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the Sustainable Energy

Action plan in

Energy 2020

- Energy plan for Region Gotland
- extracted from the full document for public consideration until April 8th, 2013

with a brief presentation of Gotland added for foreign readers

Produced as the deliverable “ISEAP” – an ”Island’s Sustainable Energy Action Plan” – in the frame of the Islepact and CoM- initiatives

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Gotland's geographic location, in the middle of the Baltic Sea

Contents

SUMMARY

Region Gotland has challenged itself to have a fully climate-neutral energy supply by 2025. Offering the highest possible efficiency and economy, the energy supply will be climate-neutral, based on local, renewable resources and will contribute to sustainable growth and the development of local business. *Vision 2025, adopted by the Regional Council.*

The overall goal for Gotland's CO_2 emission reduction is a 45% absolute reduction of the fossil CO_2 emissions from non-ETS (not including industries covered in the CO_2 emission trade scheme) activities from 1990–2020. In the early 1990s the municipality began the strategic push to turn the island into an eco-sustainable society by 2025. Sustainability here covers all aspects of the environment – energy, resources, agriculture, waste, radiation, etc. Over the past decade several actions were taken to find solutions for a sustainable energy supply on Gotland. Between 1990 and 2010 CO_2 emissions from fossil fuels were reduced by 35%, primarily due to the transition to new technology for heating in buildings. Oil has largely been replaced by biomass, especially in district heating. Increased activity in local forestry plus the development of technology for biomass heating has resulted in local biomass supplying most of the heating fuel used for buildings on the island. In smaller buildings a switchover from oil-powered boilers to geothermal heating and heat pumps also contributes to a reduced dependency on oil and/or decreased need of electricity for heating. Technical development has led to improved energy efficiency, while at the same time both the average heated building area and the transport mileage per inhabitant on Gotland has increased. The number of customers on the electrical grid is higher and electricity is used for a wider range of purposes, thus reinforcing the quality demands for voltage and frequency of electricity, despite the fact that electricity consumption in the non-trading sector is about the same as in the early 1990s. Currently 40% of the island's total electricity needs are met by local wind power; the rest is covered by the Nordic mix of mainly hydro and nuclear power. Since 1995 the municipality has reduced CO_2 emissions from fossil fuels in its own operations by almost 50%. Further regional actions regarding energy efficiency in buildings, public procurement, behaviour change, and energy efficiency advisory services are to be taken during 2012–2015. At the same time, actions for transition of transports to other fuels, improved energy efficiency in industry and the service sector, and the installation of new wind power plants will be implemented dependent on decisions outside the regional council, but to a certain extent they can be supported by regional actions. In 2012 the installed capacity of wind power will reach the present grid limit of 195 MW. With a new sea cable put in operation in 2017, the next major phase of wind power installation on Gotland is expected to take place in 2016–2020. The idea is that in the future export of wind power will balance the remaining use of fossil fuels for transport and industrial use on Gotland. Local biomass resources, with support from geothermal, solar and recycling of excess heat, will meet the energy need for heating and some of the fuel for road transports. Both wind power and bioenergy will contribute to the sustainable growth in local business. But local growth also depends upon good communication. Any major changes in the technology for road transports are not expected until 2020.

1. INTRODUCTION TO GOTLAND

Gotland is the largest Baltic Sea island, with about 57,200 residents. It is located almost half way between the Swedish mainland and the Baltic countries, about 100 km from each of them. Region Gotland already has a history of action plans and measures to reduce climate gas emissions in the public sector as well as in industries and households. The present action plan is based on the structure and identification of potentials developed in earlier plans and EU projects on sustainable energy use for Gotland. The major challenges now are to make people – private individuals, employers and entrepreneurs alike – realise the economic potential of energy efficiency in homes, public services and enterprises, create alternative fuels businesses and kick off the transition to a more sustainable transport system.

From an energy perspective, Gotland is unique. Its clear demarcation in combination with its large energy requirement, particularly with reference to the lime and cement industries and the transport sector, makes energy production a particularly demanding issue. It also makes the island an interesting subject for energy production, distribution and consumption studies. There are excellent opportunities for developing local production using wind power and biofuels on the island, and the future energy market is intended to rely on technology and economy for continued energy exchange with other regions.

1.1. Geography and territory

Gotland is a flat landscape built on various limestone and sandstone bedrock that can provide good arable land, different types of forests, beautiful shores and in some areas limestone valuable for quarrying. With good wind resources, about 1,500 sun hours per year and a lot of bioenergy capacity, the potential for renewable energy supply is good. But the energy exploitation must be counterbalanced with great environmental concern; the island is home to many rare species, the limestone bedrock makes the water situation vulnerable and much of the landscape or elements in the landscape are protected due to environmental, natural or cultural heritage considerations.

LAND USE, Source: Statistics Sweden	**AREA**	**SHARE**
Farm land total, including grazing areas:	102,300 hectare	32%
Subset: Farm land for cultivated crops:	*85,000 hectare*	*27%*
Productive forest area:	123,000 hectare	39%
Non-productive forest area:	38,000 hectare	12%
Other land types, such as grasslands and non-forested wasteland:	27,210 hectare	8.7%
Wetland:	3,050 hectare	1%
Lakes:	3,230 hectare	1%
Subset: Areas under environmental protection:	*26,386 hectare*	*8.4%*
Built-up areas including roads:	17,400 hectare	6%
Quarries and similar exploitations:	950 hectare	0.3%

REFERENCES

- Largest lake: 6.3 km²
- Highest point: 82 m above sea level
- North-south: 176 km
- East – west: 50 km
- Coastline: 800 km

1.1.1 Built environment on Gotland

There are about 32,000 heated buildings on Gotland. The buildings, on average, are relatively old; about 50% were constructed before 1945 and about 1% were constructed during the medieval period. Many buildings are valuable from a cultural heritage perspective and are protected by certain laws and regulations. The rate of demolition of buildings is close to zero. Households number about 28,000, of which about 18,000 are detached houses or farm houses for one or two families; about 10,000 live in flats.

As many as about 8,000 houses on Gotland are characterised as holiday homes, many of which are inhabited only during a few summer weeks. Many of those houses are only equipped with electrical heating *(Source: Register of buildings for taxation)*.

The city of Visby is a living world heritage site with medieval roots. Currently a popular summer destination, well-known for leisure and cultural activities, classified by UNESCO as a world heritage site: '…an extremely distinguished example of a Northern European walled Hanseatic town which has, in a unique way, preserved its townscape and its highly valuable architecture, the form and function of which clearly express the importance of this human settlement'. *UNESCO's World Heritage Committee.* 1

Over the last ten years many new buildings have been constructed on Gotland, in Visby, and all over the island. Much of the construction is for commercial purposes; about 1,000 new flats and 800 houses have been constructed for residential use, including new holiday homes. Remarkably enough, the number of permanent residents on the island has not increased during the same period. But there are quite a few house-owners who stay here during the main part of the year, while they officially live on the mainland.

The heating systems used for homes and public service buildings are fairly close to low carbon heating. Oil is still in use in some industrial buildings. Holiday homes are often equipped with only electrical heating, while the most typical heating system for a detached house is a biofuel boiler connected to a central heating system, with electrical heating as a backup. Most of the blocks of flats and service buildings in villages are connected to biofuelled district heating. The buildings are generally fairly well insulated; double or triple glazing is standard.

According to a national report from 2008 the remaining easily achievable efficiency potential in buildings on Gotland is between 20–25 GWh/yr.

