

Swedish Municipalities

Of the six Swedish cities visited on the 2004 Community Energy Mission, two were the largest cities in the country (Stockholm and Malmö). The downtown areas of these cities had several characteristics in common:

- Few high-rise apartment buildings; four- and five-story flats were more common
- Wide sidewalks and boulevards with many pedestrians
- Many cycling paths and bicycle lanes, sometimes with separate traffic lights for cyclists and “car crossings” (over pedestrian crossings)
- Many municipalities owned energy plants for heating, electricity, or the production of “biogas” as vehicle fuel that used local renewable energy supplies

Municipal Structure

- Sweden’s 290 municipalities receive ~20-30% of national income taxes, are able to levy taxes on waste and water, and many own or co-own energy plants that generate additional revenue
- Responsible for planning, home care, income support, and primary and secondary education. The country’s 21 regional authorities are responsible for health and transportation
- National government also provides a portion of the Value Added Tax (25% sales tax) to correct regional imbalances
- Swedish municipalities have a higher ratio of municipal councillors to population. E.g., Stockholm city council has 101 members serving a core population of ~800,000 (with suburbs included, the population is about 1.7 million). Ottawa has 21 councillors for a population of 775,000

Swedish Energy/Electricity Supply

Shortly after the oil crisis of 1973, Sweden began to switch its national energy policy to reduce its dependence on traditional fossil fuels and gradually increase its supply of renewable energy. Since then, Sweden’s supply of renewable energy has almost doubled.

Only 5% of Canada’s total energy supply is from renewable sources (primary energy sources are coal, crude oil, natural gas, natural gas liquids, hydro and nuclear electricity).

Electricity was deregulated in Sweden in 1996 and the national grid is owned and operated by Svenska Kraftnät. Any company generating electricity can “feed” the national grid and, beginning in May 2003, the national government replaced the subsidy for renewable electricity generation with energy certificates. These certificates determine the price per kilowatt-hour that producers can charge consumers and certify that the company is producing “green” electricity.

District heating in Sweden

District heating is an energy system that uses hot water or steam to heat several buildings via an underground pipeline network. District heating plants can also be combined to generate electricity.

- Energy sources include: waste incineration (garbage and wood waste, peat, etc.), pine oil, natural gas, waste heat, and oil
- Best suited to high-density developments (residential and commercial)
- Benefits to municipalities:
 - Safe and secure supply of heat and power that decreases risks associated with power outages
 - Additional revenue by generating heat and electricity using local energy sources (such as household garbage, wood waste, waste heat from water treatment facilities, etc.)
 - Lower landfill costs if household waste is used as the energy source
 - Pipeline network can be installed concurrently with other municipal infrastructure (water and sewage pipes)
 - Reduced GHG emissions from coal, oil or natural gas heating and electricity systems
- District heating can be supplied to detached homes. For example, the city of Linköping offered to convert homes, one street at a time at the homeowner's expense. The cost to convert one home in Linköping is ~\$17,500 CAD
- Benefits to homeowners:
 - Improved outdoor and indoor environment
 - Cost of district heating per year per home varies. A 2,000 square foot home in the city Växjö spends ~\$3,200 in heating and \$860 for electricity per year
 - Higher resale values
 - No maintenance of furnace or the need to order fuel
 - Payback period is ~10-15 years

District heating in Canada

[Markham Town Centre](#) is a 1,000-acre greenfield project that will use district heating to power 90% of the new buildings (homes and commercial/retail space).

- Markham District Energy (MDE) plant already supplies two of Markham's largest employers, IBM and Motorola, using natural gas as the energy source
- When fully built, the Town Centre will house ~25,000 people and ~17,000 employees. The district heating plant will eventually produce 27MW of power and is expanding to meet the demand (with funding from the [Green Municipal Funds](#))
- The system will cut GHG emissions in half
- Total investment is \$75-\$100 M to build the plant and the underground pipeline network, which will be repaid under 20-year contracts through fixed-capital repayment charges for the infrastructure. The cost of the energy fluctuates with the price of natural gas

Waste-to-Energy

Many Swedish cities use household garbage and wood waste as energy sources to produce heat and electricity.

