

INVEST SWEDEN

Cleantech

A country that fully embraces green technologies



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Rising up to the world's environmental challenges requires innovation, determination and a global approach. Sweden initiated and hosted the United Nations' first conference on the environment in Stockholm in 1972, has spearheaded waste-to-energy development and is today a European peer in energy use from renewable sources.

Sweden provides an environment ideally suited for the development and testing of new technology with plenty of innovative companies, mature firms and advanced test environments. Government regulations and incentives work in tandem to facilitate and speed implementation of clean technologies in all parts of society. As an example, green cars currently account for some 35 percent of new car sales.

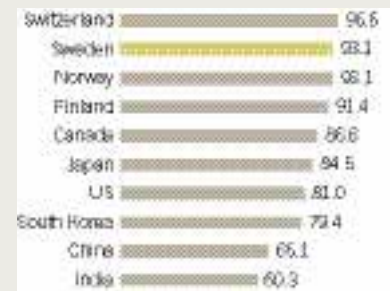
A focus on energy efficiency and alternative energy resources is evident wherever you look. This is partly explained by sophisticated industrial demand and rapid technology adoption. Swedish municipalities are also important in driving developments. Several hundred biogas plants provide electricity, heat and fuel to Swedish cities, and district heating/cooling systems reach large shares of the population.

Sweden offers business opportunities for venture capitalists, public entities and companies alike – in bioenergy generation, biofuel development, wind power technology and much more. This is a place where the climate neutral society is becoming a reality.

Welcome to Invest in Sweden!

Leaders in environmental performance

Environmental Performance Index, 2008



Source: Yale University and Columbia University in collaboration with World Economic Forum and Joint Research Centre of the European Commission

The index ranks 149 countries on 25 environment indicators, identifying performance targets and measuring how close each country comes to these goals.



“Sweden is a world leader in developing entrepreneurial companies in the cleantech space. We also appreciate the strong engineering support available to help scale up novel alternative energy projects.”

Bernie Bulkin, Senior Advisor,
Vantage Point Venture Partners and Chairman, Chemrec

How to benefit from Sweden's leadership in cleantech

Biofuels

Participate in the financing of biofuel companies and build-up of processing plants. Take part in the development of technology commercialization in innovative companies.

Environmental engineering

There is ample scope to provide environmental consulting services, both to clients in Sweden and in Scandinavia/ the Barents Sea Region.

Future solutions

Use Sweden as a laboratory for clean technologies, through establishment of proprietary R & D units or establishment of strategic partnerships with Swedish cleantech companies.

Innovations

Access Swedish technology and assist in global commercialization through direct investment or in syndication with local venture capitalists.

Sustainability

Anyone wishing to tackle environmental challenges can learn a lot in Sweden. For example, set up a local center of excellence to acquire know-how and build relations with leading industries and municipalities.

Wind power

The Swedish wind power sector offers turbine manufacturers and suppliers both market and technology potential. Invest in assembly and manufacturing operations and capitalize on Sweden to develop solutions for Arctic climates.

Business and investment opportunities

- ▶ **Bioenergy**
- ▶ **Biofuels** (for transportation)
- ▶ **Green chemistry** (grain and cellulose-based processes)
- ▶ **Wind power** (equipment for Arctic climates)
- ▶ **Sustainable building** (residential, office and industrial building)
- ▶ **HVAC technologies** (heating, ventilation and air conditioning)
- ▶ **Waste and recycling** (collection and handling, energy conversion)
- ▶ **Water and wastewater** (community and industrial wastewater)
- ▶ **Environmental engineering** (natural resources exploration)
- ▶ **Innovative technologies**

Swedish companies drive change to a more sustainable society



“Our investment in cellulose-based ethanol production in Sweden is aimed at developing technology for biomass power generation projects in China. Success will set a good example for China-Sweden cooperation in the areas of environment protection, improvement of rural living standards and development of alternative energy.”

Kai Johan Jiang, Chairman of Dragon Power Group Ltd and National Bio Energy Group Ltd, China

A global laboratory and test environment for clean technologies

An innovative business climate, demanding users and rapid technology adoption, make Sweden ideally suited for development and testing/launch. The country is renowned for close collaboration between universities, industry and public bodies.

A holistic approach in city planning

Swedish municipalities have spearheaded solutions to capture energy in organic waste and sewage and to redistribute that energy, in the form of heat, electricity and renewable fuels, in district heating systems and in public and local transport systems. A holistic approach in city planning has also contributed to new solutions and rapid technological development in energy efficiency and recycling, among others. A showcase is the Western Harbor city district in Malmö, designed as a model for the ecologically sustainable future society and the recipient of numerous international awards.

Development through collaboration

Sweden has a long tradition of dynamic relationship between government, industry and universities. There is a widespread belief – most likely stimulated by the challenge of combining broad industrial and academic excellence with a limited population – that expanding knowledge and sharing ideas helps everyone. As a result, there is a willingness to experiment, both between academia/industry and between industry/public entities. A model where academic research discoveries can easily be applied to a market and the wider economy has emerged.

