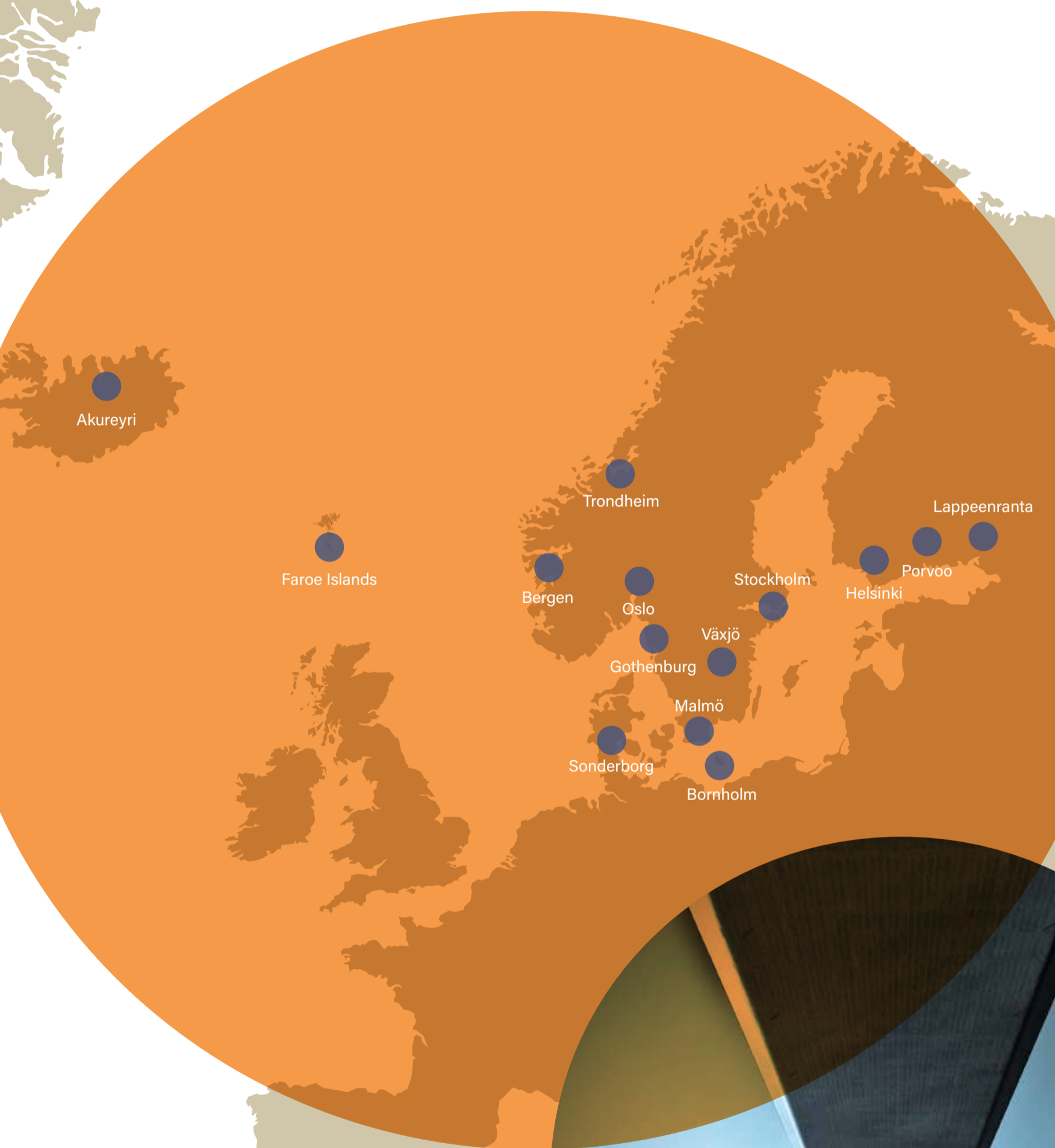


SHARING NORDIC SOLUTIONS

NordicGreenTransition.dk



Hybrid battery solutions for offshore vessels
Bergen, Norway

Climate neutrality in sight
Sonderborg, Denmark

Gothenburg for smart district heating and cooling solutions
Gothenburg, Sweden

100% green energy in the Faroe Islands by 2030
Faroe Islands, Denmark

Porvoo on its way to carbon neutral living
Porvoo, Finland

In Malmö waste becomes fuel
Malmö, Sweden

Bornholm CO2 neutral in 2025
Bornholm, Denmark

Lappeenranta acting as a trailblazer for a green revolution
Lappeenranta, Finland

Transport in Trondheim is going green
Trondheim, Norway

Fossil fuel free Växjö 2030
Växjö, Sweden

Helsinki's Kalasatama district to get the World's smartest energy system
Helsinki, Finland

City of Stockholm, Clean Vehicles and Fuels program
Stockholm, Sweden

Vistorka - Carbon neutral Akureyri
Akureyri, Iceland

The green transition in Oslo
Oslo, Norway

Shaping green economies and sustainable communities is one of the most important challenges of our time. Sharing of knowledge is essential for coping with these challenges effectively. It requires innovative thinking and strong collaboration across borders and sectors. In this publication, 14 Nordic cities and municipalities give a brief account of some of their work, recognising the need for exchange of experience and solutions to enable a global green transition.





Bossnet is an automated system that transports waste using vacuum suction. The system replaces waste bins and containers, and minimises the need for large waste collecting trucks travelling the narrow, medieval city streets of Bergen.

Hybrid battery solutions for offshore vessels

BERGEN
NORWAY

Learn more - www.bergen.kommune.no, www.bir.no/pdf

Bergen Municipality in Norway aims to become carbon neutral 2030 in accordance with the national target and has taken a large variety of actions to achieve this target. This includes efforts to optimize waste handling. One solution is to build an underground waste system that can reduce the need for driving heavy trucks in the city centre.

Waste collection – an underground movement?

Bergen's new underground waste system, named 'Bossnet' became operational in the autumn of 2015. Some € 50 million has been invested in the system, and it is one of the largest and for sure the most complicated waste system in the world.

Bossnet is an automated system that transports waste using vacuum suction. The system replaces waste bins and containers, and minimises the need for large waste collecting trucks travelling the narrow, medieval city streets of Bergen.

The waste is automatically transported from the collection points – so-called inlets – to a terminal in the outskirts of the city centre, where it is compressed and stored in large containers. These containers are then picked up and transported to various recycling facilities, depending on the type of waste they contain. The system is designed and built to handle both household waste and waste from small business (shops, cafe, offices etc.). The user operates the inlet with a RFID chip that transfers information to help optimise the logistics of the system.

A shipping fleet of the 21st century

Another source of transport related carbon emissions is shipping. Relatively few have attempted to target this source but the City of Bergen collaborates with Eidesvik to support introduction of new energy types in shipping. Eidesvik shipping company owns and operates 26 vessels, including five vessels that run on liquefied natural gas (LNG), and uses Bergen Harbour and its facilities.

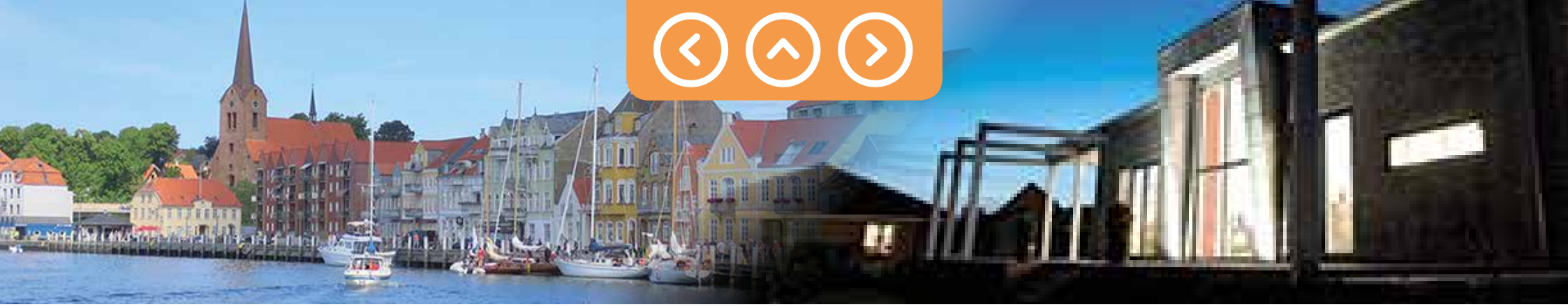
The vessels are primarily used for supply and disaster management tasks in relation to offshore installation but also for subsea maintenance tasks.

