Renewables make the difference

Directorate-General for Energy

EUROPEAN COMMISSION

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Foreword

European renewable energy policy has never been more important. Renewable energy plays a crucial role in reducing greenhouse gas emissions and other forms of pollution, diversifying and improving the security of our energy supply and maintaining our world-leading, clean-energy technology industry. It is for this reason that the leaders of the European Union have agreed on legally binding national targets for increasing the share of renewable energy, so as to achieve a 20 % share for the entire Union by 2020.

These targets, contained in the renewable energy directive, are the 'headline' of the whole European regulatory framework in this field. The European strategic energy technology plan provides a framework for developing new industrial initiatives; energy labels and eco-design energy efficiency standards help increase energy efficiency and drive down energy consumption; and the renewable energy directive requires planning, training, sustainability criteria and other regulatory reforms to ensure we get the mass deployment of clean technology we need to reach the 20 % target.

This European framework should help everyone move to a more sustainable energy supply. National and regional governments have to take measures and reduce barriers, but individuals, as energy consumers, workers, members of households and energy producers, can all actively reduce energy consumption and make energy consumption greener.

This brochure outlines the existing regulatory framework and explains the different technologies which we already have or are developing that can make the 20 % target just the first step towards a low-carbon energy future. I believe our jobs, our industry, our future and our planet depend upon this. Together we can make the difference!

Günther Oettinger
European Commissioner for Energy

Contents

Renewables in demand

Millions of people across Europe are trying to be more 'green'. We want to reduce pollution and our own 'carbon footprint', but it often doesn't seem easy. At European level, the EU is putting in place policies that will help us to do just that.

Using renewable energy is one effective way of making our energy supply more environmentally friendly. Many EU citizens would like to be better informed about what renewables are and how they can best be used. Hopefully, this brochure will provide the necessary information.

So, why is renewable energy so attractive? The answer is simple. It will enable us to diversify our energy sources and reduce our excessive dependence on gas, coal and oil. It is thus the surest means we have of both reducing emissions and improving the security of our energy supply.

In addition, at a time of economic uncertainty, the renewable energy technology industry is one which keeps on growing, providing jobs and developing new technologies, and helps Europe to maintain its place at the forefront of global industrial innovation.

Protecting the environment

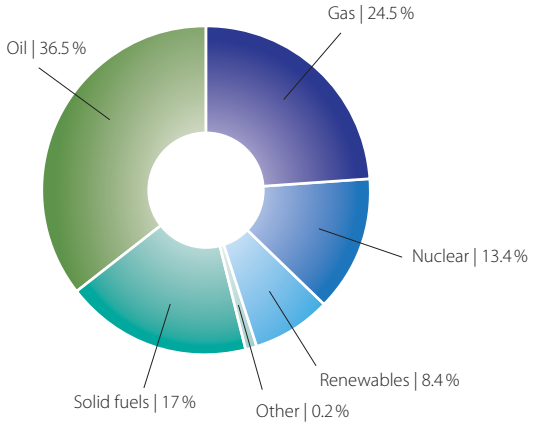
The way we obtain our energy lies at the heart of efforts to tackle climate change and reduce pollution. Our current energy supply is still dominated by fossil fuels, which give off greenhouse gases when we burn them to produce energy. Renewable energy sources on the other hand, emit no greenhouse gases or only small amounts during their lifecycle. Increasing their share in our energy mix will help cut greenhouse gas emissions and reduce our collective 'carbon footprint'. A 20 % share of renewable energy ([1]) could avoid 600–900 $MtCO_2$ emissions per year. Renewable energy will also help reduce air pollution, thereby having a direct effect on our daily health.

([1]) Based on measuring gross final energy consumption (GFEC).

Making our energy supply more secure

EU countries are highly and increasingly dependent on imports of fossil fuels (particularly oil and gas) for their transport and electricity generation. In fact, in the EU, we rely on energy imports for about half of our energy consumption. Moreover, fossil fuels account for 79 % of the EU's gross inland energy consumption (see graph). Europe benefits from increasing the range of fuels available to produce energy, as well as the sources and number of suppliers of such fuels. Such diversity reduces the risks of cuts in supply and price volatility and encourages efficiency by increasing competition in the energy sector. A 20 % share of renewable energy could cut our fossil fuel imports by 200 mtoe ([2]) per year ([3]).

Gross inland consumption by fuel (EU-27, 2008)



Source: Eurostat.

