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AGROBIOGAS

An integrated approach for biogas production with agricultural waste

Instrument: **Specific Actions for SMEs: Collective Research Projects**

Thematic area: **Sustainable development, global change and ecosystems**

Deliverable 4A:
Report on the status of competing technologies

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RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	X

PREFACE

This report comprises the results from the work accomplished under subtask 1.4.1a of the Collective Research project AGRIBIOGAS "An integrated approach for biogas production with agricultural waste" which is co-financed by European Union's the 6th Framework Programme. The report was elaborated under leadership of the Verein zur Förderung des Technologietransfers an der Hochschule Bremerhaven e.V. Umweltinstitut (TTZ) with assistance from the following partners:

- BIOAZUL (Spain)
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1. INTRODUCTION

This report is a compilation and summary of the most important statistics and information regarding renewable energy (RE) sources, excluding biogas technologies, which have been covered in the other AGROBIOGAS Deliverable reports (D1-D7). It provides a survey of the dynamics of seven renewable energy sectors. Comparisons are presented between their performances and European Commission White Paper objectives.

The information status of RE on this report covers the following issues:

- Relative sector growth in 2005;
- Public policies on energy promotion 2005;
- Purchase prices on leader countries 2005;
- Current situation and forecast towards EU White Paper Objectives in 2010;
- Main manufacturers of the correspondent RE sector 2005.

In the cases of Solar Thermal energy and Woody biomass the data dates from the year 2004. The updated data for year 2005 on these two sectors is expected to be published by the end of year 2006 on the annual European Barometer report (6th edition).

Additionally, a summary on the overall electrical power production by type of energy used for year 2004, is presented (Observer 2005 Report). This is done for each of the EU countries that participate on the AGROBIOGAS project. The purpose is to keep a holistic perspective and assess the production share of RE per country, in general terms.

Thus the most relevant RE sectors by country are reported as to compare the relevance between them. In addition, France and UK are included as references of developed RE markets and Poland as one of the most developed new EU member states.

2. STATUS OF SMALL HYDRAULIC POWER

With an installed capacity of more than 11.600 MW, the small hydroelectricity sector, defined by installations with capacities lower than 10 MW, is an integral part of the EU electrical production system. While this sector's potential is far from being reached, at present it has to face an apparently contradictory dual problem of conciliating productivity requirements with a high ecological water quality.

Unlike the other sectors, hydraulic power is highly dependent on a country's geography. In this way, more than 80% of hydraulic capacity is installed in five countries: Italy, France, Spain, Germany and Sweden.

TOTAL SMALL HYDRAULIC CAPACITY (<10 MW) INSTALLED IN THE EUROPEAN UNION COUNTRIES (IN MW)

Pays/ *Countries*	2004	2005*	Croissance en %/ *Growth in %*
Italy/*Italy*	2 591,9	2 591,9	0,0
France/*France*	2 040,0	2 040,0	0,0
Espagne/*Spain*	1 748,0	1 788,0	2,3
Allemagne/*Germany*	1 564,0	1 584,0	1,3
Autriche/*Austria*	994,0	994,0	0,0
Suède/*Sweden*	823,0	823,0	0,0
Pologne/*Poland*	285,0	318,0	11,6
Finlande/*Finland*	306,0	306,0	0,0
Rép. tchèque/*Czech Rep.*	271,7	276,7	1,8
Portugal/*Portugal*	267,0	267,0	0,0
Royaume-Uni/*UK*	184,0	184,0	0,0
Slovénie/*Slovenia*	142,9	143,3	0,3
Grèce/*Greece*	82,0	89,0	8,5
Slovaquie/*Slovakia*	70,0	70,0	0,0
Belgique/*Belgium*	56,5	58,0	2,7
Lettonie/*Latvia*	26,2	25,0	-4,6
Luxembourg/*Luxemburg*	20,4	20,5	0,5
Irlande/*Ireland*	19,0	19,0	0,0
Lituanie/*Lithuania*	18,7	18,7	0,0
Danemark/*Denmark*	11,0	11,0	0,0
Hongrie/*Hungary*	9,0	9,0	0,0
Estonie/*Estonia*	3,9	7,0	79,5
Pays-Bas/*Netherlands*	0,4	0,4	0,0
Chypre/*Cyprus*	0,0	0,0	–
Malte/*Malta*	0,0	0,0	–
Total UE 25/*E.U. 25*	**11 534,6**	**11 643,5**	**0,9**

* Estimation/*estimation*. Source : EurObserv'ER 2006

Note : Début juillet 2006, les données de puissance 2005 n'étaient pas encore disponibles pour les pays suivants : Italie, France, Suède, Autriche, Finlande, Royaume-Uni, Irlande et Lituanie. Nous avons donc repris par défaut le niveau de puissance de 2004./*At the beginning of July 2006, data about capacity installed in 2005 was not available for the following countries: Italy, France, Sweden, Finland, United Kingdom, Ird and and Lithuania. Instead, the 2004 figures were used.*

It should be noted that the inventory of the installations of this sector that were not monitored by subvention bodies and many of which are now more than 40 years old, is difficult.

The total operating capacity is estimated at 11.643,5 MW for the 25 member EU. Italy with 2.360 MW and France with 2.021 MW, are the two countries best equipped in hydraulic installations. However, a sizeable decrease in production recorded in France and Spain (-1 TWh for each), principally due to a pluviometric deficit, already makes it possible for the assertion that there was an appreciable drop in EU electricity production during the year 2005. For the time being, this figure is estimated at 43,1 TWh in 2005 vs. 44,5 TWh production in 2004.