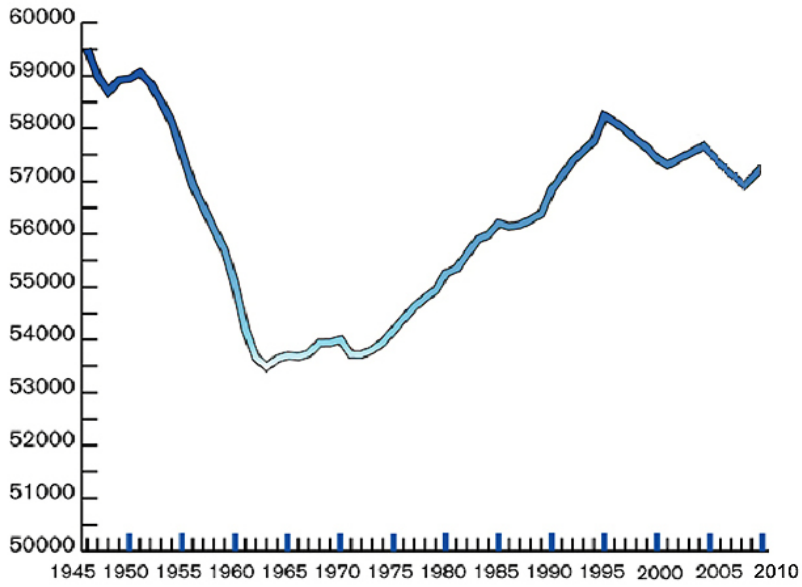
Less than 10% of households use fossil fuels to heat their homes. Less than 5% of flats are heated by fossil fuels, 90% are connected to community heating.
Fossil CO_2 emissions from heating homes has dropped by over 95% since 1990.

1.2 Demographics

The island of Gotland has 57,200 inhabitants (census 2011). The only urban community on the island is Visby, which is the centre of the municipal and county administration and higher education. Visby has about 23,000 inhabitants (census 2011). Villages with 800–1,800 permanent residents are also municipal service centres: Hemse, Slite, Klintehamn, Fårösund and Roma. About 20,000 of the island's permanent residents are scattered widely over the countryside; there are also some places with a few hundred residents such as Burgsvik, Havdhem, Katthammarsvik, Tingstäde, Lärbro and Ljugarn.

After the Second World War, the mechanisation of agriculture and the industrialisation that attracted young people to the growing urban industrial societies led Gotland, along with the whole of Sweden, to a major transition. Once a society where the majority of the population worked in agriculture, it became one where a steadily increasing number and proportion of the jobs were located in the town of Visby, the island's administrative and cultural centre. As Gotland never achieved the level of industrialisation that many other Swedish regions did, the island experienced a severe loss of young people in the late 1950s, when many of them had to move to find jobs on the mainland.

Population development on Gotland 1945–2010



The establishment and further development of the telecom industry, from the 1960s until the late 1990s, gave Gotland a share of the new industrial jobs, but they were concentrated in Visby. At the same time the growing public sector began taking responsibility for an increasing share of childcare and care of the elderly, which previously considered family duties. Thus a new labour market was created that employed many women. As urbanisation increased, these jobs also became more concentrated in and around Visby, but the public service and care jobs were spread over the whole island, wherever people lived.

Approximately 45% of the population currently lives in Visby. But Gotland's countryside is still a living rural society. Thanks to modern agriculture, which keeps the landscape open and attractive for locals and visitors alike, and the islanders' entrepreneurship and creativity expressed in a wide range of SMEs, the countryside still attracts many families to the island. Now the possibility of commuting to jobs in Visby or the villages while living in the countryside nearby means a higher quality of life for many families. But the ongoing trend of an ageing population on Gotland is even more common in the rural areas than in and near Visby. As the job market becomes more and more concentrated in Visby, young families come to live there, both from other parts of Gotland and from other regions. In the countryside there is a greater share of elderly amongst both permanent residents and new permanent residents from the mainland. Farmers break this trend, however, as the average age of active farmers on Gotland is younger than in the country as a whole. Everywhere in the countryside near the coasts around the island, and in the most picturesque blocks of small detached houses in Visby, a large number of houses are used primarily only during the summer period.

1.3 Regional economy, GDP

The annual development of Gotland's gross domestic product, GDP, in different sectors and total + carbon intensity is shown in the table below (*Source: Statistics Sweden, Regional facts*). Gotland's income level is generally a little lower than the Swedish average and the GDP development is slower on Gotland than in other Swedish regions.

Year	Product sector, SNI 01-45 SEK millions	Service Sector, SNI 50-95 SEK millions	Public & NGO sector SEK millions	Unknown sector, SEK millions	Total, SEK millions	Energy & Industrial CO_2, accts incl ETS prod	Carbon intensity; incl ETS, kg CO_2/ SEK
1993	2,229	2,678	2,518	1,072	8,497	*1,500*	*0.18*
2000	2,718	3,919	3,440	1,170	11,247	*1,940*	*0.17*
2005	2,607	5,396	4,467	1,469	13,939	*1,716*	*0.12*
2008	3,135	6,177	3,966	1,663	14,941	*1,837*	*0.12*
2009					14,879	*1,817*	*0.12*
					2010/CO_2	*1,772*	

There are slow signs of carbon decoupling , even including the ETS sector, yet no BRP figures available for 2010
Source: Statistics Sweden & Cementa AB

Number of people employed on Gotland in 2010, NACE code 2007.

	Number of	
Code	**Enterprises**	**Employees**
Code not available	258	1
A Agriculture, forestry and fishing	2,550	680
B Mining and quarrying	9	128
C Manufacturing	486	1,631
D Supply of electricity, gas, heat and cold	60	69
E Water supply, sewage, waste management and remediation activities	18	53
F Construction work	794	1,699
G Wholesale and retail trade; repair of motor vehicles and motorcycles	743	2,147
H Transports and storage	203	1,288
I Hotels and restaurants	342	1,083
J Information and communication	214	275
K Finance and insurances	75	617
L Real estate	574	391
M Justice, economy, science and technology	638	503
N Rental and estate services, travel agencies and other support services	219	760
O Public administration and defence; social security	51	2,307
P Education	211	2,686
Q Human health and social services	228	4,773
R Culture and leisure	420	854
S Other services	*447*	*530*
Gotland total	**8,540**	**22,475**

Source: Statistics Sweden, figures for year 2010

1.4 Political and administrative structures

Region Gotland is a regional and local authority, governed by an elected council and their representatives in the regional board of politicians. The region is the largest employer on the island.

Region Gotland's remit

- Childcare, schools and adult education, leisure.
- Care of the elderly and the disabled, individual and family care
- Emergency services
- Cleaning, water, streets/roads, parks, harbours
- Environmental protection, animal protection and health & safety
- Health care
- Public transport
- Culture
- Regional development – self-government since 1997.

As a region, the municipality of Gotland is responsible for working to encourage growth in the region**. Sustainable** growth is promoted by the objectives adopted in the *Vision 2025*.

1.4.1 The role of the region in energy aspects

Region Gotland can contribute to a transition to a sustainable energy use on the island through direct or indirect influence over:

- Transport, traffic planning, streets, parking areas, public transport, access for cyclists and pedestrians
- Regulations for and planning of land use
- Planning permission and building permits, public energy advisory service
- Management of recycling and waste material
- Waterworks, sewer systems and sewage work
- Public procurement of goods and services that impact climate and environment
- Education and training, consumer guidance and information to citizens
- Project funding of regional development projects
- Energy efficiency and RES penetration in buildings and transports
- Share-holding in grid and electricity company

The region has the opportunity to take action and to act as an arena for work carried out locally. This generates positive effects, including an improved living environment, cleaner air and lower energy costs. Measures aimed at reducing climate change are a powerful driving force for technological innovation and improved local economy.

1.4.2 Energy coordinating by the county administration

The island of Gotland is also a county run by a county administration of governmental employees, not publicly elected representatives. The county administration has the responsibility of coordinating and implementing national politics and policies on Gotland, as the regionalisation of the national energy strategy and the national environmental objectives.

The county administration is also tasked with supporting renewable energy and energy efficiency according to national policies, and to supervise the provision of other national interests. The county administration has a responsibility to produce a regional energy strategy that fairly covers the same areas as the municipal/regional energy action plan. It must also supply the municipal level with basic data for planning and check municipal plans.