Industry infrastructure that promotes development

In 2006, Sweden's cleantech industry comprised some 3,600 companies with 46,000 employees and revenues of SEK 97 billion (EUR 10 billion). The success of Swedish cleantech on international markets is manifested by a strong rise in exports, which grew by 75 percent in the three-year period ending 2006. The industry mixes large and medium-sized global companies such as Alfa Laval (heat transfer, centrifugal separation), Envac (automated waste collection) and Purac (plants for water treatment and biogas production) with innovative firms in the process of



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market introduction and global commercialization. These are important components in a dynamic industry cluster.

Open lab and test environments

The cleantech industry boasts numerous initiatives to promote industry cooperation, perform joint research and establish test environments for new technology. These initiatives are normally run by industry associations and other independent entities. One example is the innovation arena Sustainable Innovation, which is open to new members.

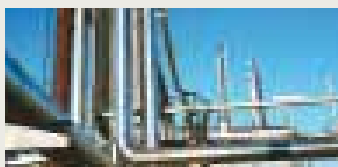
A resource base for the world's largest nations

Countries like China and the US turn to Sweden in search of new cleantech solutions. Chinese energy giant State Grid Corporation, through its subsidiary National Bio Energy and together with Dragon Power Group, has invested in a Swedish bioenergy joint venture, NBE Sweden, to build know-how for future investments in China.

Opportunities throughout the industry

Sweden is a leader in both cleantech practice and innovation, with opportunities for foreign investors in numerous technology fields. Some of these are presented below. A welcoming attitude can be expected – Swedes are used to working together in different ways to develop and test new technology and services.

Biogas applications



Sweden is a pioneer in the exploitation of biogas, with some 230 plants generating heat, electricity and fuel from waste and sewage. Companies like Purac (part of Läckeby Water Group), Scandinavian Biogas and Swedish Biogas International design, deliver and operate biogas plants all over the world. A number of companies, including Bioprocess Control, provide technologies to enhance the biogas manufacturing processes. Sweden is also leading the way in purifying biogas for use as a vehicle fuel and has the world's largest network of biogas filling stations.

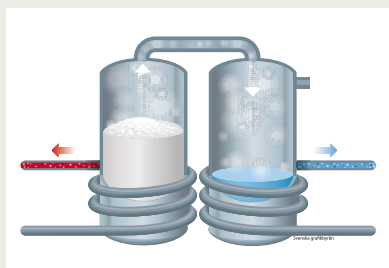
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Wastewater purification

The pilot plant at Hammarby Sjöstad in Stockholm was built to test new technology and to perform innovative R & D in wastewater purification, as part of an integrated sustainable city concept. Located on top of an existing wastewater treatment plant, Sjöstadsverket is an arena for tests, demonstration, education and analysis. Research at the facility is performed in collaboration with the Royal Institute of Technology (KTH) and the IVL Swedish Environmental Research Institute. www.sjostadsverket.se



Heat exchanger technology



Sweden offers outstanding expertise in heat exchanger technology, based on advanced research and several globally recognized companies. Alfa Laval, for example, is a world leader in heat exchangers for industrial processes while NIBE is a northern European market leader for domestic heat pumps. Multi-award winning ClimateWell, a World Economic Forum "Technology Pioneer",

has developed an indoor climate solution with the ability to store energy and convert hot water to cooling and heating without the need for electricity.

Investment examples

VC/Financial investments

- ▶ **Bioprocess Control** (Danske Bank, Denmark)
- ▶ **Chemrec** (Vantage Point Ventures, US)
- ▶ **ClimateWell** (Utilsun, Spain)
- ▶ **Scandinavian Biogas** (Masdar Clean Tech Fund, Abu Dhabi)
- ▶ **Sol Voltaics** (Teknoinvest, Norway)
- ▶ **QuNano** (Teknoinvest, Norway)

Greenfield/Industrial investments

- ▶ **Vestas**, Denmark (HQ for northern Europe in Malmö, acquisition of two foundries)
- ▶ **Enercon**, Germany (wind tower manufacturing in Malmö)
- ▶ **Alfa Solar** and **Solar World**, Germany; **Naps**, Finland; **n67 Solar**, Denmark (solar cell manufacturing in Gällivare and Porjus)

Market investments

- ▶ **Airtricity**, UK; **Dong Energy**, Denmark; **Fred Olsen Renewables**, Norway; **RES**, UK; **WPD**, Germany (wind farm development)

Hybrid plug-in vehicles (HPEV)

Sweden offers expertise in all areas relevant to building efficient systems and infrastructure for hybrid electric vehicles. These include battery technology know-how at the Ångström Laboratory in Uppsala and at ETC, the Center for Energy Technology, in Åle. A joint project to develop and test next-generation hybrid electric vehicles is underway, involving car makers Saab and Volvo, ETC, the Swedish Energy Agency and Vattenfall, Sweden's largest energy company. Important infrastructure is already in place, with tens of thousands of engine preheater sockets installed at homes and in parking lots.



Rich source for promising technology

Sweden has a record of inventing for global markets, thanks to creative and highly skilled engineers, strong R & D capabilities, and a business environment with both demanding public buyers, large corporate customers and sophisticated venture capitalists.

