RENEWABLE ENERGY in Europe

BUILDING CAPACITY AND MARKETS

Executive summary

AUTHORS AND ACKNOWLEDGEMENTS

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RENEWABLE ENERGY IN EUROPE

BUILDING MARKETS AND CAPACITY"

Renewable Energy in Europe - Building markets and capacity presents an overview of the latest technological, financial and economic information on renewable energy technologies. The publication analyses the progress achieved at the end of 2003 focusing on market aspects of the development of renewable energy in the European Union. In particular, the book explains how renewable energy sources could play a more significant role in the European Union's energy balance, a role more appropriate to their great potential. This information arrives well in time at a moment when the European Union faces outstanding challenges in the energy sector, due to ongoing liberalization of energy markets as well as the enlargement of the European Union by 10 New Member States on 1st May 2004.

Representing about 15% of the World energy supply, the European Union´s energy supply is largely based on fossil fuels which are imported mainly from the Middle East and Russia. In the future, it is widely recognized that contribution of fossil fuels to the energy balance will even increase if no active policy for renewable energy is implemented. The EU's energy import dependence could even reach 90% for oil and 70% for gas by 2020. As the Green Paper[1] stresses, "The European Union's own energy supply covers barely half of its needs. If nothing is done by 2030, the share of fossil fuels is going to increase. Energy imports will be much higher in 30 years' time, amounting to 70% of total needs. 90% of oil is likely to be imported.

The European Union has put a considerable effort in creating a favorable political framework for renewable energy, thereby contributing to security of energy supply, to climate protection as well as to strengthening the EU RES industry, one of the fastest growing industry sectors in Europe. In order to keep the pace, new ambitious, time-bound targets for increasing the share of renewable energy in final energy consumption addressing the medium (2020) and long term time frames need to be set. As stated in the conclusions of the high-level discussions of the "European Conference for Renewable Energy - Intelligent Policy Options" which took place in Berlin on 19-21 January 2004, **a target value of at least 20% of gross inland energy consumption by 2020 for the EU** is achievable.

The renewable energy resources investigated in **"Renewable Energy in Europe - Building markets and capacity"** are: biomass, geothermal energy, solar thermal, solar photovoltaic, small hydro and wind. An additional section is dedicated to the integration of renewable energy sources. By producing one common publication for the different technologies in the name of EREC, the European Renewable Energy industry community speaks with one coherent voice on renewable energy technologies and their future development.

1- Communication from the Commission to the Council and the European Parliament, Green Paper "Towards a European strategy for the security of energy supply", COM(2000)769 final, European Commission, Brussels, 2000. (www.europa.eu.int/comm/energy/res/legislation/green_paper_en.htm)

MARKET DEVELOPMENT

OF RENEWABLE ENERGY

The European renewable energy industry has already reached an annual turnover of €10 billion and employs 200,000 people. Europe is the global leader and the front runner in renewable energy technologies. The use of renewable energy has a considerable impact on the investments made in the energy sector. Renewable energy replaces imported fuels, with beneficial effects on the balance of payments. Although per unit of installed capacity renewable energy technology is more capital intensive, taking in account the avoided external costs, investing in renewable energy turns out to be cheaper for society than business-as-usual investments in conventional energy[2].

The development of smarter and more efficient energy technology over the last decades has been spectacular. The technologies have improved and costs have fallen dramatically. The examples of wind and solar photovoltaic are striking. In terms of costs, investment costs for wind declined by around 3% per annum over the last 15 years. For solar photovoltaic (PV) cells, stimulated initially by the space programme, unit costs have fallen by a factor of 10 in the past 15 years.

In the European Union, renewable energy have already reached a significant share of the total energy production. Germany, for example, has doubled its renewable output in the past five years to 8% of total electricity production. Denmark now gets 18 % of its electricity from wind power alone, and has created an industry that has more jobs than the electricity sector itself. Spain has leapt from virtually nothing a few years ago to become the second biggest wind power country in Europe with 6,000 MW of capacity. Countries such as Finland, Sweden and Austria have supported the development of very successful modern biomass power and heating industries through fiscal policies, sustained R&D support and synergistic forestry and industrial policies. As well as saving significant CO_2 emissions, equipment from all three countries is now exported world-wide.