2. ENERGY 2020 – SUSTAINABLE CLIMATE-NEUTRAL ENERGY FOR GOTLAND

2.1 Visions for a sustainable future

Region Gotland has challenged itself to have a fully climate-neutral energy supply by 2025. Offering the highest possible efficiency and economy, the energy supply will be climate-neutral, based on local, renewable resources and will contribute to sustainable growth and the development of local business. *Vision 2025, adopted by the Regional Council.*

In the early 1990s, the municipality started the strategic push to turn the island into a sustainable society by 2025. Sustainability here refers to all aspects of the environment – energy, resources, agriculture, waste, radiation, etc. Particularly during the last decade several actions have been taken to find solutions for a sustainable energy supply on Gotland.

2.1.1 CO_2 reductions already achieved

The CO_2 emission from fossil fuels for transportation and heating (excluding heating in ETS industries) was reduced by 40% between 1990 and 2010, primarily due to the transition of the technology for heating buildings. Oil has been largely replaced by biomass, especially in district heating. Increased activity in local forestry plus development of the technology for biomass heating has resulted in local biomass covering most of the heating fuel used for buildings on the island. In smaller buildings the switchover from oil boilers to geothermal heating or heat pumps also contributes to reduced dependency on oil and/or less need for electricity for heating. Technical development has led to improved energy efficiency, but at the same time both the average heated building area and the number of transports per inhabitant on Gotland have increased.

2.1.2 Continued efforts

The number of customers on the electrical grid is higher and electricity is used for a wider range of purposes, boosting demand for voltage and quality aspects of the electricity, but despite that, electricity consumption in the non-trading sector is about the same as in the early 90s. Currently 30% of the island's total electricity needs are covered by local wind power; the rest is imported from the Swedish mix of mainly hydro and nuclear power.

Since 1995, the municipality has reduced CO_2 emissions from fossil fuels in its own operations by almost 50%. Further regional actions regarding energy efficiency in buildings, public procurement, behaviour change and advisory services on energy efficiency are to be taken during 2011–2015, parallel to actions for transitioning transports to other fuels, improved energy efficiency in industry and the service sector and installation of new wind power plants. All of these mainly depend on decisions outside the regional council, but can to a certain extent be supported by regional actions.

During 2012 the installed capacity of wind power will reach the present grid limit of 195 MW. With a new sea cable put in operation in 2017, the next phase of wind power installation on Gotland will take place in 2016–2020, when about 1,000 MW of wind power will be installed on Gotland. The idea is that future exports of wind power will balance the remaining use of fossil fuels for transport and industrial use on the island. Local biomass resources with support from geothermal, solar and recycling of excess heat will meet the energy needs for heating and some of the fuel for road transports. Both wind power and bioenergy will contribute to sustainable growth in local business. But local growth also depends upon good transport systems. No major changes of technology for road transports are expected until 2020. The greatest future challenge is to meet future demands for increased mobility while, at the same time, reducing emissions from transports. Public procurement and investments in the public sector will contribute to the development.

2.1.3 Organisational and financial aspects

Some barriers have been encountered and some still remain on the path to realising the sustainable, technical and economic feasibility potential of renewable energy on Gotland.

- Low Swedish electricity prices compared to the rest of Europe are an obstacle to achieving economy in substituting electric heating with biofuels. They are also a general obstacle to motivating energy efficiency.
- Acceptance of wind power – While the public is generally positive to the development of wind power as presented in the development plan for Gotland, continued development has to be a democratic process. To succeed we make use of the potential for wind power production on Gotland without reducing areas of unspoilt nature or habitats for certain species or intruding on cultural heritage, while at the same time ensuring a certain share of local ownership and economic advantages for nearby communities.
- Grid infrastructure – A weak power grid at suitable wind power locations.
- Governmental policy – The establishment of biogas production depends on a governmental support system for fuels. Gotland, like many other Swedish regions, had hopes for a national funding scheme for biogas production support, which has now been postponed.
- Entrenched attitudes – Lack of awareness of the regional benefits of local RES production within certain sectors.
- Lack of investment capacity, which slows down the transition process in households, SMEs and public services.

Barriers overcome:

- Export of wind power: Current grid connection to mainland has been restructured to allow export. New sea cable underway.
- Low awareness: Interest in replacing fossil fuels is increasing in the general public.

- Lack of awareness of contents of municipal plans: Politicians and civil servants have been informed about the ambitious energy and environmental targets already set.
- Lack of know-how: The region's property departments are experienced in energy management techniques. Many SMEs are active in the energy service sector, while a municipal energy advisory service supports the public.
- Public acceptance of wind power: Projects are in place to provide mechanisms for local ownership, compensation schemes for nearby land owners and communities along with approved development plans.

2.2 Objectives and targets

2.2.1 Overall CO_2 reduction target for 2020

The target is a 45% absolute reduction from 1990–2020 of the energy-related fossil CO_2 emissions in the non-emission trading (NETS) sector on Gotland. Emissions of other climate gases or sources other than energy use or energy conversion are not included. The outcome in the ETS[1] sector is only very limited by local measures; it will mainly depend upon international markets and regulations.[2]

Emissions from remaining fossil fuels in the NETS sector in 2020 will be 'balanced' by exporting wind power.

2.3 Strategic guidelines

The overall strategic steering document for Region Gotland is the regional development programme *Vision 2025* (not available in English) and the underlying operative programmes, where the full version of the *Energy 2020 – energy plan and climate strategy for Region Gotland* (under public consideration and awaiting political approval, spring 2012) expresses the path to sustainable energy.

The following points reflect the headlines of the energy strategy in *Energy 2020*.

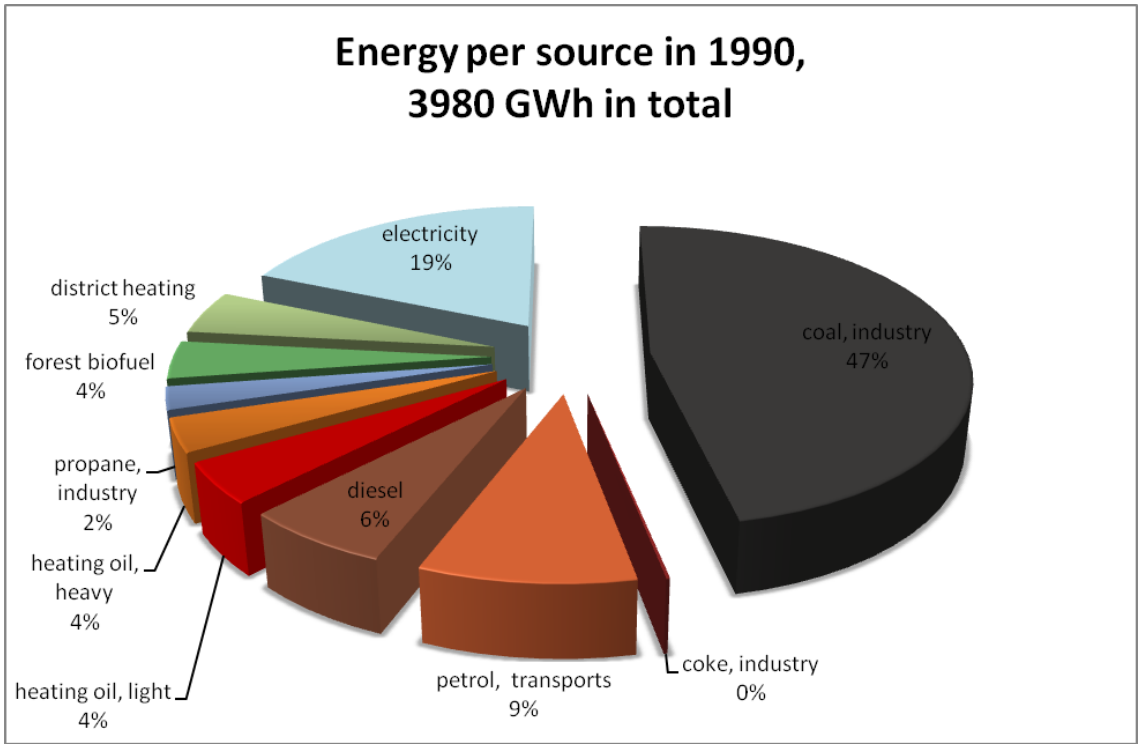
- **Dedicated plan for a society close to zero emissions of climate gases**
- **Identify and support key actors in production of electricity, heat and transport fuels from renewable energy sources**
- **Reduce the energy needs of buildings and choose energy effective technology**
- **Support the analysis, development and implementation of the technology needed for the transition to a sustainable energy system, both for the region as a whole and in the region's own operations**