Eidesvik installed a battery system on the LNG powered vessel 'Viking Lady' in 2013 and on the vessel 'Viking Queen' earlier this year. The company is now planning to do the same on the LNG powered vessel 'Viking Energy'. The total investment amounts to about NOK 17 million, and Enova SF will contribute NOK 7.44 million. Enova SF is owned by the Ministry of Petroleum and Energy and was established in 2001 to contribute to a shift towards more climate and environmentally friendly energy consumption and production in Norway. The maritime sector is one of its focus areas.

A battery system can reduce the fuel consumption, and thereby also the energy costs, by up to 20% when the batteries are used. In the case of 'Viking Energy', the annual energy consumption on the vessel will be reduced by 4.5 GWh, which corresponds to the annual consumption of more than 200 Norwegian households.

Shipping vessels vary greatly in terms of propulsion systems, operating profiles and what tasks they are used for. One solution does therefore not fit all. Even though battery systems have been tested in several vessel types, there is still a need for further development projects and trials before renewable energy solutions become the standard solution.





Climate neutrality in sight

Declaration from Sonderborg, Denmark: It is doable

SONDERBORG
DENMARK

Learn more - www.ProjectZero.dk, www.climateneutral.eu, www.compactofmayors.org

The citizens of Sonderborg Municipality act, while politician's talk and climate change is accelerating. 76,000 citizens share the vision of ProjectZero and have committed themselves to making Sonderborg climate neutral by 2029.

Sonderborg wants to prove that climate neutrality is achievable when cities take decisive action and ensure citizens and companies participate in retrofitting society's energy generation and consumption.

The ProjectZero vision and project is focused on transitioning Sonderborg into a ZEROcarbon community, based on sustainable growth and creating new green jobs. Energy efficiency and energy from the municipality's own renewable sources are the key means to making the vision a reality. New thinking is essential and public policy and investments will fuel the transition. A majority of the municipality's homes are now heated by green district heating based on solar, heat pumps, biofuel and geothermal energy extracted from the ground. A massive investment in wind energy is currently underway.

The impact on local communities has been significant. The municipality has already achieved a 30% reduction in greenhouse gas emissions since 2007. In other words, Sonderborg has proven it is doable. So what is the recipe?

Participation and local networks are crucial. 93% of the citizens know of ProjectZero, and more than 100 families have become ZEROfamilies, learning how to save energy. The results are impressive, with an average family using 25% less energy and consuming 45% less water.

The energy+ house inspires local residents

In 2009, a unique house was built in Sonderborg. A home that produces more energy than the family that lives in it consumes. The energy+ house is based on a combination of energy-efficient insulation, ventilation, solar energy, a geothermal heat pump and an ultramodern energy management system that constantly optimizes the energy use. The energy+ house and its family have inspired many other families.

Funded by the local energy company and Danish foundations, the ZEROhome program has offered 18,600 private homeowners in Sonderborg the chance to have an independent expert measure their homes' energy consumption for free. A total of 1,200 homeowners have already received a list of improvement options, and 63% of them have energy retrofitted their homes using local craftsmen, who have been specially trained to do the job.

Homeowners have also been inspired and motivated, and have reduced their energy costs, investing an average of € 21,000 in their homes. Since most homeowners often

need to finance their homes' retrofit, ZEROhome has worked with the local area's banks to create new and attractive loans for them.

Children have become energy experts in schools and family members are enjoying helping sports clubs become beacons of progress – transforming Sonderborg's 35 sports centres into ZEROcarbon facilities – and use lessons learned at work and in their everyday life.

Companies have reduced emissions by more than 45%

Sonderborg is also home to many green tech companies like Danfoss, a global player in energy efficiency technologies, and Linak, which makes key components for wind turbines and sun tracking photovoltaic installations. More than 60 companies have committed to reducing their carbon footprint. Some of them have already reduced emissions by 45%, but all of them are actively looking for effective ways to achieve ZEROcarbon in their operations.

Local energy companies and universities assist the transition to secure effective policymaking, new solutions and strong participation.

Scaling up best practices

Tackling climate change requires new ways of cooperation at all levels. Sonderborg is constantly looking for global partnerships that will inspire and scale up its local efforts, and Sonderborg is working hard to become a role model that can inspire others. In 2012, Sonderborg joined the CCI Climate Positive program working with C40, and in October 2015, Sonderborg's mayor Erik Lauritzen signed the UN Compact of Mayors agreement.



Sonderborg urges COP21 to draw heavily upon the possible contribution of all cities and local communities of the world to strengthen the role of local action in climate change mitigation and adaptation.



Innovative district heating and cooling solutions can exploit short periods with low energy prices and constitute a buffer against high energy prices in a dynamic energy system based on renewable energy. Gothenburg is demonstrating how in the Smart Cities project 'Celsius' together with 4 other European cities.

Gothenburg for smart district heating and cooling solutions

GOTHENBURG
SWEDEN

Learn more - www.celsiuscity.eu

District heating networks can be used to exploit waste heat and thereby reduce CO2 emissions without compromising thermal comfort. Gothenburg began to develop its district heating network in the 1950s and today it counts up to 100 miles of pipes. 90% of apartment buildings and 12,000 homes are heated by district heating, as well as many industrial and public buildings.

Over the years, Gothenburg have become increasingly better at using recycled energy and waste heat as fuel for district heating. Waste incineration account for 24%, while waste heat, including from refineries, contributing 36% of the energy.

"In Gothenburg, we are very good at developing the district heating system and use heat resources multiple times. We take advantage of almost all the waste heat from industrial processes to wastewater and this we want to share to other European cities", says Katrina Folland, Gothenburg's project coordinator for CELSIUS.

Gothenburg leads the EU founded Smart Cities project CELSIUS

In 2013, the European commission trusted the City of Gothenburg to lead the EU founded Smart Cities project CELSIUS with the aim to share knowledge and showcase the potential of district heating and cooling. 21 different partners are involved in Gothenburg, London, Rotterdam, Genoa and Cologne, and each city will build different demonstration plants. The aim is to recruit 50 new CELSIUS city members by 2017. The project provides support that includes workshops, interactive toolboxes, specialist expertise and study visits.

Katrina Folland: "The EU believes that a comprehensive expansion of district heating and cooling would have a significant impact on the efforts to achieve EU's climate targets. District heating and cooling also contributes to better air quality. Today, the houses in many countries, are still heated with individual boilers in each house."

The aim with the project CELSIUS clearly connects to several of the strategic objectives in the City of Gothenburg's climate program. The Gothenburg climate program

states that "by 2030, all districts heating derives from renewable energy sources, waste incineration and residual heat from industry and by 2030, the total use of primary energy for electricity and heat does not exceed 31 MWh per inhabitant".

If the City of Gothenburg delivers on these goals, then Gothenburg has a higher chance of reaching the long term goal that in 2050 Gothenburg has a sustainable and equitable level of greenhouse gas emissions.

A platform of networking and knowledge 'CELSIUS' illustrates how cities can save energy and create a more self-sustaining energy economy through the deployment of district heating and cooling systems. The CELSIUS project takes a holistic approach to overcome technical, social, financial and political barriers to district heating and cooling solutions.