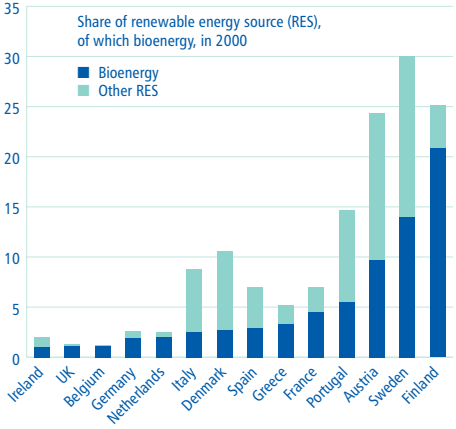
As a recent study shows, the deployment of renewable energy creates more employment, compared to other energy technologies[3]. Generally speaking, renewable energy technologies are important for local employment and income generation which results from manufacturing, project development, servicing and in the case of biomass, rural jobs and income diversification for farmers.

Renewable Energy

- 200.000 jobs in Europe already
- Annual turnover of 10 billion Euro
- Innovative Business Sector
- New Technologies

2- The IEA alternative scenario (WEO, 2002; WEIO 2003) predicts savings of about 40% for the transmission grid and 36% for the distribution due in particular by the increased use of distributed generation energy.
3- Mitre project (http://www.eufores.org/Summary.htm)

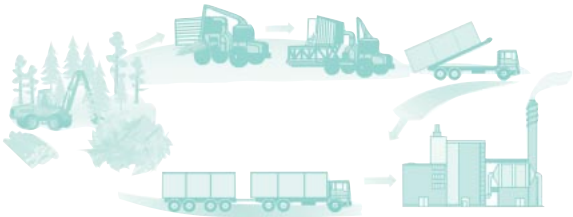
BIOMASS



Bioenergy covers a large variety of routes, with many types of resources, many conversion technologies and three final energy products, heat, electricity and different types of liquid fuels for transportation.

The present biomass contribution to the total world energy demand approaches 14 - 15 % (1,2 billions toe/year) with a much higher contribution (38%) in developing countries for heating and cooking needs. The potential ranges from 2 up to 27 billions toe[4]. In 2000 bioenergy in the EU contributed to 54 Mtoe[5], still representing a tiny proportion of the White Paper objective In terms of percentage, Finland, Sweden and Austria are leaders in Europe. Finland, Germany have the most favourable conditions for bioenergy development, mainly due to appropriate steering instruments which make bioenergy competitive with fossil fuels.

Bioenergy is a decentralised energy option and has several benefits. Implementing bioenergy plants have positive impacts on rural development by creating direct employment and by supporting related industries and employment therein. Jobs are created all along the chain, from biomass collection in the forest or energy crops grown by farmers, to transport, conversion technology providers, installers and service providers, marketing, etc. It makes bioenergy the most labour intensive among renewable energy. An European study[6] concluded that the development of renewable energy should lead to the creation of about 900 000 new jobs by 2020, about 400 000 jobs from the renewable energy industry and 500 000 jobs in the agriculture and forestry areas to supply the primary fuels.



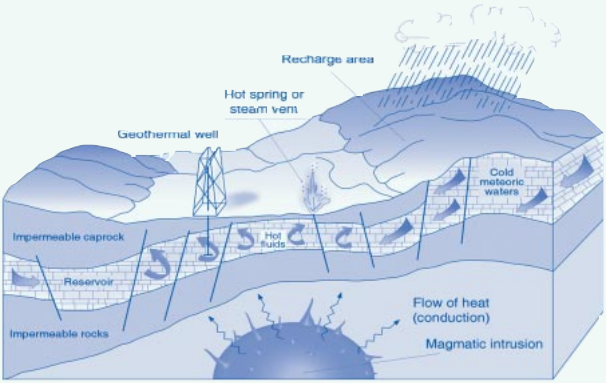
Comminution in terrain

4- Hoogwijk M;, Faaij A., van den Broek R., Bernedes G., 2002, "The global potential of biomass energy", in : proceeding of the 12th conference on Biomass for Energy, Industry and Climate Protection, 17-21 June 2002, Amsterdam, The Netherlands, p 27-30.