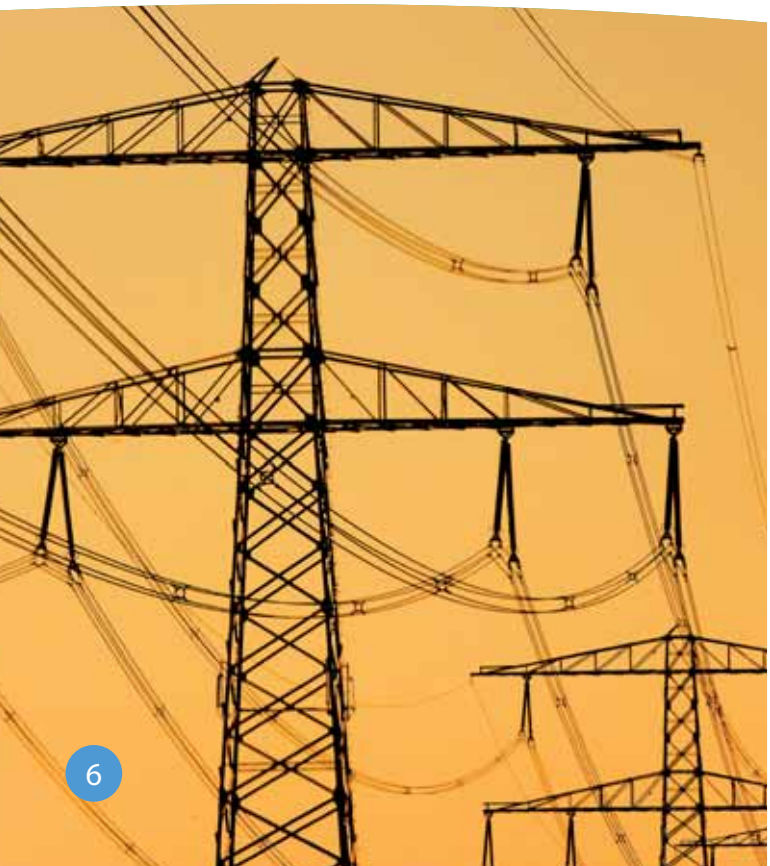
Boosting the economy

Renewable energies also have huge potential to boost Europe's industrial competitiveness. Developing new sources of low-carbon energy is crucial to avoid the massive costs of climate change and pollution, and keeping Europe at the forefront of such developments is crucial for the economy. 'Hi-tech', green industrial development brings new value added green jobs and builds on Europe's industrial strengths. European companies currently dominate the global renewable energy manufacturing sector, employing over 1.5 million people with a turnover of over EUR 50 billion. With continued strong growth the sector could provide another million jobs by 2020 and double or even triple its turnover.

([2]) Million tonnes of oil equivalent.
([3]) Based on measuring gross final energy consumption (GFEC).

The uses of renewable energies

Renewable energy can be used for all our energy needs — producing electricity, running transport and heating our houses. The different types of renewable energy (see pp. 10–17) may be used in different ways and not all are suitable for every application. Hydro and wind are exclusively used for generating electricity, while other resources like biomass (organic matter), geothermal and solar energy can be used to produce both electricity and heat.



Electricity

Renewable energy is already helping to generate the electricity that we use every day when we turn on a light or watch television (see table). The fact that EU energy markets have been opened up to greater competition also gives the consumer the chance to choose electricity suppliers that use more renewable energy sources.

Contribution of renewables to electricity production, 2008 (TWh [4] and %)

Wind	20.9 %
Solar (photovoltaic thermal)	1.3 %
Biomass	19 %
Hydro	57.7 %
Geothermal	1 %
Total electricity generation EU-27	**3 374 TWh**
Total renewable energy sources	**567 TWh**
Share of renewable energy sources	**16.8 %**

Source: Eurostat.

(4) Terawatt hour.

Heating and cooling

The heating and cooling sector accounts for half of the EU's final energy consumption, bringing heat to our homes, buildings and to industry and producing domestic hot water.

Renewable energy like biomass (which currently dominates renewable heating consumption), solar and geothermal energy has huge potential for heating and cooling. However, as renewable energy sources account for only 12 % of total heating and cooling, this is far from being realised.

More must be done to integrate renewable technology into mainstream heating and cooling industries. It is also possible to increase use of biomass-fired combined heat and power plants that simultaneously generate electricity and heat, thus increasing global energy efficiency.

Contribution of renewables to total heat needs (EU-27, 2008)

	Mtoe
Biomass	63.5
Solar thermal	1.1
Geothermal	0.7
Heat pumps ([5])	2.2
Total renewable energy sources	**67.5**
Total heat needs	**564.7**
Share of renewable energy sources	**12 %**

Source: Eurostat.

([5]) Data based on the countries that reported available information.