District heating to ships and short term thermal storage

The spine of the project includes 10 new demonstration sites and 20 already in operation. These bring to the table innovative technologies, systems and practices, covering the areas of system integration, sustainable production, storage, end-user technologies and infrastructure. In Gothenburg, the CELSIUS project demonstrates ground-breaking applications for district heating, such as the world first's connection of a passenger ship in regular service to a heating grid while it is in the harbour. It is estimated that the switch from bunker oil to district heating in the one ship alone will reduce the CO2 emissions by as much as 172 tonnes per year (62%).

Additionally, buildings are used for short-term thermal storage. If there is a forecasted drop in the outside temperature, selected buildings are "uploaded" with heat while the overall demand in the system is low, so they do not need to be heated during peak hours. In another example, washers and dryers are installed that use heat from the district heating system. Electricity is still used for the engines but 70-80% of the electricity consumption of these machines is replaced by district heating.





100% green energy in the Faroe Islands by 2030

FAROE ISLANDS
DENMARK

Learn more - www.sev.fo

Faroe Islands, an isolated archipelago in the North Atlantic Sea, between Iceland and Scotland, have ambitious goals for a bright green energy future. Due to its favourable site conditions, the islands are surrounded by renewable energy in the form of hydro, wind, tides and waves, and to a certain extent solar energy.

Since the early nineties, the share of renewable energy in the electricity sector in the Faroe Islands has been approximately 40% hydro and wind, but that is about to change in the years to come.

Prior to COP15 in Copenhagen in 2009, the Faroese Parliament agreed to comply with the Kyoto Protocol, and one of the goals is to increase the share of renewable energy in the electricity sector to 75% by 2020.

The goal has since been raised to an even higher level by SEV, the Faroese electrical company, announcing a 100% renewable electricity sector by 2030. The Faroese Government has backed this vision in the coalition agreement, signed in September 2015, stating that all onshore electricity production should be green by 2030, and that at least 50% of the households should be heated by renewable energy by 2030.

Prize winner

In October 2015, SEV received the Nordic Council Nature and Environment Prize 2015 for its continued innovation and development that already have carried the islands forward on the green path.

The Adjudication Committee stated:

"The prize goes to the Faroese electricity company SEV for its ambitious targets and innovation. SEV's work is not only important for the phasing in of renewable energy in the Faroe Islands, but also for the European grid as a whole.

The creative nature of its effort to reduce dependency on fossil fuels make SEV a worthy recipient of the Nordic Council Nature and Environment Prize 2015."

"We see ourselves as a live laboratory, where new and innovative solutions could be developed and tested in a small but full-scale environment", states Hákun Djurhuus, CEO of SEV.

One of the recent renewable energy projects is the Húsahagi wind farm, inaugurated in October 2014. This wind farm is expected to increase the share of renewable energy by 12 percentage points, from 48% in 2014 to 60% in 2015.

A battery system for the Húsahagi windfarm is currently under development. The system is designed to store the electricity generated by the turbines and then release the stored power into the grid for brief moments - seconds or minutes - according to demand. The main objective of the battery system is to stabilise the fluctuating power production from the wind farm and thus help to secure a more stable electricity supply for the Faroese consumers.

With the new Húsahagi wind farm in place, the Faroe Islands have already experienced hours with instantaneous wind penetration exceeding 80%. With this amount

of wind penetration, the Faroe Islands meet challenges that Continental Europe will meet in a few years. In order to mitigate these challenges, innovative solutions will be developed and tested in a small but full-scale environment. If successful, these solutions could be adapted for the European grid in the future.

"The windfarm at Húsahagi together with the battery system is a major achievement in our green energy strategy, and a significant step toward realising our goal of 100% green electricity production by 2030", states Hákun Djurhuus, CEO of SEV.

Other technological improvements

Over the years, SEV has closely monitored ongoing research and development abroad in the use of renewable energy, and has adopted and implemented new systems and technologies as they became available. A confluence of advances in several technical areas is now allowing SEV to successfully integrate more wind energy into the Faroese electrical grid.

"The recent years, SEV has retrofitted all hydro and fossil fuelled power plants in order to handle the penetration of fluctuating renewable energy. Technological improvements, coupled with the unique natural resources in the Faroe Islands, are proving very favourable to advancing our green energy strategy", notes Terji Nielsen, R&D Manager.

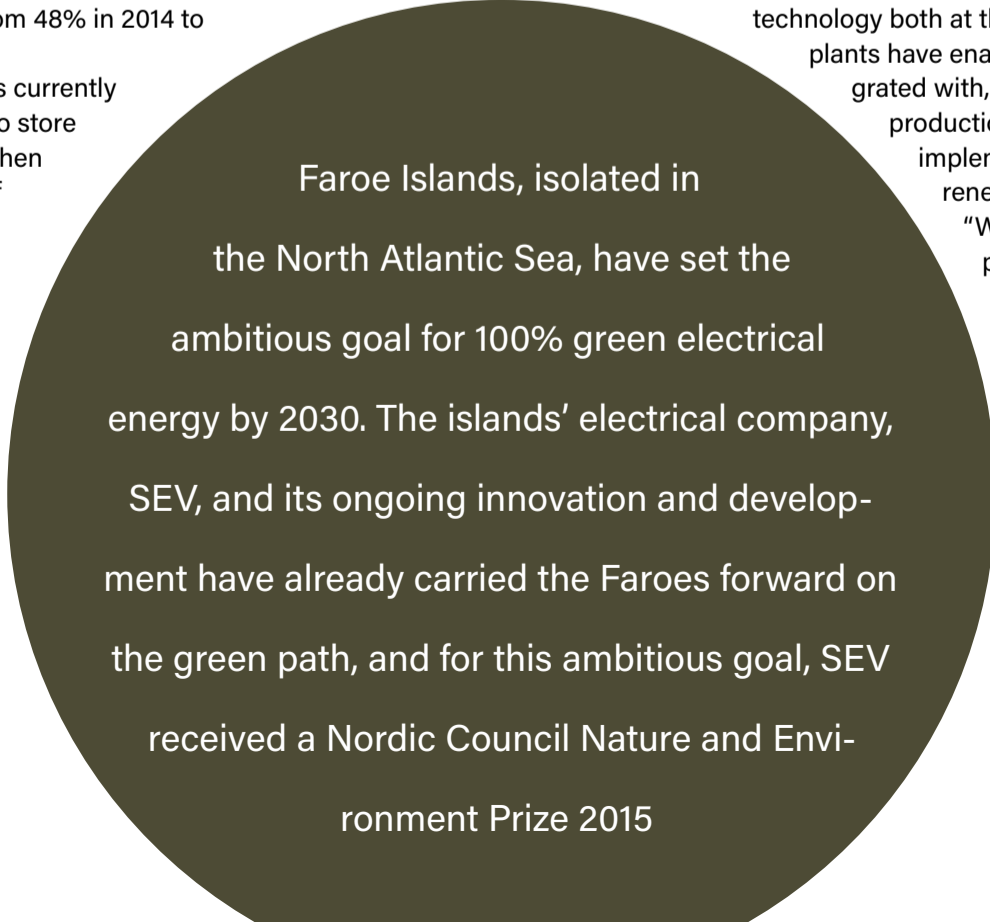
Nielsen also comments that the wind turbines that SEV has deployed are more advanced and more adaptable to the fluctuating wind conditions than its previous wind turbines, and the ancillary electrical equipment now installed is better suited to the small isolated grid.

The power hub, developed under the EU funded 'Twenties' project, is another new system that allows more wind into the grid. The power hub monitors the energy consumption for large industrial consumers, and disconnects specific consumer units in case of a severe local frequency deviation. The power hub stabilises the grid and makes it able to absorb the inherent fluctuations in wind power.

