Motiva

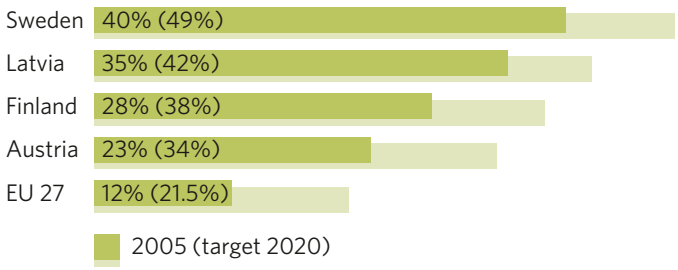
Renewable energy in Finland

Energy use in Finland

Due to Finland's northern location, there is a diverse need for energy in our country. In the dark, cold winter months, we need plenty of artificial light and many heat sources. Uninterrupted electricity and heat production is the lifeblood of our lives. Long distances and dispersed settlement increase energy use in transport. Industrial processes in Finland consume a lot of heat and electricity, especially in the wood and metal processing and the chemical industries.

About 80 per cent of the greenhouse gas emissions that have a contributing effect on climate change come from energy generation and consumption, including transport. Due to the climate targets, Finland wants to increase its share of renewable energy, even though we are among the top EU countries in the use of renewable energy next to Sweden, Latvia and Austria. Finland is particularly well known for its solid expertise in bioenergy.

Share of renewable energy in some EU countries, and the Commission's proposal for binding targets, % of final consumption



In the EU countries, the use of renewable energy varies to a great extent. In the comparison between member states, Finland is clearly at the top with its 28 per cent share of renewable energy in the final consumption of energy. In accordance with the EU target, we aim to raise the share of renewable energy to 38 per cent by 2020. Moreover, in accordance with the directive on the promotion of energy from renewable sources, Finland is also drawing up a national action plan to be submitted to the Commission by the end of June 2010.

Raising the profile of renewable energy

As a result of climate change, our energy economy is on the threshold of a great transition while we are striving towards a carbon-neutral energy system. According to the vision of energy policy, Finland will be able to carry out a transition to a low-emission energy economy with an approximately 60 per cent share of renewable energy by 2050 if the growth in overall energy use can be stopped and reversed.

Use of renewable energy and its targets by energy source and final consumption, terawatt-hours TWh
(1 TWh = 3.6 PJ)

	2005	2006	2020 target
Fuels dependent on industrial production			
Waste liquors (black liquor)	36.7	43.3	38
Industrial wood residues	23.1	26.7	22
Total	**59.8**	**70.0**	**60**
Subject to policy measures			
A. No need for subsidies			
Hydropower	13.6	11.3	14
Recovered fuels and cheapest biogases	1.7	1.9	3
B. Low need for subsidies			
Forest chips[1]	5.8	7.2	21
Small-scale use of wood	13.4	13.4	13
Wood pellets and field biomasses	0.1	0.1	3
Heat pumps	1.8	2.4	5
C. High need for subsidies			
Other biogas	0	0	0.5
Liquid biofuels[2]	0.0	0.0	6
Wind power and solar energy	0.2	0.1	6
Total	**94.9**	**102.7**	**128**
– of which total wood fuels[3]	19.4	19.3	37
Final consumption of renewable energy	**86**	**92**	**118**

1 In addition, forest chips are estimated to be used as fuel in biorefineries

2 Includes biofuels in transport and production machinery, and biofuel oil used in heating

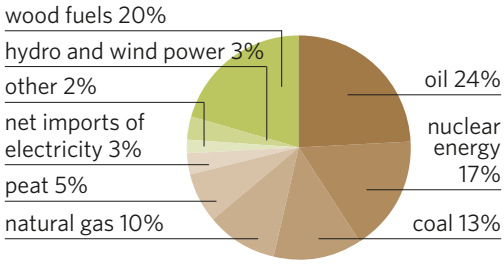
3 Industrial waste liquors or wood residues are not included

Finland's energy economy is based on exceptionally diverse energy sources, such as oil, wood fuels, coal, nuclear power, natural gas, peat, and hydro power. The efficiency rate of energy production is improved by the extensively used combined heat and power production (CHP).

