactors with new ones in June 2010
- New reactors at the same sites



Hydropower

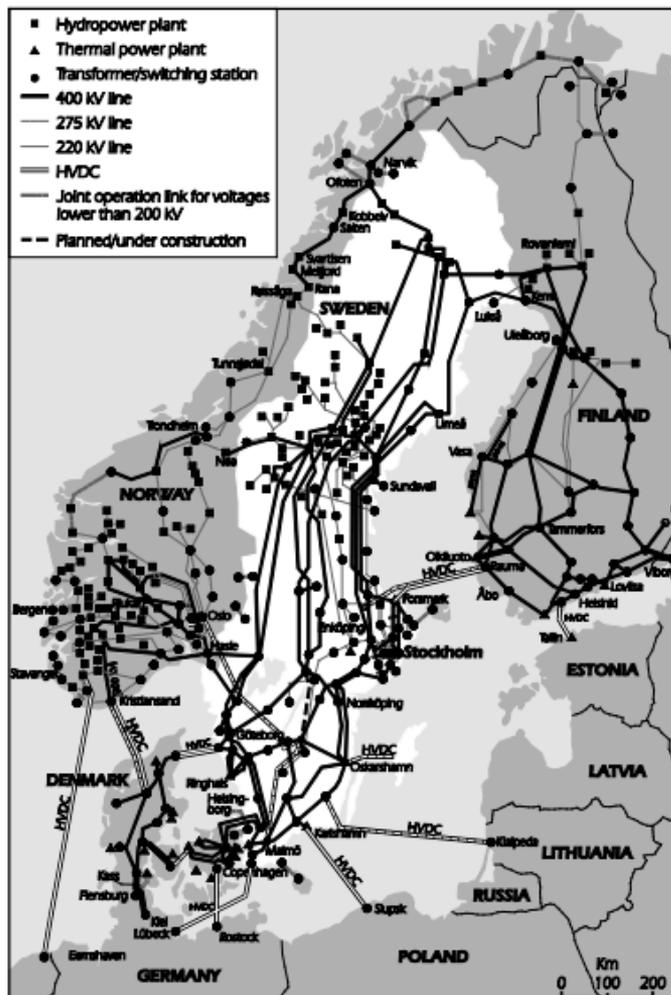
- 44% of Swedish electricity generation is hydropower
- 46% of total capacity
- Very clean, however damage to rivers and ecosystems is possible



Porsj Hydroelectric Power Plant on the Lule River

http://www.el.angstrom.uu.se/forskningsprojekt/bilder_vattenkraft/vattenkraftverk.jpg