Together with the Faroese University, SEV has mapped the tidal potential around the islands, and preliminary assessments indicate that the tidal potential is enormous. SEV is consequently following the development in tidal technologies closely.

In addition, ongoing improvements and the implementation of new technology both at the oil-fired power plants and the hydropower plants have enabled these power plants to be better integrated with, for example, the fluctuating wind energy production. Finally, a new control system will be implemented to gain the most optimal use of all the renewable resources available.

"When all is said and done, SEV is fully prepared to meet the green challenges of the future, but continued innovation and technological development is a prerequisite for reaching these ambitious goals", states Terji Nielsen, R&D Manager at SEV.



Faroe Islands, isolated in the North Atlantic Sea, have set the ambitious goal for 100% green electrical energy by 2030. The islands' electrical company, SEV, and its ongoing innovation and development have already carried the Faroes forward on the green path, and for this ambitious goal, SEV received a Nordic Council Nature and Environment Prize 2015



Porvoo on its way to carbon neutral living

PORVOO
FINLAND

Learn more - www.porvoo.fi, www.skaftkarr.fi

Porvoo, some 50 kilometres from Helsinki, is in the vanguard of energy efficient housing in Finland. Sustainable development and energy efficiency are the key ingredients that will shape the entirely new Skaftkärr district over the next few years. The whole district, which will house approximately 6,000 residents, is being planned and built so that the houses, living environment, traffic and services are all as energy efficient as possible.

“Energy efficiency and reduction of greenhouse gas emissions is one of the most important elements of the city’s strategy. The Skaftkärr project marks the start of a wide-ranging program of measures aimed at steering Porvoo towards carbon-free living. Such a major and direct investment in energy efficiency is unique in Finland,” explains Fredrick von Schoultz, Deputy Mayor.

The Skaftkärr project is a joint venture involving the Finnish Innovation Fund (Sitra), the City of Porvoo, Porvoon Energia Oy and the development company Posintra Oy. The planning and construction work for energy efficient housing involves a broad partnership between official agencies, energy producers, developers, builders, appliance manufacturers, other businesses and prospective residents.

Energy efficiency starts with planning

The Skaftkärr urban development project has three main objectives. The first was to develop the planning process so that energy efficiency is accorded greater prominence. According to von Schoultz, good city planning often has a greater impact than people think.

“We have calculated that careful urban planning can reduce greenhouse gas emissions by 30% compared to business-as-usual.”

“Studies of energy consumption and emissions in related to urban planning choices help local authorities to understand the implications of urban planning solutions for the climate,” says Jukka Noponen, director of Sitra’s Energy Program.

Vehicles tend to be one of the major sources of pollution in cities, so special attention has been paid to traffic planning in Skaftkärr.

“The quickest and shortest routes are reserved for pedestrians, cyclists and public transport,” von Schoultz explains.

The second objective of the Skaftkärr urban development effort is to put into practice a Living Lab project that aims to encourage people to think about energy efficiency in their home. It consists of a control and management system designed to promote energy efficiency and reduce electricity consumption. When the consumers are able to see immediately how much energy they are using when they switch on the coffee machine or the TV set, it has an impact on consumption.

“We studied energy efficiency in households. When the residents were provided with real-time information on their energy usage, it dropped by 15% on the average.” von Schoultz says. Therefore, the City of Porvoo offers €1,000 reduction in the price

when selling lots to builders who commit to have a real-time energy monitoring system installed in their home. Furthermore, the house owners that build in the area commit to provide their energy consumption data over a two-year time period for research and development purposes.

“We have calculated that careful urban planning can reduce green-house gas emissions by 30% compared to business-as-usual.”

Living Lab also collates data for use in future research

The third objective the Skaftkärr urban development effort is to develop business models for energy companies owned by local authorities that supports low energy and passive buildings in the future.

Porvoon Energia Oy, the local energy company in Porvoo, has invested € 50 million this year to complete the switch to 100% renewable energy in its combined heat and power plant. Until this year, the plant was driven by wood chip supplemented with natural gas during peak load times in the winter and at start-up of the plant. This meant that 10% of the energy consumption was based on fossil fuel. The recent modifications has made it possible to replace the natural gas with biogas, making the district heating in Porvoo 100% reliant on renewable energy resources.

In addition, as a response to increasing heating demands Porvoon Energia Oy is considering solar heating as an energy resource for its district heating production. Solar heating is not currently a profitable solution for Porvoo but Porvoon Energia Oy expects it to become profitable in the near future and continues to follow the market developments.

Skaftkärr is currently being built

Skaftkärr is about three kilometres south-east of the centre of Porvoo. The area covers approximately 400 hectares. Skaftkärr will consist of a number of small “villages”, of which Majberget is the first. Majberget will house 1,400 people in a mixture of high-rise flats, terraced houses and detached houses. The pedestrian and cycle paths and the streets that connect the area with the central hub and with local services are in place and houses are being built.

The entire city participates

The City of Porvoo promotes energy efficiency in a variety of ways. For example, Vårberga Library’s energy-advisory service enables residents to borrow a meter, free of charge, to monitor their energy use.

“Inveon, a vocational institute, has incorporated energy efficiency into its teaching program and students have recently built a passive house in Haikko. These are just some examples of our wide range of initiatives,” von Schoultz adds.

Positive side-effects

The Skaftkärr project has given a boost to the entire local area and made an impact further afield. The ambitious program has directly affected many. “Lessons learned in Skaftkärr has helped change attitudes throughout the local government. Climate and energy issues have become a major focus in all city planning in Porvoo.” he points out. Porvoo has, in its city strategy committed to reduce CO2 emissions by 80% by 2030 compared to 2007.

It is not only in Porvoo that Skaftkärr has made its mark but other cities such as Helsinki have shown interest in this project, particularly in Porvoo’s best practice solutions.



In Malmö, waste becomes fuel

MALMÖ
SWEDEN

Learn more - www.malmo.se

In Malmö, every third trip is taken on a bicycle. The local railways are experiencing increased business but there still remains a need for sustainable solutions for buses and cars in the city and the surrounding Skåne region.

While electric vehicles are foreseen to have a bright future in cities such as Malmö, the biogas powered vehicles have a clear benefit so far – their mileage is unrivalled. The small biogas powered cars being purchased by the City of Malmö right now have an impressive range of 600 kilometres before refuelling is required.

Locally produced vehicle fuel

"Another attractive feature of biogas is that it can be produced from waste", say Daniel Skog, City of Malmö. "Malmö is now introducing mandatory food waste recycling for all citizens and businesses. This is a great resource for biogas production. In the region of Skåne, we see biogas replacing fossil fuels in motorised road vehicles as a great opportunity for reaching a fossil free energy mix. The region of Skåne therefore tries to upgrade as much of the biogas produced as possible to a quality suitable for vehicles."

In Malmö, the approximately 200 city buses have been natural gas powered since the 1980's. During recent years the natural gas is gradually being replaced by biogas and the share of biogas reached 63% in 2012. By the end of this year, 2015, it will be 100%. Already today, the garbage trucks, a large portion of the private taxi fleet and the municipal vehicle fleet are powered by compressed natural gas and biogas. And the interest for private and corporate gas powered cars is increasing.


Longer, quieter and cleaner buses run on waste

"Last year, we introduced new high capacity buses on the most frequented bus line in Malmö, connecting two districts of the city. The 24 metres long biogas hybrid bus-

es have separate bus lanes. This has not only increased the amount of passengers by over 25% and improved the integration between the two city districts, but also significantly improved the air quality in our city. Ecological sustainability goes hand-in-hand with social sustainability", announces Daniel Skog.

Several of the city bus lines in Malmö have reached their maximum capacity and Malmö needs to provide public transport for an increasing number of passengers. On the short term, it will be these unique biogas hybrid buses. In the longer term trams will be added to the fleet. Biogas powered buses and cars not only reduce the carbon emissions significantly but they also reduce the emission of NOx and particles into the city air which is a very welcome benefit. In addition, the residual sludge from the biogas production contains valuable nutrients that can be distributed back to the agricultural land.