According to Finland's Long-term Climate and Energy Strategy (2008), in energy production, the share of indigenous energy, and that of renewable energy in particular, will increase considerably over current levels. The goal is to increase Finland's share of renewable energy in final consumption to 38 per cent by 2020 in line with the obligation proposed by the Commission.

It is estimated that Finland's natural resources would enable additional use of renewable energy. In order to realise this, the current subsidy and steering systems will be rendered more efficient. This will facilitate the transition to additional use of renewable energy. Meeting such an obligation requires an intense increase in the use of wood-based energy, waste fuels, heat pumps, biogas and wind energy. At the same time, efforts will be made to enhance the efficiency of energy use so that its final consumption will enter a downward trend.

Distribution of total energy consumption by energy source in Finland in 2007



Total energy consumption in Finland in 2007 amounted to 1,480 petajoules (PJ), or approximately 411 terawatt-hours. Source: Energy Statistics, Statistics Finland 2008

In the future, households may be generating electricity for their own use by wind power or solar panels while feeding any excess energy to the grid or receiving any extra energy from the grid, when necessary. Technically, distributed electricity generation would be feasible today.

Why renewable energy?

Early industrial production relied on renewable energy, hydro and wind power, and heat from wood combustion. Later on, the development of production was powered by fossil fuels. Alternatives to fossil fuels are sought these days, and there are many reasons for this. Climate change mitigation, i.e. the need to curb the rise in the global average temperature by reducing emissions of greenhouse gases, has become a more significant factor than the limited scope of fossil fuels. The use of domestic energy sources is being promoted at the same time.

Efficient energy use and energy production methods are key factors in the mitigation of climate change. Therefore, energy-saving technologies, renewable energy sources and related technologies are part of the current and future development. The increases in the world market prices of oil, coal and natural gas and the price of EU emission allowances will improve the competitiveness of renewable energy also in the future.

The equipment and methods used in the harvesting and transport of energy wood are highly developed in Finland. Logging residues are collected efficiently in connection with final felling.

Renewable energy is rewarding

- The use of renewable energy significantly reduces carbon dioxide emissions.
- The use of renewable energy is part of sustainable development.
- Domestically-sourced energy reduces dependence on imports, boosts employment and enhances the security of supply.
- The renewability of energy is a positive issue; it has clear benefits for the image of its producers and users.
- The use of renewable energy supports Finnish research and development work.
- When correctly planned and implemented, harvesting of energy wood increases tree growth in thinnings and facilitates reforestation after felling.
- General opinion and political targets support the renewables alternative.

What about disadvantages?

No energy production method is totally without disadvantages. When expertly implemented, the use of renewables results in fewer disadvantages than other known energy forms.

- Clearing of harvest residues may slow down the growth of young woods but, for example, in peatlands the loss of nutrients can be prevented with ash fertilisation.
- In wood combustion, poor equipment and an incomplete combustion process may result in harmful hydrocarbon, carbon monoxide and particulate emissions.
- The building and regulation of waterways for energy production have an impact on the aquatic environment.
- Without careful planning, wind farms may have a disturbing influence on local residents, the landscape and the environment.

Goal-directed promotion of renewable energy

Finland's energy taxation and subsidies are developed to promote greenhouse gas reduction, energy efficiency and the use of renewable energy.

The government supports the energy solutions and investments of companies in order for the energy economy to develop in a more pro-environmental direction and new technologies to be adopted in a wide scale. Research and product development in the field is supported extensively.