Innovative companies in many cleantech segments

Sweden's innovative cleantech firms have gained worldwide recognition for their novel approach to solving pressing environmental issues. It is clear that this country offers a highly conducive environment for R & D and innovation, and promising companies and technologies are found in most cleantech fields.

Norstel's technology for silicon carbide crystal growth promises to improve semiconductor functionality, of critical importance to making hybrid electrical vehicles a real alternative, but also to reducing power transmission losses and energy consumption in domestic appliances. Parans offers a system that collects and intensifies sunlight on a rooftop like a solar panel, then transmits it over a fiber optic network to unlit interior spaces.

The capacity of Swedish engineers and scientists to develop and integrate complex systems is manifested not only in cleantech segments, but also in other relevant industries, including the nation's aerospace, automotive and engineering industries.

Advanced research carried out at several universities

Swedish universities are renowned for their strong engineering capabilities. Advanced research is taking place at the Royal Institute of Technology (KTH) in Stockholm, Chalmers University of Technology in Göteborg, Linköping University, Luleå University of Technology, Lund University and Umeå University. Areas of expertise include biofuels, biogas technology, cellulosic bioenergy, CO₂ separation, combustion technology, soil treatment and third-generation solar cells. Dedicated cleantech incubators are associated to the universities.

Entrepreneurial researchers create spin-offs

A proud engineering tradition and a strong entrepreneurial drive explain Sweden's innovativeness, with academic re-



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search firmly rooted as the origin for many of Sweden's current cleantech stars. The Ångström Laboratory at Uppsala University is one example. The lab has spawned Chromogenics, whose award-winning electrochromic technology can reduce or even eliminate the need for air conditioning in buildings and vehicles, and Seabased, whose wave power technology has attracted the largest energy companies in the Nordic countries. The lab also conducts frontline research in hydrogen gas storage and lithium-ion battery technology.

Venture capitalists interested in syndication

Sweden offers one of Europe's most mature venture capital markets, with both public actors such as Industrifonden, private investors such as Sustainable Technologies Fund and corporate venture capitalists such as Volvo Technology Transfer active in cleantech investments. International syndication is frequent, as demonstrated by investments in Beakon Technologies, Chemrec, ClimateWell, Sol Voltaics and QuNano, for example.

Pinpointed by the US for cleantech innovation

Swedish firms have been specifically targeted by the United States as sources of cleantech innovation. Numerous innovative firms have been introduced to US investors, as part of a special project initiated by the US Embassy in Stockholm. Moreover, the US Department of Energy and the Swedish Energy Agency have agreed to work collaboratively on accelerating consumer acceptance and commercialization of plug-in hybrid vehicles.

Innovative Swedish cleantech companies – a selection

Alternative/renewable vehicle fuels

- ▶ **Ageratec**, Norrköping – Biodiesel processors
- ▶ **Chematur Engineering**, Karlskoga – Bioethanol production technology
- ▶ **Chemrec**, Stockholm/Piteå – Black liquor gasification
- ▶ **Consat**, Partille – Alternative powertrains and energy systems
- ▶ **Ecoil**, Kungsör – 2nd generation biofuel technology
- ▶ **REAC Fuel**, Lund – High efficiency biofuel technology
- ▶ **SEKAB**, Örnsköldsvik – Cellulosic ethanol
- ▶ **Swedish Biofuels**, Stockholm – 2nd generation biofuels

Boiler/combustion technologies

- ▶ **Catator**, Lund – Catalytic cleantech
- ▶ **Chemrec**, Stockholm/Piteå – Black liquor gasification
- ▶ **Compower**, Lund – Energy efficient boilers
- ▶ **Cortus**, Stockholm – Biomass gasification
- ▶ **Hotab-Gruppen**, Halmstad – Combustion plants for solid biofuels
- ▶ **NIBE Heating**, Markaryd – Heat pumps
- ▶ **Svensk Rökgasenergi**, Stockholm – Flue gas condensation

Efficient building

- ▶ **Comfort Window System**, Göteborg – Energy efficient windows
- ▶ **ChromoGenics**, Uppsala – Smart windows
- ▶ **Diana Solutions**, Malmö – Control and monitoring systems
- ▶ **Exergy Engineering & Consulting**, Göteborg – Biomass dryer technologies
- ▶ **Neova**, Jönköping – Biofuel plant technology
- ▶ **Nordiq**, Nol – Heat exchange substations
- ▶ **Parans Solar Lighting**, Göteborg – Fiber optic solar lighting
- ▶ **Rehact**, Stockholm – Energy efficient ventilation
- ▶ **TD Light Sweden**, Nyköping – Low energy lighting

Electricity production

- ▶ **Hexaformer**, Upplands Väsby – Three phase transformers
- ▶ **SEEC**, Stockholm – Energy storage systems

Engine technologies

- ▶ **Effpower**, Hisings Backa – Bipolar batteries for HEVs
- ▶ **Electric Line**, Uppsala – Electrical vehicle propulsion system
- ▶ **Nilar International**, Stockholm – Membrane battery technology
- ▶ **Norstel**, Norrköping – Silicon carbides for hybrid electrical vehicles
- ▶ **Picoterm**, Kista – Thermoacoustic engine technology
- ▶ **Opcon**, Åmål – Energy efficiency systems
- ▶ **Stridberg Powertrain**, Stockholm – Hybrid systems for vehicles
- ▶ **TranSic**, Stockholm – Bipolar power transistors