- Waste is incinerated at very high temperatures, rendering most emissions inert. In the case of garbage incineration:
 - Hazardous and medical waste is removed and disposed of separately

- Construction materials are removed and reused
- Many products never enter the waste stream as they fall under Sweden's Extended Producer Responsibility (EPR) legislation:
 - EPR = companies are required to take back packaging or waste of their products. Products include glass, metals, paper products, automobiles and their parts, including tires, and electronic wastes. **Note:** beginning in 2005, it will be illegal to landfill organic waste in Sweden
- Remaining waste is incinerated at temperatures reaching 1,000°C. Advanced scrubbers, filters, flue gas cleaning, and ash collectors are used to further reduce emissions:
 - Levels of carbon monoxide, heavy metals, nitrogen oxides, and sulphur dioxides are all within or below limits set by the European Union (2003 European Commission Air Quality Report for Sweden)
 - Levels of dioxins fell from 20-30 grams per year in 1987 to 2 grams per year in 1995 (Swedish Environmental Protection Agency figures, reported in European Union Swedish Dioxin Survey)
- Many of the waste-to-energy plants visited were co-owned by several municipalities, with some obtaining a 12-14% return on their investment. The SYSAV Group owns several energy plants in Sweden, is ISO 14001 certified and has consistently received a Triple A credit rating from Dun & Bradstreet, with a 2002 profit of SEK 43M (\$7.4M CAD)
 - The SYSAV plant visited in Malmö is owned by 14 municipalities
- SYSAV sells electricity for ~\$52 CAD per MW; net cost for bringing waste to the plant is \$65 CAD/tonne; landfill tax is \$60-\$65 CAD/tonne; capital cost for the plant was \$150M CAD, cost to operate \$65/tonne; pollution controls cost ~\$40M CAD

Waste-to-energy in Canada

Greater Vancouver Regional District has been incinerating garbage to produce energy since 1988. [Its facility](#) in Burnaby, British Columbia was upgraded in 2003 to include additional pollution controls, such as those to treat mercury and reduce nitrous oxide emissions.

- Annual revenues of \$5 million through the sale of electricity. Avoided 66,000 tonnes of GHG emissions by using garbage as energy source rather than fossil fuels
- One of only two waste-to-energy plants in North America to be ISO 14001 certified
- Facility is continuously monitored and regulated under provincial legislation with monthly reports submitted to the B.C. Ministry of Water, Land and Air. Independent stack tests are done three times a year for acid gases, hydrocarbons, metals and particulate matter

Automated Waste Collection

In Stockholm alone, 120,000 homes are connected to an [Envac](#) Automated Waste Collection System. It works this way:

1. Waste is deposited in either outdoor or indoor inlets (three waste streams = household waste, recyclable paper and plastic, and organic material. Other recyclable materials are covered under EPR, see above).
2. Temporarily stored in a discharge valve

3. Waste is sucked through piping at 70 kph to
4. An area where the waste is separated from the transport air
5. Finally, waste is stored in a container that is later picked up by truck and the transport air passes through a cleaning filter before released to the outside air.

Benefits:

- System has reduced transportation of waste by 60% in the Hammarby Sjöstad high-density development in Stockholm (20,000 residents)
- Pipes are integrated with city sewage pipes (economy of scale if pipes are laid at the same time as other municipal infrastructure)
- Minimal rental space used for storing refuse inside buildings
- Noise, litter, and smell reduced or eliminated
- 20-30 year system lifespan
- Reduces human resources required for waste collection and increases worker safety

The system is best suited to high-density developments as they are being built. Cities that have limited room for growth, however, are also good candidates. For example, half a million people in Barcelona will be connected to an Envac system by 2010.

Table 1: Sweden's renewable energy supply (TWh), 2002

Source: Swedish Energy Agency. One terawatt hour (TWh) = 1,000 gigawatt hours (GWh)

<u>Energy Type</u>	<u>2002</u>	<u>1971</u>
Biofuel, peat, wastes	98.2	40
Hydropower	66.7	52
Wind power	0.6	n/a
Geothermal energy	~0.3	n/a
Solar energy*	0.05	n/a
*Estimated		
Total	166	92

Table 2: Sweden's total energy supply (TWh), 2002

Source: Swedish Energy Agency

Nuclear power*	69
Crude oil	199
Renewable energy	166
Other sources	50

*Excluding waste heat from nuclear power plants, which totaled 132 TWh.

Table 3: Canada's total energy supply (TWh), 2003

Source: Statistics Canada

Coal	368.4
Crude Oil	1,293.8
Natural Gas	1,600.2
Natural Gas Liquids	146.5
Primary electricity (includes hydro and nuclear)	332
Refined Petroleum Products*	1,319.3

*Includes fuels such as motor gasoline, heavy fuel oil, diesel fuel, and aviation fuel