Transport

Transport's share of energy consumption and greenhouse gas emissions has increased over time, making it vital to improve fuel efficiency and reduce transport emissions. Furthermore, 96 % of energy for transport is from oil-derived products.

Biofuels (fuels derived from organic matter) are the main substitute for petrol and diesel in transport as they are widely available and usable in ordinary vehicles. Use of biofuels such as biodiesel, bioethanol and biogas can promote more sustainable energy use in transport and reduce dependence on fossil fuels. Biofuels also generally emit less greenhouse gas than fossil fuels and can help the EU meet its obligations to reduce such emissions.

Vehicles running on electricity produced from renewable energy sources are another means of increasing use of renewable energy for transport. Use of such vehicles is currently low but expected to grow rapidly.

EU renewable energy — 2020 vision

The EU is a world leader in renewable energy and the sector is already of considerable economic importance.

As renewable technologies have matured, production of renewable energy has risen steadily, and costs have come down. However, development has been uneven across the EU, and renewable energies still represent only a small share of the EU's total energy mix. Because external costs of fossil fuels, such as environmental impact, are not fully considered, renewable energy is still not competitive.

Different renewable energy sources are at various stages of technological and commercial development. Under favourable conditions, wind, hydro, biomass and solar-thermal sources of energy are economically viable. Others like photovoltaic energy (which uses silicon panels to generate electricity from sunlight) require increased demand to improve economies of scale.

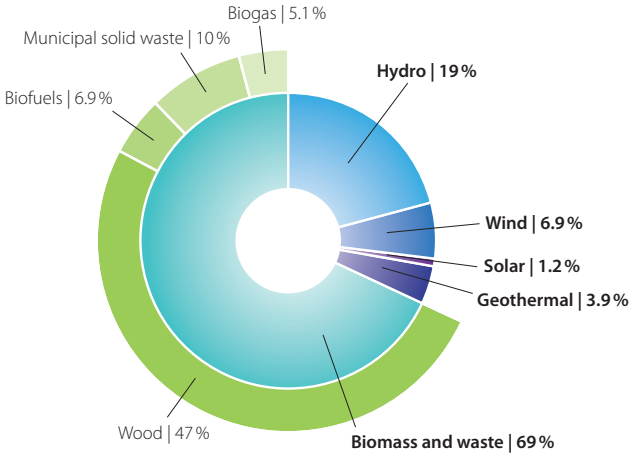
So, while renewables have begun to make their mark and provide more environmentally-friendly energy, the potential remains to increase their market share and establish them as cost-effective, widely used options.

The figures on these pages provide information on the renewable energy situation in the EU. Further details about different sources can be found in subsequent chapters and at **http://ec.europa.eu/energy/renewables/index_en.htm**

The EU set **indicative** national renewable energy targets for 2010 for electricity and transport which are unlikely to be met. The EU thus agreed on a stronger directive in 2009 which was adopted unanimously by the Council and by a large majority in the European Parliament. The key element of the directive is a set of legally binding national targets adding up to a share of 20% in the EU as a whole.

EU countries must develop national action plans to meet their targets and set specific objectives for electricity, heating and cooling and biofuels. The plans will reflect national circumstances such as renewable energy sources available in each country. These are available on the European Commission renewable energy transparency platform webpages: **http://ec.europa.eu/energy/renewables/transparency_platform/transparency_platform_en.htm**

Primary energy production from renewable energy sources, breakdown by individual source (EU-27, 2008)



Source: Eurostat.

Given the particular vulnerability and oil dependence of the transport sector, the Renewable Energy Directive also specifies a 10 % minimum target to be achieved by all EU Member States for the share of renewable energy (biofuels, renewable electricity) in overall EU transport petrol and diesel consumption by 2020.

The directive has comprehensive sustainability criteria for biofuels produced within or outside the EU. To qualify for subsidies or count towards the target, their life-cycle emissions must be at least 35 % less than the fossil fuel alternative as of 2010, rising to 60 % by 2018. Biofuels may not be produced on land in highly bio-diverse areas (primary forest, grasslands, protected areas) or on land converted from areas

