Sweden

Alan Arvelo; Bryan Faeth; Nicholas Buczacki.
Early History

-Swedish historical documents first appear in 800 CE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

- 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

Demographics

Population: 9.6 million “Swedes”.

Language: Swedish. Area: 450,000 km^2

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: Spettlekaka (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
Sweden: reduced emissions and increased GDP.

https://www.svebio.se/index.php?g=english/optimal-incentives
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
Economy

Gross Domestic Product:


Distribution of Spending:

Economy

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

http://apiaryfund.com/sites/default/files/SEK.jpg
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

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

* Provisional for 2011.  
** Negligible.

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

http://www.iea.org/countries/membercountries/sweden/
Oil Consumption

http://www.theglobaleconomy.com/Sweden/oil_consumption/
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http://www.theglobaleconomy.com/Sweden/oil_consumption/
Biofuels: Ethanol

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

Mostly imported

Heavily subsidized

http://www.ethanolproducer.com/articles/4463/ffvs-flourish-in-sweden/
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

http://www.biofuelstp.eu/biogas.html
Biomethane in Europe

343 billion gallons

Number of plants
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)

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

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

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

- Hydro: 203 TWh (53%)
- Nuclear: 86 TWh (23%)
- Fossil: 47 TWh (12%)
- Wind: 24 TWh (6%)
- Biomass: 23 TWh (6%)

Source: ENTSO-E

http://www.nordicenergyregulators.org/
Figure 7. Consumption, generation and exchange in the Nordic region, January 25\textsuperscript{th}, hour 9

Source: Nord Pool Spot
Currently heavily vested in Hydro and Nuclear

Jump in Nuclear after 1973

IEA 2011 Report on Sweden
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.
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

Porsi Hydropower 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

[Map with markers for hydropower plants, thermal power plants, transformer-switching stations, 400 kV lines, 275 kV lines, 220 kV lines, HVDC, joint operation link for voltages lower than 200 kV, and planned/under construction.]
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
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)

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

http://images.bidorbuy.co.za/user_images/957/296957_110714155003_green-vehicle-main-image2.jpg
No Net GHG Emissions (2050)

2020 - Reduce greenhouse gas emissions by 40% by 2020
2030 - Achieve Fossil-Fuel-Independent Fleet
2050 -
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
Malmö

Green Roofs

Western Harbour