Table 4: Differences between Sweden and Canada

	Canada	Sweden
Area (km ²)	9,984,670 ⁱ	410,335 ⁱⁱ
Population	30,007,094 ⁱⁱⁱ	8,882,792 ^{iv}
Major industries ^v	Services: 70% Industry: 27% Agriculture: 2%	Services: 70% Industry: 27% Agriculture: 2%
% Population living in urban areas ^{vi}	80.1	83.3
Human Poverty Index (of 17 developed nations) ^{vii} The HPI includes: 1) long and healthy life (probability at birth of living to age 60), 2) knowledge (% of adults lacking functional literacy skills), 3) decent standard of living (% of people living below the poverty line), 4) social exclusion (long-term unemployment rate)	12 th	1 st
% Population living under the poverty line ^{viii}	7.4	6.3
% Voter turnout (federal elections)	60.5 (2004) 76 (1979) ^{ix}	80 (2002) 91.8 (1976) ^x
Passenger cars/kilometres driven/year	459/16,000 ^{xi}	428/11,000 ^{xii}
# doctors per 100,000 people ^{xiii}	187	287
Life expectancy ^{xiv}	79.3	80.1
Obesity rate	~15% ^{xv}	~10% ^{xvi}
GHG emissions		
OECD ranking for GHG emissions (of 29 countries) ^{xvii}	27 th	5 th
CO ₂ per person/per year (tonnes) ^{xviii} Turkey was the lowest per capita producer of CO ₂ at less than 5 tonnes per person	16.84	6.36
% of global CO ₂ emissions ^{xix}	1.8	0.2
Sulphur dioxide emissions (decreases since 1985) ^{xx}	15.3%	80%
Nitrogen dioxide emissions (decreases since 1980) ^{xxi}	1.6%	24.8%
Wastewater and Water		
% of population receiving public sewage treatment	79%	93%
% receiving tertiary treatment ^{xxii}	33%	87%
Water usage/per person/per year ^{xxiii}	1,600 m ³	310 m ³
Waste and Recycling		
Kg of waste per person/per year ^{xxiv} (1997)	490	360
Land Mass Protection		
Percentage of land protected	9.6%	8.1%
Energy		
% Renewable Energy	~5%	+50%
Energy-efficiency increases (since 1980) ^{xxv}	21%	21%
Foreign Aid		
% of GDP spent on foreign aid (including that for sustainable development in developing nations) ^{xxvi}	0.29%	0.71%

Taxes		
Percentage of personal income taxes/year (\$CAD) (federal tax rates only as provincial/territorial tax rates in Canada differ)	On the first \$32,183 of taxable income / 16%	\$21,000 / 26%
	On the next \$32,185 of taxable income / 22%	\$31,200 / 29%
	On the next \$40,280 of taxable income / 26%	\$41,500 / 30%
	Taxable income over \$104,648 / 29% ^{xxvii}	\$52,000 / 31%
		\$93,300 / 41% ^{xxviii}
General federal corporate tax rate	21% ^{xxix}	28% ^{xxx}
Hockey		
Olympic Gold (Men)	1920, 1924, 1928, 1932, 1948, 1952, 2002	1994
Olympic Gold (Women)	2002	n/a

ⁱThe Atlas of Canada, <http://atlas.gc.ca>

ⁱⁱ*Sweden in Figures 2004*

ⁱⁱⁱStatistics Canada, 2001 Census, www12.statcan.ca/english/census01/products/standard/popdwell/Table-PR.cfm

^{iv}Ibid, note 2

^v*Canada vs. Sweden: An Environmental Face-Off*, David Richard Boyd, Eco-Research Chair of Environmental Law and Policy, University of Victoria, February 2002, p. 4. All data in the document is based on the Organization for Economic Cooperation and Development's 2001 Key Environmental Indicators and the OECD's 1999 Environmental Data Compendium. See also: www.environmentalindicators.com

^{vi}UN Human Development Report, 2004, p. 152

^{vii}Ibid, p. 150

^{viii}Ibid

^{ix}Elections Canada

^xGovernment of Sweden

^{xi}Transport Canada

^{xii}Government of Sweden

^{xiii}Ibid, note vi, p. 156

^{xiv}Ibid, p. 139

^{xv}Health Canada

^{xvi}Government of Sweden

^{xvii}Ibid, note v, p. 5

^{xviii}Ibid, p. 5

^{xix}Ibid, note vi, p. 207

^{xx}Ibid note v, p. 6

^{xxi}Ibid, p. 6

^{xxii}Ibid, p. 7

^{xxiii}Ibid, p. 8

^{xxiv}Ibid, p. 9

^{xxv}Ibid, p. 11. Note: Canada uses 0.30 tonnes of energy to generate \$1,000 USD worth of GDP; Sweden uses 0.23 tonnes of energy to generate the same amount.

^{xxvi}Ibid, p. 13 (1998 figures)

^{xxvii}Canada Revenue Agency, www.cra-arc.gc.ca/tax/individuals/faq/2003_rate-e.html

^{xxviii}*Sweden and Swedes*, March 2004, p. 25

^{xxix}Department of Finance Canada, www.fin.gc.ca/toce/2003/taxrated_e.html

^{xxx}Ibid, note 28, p. 25