Renewable energy shares of gross final consumption of energy	Renewable energy share in 2005	Renewable energy share target for 2020
Belgium	2.2 %	13 %
Bulgaria	9.4 %	16 %
Czech Republic	6.1 %	13 %
Denmark	17 %	30 %
Germany	5.8 %	18 %
Estonia	18 %	25 %
Ireland	3.1 %	16 %
Greece	6.9 %	18 %
Spain	8.7 %	20 %
France	10.3 %	23 %
Italy	5.2 %	17 %
Cyprus	2.9 %	13 %
Latvia	32.6 %	40 %
Lithuania	15 %	23 %
Luxembourg	0.9 %	11 %
Hungary	4.3 %	13 %
Malta	0 %	10 %
Netherlands	2.4 %	14 %
Austria	23.3 %	34 %
Poland	7.2 %	15 %
Portugal	20.5 %	31 %
Romania	17.8 %	24 %
Slovenia	16 %	25 %
Slovakia	6.7 %	14 %
Finland	28.5 %	38 %
Sweden	39.8 %	49 %
United Kingdom	1.3 %	15 %
EU-27	8.5 %	20 %

with high carbon stock (wetlands and continuously forested areas). The directive also requires Member States and the Commission to monitor soil, water and air impacts and social issues. In addition, bonuses are provided for 'second generation' biofuels (like bioethanol from straw) and use of electricity in transport.

The biofuels sustainability criteria established in the directive are the first legally binding sustainability rules for the use of any natural resource anywhere in the world. They have already triggered discussions about ensuring sustainable use of resources in sectors such as agriculture and in other countries and regions.

Climate change and energy efficiency targets

The targets for renewable energy and renewables in transport will contribute to meeting the EU target of at least a 20 % reduction of greenhouse gas emissions by 2020 as compared with 1990. This must be combined with more energy efficiency — hence the objective of improving the EU's energy efficiency by 20 % as compared with projections for 2020 — and reduced consumption of fossil fuels.

Key EU directives on energy and climate:

- Energy produced from renewable energy sources (Directive 2009/28/EC).
- Energy performance of buildings — recast (Directive 2010/31/EU).
- Taxation of energy products and electricity (Directive 2003/96/EC).
- Cogeneration (Directive 2004/8/EC).
- Revised emissions trading directive (Directive 2009/29/EC).
- Effort sharing decision on greenhouse gas emissions from sectors not covered by emissions trading scheme (Decision No 406/2009/EC).

How do we meet the targets?

The targets require substantial growth in all three renewable energy sectors — electricity, heating and cooling, and transport. This in turn requires concerted effort from all EU governments, industry and the public. The EU has supported renewable energy through policy, legislation, funding and research since the 1980s. In addition, Member State implementation of EU laws will lead to greater support, the removal of administrative barriers such as overly complicated planning rules, improved grid access for electricity from renewable energy and improved product and installer information for consumers.

Other EU initiatives include the Covenant of Mayors, through which more than 1 800 mayors from across the EU have committed their local communities to exceeding the EU 2020 targets for reducing carbon emissions; and technical assistance through the ELENA initiative, which is jointly managed by the European Commission and the European Investment Bank, to help local and regional authorities to mobilise financing for sustainable energy projects.

Getting involved — ManagEnergy and Sustainable Energy Europe

The EU has a number of schemes to promote wider involvement in renewable energy. The European Commission's **ManagEnergy** initiative supports local and regional authorities and those who work with them, such as energy agencies involved in energy efficiency and renewable energies, through an interactive website, training workshops and networking events. The Commission's **Sustainable Energy Europe** campaign raises public awareness about sustainable energy, including through the EU Sustainable Energy Week and Energy Days, and helps everyone play their part in changing the energy landscape.

Find out how to get involved at:
www.managenergy.net
www.sustenergy.org

Biomass: LahtiStreams

This innovative solid recovered fuels (SRF) gasification power plant is developed by Lahti Energia Oy, Finland.

Technology has already been demonstrated for using clean solid biomass in co-gasification for coal power production. However, this project uses hot gas cleaning and gas boiler with high value steam cycle, which enables the overall power production efficiency to exceed 35 % in condensed mode, thus meeting the EU's waste incineration directive limits.

This will produce 40 % more electricity/tonne SRF than state-of-the-art, mixed-waste-fired grate boilers.

www.lahtistreams.com

Bioenergy: biomass, biogas and biofuels

Biomass is derived from different types of organic matter such as energy plants (oilseeds, plants containing sugar) and forestry, agricultural or urban waste including wood and household waste. Biomass can be used for heating, cooling, producing electricity and transport biofuels.

Use of biomass significantly reduces greenhouse gas emissions. The carbon dioxide it gives off when burned is counterbalanced by the amount absorbed when the plant in question was grown. However, there are always some emissions from processes like cultivation and fuel production, so biomass is not completely carbon-free.

Different types of biomass use different technologies and processes for the production of bioenergy, as shown below.

Solid biomass (like wood and straw) can be put through processes including combustion, pyrolysis, hydrolysis or gasification to produce bioenergy.

Biogas can be produced from organic waste through anaerobic fermentation and obtained from landfill gas. It can be used in vehicles adapted to run on natural gas.