Fuel cells

- ▶ **Opcon**, Åmål – Energy efficiency systems
- ▶ **Morphic Technologies**, Karlskoga – Renewable energy systems

Solar technologies

- ▶ **ClimateWell**, Stockholm – Solar cooling and heating system
- ▶ **EarthSun Technology**, Finspång – Solar thermal energy systems
- ▶ **Kockums**, Malmö – Concentrated solar power
- ▶ **Midsummer**, Stockholm – Thin-film solar cells
- ▶ **Parans Solar Lighting**, Göteborg – Fiber optic solar lighting

Transportation systems

- ▶ **SkyCab**, Stockholm – Rapid transit systems

Waste-to-energy

- ▶ **Beakon Technologies**, Malmö – Thermoelectric chip
- ▶ **Bioprocess Control**, Lund – Biogas production optimizer
- ▶ **Econova**, Åby – Waste to energy solutions
- ▶ **Karlskoga Biofuels**, Karlskoga – Biogas production process
- ▶ **Läckeby Water Group**, Lund – Water treatment and biogas production
- ▶ **Opcon**, Åmål – Energy efficiency systems
- ▶ **Ranotor**, Sigtuna – High performance steam engines
- ▶ **Scandinavian Biogas**, Uppsala – Biogas production
- ▶ **Swebo**, Boden – Bioenergy systems
- ▶ **Swedish Biogas International**, Linköping – Biogas production
- ▶ **Xylophane**, Göteborg – Barrier material for packages
- ▶ **ÄFAB**, Lidköping – Bioenergy consultant

Wave power

- ▶ **Seabased**, Uppsala – Wave power solutions

Wind power

- ▶ **Swedish Vertical Wind**, Uppsala – Wind turbines
- ▶ **TranSiC**, Stockholm – Bipolar power transistors

Source: US Embassy in Stockholm "Wood's List 2008"

Showcase for integrated infrastructure

Combining environmentally conscious policymaking and collaborative R & D efforts has enabled Sweden to introduce innovative solutions to a wide range of sustainability challenges facing cities and industries.

For decades, a step ahead

40 percent of Sweden's energy consumption is sourced from renewable energy resources, placing Sweden first in a European comparison and well ahead of the EU average of 8.5 percent. Sweden has been an environmental leader since the early 1960s, when environmental campaigns paved the way for policy and legislation far ahead of its time. Today, efforts are guided towards reaching the goal set by Sweden's Parliament: to hand over to the next generation a society in which the country's major environmental problems have been solved. By 2030, the capital of Stockholm aims to be completely carbon-dioxide neutral.

Integrated infrastructure, innovative technology

Swedish cities have integrated the planning of transport and traffic, water and sewage treatment, waste collection, employment and housing to create increasingly sustainable cities with low carbon footprints. The solution is to embed a wide range of both classic and innovative technologies into the everyday systems of a city, realize energy synergies and increase use of renewable energy, promote sustainable transport and increase energy efficiency in buildings. NSR, a recycling company owned by six municipalities in the northwest Skåne region, is one of Europe's foremost biogas producers, with a number of pioneering technology implementations.

A leader in bioenergy generation and distribution

Bioenergy today accounts for more than 25 percent of Sweden's energy consumption. Extensive know-how in energy generation from organic and cellulosic sources has been built up. Sweden's ability to distribute its bioenergy owes much to a well-developed district heating and district cooling system, with 75 percent of commercial buildings and more than 50 percent of homes connected to district heating. Increasing volumes of biogas are distributed



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in the natural gas grid, which allows for wider and more industrialized biogas applications.

Sustainability and energy efficiency in buildings

Sustainability in buildings is highly prioritized and is applied both to new and older constructions. All Swedish buildings will be declared for energy efficiency, with individual action plans to increase energy efficiency provided to all property owners. New norms are constantly applied for energy use in new buildings, and have contributed to the rise of Swedish expertise in heat exchangers. The fact that all buildings have electric meters facilitates development work. Municipal energy advisors to guide consumers and business have been in place since the 1980s.

Sweden also embraces passive house technologies, due to become a European construction norm. By 2009, passive houses are to account for at least 40 percent of new residential construction for Göteborg's municipal housing company.

CASE: SUSTAINABLE CITIES

Eco-cities: the Swedish model

Many Swedish cities and city districts have implemented comprehensive eco-cycle models for the local energy, waste and water infrastructure, including the cities of Göteborg, Helsingborg, Skellefteå and Växjö (Europe's greenest city in 2007). The city districts of Hammarby Sjöstad in Stockholm and Western Harbor in Malmö, both constructed in former industrial areas, are some of the world's foremost sustainable city concepts.

www.alvstranden.com

www.malmo.se/sustainablecity

www.hammarbysjostad.se

www.symbiocity.org



Hammarby Sjöstad, Stockholm



Ålvstranden, Göteborg

CASE: SUSTAINABLE INDUSTRY

More renewable supply to Swedish petrochemical cluster

Large synergies can be reaped when traditional and renewable industries become more integrated. A large-scale biogas generation project promises more renewable supply to Western Sweden's petrochemical cluster, with benefits enhanced by the proximity to the natural gas grid.