Skåne is very proud of its success with gathering food waste, producing biogas, and upgrading it to a quality suited for vehicles – and is keen to share its know-how with the World. Through the BIOGASSYS project, funded by EU Life, the City of Malmö has worked together with neighbouring cities and biogas stakeholders to demonstrate the concept and disseminate the lessons learned more widely throughout Europe.



Already today, the garbage trucks, a large portion of the private taxi fleet and the municipal vehicle fleet are powered by compressed natural gas and biogas. And the interest for private and corporate gas powered cars is increasing.



The strategic energy plan

'Bright Green island' sets the direction for Bornholm's journey to a carbon neutral community in 2025. NRGYSIM, a unique simulation model, allows hourly simulation of the consequences of any change in the Bornholm's smart energy system.

Bornholm CO2 neutral in 2025

BORNHOLM
DENMARK

Learn more - www.kortlink.dk, www.brightgreenisland.com

Even though Bornholm is a small rural island in the middle of the Baltic Sea, or perhaps because of this, Bornholm is the centre of developing and testing the energy solutions of tomorrow.

"Bornholm's remote situation in the Baltic Sea and fragile connection to the Nordic power market has proven a godsend to developing Bornholm as a test-community for renewable energy solutions" says Winni Grosbøll, Mayor of Bornholm. "Together with the zest and cooperation of the citizens of Bornholm this means that we can test energy solutions on a community scale."

With approx. 40,000 inhabitants, Bornholm is a full scale community, with hospital, court house, schools, industry, ferries and airport facilities. Bornholm has an operating energy system integrating electricity production, wind turbines, biogas, waste, solar panels, solar cells, heat pumps and district heating.

In 2007, the Bornholm community joined together to develop a development strategy for the island, called 'Bright Green Island'. In 2008, the Municipality of Bornholm decided on a vision that Bornholm should become a carbon neutral community by 2025.

In 2015, the utility companies and the municipality of Bornholm revised the strategic energy plan showing just how Bornholm will fulfil the vision.

Bornholm – Simulating the solutions of tomorrow. Today.

The strategic energy plan is based on a unique, locally developed simulation model containing data from a complete mapping of the energy consumption and production for heat, electricity and land based transport. The simulation model currently encompasses:

- 40,236 inhabitants
- 26,023 heated buildings
- 24,476 vehicles
- 6,500,000 square metres of building space
- 19 different production units, including 7 storage tanks
- 6 separate heating distribution grids
- 1 power distribution grid
- 1 undersea cable
- 35 large wind turbines and 34,500 square metres of solar cells
- 57,000 weather data registrations per year, and calculation of an additional 105,000 weather values per year.

"This gives us a detailed picture of the interaction of Bornholm's entire energy system, and allows us to analyse the consequences of any change in the energy system", says Klaus Vesloev, Marketing and development Director, Østkraft. "We can simulate, on an hourly basis through an entire year, the consequences of, for example, changes in fuel, changes in technology or changes in weather. If the population increases or decreases. If houses are renovated or change from oil burners to heat pumps. If we get a lot of electric vehicles, or gas vehicles, or people get newer cars. We can see the consequences the changes have for companies, the grid and citizens, and, we can assess the security of supply at any time. Bornholm is connected to the Nordic power market by a single under-sea cable only, making security of supply a high priority."

Since 2011, Bornholm has been involved in testing new ways of making power consumption more flexible to match the intermittent production from the many wind turbines mounted on the island. Wind accounts for more than 60% of the power produced on Bornholm.

The international project 'EcoGrid EU' involved 2,000 Bornholm power customers, equivalent to 10% of the island households. All participants were equipped with smart meters, and 1,200 households were additionally equipped with Home Energy Management Systems providing automatic regulation of power consumption from electric heating, heat pumps and hot water boilers.

The EcoGrid participants responded to a price, which reflected share of wind generation, and thereby increased the amount of renewable energy with 8%. The results also showed a 1.2% reduction in peak load.

EcoGrid EU completed in September 2015, will be followed by 'EcoGrid 2.0' in 2016. Here Bornholm will widen the range of products offered to the customers and work on increasing the system reliability to create a setup, where flexible consumption will play a vital role in its future energy system.





Lappeenranta acting as a trailblazer for a green revolution

LAPPEENRANTA FINLAND

Learn more - www.lappeenranta.fi, www.lappeenranta.fi

The City of Lappeenranta is situated in South-East Finland. Lappeenranta has 73,000 inhabitants and is the 13th largest municipality in Finland. Traditionally, the region is known for its forest industry and large inland lakes. Lake Saimaa, the fourth largest lake in Europe, starts in Lappeenranta.

"We were quite amazed by this recognition", says Kimmo Jarva, Mayor of Lappeenranta. "We have turned a city that has been known for its industry into a green city. We have been able to cut our greenhouse gas emissions by switching our energy production to biomass." This investment has been one of the biggest in the history of Lappeenranta, but it seems to have been worth it."

"The change maker has been the jointly owned power plant called KauVo, which was constructed together with UPM-Kymmene Oyj, a Finnish pulp, paper and timber manufacturer", Mayor Kimmo Jarva explains. A local industrial power plant was replaced by a new 210 MW combined heat and power plant, which relies on biomass from forestry industry and forest residues. The plant supplies heat and electricity both for the company and citizens.

Relative to 1990, the city has been able to decrease its CO2 equivalent emissions by 38%. That means that the Lappeenranta has exceeded its initial target of 30% reduction in greenhouse gas emissions. This is mainly due to KauVo, but other actions have also contributed. A 21 MW inland wind farm was erected in 2013 and Lappeenranta is also a leading region in terms of installed photovoltaic capacity per inhabitant in Finland. Other contributors are an increasing energy efficiency in the housing stock as well as an increase in heat pumps in dwellings.

Lappeenranta University aspires to be a frontrunner in solving the global climate problems. "Trailblazer, Show the way. Never Follow." These words describe the ambition level of the university professionals. 40% of the energy research in Finland is performed in Lappeenranta.

The City of Lappeenranta and Lappeenranta University have a common interest in green growth. Lappeenranta University of Technology offers the most versatile selection of university level research and education in Finland within the energy field,

with renewable energy development as one of the focus areas. The city provides opportunities for the university to test its innovations in the real world. One success is the development of the energy efficient pump now in use in Kivisalmi pumping station. "A massive amount of energy is wasted due to inefficient pumping systems in the World," says Jaakko Larjola, former professor of Fluid Dynamics at Lappeenranta University. The pump consumes only a quarter of the energy of other commercially available pumps.

Another university product design under way is a diesel-electric hybrid bus. The bus will be put into operation in local public transport in 2016. "The shift to renewable energy in energy production is relatively well developed but the transport sector lacks behind", says Ilkka Räsänen, Director of the Environment, City of Lappeenranta. "I believe that transport solutions that decrease carbon emissions have a huge potential"

Lappeenranta boasts several large heat pumps and a hydrogen power plant in Joutseno area. The hydrogen is sourced from local industry and used as a source for local district heating. The abundance of biomass makes the region very attractive for biodiesel production. At the UPM Kymmene Oy industrial site on the shore of lake Saimaa, the World's first 2nd generation biodiesel production plant, produces 100,000 tonnes biodiesel annually from wood tar oil. "It is a full scale production unit, not a pilot plant. The industry has noticed that the region holds possibilities both in terms of energy resources and know-how," says Markku Heinonen, Director of Development, City of Lappeenranta.

In 2014, Lappeenranta was nominated for the Climate Capital of Finland by the World Wildlife Foundation. The nomination was a part of Earth Hour City Challenge - a competition among cities for climate friendly actions.