Why biomass?

- It diversifies the energy supply.
- It replaces high CO_2-emitting conventional fuels.
- It helps recycle waste.
- It protects and creates jobs in rural areas.
- It extends the EU's technological leadership in bioenergy.

Biofuels and bioliquids originate from renewable resources using biomass (organic matter or plants). Today they represent the only widely available energy resource that can replace fossil fuels in the transport sector.

There are two main types of 'biofuels' (biomass used in the transport sector) — biodiesel and bioethanol. These are both liquid fuels currently mostly processed from agricultural crops or plants.

Biodiesel is mostly produced from oleaginous plants such as rapeseed or sunflower. It is the product of vegetable oils reacting with methanol.

Bioethanol is produced mainly by fermentation of sugar from sugar beet, different cereals, fruits or even wine.

Second generation biofuels, specifically promoted by the new directive, are being developed from cellulose biomass feedstock. This will allow new methods of biofuel production from agriculture, forestry, wood, pulp and paper products, by-products and waste through more sophisticated processes.

Why biofuels?

- They constitute the only widely available renewable alternative to fossil fuels in transport.
- They help recycle waste.
- They diversify energy sources for non-oil producing countries.
- They reduce CO_2 emissions and other forms of pollution.
- They create jobs, especially in agriculture and forestry.

All biofuels and bioliquids produced with support from public funds in the EU or counting towards Member State targets for renewable energy in transport must comply with the renewable energy directive sustainability regime.

Biofuels: technology initiative for the sustainable production of biofuels

The European Commission and EU industry have kick-started a major energy technology initiative for the sustainable production of biofuels. Industry will develop new ways to convert biomass residues into ethanol and other valuable products using advanced and innovative technologies.

Six large demonstration projects will address the entire conversion chain from the use of biomass, intermediary processing steps and its conversion into end-products at large-scale demonstration facilities.

The projects are:

Kacelle	*www.kacelle.eu*
LED	*www.ledproject.eu/en/home*
FibreEtOH	*www.upm.com/en/about_upm/media/upm_stories/upm_is_looking_into_ethanol_production/*
BIOLYFE	*www.biolyfe.eu*
OPTFUEL	*www.optfuel.eu*
BIO-DME	*www.biodme.eu*

Solar thermal: SOLERA

This project aims to develop highly integrated solar heating and cooling systems for homes, small office buildings and hotels.

The goal is to use solar heat in summer to power a thermally driven cooling process for air-conditioning. The system can also provide direct heating.

SOLERA aims to demonstrate the technical feasibility, reliability and cost-effectiveness of these systems. They are conceived as integrated packages which will make better use of available solar radiation than systems currently in use.

www.solera-project.eu

Solar energy

The sun is the world's primary source of energy, and solar power can harness the sun's rays as a high-temperature, clean energy source for heat or electricity.

The conversion of solar radiation for **heating and cooling** purposes has a wide range of applications including domestic hot water, heating in buildings and industrial processes, solar-assisted cooling, desalination and swimming pools. Even the simplest solar thermal systems can provide for a (sometimes large) part of domestic hot water needs. Whilst such systems are clearly more productive in sunny climates, the efficiency of new equipment means that they can at least contribute to hot water or space heating anywhere in the EU (often combined with existing boiler systems). Solar power can also be used in a cooling system to create air conditioning with heat absorption systems (in a similar way to a refrigerator).

To produce **electricity**, solar power has to be converted or concentrated. This is because solar radiation reaches earth at an adequate density for heating but not for generating an efficient thermodynamic cycle required for producing electricity.

Why solar energy?

- It diversifies the energy supply.
- It does not produce noise, harmful emissions or polluting gases.
- It creates local jobs and stimulates the local economy and technology development.
- It uses a free and inexhaustible energy source.
- It can generate both heat and electricity.
- It requires minimal maintenance.

Solar thermal: Solugas

The **Solugas** project consists of the demonstration of a solar-hybrid power system with direct solar heating of pressurised air in a gas turbine. The turbine will be connected to a generator that will feed its electricity into the grid.

The major technology innovations include a dedicated heliostat field with innovative flux control strategies, a dedicated testing tower, a new receiver, a hot gas piping and flow control system, and a specially adapted gas turbine with newly developed control and injection system.

www.solugas.com

Solar photovoltaic: MetaPV

MetaPV is the first European demonstration project preparing technology and management systems for future distribution grids, so as to facilitate penetration of renewable energies.

New photovoltaic systems can contribute to supporting the grid through active power control, facilitated energy management and adaptation to islanding operation and avoid the need to install new grids or increase the capacity of existing ones.