5- the primary energy production from biomass reached 45 450 Mtoe in 1995 and 54 352 Mtoe in 2000, of which 26% for wood in households, 24% for wood in industry and power plants, 8% from Municipal Solid Waste, 2% from biogas and 1% from liquid biofuels. Biomass/wastes represented 62% of total RES energy production in 2000.

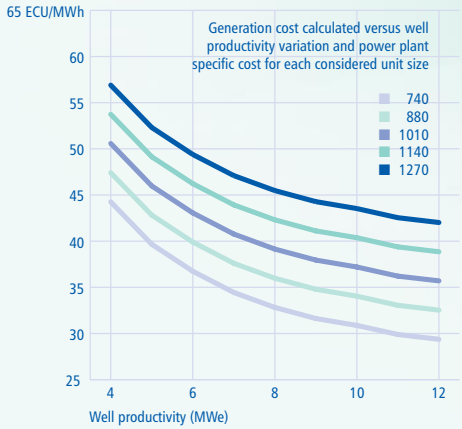
6- Energy for Sustainable Development Ltd (ESD) Mitre - Meeting the targets & Putting Renewables to work EC - DG Tren No. 4,1030/C/00-025/2000; http://mitre.energyprojects.net

GEOTHERMAL ENERGY



Earth dynamics

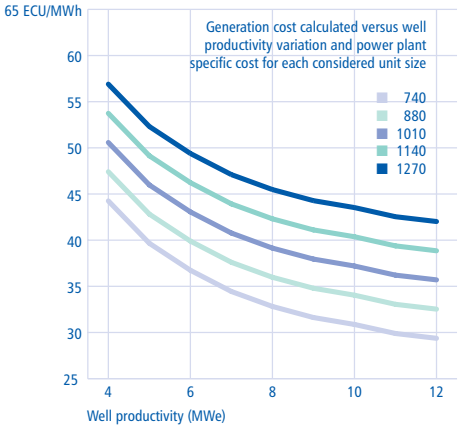
The term **'geothermal energy'** refers to the part of the earth's heat that could be recovered and exploited by humanity. The thermal energy of the earth is immense, but only a tiny fraction can be utilized. So far the utilization of this energy has been limited to areas in which geological conditions permit a carrier (water in the liquid phase or steam) to 'transfer' the heat from deep hot zones up to or near to the surface, thus giving rise to geothermal resources.



The geothermal resource is largely available in the European Union (the EU-15), and Italy, Greece, France (Guadeloupe, Réunion), Portugal (the Azores) and Austria are generating electricity, with Italy being by far the largest producer. Hot dry rock (HDR) resources which are currently under research are expected to open new areas in the production of electricity within the next decade. Geothermal resources vary in temperature from 50°-350°C (see Figure 3), and can either be dry, mainly steam, a mixture of steam and water, or just liquid water.

Geothermal electricity and heat has several benefits. Geothermal electric plants can operate 24 hours per day and thus can provide base-load capacity. Power generation from geothermal is not intermittent. The energy efficiency of geothermal combined heat and power is at an impressive 97%. Due to the costs of geothermal-based electricity generation being closely related to the characteristics of the local recourse system and reservoir, its potential in Europe is not as excessive as in other parts of the world, such as Asia or South America.

SMALL HYDROPOWER



Approximately 70% of the earth's surface is covered with water, a resource that has been exploited for many centuries. The exploitation of hydropower has since been characterized by continuous technical development, making it the leading renewable energy source in the European Union (EU-15). Hydropower now accounts for about 84% of the electricity generation from renewable sources and for 13% of total electricity production in the EU-15.

Small hydropower [7] schemes generate electricity or mechanical power by converting the energy available in the flowing water of rivers, canals and streams. Small hydropower has been technically feasible for decades, and given a favourable site, it can be economically attractive, sometimes even offering the least-cost method of generating electricity. High-head sites tend to be in areas of low population density, however, where the local demand for electricity is often relatively small, and the long transmission distances to the main centres of population can often nullify the low-cost advantages of the hydro plant. Low-head sites are statistically much more common, and tend to be found in or near concentrations of population where there is a demand for electricity.