[1] ETS Emission Trade Scheme, the ETS sector include enterprises within the European CO_2 Emission trading scheme, – NETS means the Non- ETS, including all other operations
[2] CO_2 emissions from electricity via mainland cable calculated as Nordic Mix

3. Energy balance and emission inventory

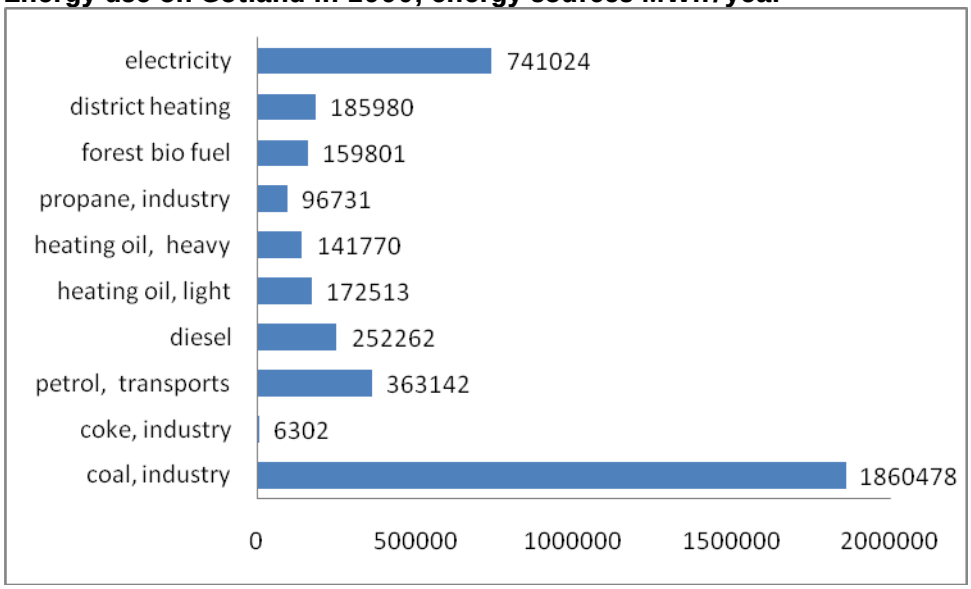
3.1 Final energy demand in 1990 & 2010

Energy use on Gotland in 1990



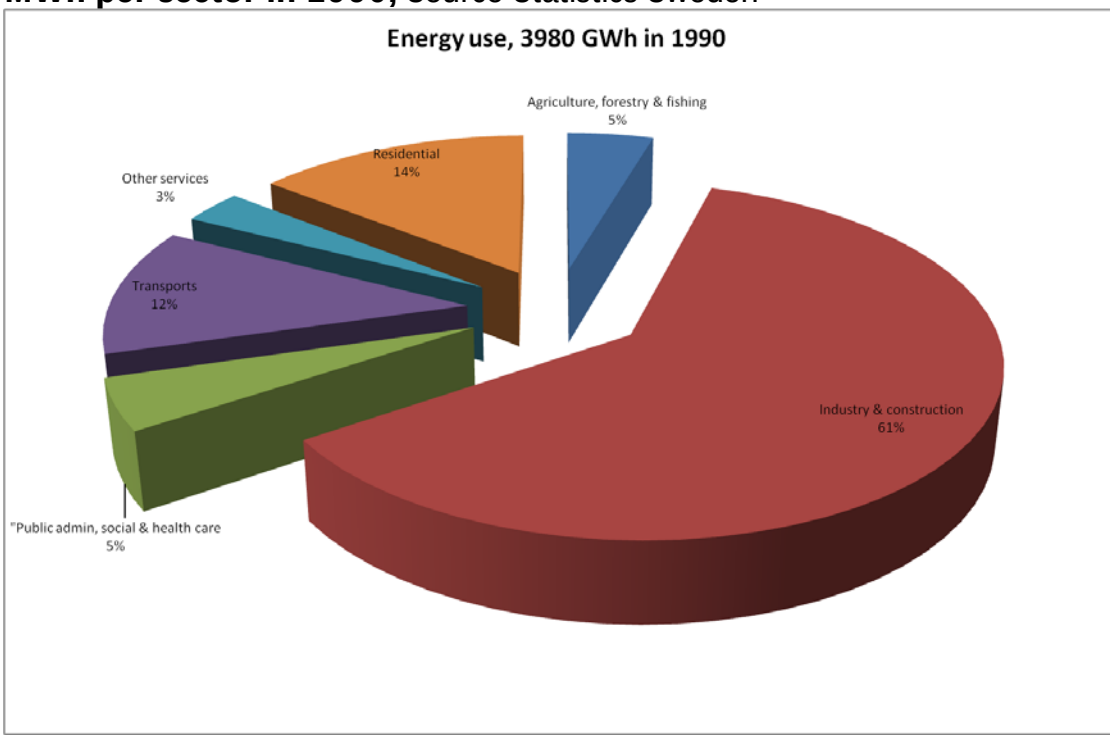
In 1990 the Swedish electricity prices over the year seem to have been favourable in comparison to oil prices; resulting in a high share of electricity in the heating systems.