The project is under way in the Belgian province of Limburg and consists of 128 residential systems of 4 kW each and 31 industrial systems of 200 kW each.

www.metapv.eu

Solar power can be converted into electricity using **photovoltaic** (PV) solar cells to convert light directly into electricity. This can also be done using **concentrating solar power** (CSP), where parabolic solar collectors or solar towers are used to focus the light to heat a single point, thereby creating steam to drive a turbine. PV plants can be connected to batteries for storage, or feed into the electricity grid. CSP heat can be stored so that power can be produced during the absence of sunlight.

Wind energy

Wind energy is one of the most promising renewable energy technologies and an area which has seen many developments that have made its electricity generation more effective. Between 1991 and 2006, cumulative wind power capacity in the EU increased by an average of 33 % per year.

Between 1995 and 2009, cumulative wind power installations in the EU increased their capacity from 2 497 MW to 74 767 MW ([6]).

Modern wind turbines extract energy from the wind by transferring the momentum of passing air to rotor blades. The power that can be generated by the turbines depends on the density of the air, the wind speed and the size of the turbine. The rotors of most wind turbines face into the wind and move to follow changes in wind direction. Energy is concentrated in a rotating shaft and converted into electricity.

Why wind energy?

- It is a source of clean energy free of carbon dioxide emissions.
- It provides low-cost indigenous power.
- It is already an important export industry.
- Although it changes the landscape, agricultural/industrial activities can continue around it.
- It can be deployed both on land and offshore.

([6]) www.ewea.org/fileadmin/ewea_documents/documents/statistics/100401_General_Stats_2009.pdf

Wind: Twenties

Twenties is the largest renewable energy research project ever funded by the EU. It aims to significantly advance the development and implementation of new technologies which allow the consolidation of wind power's position in the European electricity system.

Using six demonstrations, it will explore ways of removing barriers to the incorporation of offshore and onshore wind energy to the electricity system. The demonstrations aim to show the benefits of novel technologies coupled with innovative system management approaches.

www.twenties-project.eu

Ocean energy: PULSE STREAM 1200

This project aims to demonstrate an innovative tidal energy converter at full scale in UK waters. The main objective is to test a certified, high performance, 1.2 MW tidal flow technology to ensure its readiness for commercial deployment. The prototype to be demonstrated uses oscillating hydrofoils.

The hydrofoil approach allows power to be captured across a wide, shallow swept area. In a given depth, oscillating foil systems can be up to four times more powerful than single axial flow rotors.

http://cordis.europa.eu/fetch?CALLER=FP7_PROJ_EN&ACTION=D&DOC=1&CAT=PROJ&QUERY=012992e1e698:f601:09e2354e&RCN=94495

Ocean energy

Oceans cover three quarters of the planet and consequently ocean energy represents one of the most plentiful renewable energy sources. This energy comes from flows such as waves, tides and ocean currents, as well as differences in salinity and temperature. It still needs time to become competitive with more advanced renewable energy sources.

Wave energy technologies differ according to the location of the energy converter device relative to the shoreline. The devices can be shoreline devices fixed to, or embedded in, the shoreline, or they can be placed in the sea near the shore or offshore, the latter drawing on the more powerful wave regimes available in deep water.

Europe is the world leader in wave energy technology. With some European countries investing in research and development or demonstration projects, the EU should be well placed to compete when a commercial market for the technology evolves.

Tidal schemes exploit the natural ebb and flow of tidal waters in order to generate electricity. This can be done either by harnessing the rise and fall of the sea level using barrages, or by drawing energy from tidal currents using turbines in a way comparable to wind power.

Why ocean energy?

- No fuel is needed.
- No waste is produced.
- It has no major environmental impact.
- Tides are entirely predictable.
- It has major potential for technology development.

Hydro power

Hydro power is produced from the movement of a mass of water such as a river, canal or stream. Hydro schemes convert the potential energy of the water, flowing with a certain fall (or 'head'), into usable energy.

Such schemes require a suitable rainfall catchment area, a hydraulic head, a pipe or device to carry water to a turbine, and a turbine house containing power generation and water regulation equipment. Water is returned to its natural course after it has been used.

Small hydro sites are generally defined as those with installed capacity of less than 10 MW, while large-scale hydro schemes have large dams and storage reservoirs. Small hydro is useful for producing electricity, especially for isolated areas. Large hydro is reaching saturation point, hence the focus on small hydro, where development is possible.

Why small hydro?

- It diversifies the energy supply.
- It aids local development.
- It assists in the maintenance of river basins.
- It supports rural electrification.
- It has a high energy payback ratio.