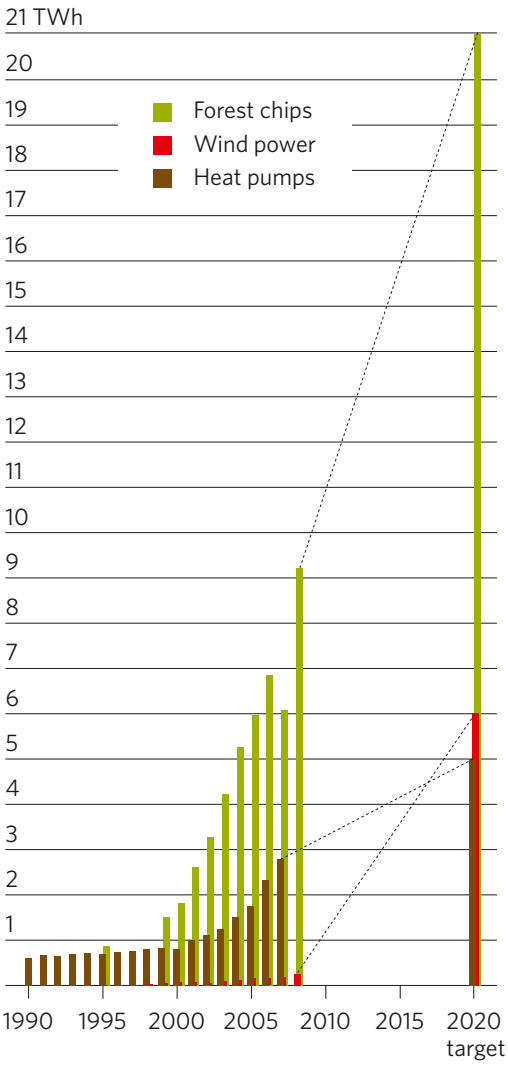
In order to promote electricity generation based on renewable energy, Finland will introduce a feed-in tariff system operating on market terms, and this would partly replace the tax subsidies and some of the investment subsidies for electricity generation. In the feed-in tariff system, which will enter into force in 2010, electricity users will pay the difference between the market price and the feed-in tariff if the market price is below the agreed feed-in tariff. The feed-in tariff system would apply at least to wind power and biogas, and possibly also to electricity generated in other renewable ways at a later date.

All sectors of heat production have scope for increasing the use of renewable energy. In new construction, building regulations on energy efficiency will be tightened by about one-third in 2010. In renovation building, energy subsidies for the improvement of energy efficiency and changes in heating systems will be granted for residential buildings, mainly for apartment blocks and terraced houses. Refurbishments of energy systems in detached houses may be eligible for improved domestic help credit. Moreover, grants for energy improvements in detached houses are used as a supplementary aid for low-income households.

The use of alternative fuels and energy sources is increased also in transport. Increase in the use of liquid biofuels in transport has been implemented in the initial stage with a distribution obligation. Use of biofuels in transport can be steered, e.g., with a tax towards second-generation biofuels.

Air heat pumps are a good source of extra heat, especially for use alongside with electric heating.

Energy produced by forest chips, wind power and heat pumps in Finland since 1990, and targets for their increase by 2020, terawatt-hours TWh



There are good preconditions for growth in the use of forest chips from thinnings and logging residues as biofuel. The amount can be more than doubled by 2020 from the 2006 level. However, the functioning of the fuel chain from the forest to energy production must be ensured, and therefore modern information technology plays a key role in its development.

Until now, wind power construction in Finland has been at a moderate level but, with major new construction plans, the target of six terawatt-hours can be achieved. Development in the sector is accelerated by the completion of the so-called wind atlas, which is an analysis of the wind climate, and the feed-in tariff planned for wind power.

It is possible to double the amount of thermal energy produced by heat pumps by 2020.

Renewable energy sources and targets for their use in Finland

Black liquor produced as a by-product of chemical wood processing is the most significant source of renewable energy in Finland. As the volume of forest industry production is forecast to diminish, the significance of black liquor will also fall.

Forests provide a wealth of opportunities in bioenergy

In Finland, the by-products of forest industry processes are utilised to the full either in the boilers of the industry itself or in outside power plants and heating plants. By-products include the bark, sawdust and other wood residues from mechanical wood processing, and the black liquor produced in pulp production. Biofuels are also used for producing heat and electricity in co-generation with a high efficiency rate.