More cyclists: Trondheim has rapidly become a cycle-friendly city. Cycling to and from the city centre has increased by 50%. This picture is from the historical neighbourhood of Bakklandet.
Photo: Knut Opeide

Transport in Trondheim is going green

TRONDHEIM
 NORWAY

Learn more - www.miljopakken.no

A growing population with more trips to make, but fewer cars on the roads. A stream of new, green buses and an increasing number of newly converted cyclists. Fewer traffic jams. Cleaner air. And lower greenhouse gas emissions.

In the course of a few short years Trondheim has achieved a shift from standard cars to greener transport modes than has never been seen before in a Norwegian city. The quick result has been achieved due to political resolve and a policy mix designed both to restrict car use and encourage other modes of transport.

In 2008, Trondheim was a city beset by traffic problems and lacked funds to build new infrastructure. In the same year the Norwegian parliament adopted new targets to make Norway climate neutral by 2030.

Local politicians in Trondheim decided to take action. Half of the city's greenhouse gas emissions came from transport. Traffic had to be reduced. A majority in the city council approved 'Miljøpakken - Greener Trondheim, a partnership for sustainable transport.'

The main goal of the Miljøpakken program is to cut greenhouse gas emissions by reducing car traffic. At the same time Trondheim is gaining 2-3,000 new inhabitants every year. The corresponding growth in transport demand must in practice be covered by walking, cycling or public transport.

The first measures were implemented already in the summer of 2008 - bus lanes through the centre of the city. The effects were immediate. Buses arrived at their destinations more quickly and car traffic was reduced.

The Norwegian parliament approved Miljøpakken in 2009. This means that Trondheim can receive financial support from the state towards implementing the program. The most controversial measure has been the introduction of a toll system with double charging for rush-hour traffic. Half of the income from the toll system

goes to improving the road network while the other half goes to developing green transport solutions. In other words, a transfer of funds from motorists to those who use environmentally-friendly forms of transport.

Citizens using public transport now has access to better and more frequent buses at up to half the fare price.

Simultaneously, work started on improving the infrastructure for cyclists. New cycling bridges were built to connect densely populated areas of the city; cycle routes now run from the suburbs to the heart of the city, and Jens Stoltenberg, the then Prime Minister, opened the first of a new network of cycle lanes in the town centre, clearly marked with red tarmac. Trondheim showed that it valued its cyclists.

And those that choose to walk are also taken care of. A dedicated team is working to map and improve the urban short cuts that make it easier to leave the car at home. Miljøpakken also focuses on safe school routes so that children don't need to be driven to school.

A recipe for success:

- Traffic measured at the city's toll stations is 17% lower today than in 2010. Extensive questionnaires confirm that car use is in decline in Trondheim.
- Use of public transport is up by 60% since 2008. Commuter traffic from neighbouring municipalities to Porvoo by public transport has increased even more. Yearly growth rates of 25% have been achieved as driving has become more expensive while bus fares have become cheaper.
- Cyclists commuting to and from the city centre has increased by 50% since 2010. The average daily number of cycle trips has increased from 34,000 to 45,000 in four years. Trondheim has adopted a target of 100,000 daily trips by 2025. The city now has the highest share of cycle trips nationally, despite a tough climate and many steep hills. One of these can be tackled using the world's only bike-lift - proclaimed by CNN to be one of the world's seven coolest modes of transport.
- The number of people walking to and from the city centre has increased by 28% since 2010.

Proposing Miljøpakken was a brave move for the politicians. People in Trondheim celebrated when a previous toll system was abandoned in 2005. However, just three years later Rita Ottervik, Mayor spearheaded an initiative to reintroduce just such a system. Opposition was widespread and concerted, but Ottervik was

determined and public opinion has gradually softened as the positive effects of Miljøpakken have become visible. The city's inhabitants have a better transport network, traffic moves more freely and air quality is better than it has been in 20 years. In 2010, a clear majority was against a new toll system. By 2015 opponents of the system were in a minority at only 35%.

According to a survey by the Norwegian Automobile Association, Trondheim has the most satisfied road users among Norwegian cities.

Motorists predicted the collapse of Trondheim's transport system when kilometres of car lanes became bus lanes in 2008. The subject is now a non-issue in public debate. By 2011 a clear majority of motorists - 75% - say that they value the bus lanes. And Trondheim hasn't looked back since.

Text: Hans Kringstad



The main goal of the Miljøpakken program is to cut greenhouse gas emissions by reducing car traffic. At the same time Trondheim is gaining 2-3,000 new inhabitants every year.

The corresponding growth in transport demand must in practice be covered by walking, cycling or public transport.

The priest and the imam: Miljøpakken takes many different approaches to encouraging environmentally-friendly transport. A genuine priest and an imam ask to use your bike in this advertisement.
Photo: Knut Opeide



The secret to success is nothing more than unity between the politicians, ambitious officials and good cooperation with the business sector and the university spurred on by a collective, genuine wish and ambition for a more sustainable society.

Fossil fuel free Växjö 2030

VÄXJÖ
SWEDEN

Learn more - www.vaxjo.se

Växjö is situated in the southern part of Sweden, a strategic location for regional infrastructure, administration, trade and education. Växjö consists of a central town and a big rural area. In total, 86,000 persons live in Växjö. Växjö has a university and many small and medium-sized companies.

The Växjö Declaration was signed in March 2015 by the City of Växjö, Linnaeus University and Sustainable Småland, a regional business network.

In close collaboration between public and private actors, Växjö, the Greenest City in Europe, has been putting words into action since the 1970s in its environmental work and can proudly show the world that it is possible to work locally towards a global sustainable future. Växjö has already built a combined heat and power plant that produce fossil fuel free heating, cooling and electricity, it was inaugurated in March 2015.

Växjö has set the goal of becoming a fossil fuel free city by 2030, but cannot do it alone. In the Växjö Declaration, Växjö therefore urges the Swedish Government and European local authorities to take meaningful action to become fossil fuel free.

Within the latest 20 years, City of Växjö has carried out annual monitoring of CO2 emissions, not only emission of the municipal activities, but also for the entire geographical area. The statistic from 2014 shows that City of Växjö has nearly halved its CO2 emissions over a period of 20 years (1993-2014).

"It's no great mystery. Any council should be able to do what we've done. You need to have a vision and then consciously translate it into action." says Bo Frank, Mayor of Växjö.

In 2014, the City of Växjö adopted the revised environmental program for the city. It includes 30 ambitious targets within several fields of activities. "We can still see the important targets about climate change, energy use, transport, and water. But there are also new targets that show another focus for us. We want the food that we eat in the schools and geriatric care to be organic. We want to make sure that toys, furniture, clothes and other things we use in the municipal child care do not include hazardous chemicals, and we do have one of the most ambitious targets for air quality in Sweden."

Växjö has

- Built passive houses that use waste heat, e.g. from cooking, thermal gain and heat recovery from waste water
- Been something of a pioneer when it comes to building wooden high-rise blocks to fulfil the wooden strategy
- Invested in solar power on several schools and on the city hall. And it works better than expected.
- Provided cooling via the district cooling network. There is also an increasing need of cooling even in Växjö. Hospitals, factories, supermarkets and so on. They used to use electricity but will be able to use the district cooling system, which will further reduce electricity usage
- Turning sludge and food waste into biogas, primarily to produce heat and electricity, but also to provide fuel for vehicles primarily for the city buses
- Changing its citizens' behaviour through a combination of installing meters in homes and by providing information on how to reduce energy use.

Frank, Mayor of Växjö, looks ahead: "We have two major challenges that we will now start to address. One is to save even more energy by renovating buildings. The second is to get more people and businesses to drive environmentally friendly cars."

As one can see there is a lot to the success story of Växjö! Many actions have been initiated, dedicated work is being carried out at this very moment and plans are being made for future development. How is all this possible? The secret is nothing more than unity between the politicians, ambitious officials and good cooperation with the business sector and the university. This may seem like a solid task to coordinate but after you boil it down, it is as simple as a collective, genuine wish and ambition for a more sustainable society.