Göteborg is Sweden's second largest city and its main industrial home – half of Scandinavia's industrial capacity is located within a 300-kilometer radius of the city. This includes the major petrochemical industry cluster, with seven refineries and chemicals plants in the area.

The city itself has long since promoted sustainable energy supply. Heat from

industrial waste heat exchangers and a waste cogeneration plant supply some 55 percent of the city's annual heat demand. During the winter additional heat is produced from a natural gas fired cogeneration plant.

Seeking to increase the share of biogas to the natural gas grid passing through the city, the municipal energy company Göteborg Energi has decided to invest in the world's largest gasification plant for biofuels (see page 10). The biogas will be distributed via the natural gas grid and used for a variety of applications in power and heat generation as well as chemicals and transportation fuels production.

Co-distribution of biogas in the gas grid opens up a lot of opportunities to the petrochemical industry, in particular. Of key importance is the proximity of necessary facilities and infrastructure: the biogas plant; the refining and petrochemical capabilities; the gas grid; the district heating system. True synergies can thus be realized.

A number of possibilities for biogas upgrading have been identified in the cluster network and are in different stages of investigation or implementation. These include biogas as reformer feedstock for hydrogen production (Preem refinery in Göteborg) and biogas as feedstock for methanol production in a deeply integrated methanol plant (Perstorp Oxo, Stenungsund).

Bio-synergies not specifically related to biogas are already exploited in Stenungsund. In Sweden's largest plant for vehicle biofuels, Perstorp Oxo produces RME (rapeseed methyl ester) for blending with diesel at a capacity of 160 kton per year. In addition, Borealis produces ETBE (ethyl tert-butyl ether) for blending with gasoline.

www.businessregiongoteborg.com



The petrochemical cluster in Western Sweden comprises Akzo Nobel, Borealis, Ineos, Perstorp Oxo, Preem and Shell. A wide range of fuels and chemicals are manufactured at advanced facilities in Göteborg, Lysekil and Stenungsund. The Preem refinery in Lysekil is Scandinavia's largest and the manufacturer of the world's cleanest diesel. In total, the cluster employs more than 3,000 staff.

In the frontline of transportation biofuels

Sweden is the ideal place to develop and test biofuels, thanks to a fortunate mix of raw material assets, relevant processing capabilities and expertise in engine development. Sweden offers opportunities in both first and second-generation biofuels.

A unique asset base

Few countries boast such good prerequisites for biofuel development as Sweden. To begin with, there is ample access to raw material, such as biomass from vast forests, agriculture, waste and by-products from pulp and paper manufacturing. Secondly, capabilities in forest chemistry have resulted in technologies for creating biofuels with high energy value. Thirdly, Sweden has solid refining know-how in its petrochemical industry (a Swedish refinery produces the world's cleanest diesel) and is home to the two largest manufacturers of heavy diesel engines, truck makers Scania and Volvo. Volvo Trucks recently introduced seven carbon-neutral engines capable of running on specific alternative fuels – engines that are being put to the test in Sweden. In addition, Sweden's automotive brands Saab and Volvo are pioneering hybrid plug-in vehicles. Sweden also has several dedicated vehicle test environments, e.g. Test Site Sweden and Swedish Winter Test Region.

Widespread use of renewable fuels

Sweden has embraced renewable fuels, including biogas and ethanol, in a major way. This is partly due to a law requiring filling stations of a certain size to offer renewable fuels. A range of incentives has resulted in rapid growth in green car sales, which account for some 35 percent of new car sales. Sweden's leadership in biogas is manifested in numerous ways. Some 35 Swedish plants currently produce vehicle fuel from biogas and there are large numbers of biogas-driven vehicles and biogas filling stations.

Large-scale biogas plants are planned in several locations. One example is the GoBiGas (Göteborg Biomass Gasification) project, which will see a variety of biofuels, including synthetic diesel, dimethyl ether (DME), hydrogen gas and upgraded biogas, being produced from biomass. The project, a world-first for its size, is a cooperation



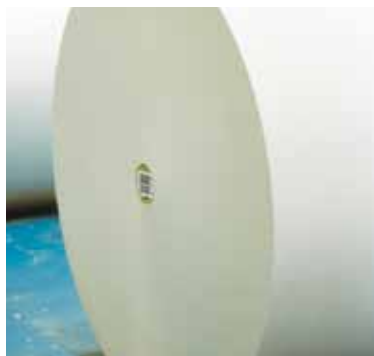
INVESTMENT OPPORTUNITY

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between the municipal energy company Göteborg Energi and the German energy company E.ON. Another public pioneer is Stockholm Public Transport, which operates the world's largest fleet of ethanol buses. Biogas in public transport is widespread in the Göteborg, Norrköping/Linköping and Skåne regions.

Innovative solutions for cellulosic biofuels

A number of innovative biofuels companies are developing solutions based on Sweden's forest assets. The Chemrec and Sunpine technologies are presented on the next page. Swedish Biofuels, a US Defense Department contractor, has developed a 100-percent grain-derived biofuel as an alternative to JP-8 jet fuel, the most commonly used jet fuel in the US military, and aims to repeat the achievement using wood pulp and agricultural waste.