Figure 38. Map of the Swedish electricity transmission grid, 2011

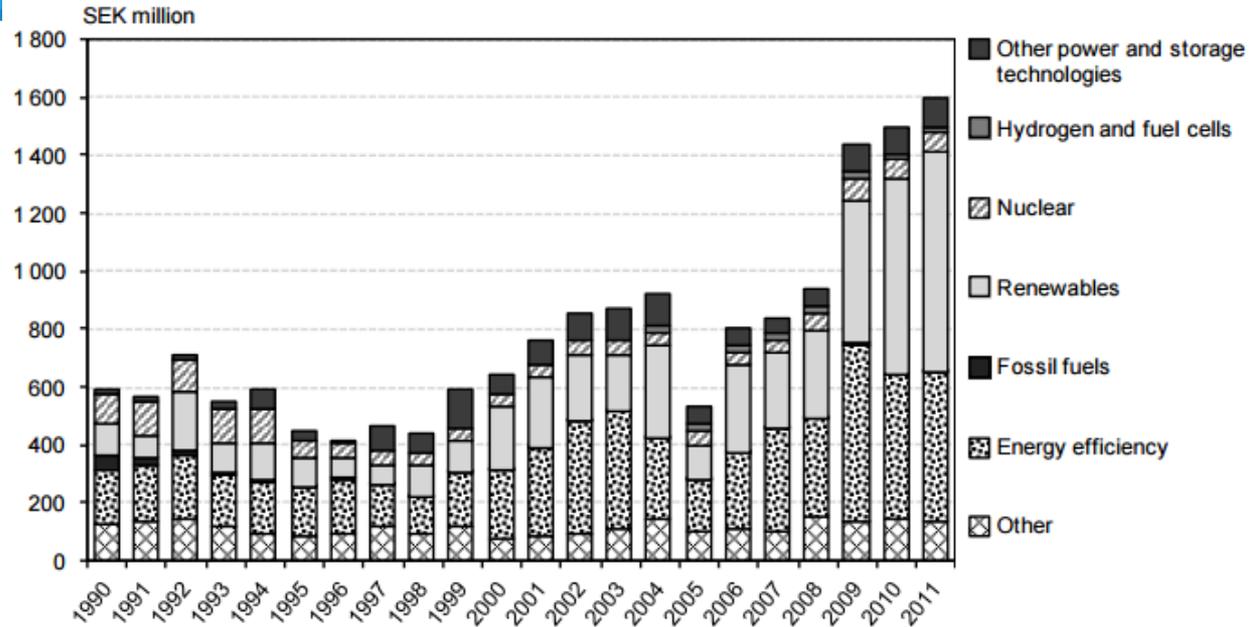


This map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Future

- Smart Grids
- Renewables
- Nuclear
- Markbygdyn

Figure 46. Government RD&D spending on energy, 1990-2011*



* Provisional for 2011.

Sources: OECD Economic Outlook, OECD Paris, 2012; submission by the Swedish government to the IEA.

Institutions and Agencies

- Ministry of the Environment
- Swedish Energy Agency
- Swedish Energy Markets Inspectorate
- Swedish Environmental Protection Agency

Policies

Sweden has set goals to:

- form a fossil-fuel-independent vehicle fleet by 2030
- achieve no net greenhouse-gas emissions by 2050

Attempts to account for *2030/2050 challenges*

Fossil-Fuel-Independent Fleet (2030)



http://images.bidorbuy.co.za/user_images/957/296957_110714155003_green-vehicle-main-image2.jpg

Achieving decarbonization:

- Currently promoting biofuels
 - motor vehicle tax breaks
 - strong R&D activities
- at least 10% share of renewable energy in the transport sector by 2020

No Net GHG Emissions (2050)

2020 - Reduce greenhouse gas emissions by 40% by 2020

2030 - Achieve Fossil-Fuel-Independent Fleet

2050 -

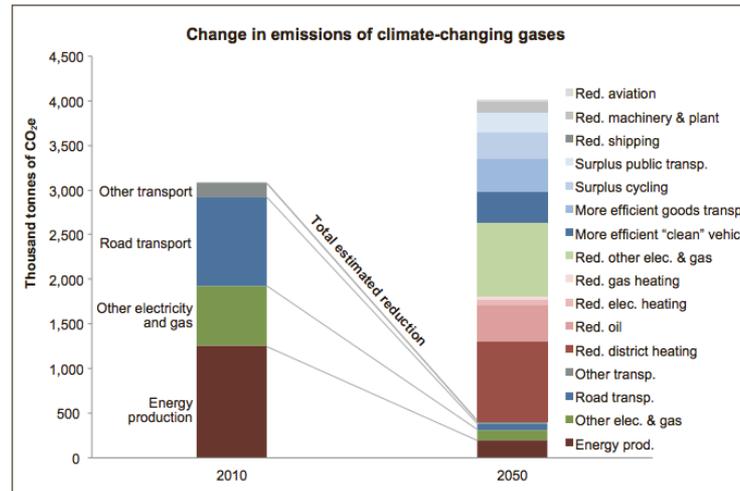


Figure 2: Emissions of greenhouse gases for the base year and for 2050. The upward adjustment is based on the projected population increase. The base year is compiled using the values from 2009 (district heating, oil, gas, electricity, wood fuel, other electricity and other gas) and 2010 (transportation, aviation, shipping, construction machinery). 2009 was chosen as the base year because 2010 was an extremely cold year, so the values for 2009 are a better reflection of a normal year.