Hydro: Shapes

The overall objective of **Shapes** (Small Hydro Actions for the Promotion of Efficient Solutions) is to facilitate and strengthen cooperation between EU small hydropower (SHP) Research and Market actors. This should help to streamline future research and development and promote R & D results in order to enhance penetration of SHP and know-how within the EU and new markets in developing countries.

Other main aims of Shapes include providing input to European research via R & D evaluation and coordination and exploration of synergies with other renewable energy technologies.

www.esha.be/index.php?id=97

Geothermal: GROUND-MED

The **GROUND-MED** project demonstrates the next generation of geothermal heat pump (GSHP) systems for heating and cooling at eight demonstration sites in southern Europe. A seasonal performance factor (SPF) — the ratio of useful energy output to energy input averaged over an entire heating season — of above 5.0 should be demonstrated. As the SPF is determined by all parts of the system, integrated GSHP systems incorporating the following technological solutions will be developed, installed and evaluated:

1. Prototype water source heat pumps with improved seasonal efficiency.
2. Borehole heat exchangers and heating/cooling systems which can operate with minimum temperature differences.
3. Auxiliary system components requiring minimum power consumption.

www.groundmed.eu

Geothermal energy and heat pumps

Geothermal energy has been used for centuries for bathing and heating water. It is extracted from the earth's natural heat in dry, steam or liquid form and can be used for electricity and heating.

Deep geothermal resources include hydrothermal (hot water and/or steam trapped in fractured or porous rock), geo-pressured (hot water aquifers under high pressure) and enhanced geothermal systems (geological formations that are dry but abnormally hot).

In Europe, the heat pump is the most promising way of using geothermal energy. This consists of extracting heat from hot, shallow geothermal fluid and transferring it to water or air which is used to supply heat. Even at shallow depths of 50–100 m, the earth harbours heat that can be extracted by heat pumps — often located in the gardens of suburban houses — and used directly in domestic heating. Heat pumps using ambient air or water resources are another means of capturing ambient heat for use in our homes and buildings.

Why geothermal energy?

- It reduces greenhouse gas emissions.
- It uses an inexhaustible source.
- It can supply heating directly.
- It needs less land than other energy resources.
- It is continuously available.

Looking to the future

Europe has a world-class industry and a stable regulatory framework created by the renewable energy directive. Billions of euro of European funding are available for technological development, through the EU framework programmes for research and development, the European economic recovery programme and the European Investment Bank. Member States may also use Structural Funds and emissions trading scheme revenues from 2013 for supporting renewable energy development.

Intelligent energy

The 'Intelligent energy — Europe' (IEE) programme is at the cutting edge of renewable energy promotion. Part of the EU competitiveness and innovation framework programme, IEE is worth EUR 727 million for 2007–13. It helps to remove barriers, particularly administrative, which delay authorisation and construction of new renewable energy projects, thereby slowing market growth.

Its aims include:

- Increasing the uptake and demand for energy efficiency.
- Promoting renewable energy sources and energy diversification.
- Stimulating the diversification of fuels and energy efficiency in transport.

Welcome to your new carbon-neutral home!

Homes are responsible for a significant amount of carbon dioxide emissions, but all that could change in the future thanks to the arrival of the carbon-neutral or zero-emission home. These newly designed 'eco-houses' generate their own energy from renewable sources, and are extremely well insulated to prevent heat loss. Such houses may not be the norm yet, but do not be surprised if in a few years' time you are living in one with your heat and electricity supplied by your home's very own biomass boiler and solar panels significantly reducing your 'carbon footprint'.

Strategic energy technology plan

To help ensure that low-carbon technologies become affordable and competitive, the European Union has created the European Strategic Energy Technology Plan. This focuses on the European industrial initiatives (EII); industry-led groups aiming to strengthen industrial participation in energy research and demonstration, boost innovation and accelerate deployment of low-carbon energy technologies. EIIs target sectors for which working at EU level generates most added value, and technologies for which barriers, risks and the necessary scale of investments can be better tackled collectively.