Complete value chain for cellulosic biofuel development

The BioDME and SunPine projects clearly demonstrate Sweden's competitive advantages for biofuels development, with abundant access to raw material and pulp mills and strong biorefinery know-how.

Sweden is a great location for forestry-based biorefineries, due to the vast forest resources and presence of numerous pulp and paper mills. Considerable efforts are now devoted to creating new revenue streams out of the forest resources and to developing efficient processes in optimally integrated biorefinery systems. The Solander Science Park in the city of Piteå is specifically focused on wood-based biorefining technology, and brings together numerous research and business development activities.

The BioDME and SunPine projects will see construction of two separate plants for biofuel production in Piteå, one for the manufacturing of DME dimethyl ether from black liquor and the other for the manufacture of green diesel from tall oil.

The BioDME project

The Swedish truck manufacturer Volvo coordinates the BioDME project, a collaborative project involving the automotive industry as well as fuel producers and distributors. The project, which demonstrates the entire technology chain from biomass to trucks powered by DME fuel and including fuel distribution and filling stations, has partners from all industrial sectors necessary to introduce a new fuel.

The Swedish company Chemrec, which holds the gasification technology patents, is constructing the plant together with the Norwegian company Haldor Topsøe. Volvo will demonstrate the DME technology in 14 trucks

and Preem will build filling stations in four Swedish cities. The project is co-financed by the consortium partners EU's Seventh Framework Program (FP7) and the Swedish Energy Agency.

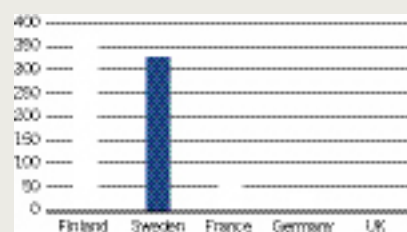
Construction of the plant began in 2008 and by early 2010 it is anticipated to deliver 4-5 tons of BioDME daily. The plant will be built as an integrated biorefinery at Smurfit Kappa's paper mill in Piteå. Full implementation of the Chemrec technology in all Swedish pulp mills would yield enough biofuel to supply 25 percent of the current domestic automotive fuel consumption.

The SunPine project

The company SunPine, a partnership between forest owners Sveaskog and Södra Skogsägarna, the refinery company Preem and Lars Stigsson, the inventor of the SunPine technology, began construction of its pine diesel factory in Piteå in the fall of 2008. Planned for a capacity of 100,000 cubic meters, the factory will begin production in early 2010, establishing Sweden as the first country in the world to produce green diesel from wood raw material

Vast forest resources in Sweden

Timber stocks per capita, cubic meters



Source: Swedish Forest Industries Federation, 2008

on an industrial scale. Crude tall oil will be supplied from a number of paper mills.

Following shipment by boat, the raw pine diesel will be refined in a second process at Preem's petroleum refinery in Göteborg, where a plant capable of refining renewable raw material is under construction. This new plant is also the first of its kind. The SunPine fuel will be used to create a bio-diesel with almost 30 percent share of renewable energy source and will primarily be distributed to corporate customers with own filling stations.

THE BIODME-PROJECT

Black liquor to DME, dimethyl ether

World's first BioDME-plant to be built at Smurfit Kappa Kraftliner factory in Piteå.

Project partners: Chemrec (gasification technology), Volvo Trucks (demonstration trucks), Smurfit Kappa (raw material supply), Preem (distribution).

Other partners: Delphi (DME fuel injection systems), ETC, Center for Energy Technology in Piteå (synthesis gas expertise), Haldor Topsøe (DME synthesis technology), Swedish Energy Agency (financial support), Total (DME fuel grade specification).

www.biodme.eu

THE SUNPINE PROJECT

Biodiesel from tall oil

World's first industrial-scale manufacturing of green diesel from cellulose.

Developer: SunPine (owned by Preem, Sveaskog, Södra Skogsägarna and the founders). Plant in Piteå to produce tall oil diesel, shipping to Göteborg for upgrade at Preem biorefinery. Distribution to corporate customers.

Investments: EUR 25 million in SunPine plant in Piteå, EUR 25 million in biorefinery in Göteborg

www.sunpine.se

Extensive wind power build-up under way

Sweden has a solid industrial base for wind power manufacturing and offers some of Europe's best potential for wind farm expansion, due to vast sparsely populated areas, good wind conditions and a long coastline.

A force in wind power technology

A number of world-leading suppliers to the wind energy industry are based in Sweden, including SKF (bearings and sealing solutions, remote monitoring systems), ABB (power and fiber optic cables) and ESAB (welding and cutting technology). Foreign investment activity is high. Danish Vestas has acquired two Swedish foundries to secure supply and has established its northern European headquarters in Malmö, to cover the Nordic and Baltic markets, the UK and Poland. Malmö is also home to wind tower manufacturing for Enercon.