Energy use on Gotland in 1990, energy sources MWh/year

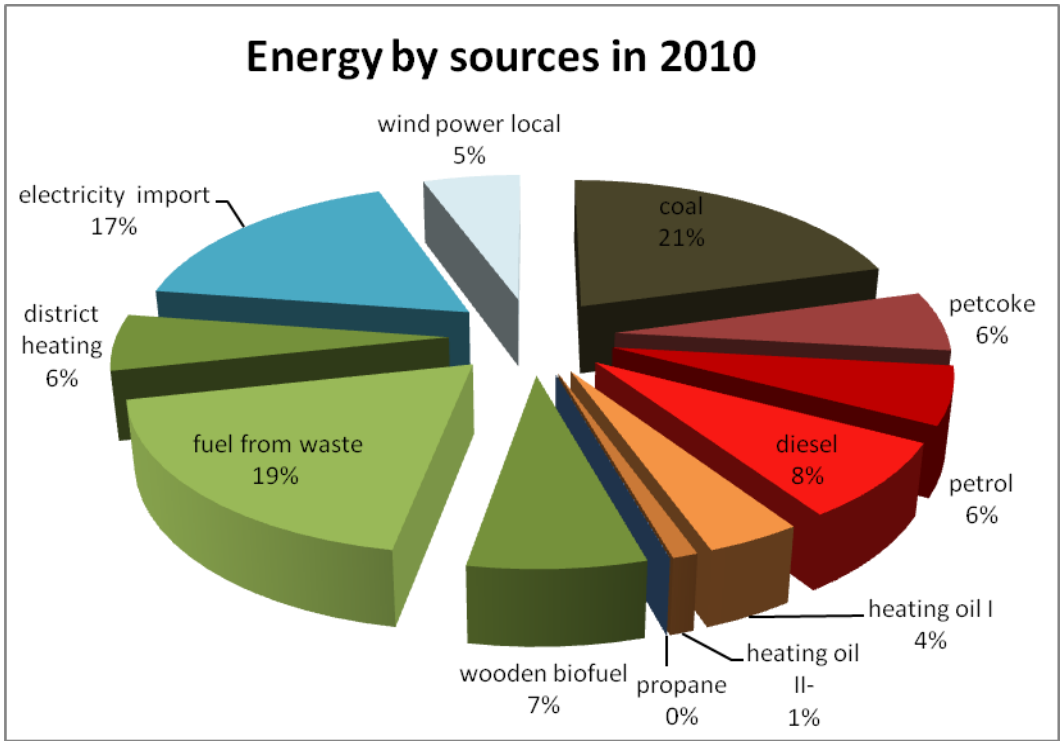


The sectors in the figure below are the ones shown by Statistics Sweden

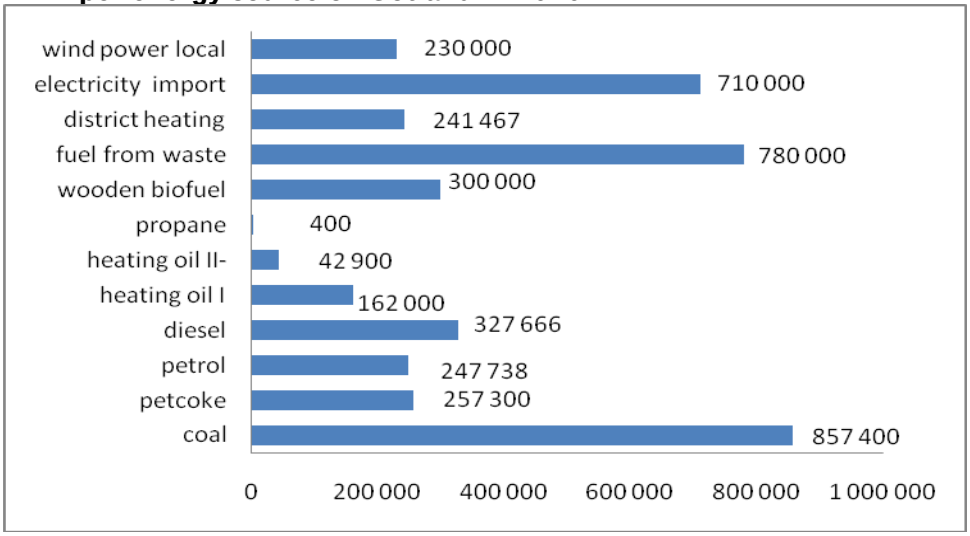
MWh per sector in 1990, Source Statistics Sweden

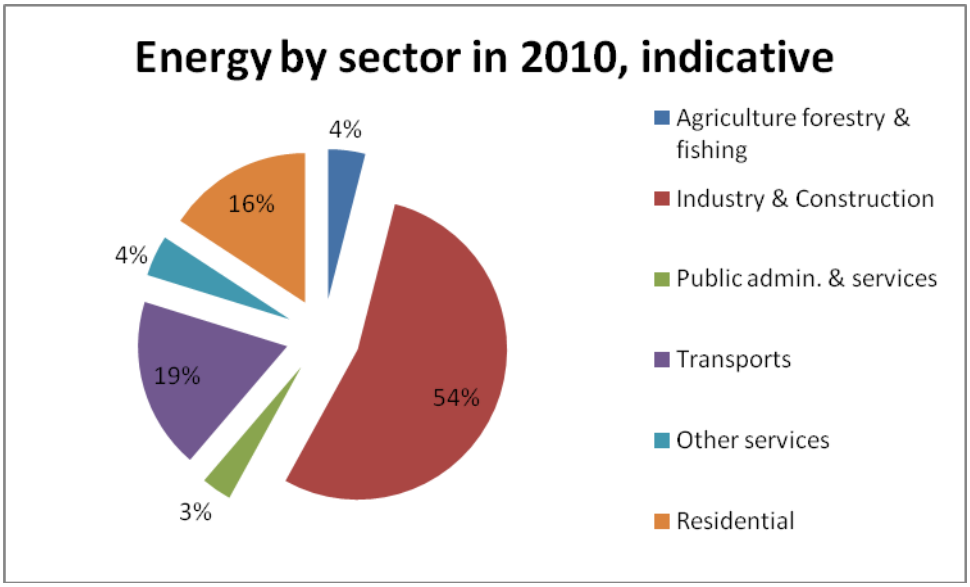


Energy supply by energy sources in 2010, 4160 GWh



MWh per energy source on Gotland in 2010





Statistics Sweden has not yet published regional energy use by sector for 2010. From 1990 to 2010 energy consumption as such was not reduced on Gotland, but changed from fossil fuels to waste products, recycled energy and renewable energy. The energy consumption in 2010 was met about 20% by local renewable energy, 14% by recycled local energy, 20% by coal (only for industrial heat), 35% by petroleum products, and the remaining part mainly came from imported renewable energy as biowaste and hydropower. The RES penetration in transport fuels was just about 3.5 percent in 2010.

3.2 Secondary energy conversion

3.2.1 Wind power production

The conversion of wind energy to electricity is the island's absolute main resource for electricity production. Until recently only around 10% of its expected potential was used. According to the development plans and objective for local supply of renewable energy on Gotland, in the future wind power is expected to make the largest contribution to the renewable energy supply, with around 1,000 MW installed capacity.

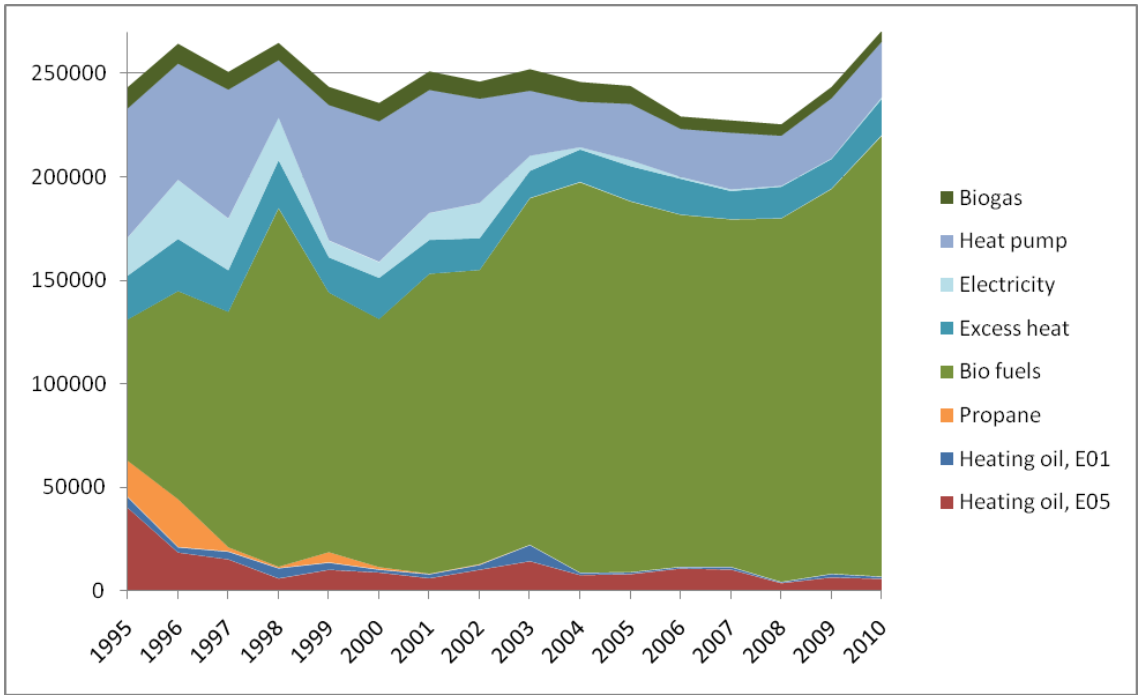
3.2.2 District heating

On Gotland the main conversion of fuel is for heat production. In the ETS[3] sector the main conversion takes place in the cement industry; the ETS industries used almost 40% alternative fuels in 2010, both biofuels and fossil fuels.

There is no regular transformation to electricity from fossil fuels on Gotland, only as occasional back-up during the rare power outages in the sea cable transmission. The availability of back-up power production is crucial to Gotland but as the production and the following emissions are small, it is not in the scope of any present actions for transition.