Small hydropower7 costs can be one of the most economic methods to generate electricity. These plants have a long life span and relatively low operating and maintenance costs. Once the high up-front costs are written off, the plant can provide power at low costs as such systems commonly last for 50 years or more. Small hydropower can provide base-load capacity and its potential in Europe is not yet fully exploited.

7- Only plants with an installed capacity of up to 10 MW are considered as small hydro power plants. This Figure is adopted by, at least, six Member States, the European Small Hydropower Association (ESHA), the European Commission and the International Union of Producers and Distributors of Electricity (UNIPEDE).

SOLAR PHOTOVOLTAIC

Top ten European manufacturers of solar cells

Company	Production Total 2002 (MW)	Production Total 2001 (MW)	Growth
1- Isofotón (Spain)	27.4	18.7	46%
2- RWE Schott Solar (Germany)	24.5	18.1	35%
3- Photowatt (France)	17.0	13.5	26%
4- BP Solar (Spain)	16.7	12.2	37%
5- Q-Cells (Germany)	9.0	0.4	23%
6- Ersol (Germany)	9.0	3.9	4%
7- Shell Solar (Netherlands)	9.0	10.3	-13%
8- Astra Solar(Spain)	6.0	6.0	0%
9- Sunways (Germany)	4.8	3.0	60%
10- Dunasolar (Hungary)	3.0	2.5	20%
TOTAL	**148**	**121**	**22%**

Photovoltaic, or PV, technology involves the direct generation of electricity from light. The process is generally exploited by use of semiconductor materials, which can be adapted to release charged particles, forming the basis of electricity. The most common semiconductor material used in PV cells is silicon, which is widely available, but must be purified before it can be used.

Solar electricity is a success story. Over the past 5 years, the global rate of growth in the solar electricity sector has been 30 to 40% a year. In 2002 the PV sector in Europe registered a 33% growth. It already supplies electricity to hundreds of thousands people around the world, provides employment to several tens of thousands and already constitutes an annual business worth more than € 1 billion. PV systems are used to be connected to the local electricity network or can as well be used for off-grid installations.

The European market is still very much centered on Germany which is clearly the leading country, representing, alone more than 80% of the grid-connected market in Europe, a direct result of the support schemes launched some years ago. The real implication and involvement of certain countries of the European Union like France, Italy and Spain is sometimes difficult to define. The European Industry[8] estimates that the EU scenario (3,000 MWp by the end of 2010) is completely feasible and attainable. Its success depends, above all, on the political willpower of each Member State to guarantee industrialists that there will be sufficient demand. Development of a strong position in the European markets will provide the European PV industry with a basis for successful and competitive exports in developing countries where off-grid systems are needed and millions of people are eager to get access to electricity.

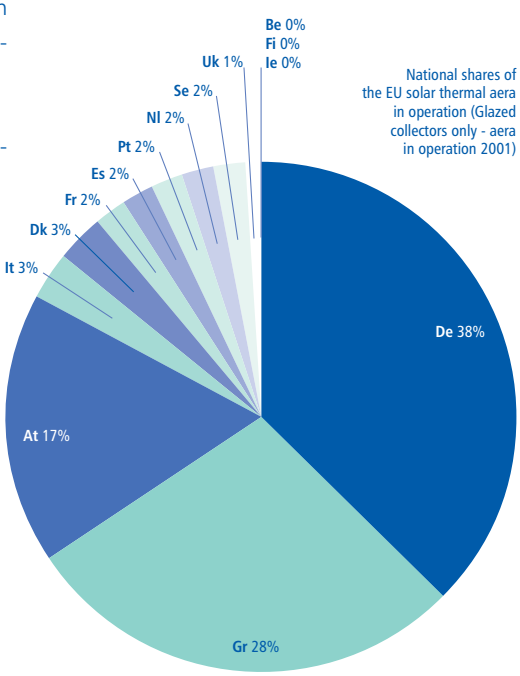
8- EPIA - European Photovoltaic Industry Association; www.epia.org

SOLAR THERMAL

Solar thermal technologies transform solar radiation into useful heat or cooling. The solar yield replaces conventional sources of heat, mainly fossil fuels or electricity. The enormous growth potential of solar thermal is therefore key in moving the heating and cooling sector towards sustainability, reducing environmental impact as well as energy imports. Domestic hot water is the most common application of solar thermal technology. Such systems consist of a solar thermal collector, a water tank and a 'solar loop' connecting all the components. Normally, the solar heat is stored directly in the domestic hot water tank, but there are also systems that store the heat in a buffer tank.