Climate Roadmap for 2050

Climate Roadmap:

- Proposes in 2012
- Adopted in 2013
- Significant domestic emissions reductions
- purchasing allowances

Issues and Concerns

- Mainly raised by the IEA
- Encourages more detailed roadmaps for all industries
- Solidify an action plan for the transport sector for 2030

Climate Taxation

* Pre-existing CO2 and energy tax *

In 2009, Sweden:

- Reduced exemptions
- Increased the participation of the non-ETS sectors
 - agriculture
 - forestry.

Possible Destinations

- GoBiGas (Gothenberg)
- Stockholm Concert Hall
- Malmo

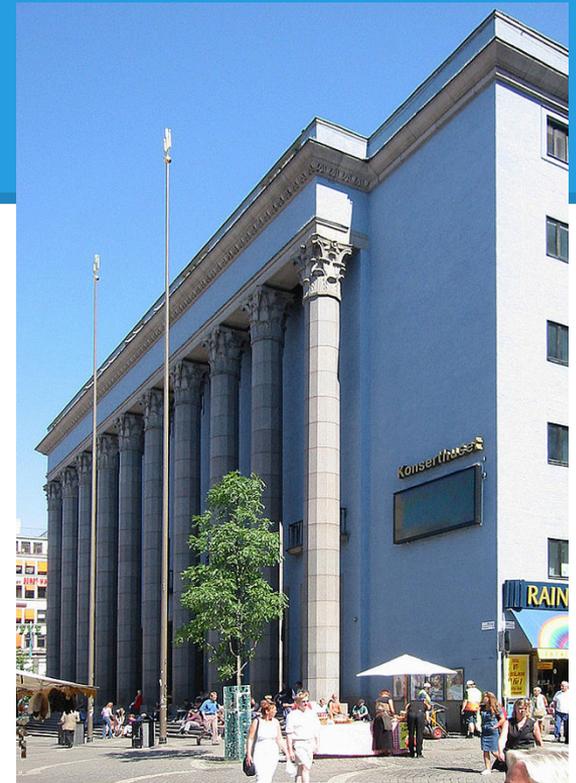
GoBiGas

- Located in Gothenburg
- Produces Biomethane from thermal gasification



Stockholm Concert Hall

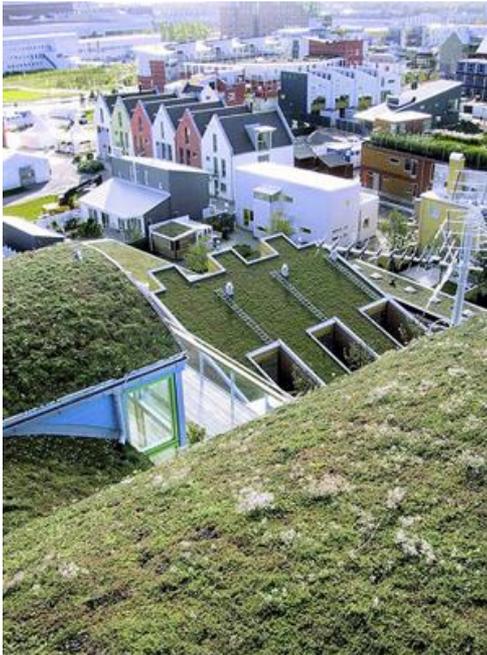
- Built in 1926
- Where all non-Peace Nobel Prizes have been awarded since 1926
- Winners have included: Pauli Neils Bohr, Dorothy Hodgkin and many more
- The Peace Prize is awarded in Oslo's City Hall



http://upload.wikimedia.org/wikipedia/commons/0/0a/Stockholm_Konserthuset_2002.jpg/

Malmö

Green Roofs



Western Harbour