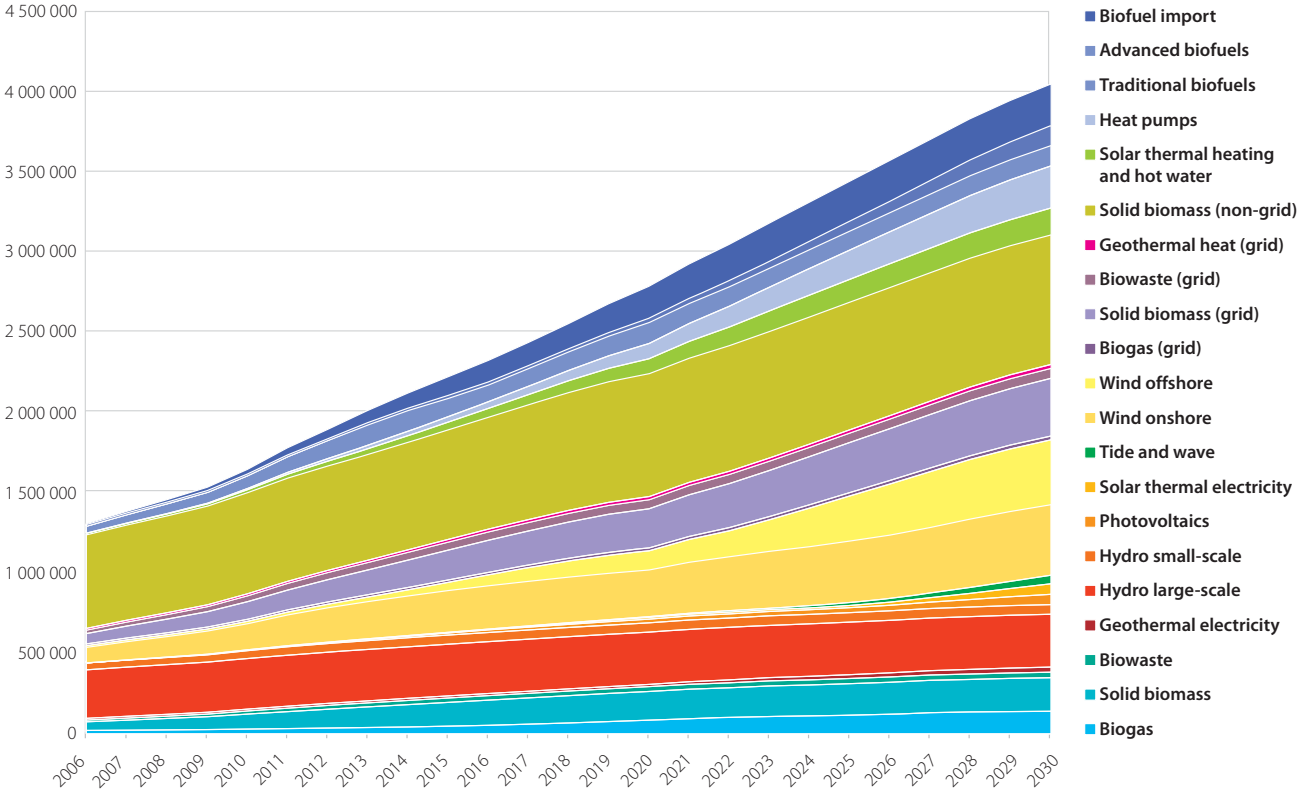
To find out more, visit:

The SET-Plan:	**http://ec.europa.eu/energy/technology/set_plan/set_plan_en.htm**
Renewable energies:	**http://ec.europa.eu/energy/renewables**
The European industrial bioenergy initiative:	**http://www.biofuelstp.eu/eibi.html**
The European CO_2 capture, transport and storage initiative:	**http://www.zeroemissionsplatform.eu**
The European electricity grids initiative:	**http://www.smartgrids.eu**
The fuel cells and hydrogen (FCH) joint technology initiative:	**http://ec.europa.eu/research/fch**
The sustainable nuclear initiative:	**http://www.snetp.eu**
Energy efficiency — the smart cities initiative:	**http://ec.europa.eu/energy/efficiency**
The solar Europe initiative:	**http://www.eupvplatform.org** **http://www.rhc-platform.org/cms**
The European wind initiative:	**http://www.windplatform.eu**
The SET-Plan Steering Group (SET-Group):	**http://ec.europa.eu/energy/technology/set_plan/steering_group_en.htm**
The European Energy Research Alliance (EERA):	**http://www.eera-set.eu**
The SET-Plan information system (SETIS):	**http://setis.ec.europa.eu**

The outlook for 2020 and 2030

Renewable energies are set to produce increasing amounts of electricity over the coming years — with projections showing that renewable electricity output could roughly triple between 2004 and 2020. Renewable heating is also on the rise — with output projected to increase consistently up to 2030. Both elements are clearly demonstrated in the graph below.

Green X-model estimate of renewable growth for the 'EU–27, 2006–2030, GWh ([7])'



Source: Green-X model from the Fraunhofer Institute and EEG (European Economics Group — Vienna University of Technology).

Further information: http://ec.europa.eu/energy/index_en.html

([7]) Gigawatt-hour per year.

European Commission

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