Forest management and wood harvesting produce copious amounts of thinning and other wood material that is not suitable for use as raw material in wood processing. Biomass gathered from knotter pulp and crown mass, small-sized trees, stumps and root stock is called forest chips. It is possible to increase the use of forest chips further. Finland aims to increase the use of forest chips from approximately 4.7 million solid cubic metres in 2008 to more than 12 million solid cubic metres by 2020. The objective is to use forest chips directly in energy production and as raw material for liquid biofuels.

Bioenergy from farms

Agriculture offers several raw materials for the production of renewable energy. Plant- and animal-derived biomasses are combusted directly in energy production, refined into liquid fuels and processed into biogases. Reed canary grass is the most important arable crop used as fuel in energy production installations.

In Finland, the most common raw materials for biogas produced on farms and in rural enterprises are manure, various animal-derived by-products and other organic material. The use of plant tissue in biogas production is on the increase. Finland aims to promote the production of energy plants and the use of bioenergy obtained from the by-products of agriculture and manure, for example, in the form of

Heat entrepreneurship, i.e. production and sale of heat to customers works well in many district heating plants and building-specific heating plants. In Finland, there are almost 400 heating plants managed by heat entrepreneurs, with a total boiler power of some 200 megawatts.

biogas in order to obtain about 4–5 terawatt-hours of renewable energy based on them. In addition to farms, wastewater treatment plants and landfills are key producers of biogas.

Bio-alternatives in heating

The significance of biofuels in the production of district and zone heat has gained a solid foothold in many small and medium-sized heating plants. In households, conventional wood heating has retained its position, especially as a secure and economic source of extra heat, and it will also play a key role in the future. Development work on correct combustion methods, high-standard firewood and fireplaces is carried out in order to improve the efficiency rate of combustion and to reduce particulate emissions from wood combustion. In heating, replacing mineral oils with bio-based fuels is also investigated and developed.

There are good preconditions for the use of wood pellets in the heating of buildings in Finland. Pellets are compressed mainly from the residues of mechanical wood processing, and they can be used in power plants and heating plants and in the heating of detached houses. This is a modern heating method, which is also fairly easy to use.

Transport fuels from wood, waste and field biomass

In transport biofuels, Finland wants to promote second-generation liquid biofuels whose raw material supply is based on products other than those used as nutrition. The key domestic raw materials are wood, waste and field biomasses. According to a proposal by the European Commission, the share of renewables in transport, including renewable electricity, must be at least 10 per cent by 2020. Finland has committed itself to this target, which means that the use of renewable energy in transport could be about 6 terawatt-hours in 2020.

From waste to energy in a sensible way

In waste management, the primary issue is the prevention of waste accumulation. It is sensible to combust only the part of waste that cannot be reused or recycled. Bioenergy accounts for more than half of all municipal waste.

Finland is developing waste to energy in the most environmentally efficient direction. The target is to increase the use of recycled fuels as an energy source by at least 1.5 times by 2020. Waste digestion into biogases and co-incineration of separately sorted energy waste are primarily encouraged. It is possible to use biogas in electricity and heat production and, and when cleaned, as gaseous transport fuel.

Reed canary grass is the most interesting energy crop plant in the Finnish conditions. The species grows wild in Finland, and reed canary grass cultivated into energy crops is very productive. It is suitable for growing on fields and in disused peat production areas.

Electricity from wind

Finland has good preconditions and growth opportunities for wind power construction. The focus of industrial wind power construction is on areas where it is most cost effective, preferably in integrated, extensive wind farms. For the time being, wind power has been built mainly on the coast, but new construction plans extend from the sea areas to inland. Construction of small-scale wind power is also increasing.

The wind atlas, prepared in 2008–2009, describes Finland's wind conditions throughout the country. Based on information provided by the wind atlas, it is possible to examine the suitability of various areas for wind power production in a more reliable way than before.

The objective is to increase the installed overall output to approximately 2,000 megawatts by 2020 with annual electricity generation by wind power at 6 terawatt-hours. In order to reach this target, it will probably be necessary to build offshore wind farms as well. To promote wind power construction, a feed-in tariff system is under preparation, scheduled for introduction in 2010.