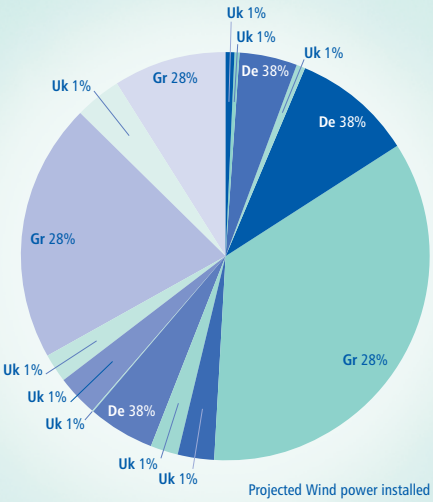
The market in the EU has more than doubled compared to the mid 1990s and is three times bigger than in the late 1980s. Between 1990 and 2001, the average yearly market growth[9] has been 13.6%. Apart from other renewable energy, no other energy sector has grown faster than solar thermal in the last decade. Since 2000, the market has clearly passed the mark of 1 million m^2 newly installed collectors per year. After a significant contraction in 2002, mainly originated in Germany, a new peak over 1.4 million m^2 was reached in 2003.[10]

Taking into account the last estimates, the surface in operation at the end of 2003 is roughly 11.9 million m^2, corresponding to an average of 32 m^2 per 1,000 inhabitants. During the decade from 1990 to 2000, the cumulated surface in operation tripled, growing every year by 11.6%. 82% Of the cumulative surface area in operation in 2001 in the EU was concentrated in only three countries: Austria, Germany and Greece. The difference in the surface installed per capita is even more striking. If all European Union countries had per capita rates in the range of Greece and Austria, the European Union would already be very close to reaching the target of 100 million m^2, corresponding to 266 m^2 per 1,000 inhabitants.



9- Sun in action II, ESTIF, 2003, www.estif.org
10- Time of writing: September 2002

WIND



Projected Wind power installed by Member State 2001-2010

Wind turbines generate electricity, as distinct from windmills, which were, like their water-powered counterparts, primarily used for milling grain. At their peak, the number of traditional 'Dutch' windmills in Europe reached 100,000, and constituted an essential part of industry, employment and rural industrial life. Large wind turbines (above 100–150 kW) usually generate 690 V, three-phase alternating current (AC). This current is sent through a transformer next to the wind turbine (or inside the tower) to raise the voltage to somewhere between 10,000 V and 30,000 V, depending on the local electricity grid. The electricity is then transmitted onto the grid in exactly the same way as electricity generated from other technologies.

Wind power is today the fastest growing electricity generation technology. Impressive annual growth rates of more than 35% between 1996 and 2001 have made Europe into the frontrunner in wind energy technology development. At the end of 2003 the installed capacity of wind power reached 28,440 MW in the EU 15 and more than 39,000 MW world wide. More than 90% of the installed wind energy capacity in the world is produced in Europe. Every country in the EU15 has installed grid connected wind capacity.

Market assessments and industry analysis[11] indicate that Europe will be the most significant market over the short term. The industry is capable of continuing its high growth rates if other countries follow the success stories of Germany, Spain and Denmark, which together accounted for more than 80% of the 2003 market. In these three countries, thriving industries and tens of thousands of jobs have been created. These successes could be rapidly replicated in other countries throughout an enlarged European Union. During the last 10 years, annual installations of wind power in the EU have been increasing at an average rate of almost 40%. Therefore, new targets for the EU-15 have been set by EWEA with 75,000 MW of installed capacity by 2010 (including 10,000 MW of offshore capacity) and 180,000 MW by 2020 (including 70,000 MW offshore).