In the NETS[4] sector the main conversion of fuels for commercial heat production takes place in the wood-chip-fuelled district heating plants. The district heating systems supply end users on Gotland with around 250 GWh of clean energy every year.

Graph: The development of district heating to using less than 3% fossil fuels, MWh/year



[3] Emission Trade Scheme
[4] Non-Emission Trade Scheme

3.2.3 The path to a sustainable energy balance for Gotland

Development in 1990–2010, expected levels for 2020 with development activities.

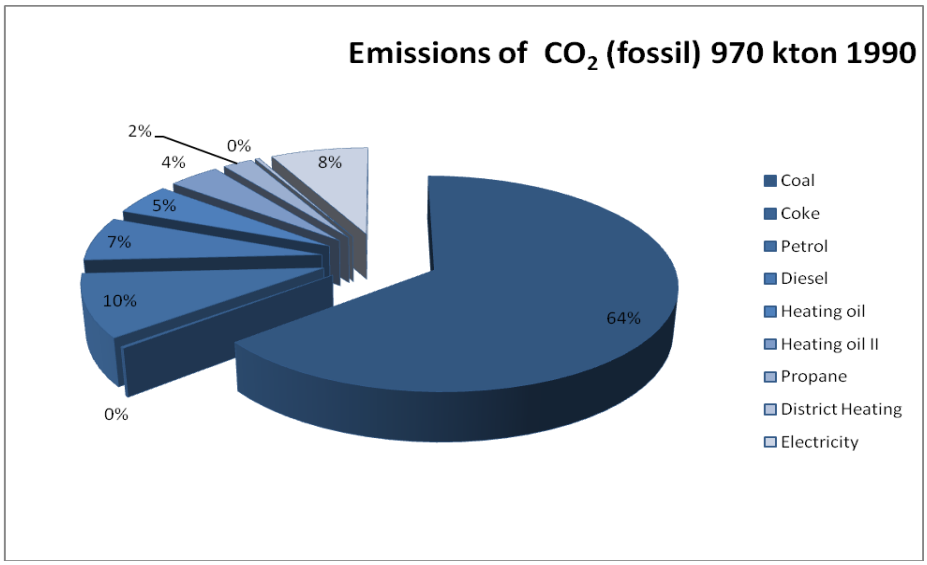
A Electric power **B** Heating/fuel **C** Recycled **D** Renewable **E** Total local prod.

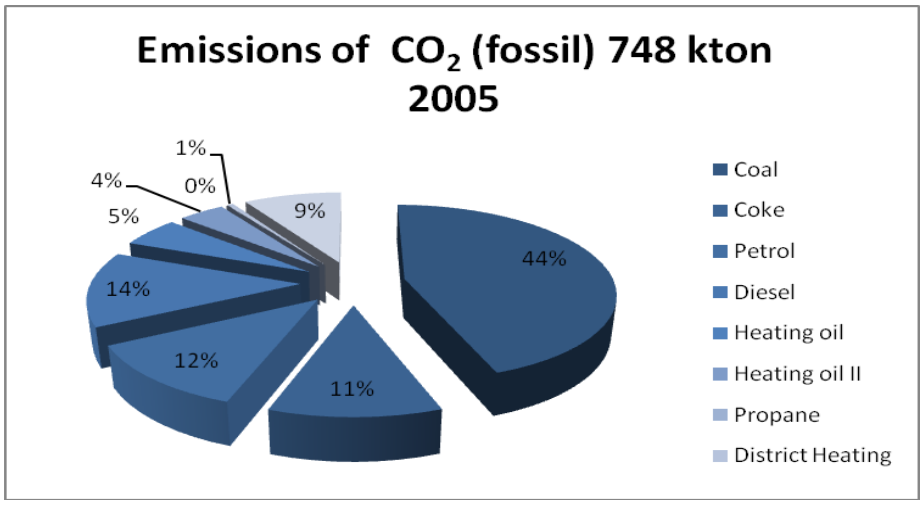
	Local energy supply I = installed capacity (MW) O = Annual output, GWh/yr		1990	2005	2010	2020 Possible outcome
A	**Wind power**	I	5(?)	90	112	700
		O	10(?)	173	230	1,850
	Solar panels	I	0	0.005	0.005	0.5(?)
		m²	?	50	50	500
		O	0	<0.1	<0.1	1
	Biofuel *combined heating and power plant, CHP*	I	0	0	0	20(?)
		O	0	0	0	?
	Biogas *electric power*	O	0	0	0	?
B	**Biofuel** *district & community heating, local fuel*	I	45	45	45	40
		O	18	100	213	300
	Biogas *heating*	O	6	9	8	22
	Biofuel *individual use*	O	100	133	320	320
	Subset wood pellet	O	0.5	35	45	50
	Solar heating	m²	200(?)	3,000	15,000	25,000
		O	0.6	1.4	5	11
	Heat pumps	I**	15	20	25	40
		O	52	70	72	140
	Biofuel: Ethanol/RME import	O	0	0	18	33
	Biogas	O	0	0	0.4	114
C	**Recycled energy** *(waste, heating and electricity)*	O	73	533	596	756
D	***Subset Renewable &/or recycled, /*** *including import*	O	490	872	1413	3,342
	Renewable share of total energy use including export	%	11.6	21	32.5	50/60
E	**Locally generated electricity**	O	**10**	**173**	**230**	**1,850**
	Locally produced heating & fuel	O	**190**	**355**	**848**	**978**
Energy supply, local origin		O	200	528	1,102	2,828
Primary energy supply to Gotland*			**3,980**	**4,132**	**4,160**	**4,030**

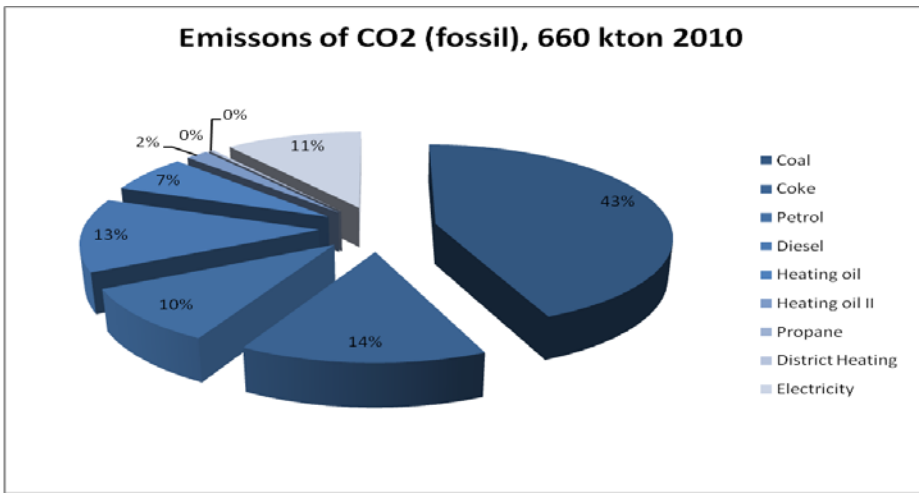
*aviation and heavy marine transport fuels are not included in the total supply for Gotland

3.3 CO_2 emissions from primary energy use in 1990–2010

The summaries include energy for ETS industries, but not their process emissions from limestone or other process emissions. CO_2 emissions are calculated with national emission factors from the Swedish EPA applied on regional figures from Statistics Sweden. CO_2 from electricity via mainland cable is counted as Nordic mix.







3.3.1 Final energy demand with energy actions until 2020

Thanks to the extended use of energy recovery, excess heat and heat pumps, the gap between final energy demand and primary energy supply in 2020 will be smaller than today, which might be one of the major contributions to more efficient energy use in 2020 than in 2010.

3.3.2 Secondary energy conversion with energy actions until 2020

In the active scenario, energy conversion on Gotland in 2020 will include about 700 MW of installed power production capacity and about 300 MW of installed capacity for renewable power generation, currently in progress. Wind power will be the main resource with contributions from other power sources. A CHP might be one of the Islepact bankable projects. Local production of biogas and power will increase the share of renewable energy sources. New technology will improve energy efficiency in the production and consumption of electricity, heat and cooling.