There are plans to build wind power on the coast, in offshore areas and on the treeless mountains of Lapland.

Power upgrades in old hydropower plants

Hydropower is a clean production method using renewable energy. Finland's average hydropower production amounts to 13 terawatt-hours, accounting for 15 per cent of total electricity consumption. Depending on precipitation, this represents about 3–4 per cent of total energy procurement.

Hydropower production will be increased mainly by accelerating the power upgrades in plants located in constructed waterways and by promoting the use of small-scale hydropower. This way, annual hydropower production could exceed 14 terawatt-hours.

Finland's major hydropower plants were built in the 1950s and 1960s. By replacing their turbines, generators and control and automation equipment, their performance may be improved by more than 20 per cent.

The sun is a key resource

Utilisation of solar energy in Finland is sensible. In these latitudes, only in the middle of the winter is the sun so low in the sky that it provides hardly any power for heat or electricity generation. Careful planning and replacing the surface materials of buildings with solar power panels or thermal collectors may improve the overall economy of solar energy.

Connecting solar heat to a water-circulated system and to the heating of domestic water supply is encouraged. Solar heat systems have been installed especially as a source of extra heat in oil-heated buildings.

Producing solar electricity with the current technology is fairly expensive. Solar power may become more popular in the future if the manufacturing costs of solar panels can be reduced and the efficiency rate improved. New innovations produced by research and development work may change the situation in favour of solar power.

Ambient heat utilised with heat pumps

Heat pumps are a noteworthy choice for the heating of buildings. They utilise ambient heat, i.e. heat from the ground, water or air, and therefore reduce the need for other energy. Especially ground- and air-source heat pumps have become more common in new and refurbished detached houses.

Growth in the sector has been strong since 2000. Efforts are made to increase the net energy produced with heat pumps, regarded as renewable energy, to 5 terawatt-hours per year by 2020.

Solar heat may be utilised also in Finland for the major part of the year.

Marketing and opportunities

In Finland, a great many clean technology products are manufactured for the export markets. Exports of energy technology products have been rising steadily in the past few years.

An inventory of the Finnish forest resources is taken on a regular basis, and therefore the possibilities of their bioenergy use are well charted.

Climate change is a threat, but it also creates a demand for new kinds of products and methods in the fields of renewable energy and energy efficiency. Finland aims to significantly increase the use of renewable energy sources and have active co-operation with other countries. The Ministry of Employment and the Economy plays a key role in achieving Finland's energy targets.

Finnish expertise, especially in the cost-effective use of biomass and combined heat and power generation, is a strong asset, for which there may be demand in many other countries. Due to the excellent know-how and innovative production systems, Finland's energy and environmental industry has a wealth of opportunities in the global market.

Mitigation of climate change requires a transition to a low-emission energy economy. In Finland, top research is being carried out in several universities and at VTT Technical Research Centre of Finland. Scenario studies have been produced as a basis for future energy technology solutions, assessing the demand for Finnish clean energy technology in other countries. In the studies, in which greenhouse gas emissions were restricted to a great extent, investments in wind power and bioenergy in particular will have increased by many tenfolds by 2050.

Enterprises, universities and research institutes have formed Strategic Centres for Science, Technology and Innovation (SHOK). CLEEN Oy, the energy and environment strategic centre for science, technology and innovation, brings together the research units and companies utilising the research results. Close co-operation is carried out, for example, for the benefit of carbon-neutral energy production, distributed energy systems and renewable fuels.

The Cleantech Finland brand also offers support especially for export endeavours. Its idea is to gather together companies in the environmental sector and to come up with products and solutions in clean technology for the export markets.

Many Finnish organisations are involved in international programmes that support the targets of the national climate strategy. In addition to the EU countries, these companies are taking part in joint projects in the nearby areas and the Baltic Sea region. For example, Motiva is promoting more widespread use of renewable energy by means of communication, marketing and project work. Good co-operation with various actors is bearing fruit.