Photo: Jarmo Roiko-Jokela/Helen



Helsinki's Kalasatama district to get the World's smartest energy system

HELSINKI
FINLAND

Learn more - www.hel.fi

Kalasatama, the centrally located old harbour area in Helsinki, was freed up for new construction when cargo traffic moved to Vuosaari. The area is firmly connected to the city core. The Kalasatama district will see some 175 hectares re-developed with a total of 1.3 million square metres of homes, offices and service areas.

Construction of Kalasatama began in 2011 and will continue until the 2030s, by then it will be home to 20,000 residents and a working district for 8,000 people.

The world's smartest energy system is to be built in the Kalasatama quarter of Helsinki. Kalasatama smart grid is unique in size and scale in the world. Kalasatama smart grid is a flagship research project of a consortium consisting of the energy companies Helen and Helen Sähköverkko plus Fingrid, the national power system operator, and ABB. The consortium is planning a smart energy system in Kalasatama, which utilises combined heating and cooling, local solar power, an infrastructure that supports electric vehicle use, energy storage facilities, and energy efficient building automation.

Flexibility in energy use

In future, smart grid systems will make it possible to produce, consume, store and sell energy even more flexibly than before. At the same time, consumers will receive more detailed information about their energy consumption. In essence, a smart grid system is a means to balance energy consumption and production. It can be used for preventing consumption peaks while safeguarding a reliable supply of energy. In a traditional energy network, electricity, heat and cooling flow in one direction, from power plants to end-users. In a smart grid, the energy and data flows travel in two directions, in which case the customers can more effectively utilise their own energy production, such as solar power, by selling the surplus production on to others. This means an expansion of the energy market: a customer who has previously purchased energy is now also a producer and seller of

electricity.

Energy storage is important in terms of the efficient functioning of the smart grid system. Storage is needed for balancing production and network loads, for reserve power, and for undisturbed electricity distribution. An energy storage facility with a capacity corresponding to the peak output of about 4,000 solar panels is also under planning in connection with the new substation to be built in the Kalasatama area. This will reduce the need for reserve generation capacity and a heavy duty grid on present lines and could save hundreds of millions of euros. Through automation the smart energy system can divert load to cheaper periods which will benefit the customers of energy.

To manage usage of electricity, it is intended to implement a new type of user interface for smartphones. Most of the technologies applied in Kalasatama are well known technologies, and they have been constructed in a way so they work together. The challenge is how to integrate them into a single smart system of information and communication, to manage the flexibility in demand and energy storage through especially electric vehicles. The energy sector has so far only scratched the surface of the opportunities that the new communication technologies offer for dynamic flexibility and price responsiveness.



The new Kalasatama area of Helsinki is an experimental innovation platform to co-create smart urban infrastructure and services with the users and people living in the area. The city of Helsinki, small and medium size industries, and researchers all participate and bring their know-how to the mix.



It is estimated that CleanTruck has reduced harmful emissions by:

- 3,400 tonnes of CO2 equivalents
- 24.5 tonnes of NOx
- 137 kg particulates (PM10 and smaller)

City of Stockholm, Clean Vehicles and Fuels program

STOCKHOLM
SWEDEN

Learn more - <http://www.stockholm.se/cleantruck>

The 'Clean Vehicles in Stockholm' program has existed since 1994. The aim of the program is to speed up the transition to vehicles powered by renewable energy – commonly referred to as clean vehicles and clean fuels.

From the start, a central stumbling block for the work was the classic dilemma – which comes first, the chicken or the egg? Many people raised the question of whether clean vehicles or refuelling stations for clean fuels should come first. Without cars running on clean fuels no one would open refuelling stations, and without refuelling facilities the car industry would not produce cars running on clean fuels. A major challenge from the outset was to rectify this deadlock. As a way out of this dilemma the City of Stockholm chose to address vehicles and fuels in parallel and to use the municipal fleet to facilitate the transition.

Much has happened during the more than 20 years since the first municipal cars in the City's fleet were exchanged for clean vehicles. Clean vehicles with low or no carbon emission technology have now become normal and represented almost 20% of the new car sales in 2014. The range of models to choose from is increasing and the general knowledge regarding clean vehicles has increased. More and more people see the benefits of clean vehicles and fuels. During the early years, local air quality was an important driving force, followed by climate protection. More recently, the fact that oil reserves are limited has augmented interest in clean vehicles and clean fuels.

The overall strategy of the Clean Vehicles program in Stockholm has been to facilitate market introduction of clean vehicles and sustainable fuels. The guiding principle has been to collaborate with the market players and to find ways of increasing the demand for clean vehicles and clean fuels. From the onset, the work has developed in dialogue with companies and municipalities that have an interest in clean car initiatives and vehicle manufacturers and fuel suppliers.

The development has gone through three phases. The first phase aimed to remove barriers and pave the way for users of clean vehicles. Once this goal was reached by way of new models in the market, the work focused on broadening the market. Today, Sweden is seen as an important pilot country for clean vehicles. Motivating manufacturers to launch new generations of clean vehicles requires a bigger market

than Sweden alone. The third phase of the work has therefore largely concentrated on increasing the market for clean vehicles outside Sweden, in cooperation with other European cities.

The work relating to passenger cars that can run on ethanol and upgraded biogas has now reached the third phase. Broadening the market for electric cars and clean trucks has been a much slower process. When the Clean Vehicles in Stockholm program started 1994, the focus was on electric cars but only a few new models were developed and the limited driving range for existing electric cars meant that interest dwindled. Instead, ethanol and biogas powered cars were more widely introduced. Now clean trucks, electric vehicles and a charging infrastructure have come into focus again.

The City of Stockholm has managed a nationwide procurement program for electric vehicles and plug-in hybrid electric vehicles in the period 2010-2015 and has introduced over 1,000 electric vehicles through this procurement project.

One example: The CleanTruck project

The CleanTruck project was carried out by three parties – City of Stockholm, AGA and OKQ8/IDS. CleanTruck was financed with the support of the EU environmental program LIFE+, Vinnova and the Swedish Energy Agency.

The Environmental & Health Administration of the City of Stockholm coordinated the project and was responsible for project management. AGA was responsible for building Stockholm's first filling station for liquid and compressed gas as well as filling stations for LIC and nitrogen gas. OKQ8/IDS invested in the world's first public fuel facility for ethanol diesel ED95.

18 private transport companies participated in the project purchasing a total of 50 CleanTrucks.





Biodiesel produced from used cooking oil and animal fat and biomethane from an old landfill site contribute to a greener Akureyri.

Vistorka – Carbon neutral Akureyri

AKUREYRI
ICELAND

Learn more - www.akureyri.is

Akureyri is located in the Northern region of Iceland and is the largest populated area outside the capital area in the south-west with around 20,000 inhabitants. Akureyri is an advanced, modernised small community offering, to a large extent, the same services to its inhabitants as higher populated areas including education at all levels, advanced healthcare, diverse sport facilities and a strong cultural identity. The main industries in the area are fisheries, agriculture and food manufacturing.

Akureyri has now set itself an ambitious goal – to achieve carbon neutrality in 2025.

“The carbon footprint for all homes in Akureyri would be around 100,000 tonnes CO₂ per year if all the energy came from fossil fuels and all organic waste was deposited in a landfill,” says Bjorgvinsson, Mayor of Akureyri. However, over the years, Akureyri Municipality has implemented solutions with the aim to not only reduce reliance on fossil fuels but also to recycle valuable materials such as organic waste.