Access to cutting-edge know-how

Sweden's solid industrial know-how in heavy engineering and advanced construction is a considerable benefit for companies planning to establish manufacturing or assembly activities here. For instance, Sweden is home to several globally leading specialty steel companies. In addition, Sweden boasts strong aerospace, information technology and electronics industries. Research on wind power in Arctic environments and on composite material for wind turbines is carried out at a number of locations.

Large onshore developments

Two-thirds of Sweden's targeted wind power output by 2020, or 20 TWh, is projected to come from onshore wind farms. Numerous large-scale projects are under way, both by Swedish developers such as O2 Vindkompaniet and Vattenfall and by foreign developers like Airtricity, Dong Energy and RES. Land owners including forest companies such as SCA, Sveaskog and Södra are involved in project development. One of the largest approved projects is Skellefteå Kraft's construction of 100 wind turbines in the Blaiken area in northern Sweden. As of end-2008, 3.8 TWh of onshore wind farm projects were under construction or had all necessary consents, 4.4 TWh were under environmental assessment.



INVESTMENT OPPORTUNITY

The Swedish wind power sector offers turbine manufacturers and suppliers both market and technology potential. Invest in assembly and manufacturing operations and capitalize on Sweden to develop solutions for Arctic climates.

A long coastline promotes offshore wind farms

Offshore wind farms are projected to account for one-third of Sweden's targeted wind power output by 2020, or 10 TWh. Sweden is well placed for offshore wind farms, with a 1,350 km coastline in the Baltic Sea and along the southwest of the country (the Kattegat and Skagerrak sea areas). The waters of the Skåne region in southern Sweden are particularly in focus for offshore developments. Examples of large developments include Vattenfall's Lillgrund in the Öresund Strait, the world's third largest offshore wind farm, which was inaugurated in 2008. Some 30 km south of Trelleborg, Vattenfall is planning to build Kriegers Flak with 128 turbines. As of end-2008, 6.5 TWh of offshore wind farm projects were under construction or had all necessary consents, 1.9 TWh were under environmental assessment.

CASE: SWEDEN'S WIND POWER POTENTIAL



Increasing wind power output 20-fold

Sweden is a dynamic place for wind farm construction and will see extensive developments over the next decade. The target for wind power output, as recommended by the Swedish Energy Agency, is 30 TWh by 2020, a 20-fold increase compared with the current production levels. To reach that goal, some 5,000 new wind turbines may be needed.

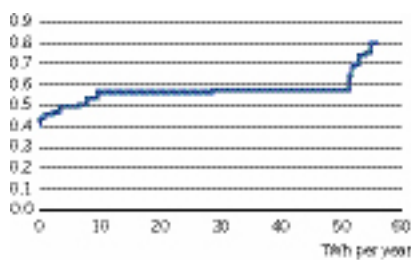
Northern Sweden, particularly the Väs-

terbotten and Jämtland counties, is likely to see the most extensive build-up.

These are sparsely populated areas with good wind conditions, where few parties are affected by developments. In the Markbygden area, outside Piteå, there are plans to build Europe's largest wind farm – 1,000 wind turbines to generate 8–12 TWh annually. Construction on the wind farm began in 2008.

Swedish wind power potential

Cost in SEK per kWh, assuming 10% of the technical potential is realized

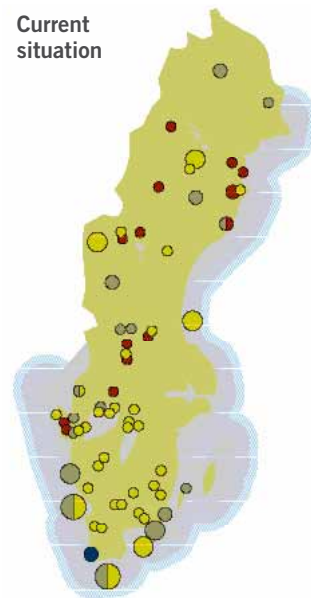


Source: Elforsk, "Vindkraft i framtiden", 2008

The Swedish Energy Agency and the energy industry research institute Elforsk have studied the economic potential for onshore and offshore wind power in Sweden by 2020. The study considers physical, technical and economic conditions that affect profitability in wind projects, and shows a total technical power potential of 510 TWh per year on land and 46 TWh per year offshore. Assuming 10 percent of the technical potential can be realized, this leaves potential for more than 50 TWh per year from wind power in Sweden. The graph shows estimated costs for such a build-up. www.elforsk.se

Wind farms > 20 MW

Current situation



- In operation
- Under construction
- Has all necessary consents
- Under environmental assessment

Source: Swedish Wind Energy, October 2008

A great market for environmental engineering services

Sweden's industrial base in heavy engineering – with leading automotive, energy, engineering, metals, mining, and pulp and paper companies – drives demand for environmental engineering know-how.

A leading industrialized nation

For more than a century, Sweden has relied on its industry base to become one of the world's most competitive and productive economies. Companies like ABB, Alfa Laval, Ericsson, SKF and Volvo are synonymous with product quality and business acumen. In latter years, Sweden's multinationals have also come to lead in corporate social responsibility issues, investing heavily to improve environmental performance and being highly transparent about what is being done. It comes as no surprise then, that sustainability issues are a top priority – Volvo, for example, has opened a completely climate-neutral car factory.