3.3.3 'Business as usual' as reference scenario?

For Gotland the reference scenario simply means that investments in wind power stop at the present grid limit, the biogas infrastructure does not develop to include new plants, and the investments made to fossil oil with bioenergy will only continue slightly further, until 2020. Instead of development and energy transition, households and businesses on Gotland will basically retain the same energy infrastructure as in 2010. There will probably be increasing energy costs, especially for transports, which will be a disadvantage for the whole region.

The term 'business as usual' is not quite accurate, as it normally includes previously initiated activities. Many activities have already been initiated on Gotland, such as the plan for wind power development and a plan for a new electrical grid, and there are national objectives in place, but the initiated activities do not ensure that the real changes will be carried out.

Scenario planning has the disadvantage of including a supposed but impossible capacity to foresee what will happen in the future. Backcasting[5] has identified the most strategic focus areas for energy transition on Gotland as: increased local supply from wind power, biogas and wood biofuels together with improved energy effectiveness and public awareness. The range of actions in chapter 4 all contribute to those fields, but by 2020 some new important areas for energy transition might also open up, and development in some areas might slow down due to external circumstances.

3.3 4 Expected primary energy demand in 2020 including actions

Table 3.2.3 explains the expected results of local action, including expected results from national and other regulations. The actions in chapter 4 aim to improve primary energy infrastructures, secure energy supplies and to make extended use of clean energy.

[5] A view backwards from when the adopted objectives are achieved in terms of conditions specified in advance, focusing on the necessary actions and possible strategies to achieve the objective

4. Actions for 2012–2020

Consult the table section for explanations of the local actions below. These local actions are expected to take place in the public sector as well as in enterprises. Some of them also involve private households.

4.1 Buildings/equipment, facilities & industries

4.1.1. Municipal buildings/equipment

- Replacement of oil as a heat source for buildings and for the municipality's own operations, energy efficiency measures in buildings and processes, electricity-saving campaigns amongst employees
- Continued energy efficiency measures in the municipal housing company 'Gotlands-Hem'
- Low energy standard developed for refurbishing and new construction of municipal buildings
- Transition to LED in municipal public lighting
- Installation of new PV plants at schools for demonstration and, when economically feasible, in buildings with high internal energy demands or no grid connection
- Continued public procurement of 'green' electricity – ongoing since 2002

4.1.2 Other buildings/equipment, business, SME industries

- Continued projects like the 'Climate entrepreneurs' (II); energy efficiency workshops for businesses
- Demands for energy-efficient buildings for new construction
- Heating oil in the food industry (used for steam production) replaced with biogas from manure, energy crops and biodegradable waste

4.2 Transport

4.2.1 Municipal fleet

- Replacing vehicles in the municipal fleet (for leasing cars normally every 3rd year) with biogas cars as first choice and electric vehicles as a future complementary option
- Procurement of coordinated transport of goods to public customers within the city
- Further construction of biogas plants and production of upgraded biogas for use both in public transport and private cars – underway with the first plants for upgrading and production
- Public procurement of biogas for transports such as school buses, public buses, goods transports and so on.

- Investment in production plants and infrastructure for biogas mainly within the private business sector, not in the municipal/regional organisation, even if the region stays involved both as a producer and a customer of biogas

4.2.3 Public and private transports

- Municipal procurement to support the development of public transport with the best available technology in environment-friendly vehicles, exemplified by the biogas buses in Visby and the environmental demands on diesel coaches in rural areas
- Public procurement of transports in line with the region's biogas strategy
- Support the infrastructure to make biogas available
- Biogas fuel and/or more fuel-efficient transports in the private sector

4.3 Local electricity production

- Installation of 900 MW of additional effect of wind power; at the same time, wind power will be the major contributor to the renewable energy supply on Gotland
- A regional wind-power coordinator, hired on a project basis, works together with wind power developers on Gotland, national and regional grid companies and other stakeholders
- Smart Grids Gotland, a project developed through the cooperation of national energy companies and the local grid company, will introduce new technology in the grid

4.4. Local district heating/cooling and CHP

- New development areas in Visby are to be connected to district heating; geothermal is under investigation as an option for the future supply of district heating in Visby
- Construction of a CHP plant in Visby has been adopted as one of the bankable projects that are subject for more in-depth investigations in the Islepact project

4.5 Land use planning

- New development in Visby: the eco city 'Visborg', a programme with sustainability standards, is under development for adoption in spring 2012
- Continuous improvement of cycle paths, bus services and intermodal transports
- Detailed comprehensive planning with integrated sustainability aspects is under way for development areas, according to the Region's comprehensive plan

4.6 Working with the citizens and stakeholders

- Energy and climate advisory service to SMEs and private households
- Islepact project's support for development of bankable projects

A range of awareness-raising activities – important but hard to measure

5. Organisational and financial mechanisms

5.1 Coordination and organisational structures

The Regional board (supporting the local advisory board, consisting of representatives from the regional administration, the county administration, university and regional energy stakeholders) has made assignments for various parts of the action plan and the follow-up of the results. The strategic climate work is coordinated from the executive office of Region Gotland and the urban planning department (technical department). Region Gotland has the primary responsibility for the action plan, developed within the framework of the EU project Isle Pact, EU's CoM and the ongoing work with energy efficiency actions, energy planning and comprehensive planning.

5.2 Staff capacity

The executive office has one person allocated for strategic energy and climate planning; the departments of urban planning and technical department altogether have three people allocated for spatial planning, one person for the EU project Islepact, three for energy efficiency measures in municipal buildings and transports and one for the free energy advisory service for municipal residents and SMEs, as well as other strategic functions such as waste management, wastewater cleaning and biogas production, traffic management, management of public areas and buildings.

5.3 Involvement of stakeholders

A local work group and regional advisory board (see above) developed the action plan based on the climate targets and previous/ongoing work, where stakeholders and citizens have been and are involved. Financial involvement from stakeholders and personal involvement from citizens are vital for achieving the targets of the plan. There are several ongoing energy projects on Gotland, and it appears that more will follow, especially in the areas of raising awareness and seeking public support for climate investments.

5.4 Budget

Region Gotland has allocated an approximate internal budget for energy transition and efficiency measures in its own operations, including strategic climate measures of EUR 250,000 per year, spread out over several departments. For the years 2012–2014 there are certain budget demands for funding of energy optimisation of the region's operations; details are not yet determined. However, most of the actions for CO_2 reduction and energy transition will be taken by other regional stakeholders, not within the tax-funded public regional budget. See the economy chapter for further considerations of the socioeconomic effects. It is not possible to estimate the total budget for this transition yet; even investments that clearly seem to be under way in a few years can be delayed or changed depending on upcoming new circumstances.

5.5 Financing sources and instruments

Except for the investments that regional stakeholders in different sectors will take responsibility for, the regional and national public sources will allocate funding from the National Energy Agency; the programme for energy efficiency measures in the public sector and the possibility of contributions from different EU programmes will be investigated.

5.6 Monitoring and follow-up

Since 2005, an annual energy and CO_2 assessment has been carried out as part of the data collection for the municipal annual report. This inventory manual is the basis for monitoring the results on a geographical level. The energy action plan is to be followed up every year and evaluated every mandatory period.