Information about renewable energy

Ministry of Employment and the Economy, **www.tem.fi**
Ministry of Agriculture and Forestry, **www.mmm.fi**
Ministry of the Environment and Regional Environment Centres, **www.ymparisto.fi**
Ministry of Transport and Communications, **www.lvm.fi**

Motiva, **www.motiva.fi**
Regional energy agencies, **www.motiva.fi/energiatoimistot**
The wood energy advisors at the Forestry Centres provide information about wood energy, **www.metsakeskus.fi**

Ecolabel for energy, **www.norppaenergia.fi** and **www.kilpailuttaja.fi**

Renewable energy associations

Finbio ry, **www.finbio.fi**
Puuenergia ry, **www.puuenergia.fi**
Finnish Wind Power Association, **www.tuulivoimayhdistys.fi**
Vindkraftförening rf, **www.vindkraftforeningen.fi**
Suomen lämpöpumppuyhdistys SULPU ry, **www.sulpu.fi**
Aurinkoteknillinen yhdistys ry, **www.aurinkoteknillinenyhdistys.fi**
Pienvesivoimayhdistys ry, **www.pienvesivoimayhdistys.fi**
Finnish Biogas Association, **www.biokaasuyhdistys.net**
Suomen Pellettienergiayhdistys, **www.pellettienergia.fi**

Environmental associations

Dodo ry, **www.dodo.org**
Greenpeace, **www.greenpeace.org/finland**
Friends of the Earth Finland, **www.maanystavat.fi**
Finnish Association for Nature Conservation, **www.sll.fi**
WWF Finland, **www.wwf.fi**

Business development and financing

Tekes, **www.tekes.fi**
Finnish Science Park Association, **www.tekel.fi**
Finpro, **www.finpro.fi**
Green Net Finland, **www.greennetfinland.fi**
CLEEN Oy, the energy and environment strategic centre for science, technology and innovation, **www.cleen.fi**

Research and training

Finnish Forest Research Institute, **www.metla.fi**
VTT, **www.vtt.fi**
Work Efficiency Institute (TTS), **www.tts.fi**
Finnish Meteorological Institute, **www.fmi.fi**
University of Helsinki, **www.helsinki.fi**
University of Jyväskylä, **www.jyu.fi**
Aalto Unversity, **www.aaltoyliopisto.info**
Helsinki University of Technology, **www.tkk.fi**
University of Vaasa, **www.uwasa.fi**
Lappeenranta University of Technology, **www.lut.fi**
Tampere University of Technology, **www.tut.fi**
Åbo Akademi University, **www.abo.fi**
North Karelia University of Applied Sciences, **www.ncp.fi**
JAMK University of Applied Sciences, **www.jypoly.fi**
Kymenlaakso University of Applied Sciences, **www.kyamk.fi**
HAMK University of Applied Sciences, **www.hamk.fi**
University of Oulu, **www.oulu.fi/english**

Information about climate change

www.ilmasto.org
www.fmi.fi/research_climate/climate.html

Sources:
Long-term Climate and Energy Strategy, VSN 11/2008
Statistics Finland, Energy Statistics 1997–2007
Metsätilastotiedote 15/2009, Metla (Statistical reports of the Finnish Forest Research Institute)
Wind energy statistics in Finland, VTT

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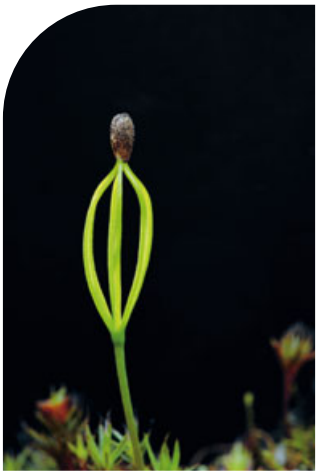

Motiva

Motiva Oy
Urho Kekkosen katu 4–6 A
P.O.BOX 489
FIN-00101 Helsinki, Finland

Telephone +358 424 2811
Fax +358 424 281 299
www.motiva.fi

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