



## SWEDEN

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### INTRODUCTION AND BACKGROUND

The Swedish Energy Agency is governed through the Ministry of Enterprise and is responsible for all R&D funding related to energy technology, which includes all parts of the energy value chain including horizontal aspects (sustainability and policy measures). The yearly budget is roughly 1,000 million crowns.

### UPDATE ON MEMBER'S ENERGY FRAMEWORK

The Swedish Energy Agency's focus on hydrogen is in the production arena, mainly via gasification of biomass to synthetic gas. Relative to hydrogen as a fuel for propulsion and stationary applications, the funds for R&D directed to fuel cells are considered small.

Sweden has a consortium on artificial photosynthesis and has some research for different kind of fuel cells. Update overview on relevant programs and projects

- Overall funding on Swedish hydrogen and fuel cells R,D&D in 2011, gasification technologies excluded, was roughly 5 million crowns.
- The highlight of progress worth mentioning is improved understanding of hydrogen production through use of solar energy.

### HYDROGEN R,D&D SPECIFICS

The Swedish government decided in 2008 to dedicate approximately 900 million crowns to demonstration facilities of new energy technology. From this sum, close to 725 million went to demonstration projects for biofuel production through gasification technologies. Programs,

### PROJECTS, INITIATIVES IN BRIEF

Since the funding is of such a large nature, the decision had to be approved by the European Commission (DG Competition would have to approve the state not taking too big of an involvement in the market). In Spring 2011, both of the projects were given a green light and will be operational in 2014.

- Gasification of wood chips to biomethane in Gothenburg. Project acronym Gobigas, awarded 225 million crowns.
- Gasification of black liquor at Domsjö using Chemrec technology. Aim to create bio-DME in an entrained flow gasifier. Project awarded 500 million crowns.

### VITAL STATISTICS

Sweden is a member of the EU but not EMU.

#### Population

Sweden has a population of 9,495,113 (March 2012) (SCB, Swedish official statistics)

#### Territory

449,964 km<sup>2</sup>

#### Capital

Stockholm is the capital of Sweden

#### GDP/capita

369,900 SEK or 55,200 USD

Average Annual GDP Growth 3% average from 1990–2010 (SCB)

#### Production

Swedish electricity production — made up by hydro-nuclear and CHP from biomass — is almost fossil free.

Sweden imports almost all liquid energy for transport (electricity for trains and some biofuel production for road transport excluded). The transport sector uses roughly 100 TWh/year.

PRELIMINARY ELECTRICITY STATISTICS FOR 2010, TWh

	2009 TWh	2010* TWh	Change from 2009
Supply			
Hydropower	65.3	66.2	1.4%
Wind power	2.5	3.5	40.0%
Nuclear power	50.0	55.6	11.2%
Other thermal power	15.9	19.7	23.9%
<b>Total electrical power production</b>	<b>133.7</b>	<b>145.0</b>	<b>8.5%</b>
Net import/export**	4.7	2.1	
<b>Total domestic electricity usage</b>	<b>138.4</b>	<b>147.1</b>	<b>6.3%</b>
Temperature-adjusted electricity usage	139.6	143.6	2.9%

\* Preliminary data from Swedenergy  
 \*\* A negative value is equal to export

Sources: Swedenergy and Statistics Sweden





**PRIVATE INITIATIVES**

**Powercell**

PowerCell Sweden AB originates from a core research team at Volvo Group and was founded in 2008. Today PowerCell has about 50 employees.

In 2009, Volvo Technology Transfer, Midroc New Technology, Ocas Ventures, and Fouriertransform jointly made a significant investment and financed an expansion of the Powercell company.

PowerCell is a developer of PEFC fuel cells and fuel cells system including a reformer that can use fossil fuels like diesel and gasoline as fuel. The so-called PowerPac system is being engineered to use today’s fuels, both fossil and renewable to power the fuel cell. The intention is to use the fuel cell system as APU for trucks and boats. In addition, the PowerPac is being planned for easy adaptation to other renewable fuels such ethanol and methanol, which can be converted into hydrogen rich gas.