11- "Wind Force 12", EWEA (www.ewea.org), Brussels, 2002;

Targets for renewable energy - from 12% in 2010 to 20% in 2020

Ground-breaking targets along the way towards sustainability are important both for renewable energy and end-use efficiency. Such targets can guide policy-makers during decision-making and send important signals to investors, entrepreneurs and the public. There are several case studies that demonstrate how concrete targets lead to increased impacts in various fields. In the case of renewable energies, policy-makers formulate concrete policies and support measures that foster their development, and investors develop related strategies and renewable businesses as the targets convince them that their investment will yield the expected returns.

The targets set out in the EC White Paper of 1997 foresee a 12% share of renewable energy in total energy consumption by the year 2010 (a doubling of 1997 share). Individual targets for each renewable energy technology are set out. Looking at the annual growth rates between 1995 and 2001, it is clear that one sector (wind) is far beyond the target and others are well in line with the expectations of the White Paper, i.e., hydro, geothermal and photovoltaic. To reach both the overall target and the sectorial targets, which is feasible, specific support actions for some technologies that lag behind, such as biomass and solar thermal have to be taken soon.

Given the present state of market progress and a strong political support, the current expectation is that the overall contribution of **renewable energy to energy consumption in 2020 will be 20%[12].** These estimates are based on a conservative annual growth scenario for the different technologies. In order to reach the target, strong energy efficiency measures have to be taken to stabilise the energy consumption between 2010 and 2020.

If future targets are met, renewable energy will deliver the following benefits:

Investments: The implementation of new policies to promote renewable energy sources will have a considerable impact on the amount of investments made in this sector. In order to reach the target an investment of €443 billion in renewable energy is needed over the period 2001-2020.

Avoided fuel costs and avoided external costs: Increasing prices in oil and gas supply due to limitation of the resources can, to a large extent, be covered through the avoided fuel costs by using cost free fuel or low cost renewable energy sources. Wind, PV, Solar thermal and hydro power has zero fuel input costs as the resource is free and supply is endless. Additional renewable energy eliminates direct fuel costs for the lifetime operating plant. Moreover, the external costs to society derived from burning fossil fuels or from nuclear generation are not fully included in energy prices. There is a lot of uncertainty about the magnitude of such costs, and they are difficult to identify and quantify.

CO^2 emission savings: by providing carbon-neutral sources of power, heat, cooling and transport fuels, renewable energy options offer a safe transition to a low carbon economy. The CO_2 savings due to RES development during the period 2001-2010, will be 320 Million tonnes per year in 2010. This amount represents 95% of the EU Kyoto commitment of reducing Green House Gas emissions (GHG) by 8% between 1990 and 2010. By 2020 the CO_2 reduction due to RES will be 728 Mt/year, representing a decrease of 17,3% of the total GHG emissions in 1990 in the EU-15.

Employment: Using renewable energy technologies creates employment at much higher rates than many other energy technologies. There are economic opportunities for new industries and new industrial and craft jobs through production, installation and maintenance of renewable energy systems.

12- Renewable energy Target in Europe: 20% by 2020, EREC, 2004. http://www.erec-renewables.org/documents/Berlin_2004/targets/EREC_Targets_2020_def.pdf

The European Renewable Energy Council (EREC) is the umbrella association of the major European renewable energy industry, trade and research associations active in the field of photovoltaics, small hydropower, solar thermal, biomass, wind and geothermal energy.

EREC has the following members

- **EPIA** - European Photovoltaic Industry Association
- **ESHA** - European Small Hydropower Association
- **ESTIF** - European Solar Thermal Industry Federation
- **EUBIA** - European Biomass Industry Association
- **EWEA** - European Wind Energy Association
- **EUREC Agency** - European Renewable Energy Research Centres

and as Associate members

- **AEBIOM** - European Biomass association
- **EGEC** - European Geothermal Energy Council

The Renewable Energy House

EREC shares its office with several of its member associations in the Renewable Energy House in Brussels, the central meeting point for renewable energy actors in the capital of Europe.

EREC

European Renewable Energy Council - EREC
Renewable Energy House
26, rue du Trône - 1000 Brussels
T : +32 2 546 1933
F : +32 2 546 1934
E : erec@erec-renewable energy.org
I : www.erec-renewable energy.org