Akureyri’s new project for carbon neutrality is called ‘Vistorka’ or ‘Akureyri Clean-Tech’. The approach of the project to increase sustainability consists of three paths:

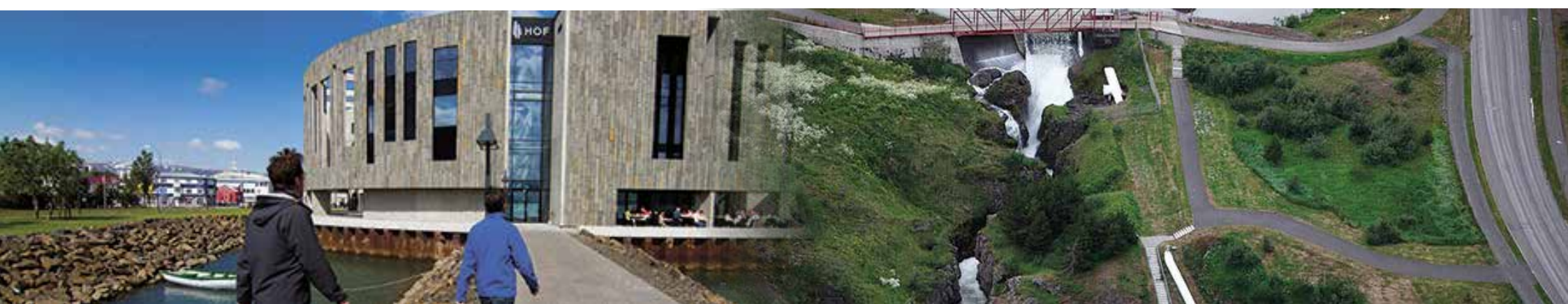
- Renewable energy
 - Geothermal (Housing)
 - Hydro Power (Housing)
 - Methane (Transport)
 - Biodiesel (Transport)
 - Electricity (Transport)
- Energy efficiency
 - Free-of-charge town-bus
 - Improved access (cycling, footpaths, snow removal, etc.)
 - Waste management/collection
- Carbon capture & storage
 - Composting
 - Landfill
 - Forestry
 - Wetland restoration

According to Sigurdarson, Director of Vistorka, Akureyri has already reached important milestones towards becoming carbon neutral.

“Following the oil crisis in the seventies the municipality initiated a search for hot springs in the area. The exploitation of geothermal energy proved difficult and almost left the municipality bankrupt”, Sigurdarson says. “However, today, all our heating is based on geothermal resources and the energy company is now one of the strongest and most dynamic companies in area. The energy company is 99% owned by Akureyri municipality. In addition, all electricity for the homes in Akureyri is supplied from hydropower plants. In addition, we have two types of biofuel available in Akureyri. Biodiesel is produced from used cooking oil and animal fat and biomethane is produced from the established landfill with a total potential production around 1 million litres per year. Since 2009, all biodegradable household waste is collected and brought to a composting plant where it is converted to a highly nutrient soil alternative to chemical fertilisers. The landfill site is no longer used, but is used for biomethane production. By doing so, over the next 20-30 years around 10,000 tonnes of CO₂ will be captured from the landfill every year.”

Furthermore, the forested area around Akureyri has grown substantially since 1990. The Icelandic forest service estimates the carbon capture to be 4,400 kg/hectare/year.

Vistorka’s Community Solution focuses on generating fuel from organic waste material in the Eyjafjordur area of Northern Iceland. Work is also underway to investigate how production synergies can be leveraged. The value created is based on relatively small and flexible production units. Synergy between processes is guaranteed with the technical integration of different production processes where efficient use of raw materials and products is optimised and efficient production is achieved by linking individual modules (see picture below).





The green transition in Oslo

– A holistic view on sustainable urban development

OSLO
NORWAY

Learn more - www.oslo.kommune.no

Oslo has set itself the target to cut greenhouse gas emissions by 50% by 2030 and becoming fossil free by 2050. The new City Government is currently proposing to raise the bar and aim to reach the 50% target already by 2020. Oslo's vision is a zero emission city. The strategy is simple: Daring to make changes and developing a city that allows for both current and future generations to thrive and live a good life.

Reaching the climate targets requires collaboration across levels of government, the business sector, academia and the local citizens. Hence, when developing Oslo's climate and energy strategy, the city ensured the involvement of different stakeholders in establishing a strategy and a road map for reaching the city's climate targets.

Oslo has developed a holistic roadmap that points out the necessary climate actions in the different sectors. The main concept is comprehensiveness in all actions and fossil free urban planning. Changing energy systems, introducing new transport solutions and involvement of its citizens are key elements when moving from fossil fuel to renewable energy.

The time for action is now. Lan Marie Nguyen Berg, Vice Mayor for Environment and Transport, City of Oslo, states this very clearly: "Climate emission reduction is not something that is to be done by someone else, somewhere else at some other time. We need to make this happen right now, to be able to deal with the climate challenges the world is facing".

Special focus on urban planning and mobility

Norway and Oslo have a unique position when it comes to access to renewable energy through hydro power. Oslo wishes to take advantage of this position to showcase the possibilities for electrification of the transport sector, testing of electric vehicles and maturing the electric vehicle market. As testing ground and dedicated work to produce new solutions, Oslo's experience can offer valuable insights for other cities when they, in time, reach the same levels of renewable energy in their energy systems.

A robust energy system: Oslo's climate and energy strategy focuses on energy efficiency actions for both new and existing buildings. The aim is to switch the energy source for heating in buildings. Electricity consumption is to be reduced, encouraging the use of fossil free district heating. Oil boilers will be banned from 2020. This means increased utilisation of local energy sources and waste heat, along with introducing a smart grid system for controlling the need for electric power. These measures will enable Oslo to manage the increased electrification of the transport sector without requiring new, unnecessary investments in the existing energy infrastructure.

Public transport: In Oslo, all public transport will run on renewable fuels by the end of 2020. Ruter, Oslo's public transportation company, will leverage its position as a buyer of new technology solutions to ensure this happens. From 2020, busses, taxis and new ferries will utilise biogas, hydrogen, biodiesel or electricity. However, Oslo also needs to take the expected population growth into account in the fossil free transport system scenario. In order to handle the predicted population growth in a sustainable manner, urban development will primarily be through densification around public transport hubs and along public transport routes. This will limit the use of private cars, and instead investments can be made to make Oslo into a city where walking, cycling, and public transport are the preferred solutions.

Electric vehicles: Oslo is the world's electric vehicle capital. The share of electric vehicles is increasing radically, and in 2015 almost 30% of all new cars sold in Oslo are electric vehicles or hydrogen cars. The target is 100%. To reduce both global and local emissions from mobility, Oslo has promoted electric vehicles through local and national incentives:

- Investing in 1,000 charging stations in the city and preparing for biofuel stations
- Free parking for electric vehicles
- Free energy at local charging stations (the City will now stop this incentive and encourage market involvement in the biofuel station business).
- Exemption of VAT on electric vehicles
- Permission for electric vehicles to use the bus lanes
- Free passage on the toll ring around Oslo
- Reducing parking space for other cars and increasing their parking fees

The City of Oslo will now 'tighten' the everyday life of the users of fossil fuel driven cars by introducing zero-emission areas in the city.

Oslo as a testing ground

The experiences harvested in Oslo can be applied to ease and prepare the transition process in other major cities and regions. The transition also requires a change in governance structures. Oslo will therefore increase the focus on identifying and implementing appropriate organisational and governance structures that allow for sustainable urban development, especially through involving different stakeholders and citizens to reach acceptable solutions that promote the paradigm shift. This means paying special attention to forming the lifestyle of the younger generation. Dialogue with the younger generations is also seen as key for finding the new solutions that the World needs.

Using a holistic approach, Oslo is one of the many Nordic cities that work to realise the green transition.

Incentives applied to promote electric vehicles include:
1,000 charging stations in the city, free parking, free charging at local stations, VAT exemption, permission to use the bus lanes, free passage on the toll ring around Oslo, and reduced parking space for other cars and increasing their parking fees.



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