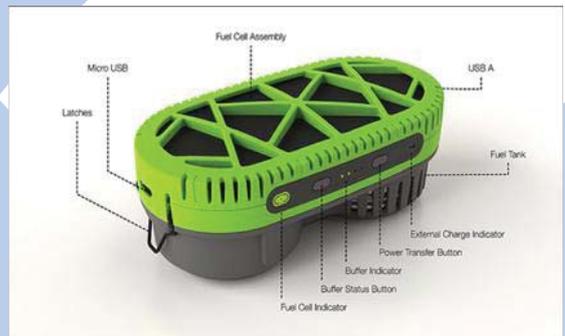


**myFC**

myFC from Sweden is an SME that provides a portable hydrogen fuel cell power source for on demand charging of cell phones and other low power portable electronics away from the grid. The charger is called PowerTrek. It is a 2-in-1 solution that is both a portable battery pack and a fuel cell. Users simply insert a fuel pack Pukk and add water. To charge portable devices – for example mobile phones, cameras and GPS devices – users connect a device to Power Trek via a USB port, and the power is generated immediately. The Power Trek is now available for sale.



Pictured here is a new product developed by myFC: a 3mm thick hydrogen PEFC fuel cell that is to be inserted in the lid of a PC laptop. It will extend the operating time significantly as it can be charged by methanol cartridges.





### Cellkraft

Cellkraft AB is a small company in Sweden that produces robust hydrogen fuelled PEFC. They developed fuel cells for special purposes, such as back-up for telecom and APU in harsh climates, for instance, the Mawson base on the South pole continent. Cellkraft has fuel cells products up to 3 kWe. Cellkraft has cooperation with Genesis Fueltech, USA for reformer technology. Together, they have developed a system that can power a small boat using methanol as fuel.

### Catator

Catator was founded in 1990 by a group of researchers at Lund University in Sweden. It quickly became a high-tech company in the field of catalysis and customized catalytic process design. Among their products, Catator developed different kinds of reformers for reformat and hydrogen production. Catator cooperates with several fuel cell developers, both SOFC and PEFC.

The fuel processor units for hydrogen production are so-called multi-fuel processors, and work with a wide range of fuels, e.g. natural gas, LPG, ethanol, methanol, diesel, kerosene, and jet-fuel (JP8). They can be delivered in capacities from 50 We to 30 kWe or according to customer specifications.

### Malmö hydrogen filling station



The hydrogen filling station in Malmö was inaugurated in September 2003. It has been used for several different Hythane and hydrogen vehicle projects. The station is now mothballed and waiting for a new project under discussion, a hydrogen FC-bus in Malmö.

The station uses an electrolyser from Hydrogenics in Belgium as source for hydrogen.



## REFERENCES

Swedish Energy Agency – <http://www.energimyndigheten.se/en/>

### OTHER IMPORTANT WEBSITES:

Gobigas project - [http://www.goteborgenergi.se/English/Projects/GoBiGas\\_Gothenburg\\_Biomass\\_Gasification\\_Project](http://www.goteborgenergi.se/English/Projects/GoBiGas_Gothenburg_Biomass_Gasification_Project)

Domsjö DME from black liquor: [http://www.chemrec.se/Domsjoe\\_Fabriker\\_producing\\_green\\_fuels\\_with\\_Chemrec.aspx](http://www.chemrec.se/Domsjoe_Fabriker_producing_green_fuels_with_Chemrec.aspx)

Powercell - <http://www.powercell.se/>

Cellkraft AB - [http://www.cellkraft.se/index\\_en.html](http://www.cellkraft.se/index_en.html)

myFC AB - <http://www.myfuelcell.se/>

Catator – <http://www.myfuelcell.se/>

Elforsk Swedish fuel cell group [www.branslecell.se](http://www.branslecell.se)

Hydrogen Sweden branch organisation- <http://www.vatgas.se/in-english>