Large project investments

A boom in energy and mining-related investment projects now adds to demand for advanced environmental engineering services, particularly in project planning and engineering, and in environmental assessments and pilot studies. Northern Sweden is particularly in focus for the investments projects, due to the richness of natural resources there. At the copper mine in Aitik, the mining company Boliden will double capacity from 18 to 36 million tons. In Kiruna, home to large iron ore reserves and the LKAB mines, future exploration requires the city center to be moved.

Gate to the Barents Sea Region

Sweden is also an excellent platform for business activities targeting oil and gas explorers, energy companies and metals and mining companies in northern Sweden, Norway, Finland and Russia as well as the Barents Sea Region.

The northernmost part of the Scandinavian peninsula, including the Barents Sea, is one of the world's richest in natural resources. These include oil and gas in the Barents Sea, mining in northern Sweden, hydropower in northern Sweden, and pulp and paper activities in northern Sweden and northern Finland. Lately, these areas have also be-



INVESTMENT OPPORTUNITY

There is ample scope to provide environmental consulting services, both to clients in Sweden and in Scandinavia/the Barents Sea Region.

come the center of attention for wind energy. Massive investments are planned in this area over the coming decades, in the form of exploration activities, the opening of new mines, expansion of hydropower plants, the build-up of wind farms, etc. There is also substantial potential to assist in sustainable development in the Murmansk region in Russia. This area, which is rich in minerals and forest resources, and which offers good potential as the base for oil and gas exploration in the Barents Sea, is officially recognized as the most environmentally devastated region in the Arctic region.

Choosing Sweden as the base for business makes sense, given its central location and the sheer scale of investments planned here. Culturally, it is easy to do business here – the northern areas in Norway, Sweden, Finland and Russia are areas that traditionally have had substantial exchange in terms of trade and cultural traditions.

Contact Invest Sweden or its local partners for investment assistance

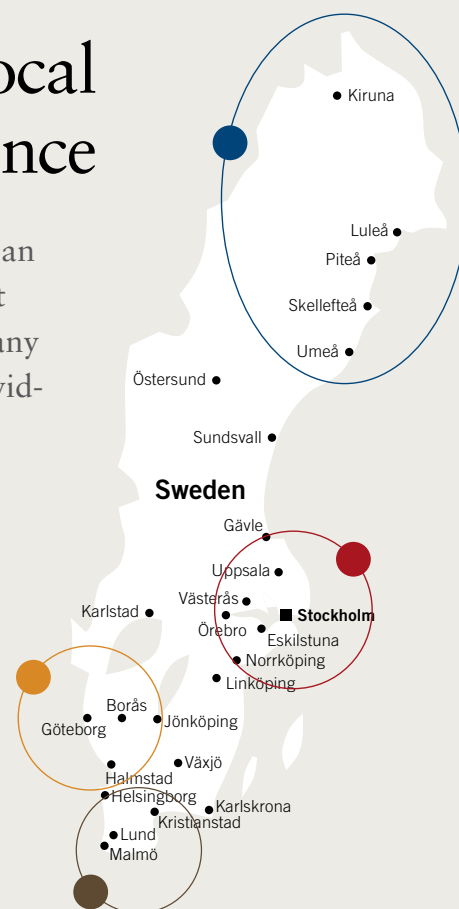
Sweden provides extensive local assistance for the duration of an establishment or expansion process. Do not hesitate to contact either Invest Sweden directly (cleantech@investsweden.se) or any of the local cleantech partners presented here. All services provided are free of charge.

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ABOUT SWEDEN

Center for innovation

Sweden is one of the world's most globalized and competitive nations, as demonstrated for example by a recent report from the World Economic Forum. Sweden also invests more in R&D as a proportion of GDP than any other OECD country. Sweden's capacity for innovation is due to a number of factors: the propensity among Swedish businesses to adopt new technologies and skills; high R&D spending in the private sector and fluid cooperation between business and academia. Sweden's strengths also include a high quality educational system, a qualified workforce and a commitment to lifelong learning in business and the public sector. Companies that originate in Sweden include AstraZeneca, Ericsson, H&M, Ikea, Securitas, Tetra Pak and Volvo.

Europe's most competitive countries

2008, score

Sweden	5.71
Denmark	5.64
Finland	5.64
Netherlands	5.44
Austria	5.34
Germany	5.34
Luxemburg	5.22
France	5.12
UK	5.12
Belgium	5.11

Source: World Economic Forum, Lisbon Review 2008

R & D expenditure

2006, percent of GDP

Israel	4.5
Sweden	3.7
Finland	3.4
Japan	3.3
Korea	3.2
Switzerland	2.9
US	2.6
Taiwan	2.6
Germany	2.5
Austria	2.4

Source: IMD, 2008

Advantages to foreign investors

Businesses across a wide range of industry sectors capitalize on Sweden for product and process innovation. Many multinationals choose Sweden as the location for regional headquarters to cover markets in Scandinavia and Northern Europe.
www.investsweden.se

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Invest Sweden is the government agency responsible for promoting business and investment opportunities in Sweden. Companies planning to establish or expand operations in Sweden can, free of charge, obtain information and assistance from Invest Sweden and its regional and international network.

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