Key figures monitored for Gotland as a whole are:

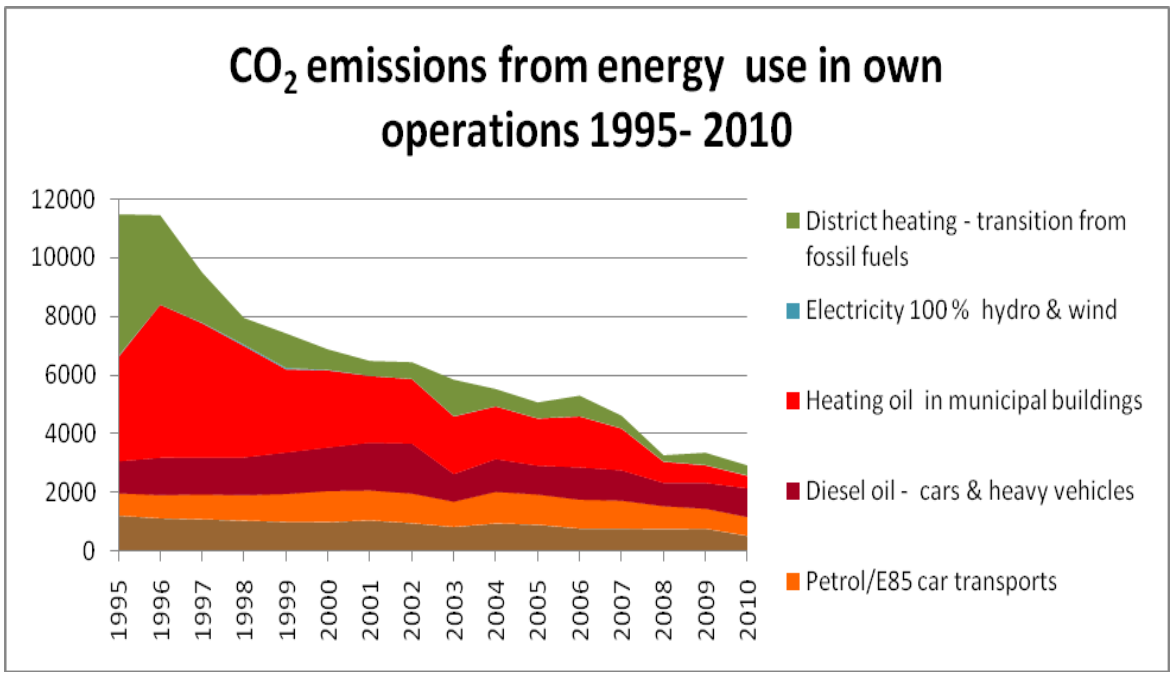
●Total energy supply ●Total electricity supply ●Total supply of fossil fuels ●Total supply of district heating ●Number of bus trips on public buses ●Number of cars ●Transport mileage in road traffic ●Energy related CO_2 emissions on Gotland ●The penetration of RES in road transports, district heating, electricity supply and ETS industries

Key figures for the region's own operations are:

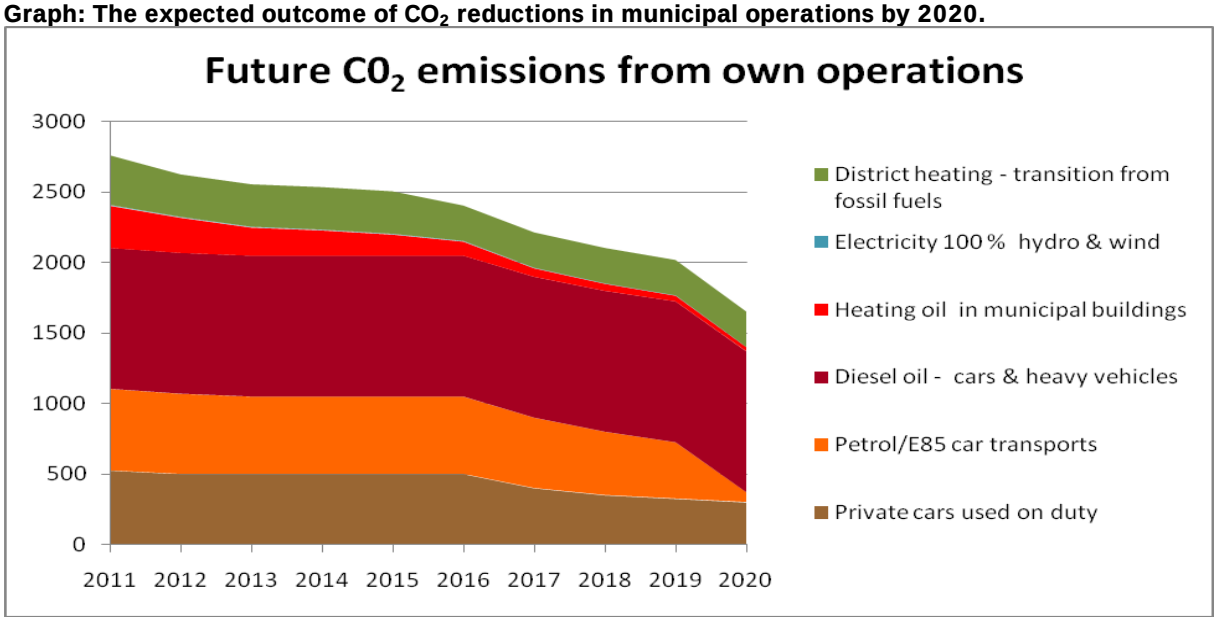
●Energy efficiency in buildings ●Energy for car transports ●Electricity for operations ●Share of renewable energy in the three sectors mentioned above

On the next page are the internal key figures for CO_2 emissions, its development and the future expectations.

Graph: Result of CO_2 reductions in municipal operations



Graph: The expected outcome of CO_2 reductions in municipal operations by 2020.



Observe the different scale of the x-axis in the both diagrams above

6. TABLE SECTION

Tables of possible actions on Gotland to increase energy efficiency and availability of local RE; not all of the electricity produced is supported for local use; some of it 'balances' some continued use of fossil fuels, mainly in ETS industries, whose additional actions are not included in the table. Due to already low CO_2 emissions allocated to municipal buildings' energy supplies, not all of them will be cost effective from the aspect of CO reduction, but they will give a return on investments in the form of lower energy costs.

Ownership by the Region	Cost efficiency counted as €/ annual CO_2 reduction unit	Local potential Energy efficiency, MWh	Additional local RE potential, use or supply, MWh annually from 2010 and on
4.1.1. Municipal buildings/equipment			
Very high	**Very high**	**15,000**	**1,200**
4.1.2 Tertiary buildings/equipment, SMEs			
Low	**Very high**	**60,000**	**230,000**
4.2.1 Transport, municipal transports			
Very high	**Very high**	**750**	**5,000**
4.2.2 Transport, public & private transports			
High	**Very high – very low**	**+-0**	**31,000**
4.3 Local electricity production			
Very low	**High**	**+-0**	**1,620,000**
4.4 Local district/heating, cooling CHP:s			
Low	**Average**	**10,000**	**7,000**
4.5 Land use planning			
Average	**Average**		
4.6 Working with the citizens and stakeholders			
High	**Average**		

Ownership – the Region's right of disposition	
Very high	Within own budget frame
High	Own disposition over means of control
Average	National ordinances
Low	National laws
Low	Cooperation with other players
Very low	External financiers
Very low	EU law or voluntary project

Cost efficiency	
Very high	Economically viable
High	SEK 0–1 per kg CO_2
Average	SEK 1–5 per kg CO_2
Low	SEK 5–10 per kg CO_2
Very low	SEK >10 per kg CO_2

7. References

Energy 2010 – Energy Plan for the Municipality of Gotland (The local energy system's development until 2010 and energy scenario until 2025)

Vision 2025 – Regional Development Programme for Gotland (Regional objectives for 2025)

Statistics Sweden, www.scb.se (Municipal and regional energy statistics, 1990-2010)

The path to RES www.path2res.eu (The approach for regional energy planning)

Energy Scenario for Sweden 2050, report from IVL, the Swedish Environmental Research Institute (Long term energy scenario for Sweden)

Stockholm Action Plan for Climate and Energy 2010–2020, Stockholm Environment and Health Department (The structure of chapter 6. Table section)

Elaboration:

Region Gotland, Executive office, as a deliverable from Gotland in the CoM iniative and in the Islepact project, approved December 18th, 2012 by the Executive Board of Region Gotland.

This document was is in accordance with the full version of Energy 2020 – energy plan for Region Gotland; for public consideration.

Approval of the full document, by the Regional Council, remains until after the public consideration.

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