2.1 NEW ITALIAN TARIFFS

A new law was adopted in 2005 to favour development of small hydraulic power plants in Italy. Deliberation N° 34/05 provides for the creation of an incentive tariff for installations with capacities lower than 10 MVA (approximately 10 MW). The production is purchased by a company called Acquirento Unico that is in charge of reselling the electricity production at a preferential price (estimated at 70 € per MWh in 2006). For installations having capacities lower than 1 MW, the purchase price is even more attractive (95,65 € per MWh up to 0,5 GWh, then 80,54 € per MWh up to 1 GWh, then 70,48 € per MWh up to 2 GWh and finally 70 € per MWh up to 5 GWh. This system, which is more favourable for small capacity installations, must however come to terms with a specific

water protection plan "Piano di Tutela delle Acque" that has also been set up and already adopted by several different Italian regions.

2.2 French potential and uncertainties

The situation of small hydraulic power in France today is a mixed and uneven one. Article 36 of the law of program of July 13, 2005 fixing the orientations of the energy policy foresaw a revalorisation of the feed-in tariff for the new installations. The decree of application specifying this remuneration is awaited by the autumn of 2006. However, it will have to come to terms with the new law on water that is presently under discussion in Parliament. A badly balanced text could call into question the renewal of already existing concessions and the start-up of new power plants.

2.3 Greater capacity for Spain

In 2005, the IDAE (Institute for Energy Diversification and Savings) estimates total Spanish installed capacity at 1.788 MW, i.e. 40 MW more than in 2004, to which another 70 MW should be added this year (2006). Nevertheless, the APPA (Spanish Association of Renewable Energy Producers) estimates that substantial work still remains to be done to reduce administrative and environmental barriers to the granting of exploitation licences, without which the Plan's targets will not be reached.

2.4 Swedish small hydraulic on the hot seat

The situation could deteriorate, however, beginning in the next decade. The Swedish government plans to exclude small hydraulic power from the green certificates system beginning on January 1st, 2011. This decision jeopardises not only new projects but also existing projects that need to be renovated or modernised. Sector professionals, who are very worried about their future, are hoping for a reversal of the situation at the next elections that took place in September 2006.

2.5 German purchase price favours renovation

According to the AGEE Stat, which centralises renewable energy statistics for the Ministry of Environment, total German installed capacity amounted to 1.584 MW in 2005, i.e. 20 MW more than in 2004. The German Hydraulic Association estimates the corresponding number of power plants at between 7.500 and 8.000. On the legislative level, the amendment to the Renewable Energies Law of August 1st, 2004 opened up new opportunities for the small hydraulic sector. In 2005, the electricity coming from hydroelectric installations smaller than 5 MW was purchased at 95,7 € per MWh for an installation capacity equal to or lower than 500 kW and 65,8 € per MWh for a capacity lower than or equal to 5 MW (with 1% graded rates since January 1st, 2005).

Beginning on December 31st, 2007, the purchase price for installations smaller than 500 kW will only apply to those installations on flowing water and which will have concretely achieved a satisfactory ecological water condition. For installations included between 5 and 150 MW, the purchase price will be paid only if the plant is modernised between August 1st, 2004 and December 31st, 2012. This modernisation must imperatively lead to a 15% increase in energy capacity and make it possible to achieve a satisfactory ecological condition of the water.

2.6 Austrian system judged too favourable

The total installed capacity in Austria (estimated at 994 MW in 2004) should significantly increase in the coming years. According to transmission system operator, E-control, 1.146,4 MW of grid-connection contracts were authorised at the end of 2005. This new authorised capacity entails the construction and the connection of approximately 150 additional MW by the end of 2007. The 2003 Austrian renewable electricity law that established purchase prices has been very beneficial to the development of hydroelectric projects. These feeding tariffs favour new installations and modernisations having permitted an increase in yield:

- from 62,5 € per MWh for the first GWh to 37,8 € per MWh above 25 GWh for new power plants or those where yield has been increased by 50%;
- from 59,6 € per MWh for the first GWh to 33,1 € per MWh above 25 GWh for power plants where yield has been increased by 15%;
- from 56,8 € per MWh for the first GWh to 31,5 € per MWh above 25 GWh for the others.

The new government judges these purchase prices as being too favourable and is preparing a reform in its incentive system. However, the Austrian government has stated that the small hydroelectric power plants, whose connection has already been authorised in the framework of the new law, will conserve their right to financial aid for the complete 15-year period and will not be affected by the re-examination of the current support system. Furthermore, the small hydraulic power plants (HCP) will still benefit from the special purchase prices in the case of modernisation or renovation carried out before December 31st, 2007. For the other installations, the purchase prices will apply until December 31st, 2008.

2.7 Promising markets in Poland and Czech Republic

Among the new member countries, Poland is the one that has most developed its installed production capacity. The Centre for Scientific Research on Renewable Energies EC/BREC estimates Poland's total installed small hydraulic capacity at 318 MW, i.e. an increase of 33 MW with respect to 2004.

Poland owes this success to its new green certificate system that was set up on October 1st, 2005 and which allowed the sector to valorise its electricity in the neighbourhood of 80 € per MWh. Small hydraulic sector development is also very promising in the Czech Republic. The Czech Republic revised its purchase prices for small hydraulic origin electricity in February 2005 so as to favour installation, construction and renovation. The tariffs represent an average of 57 € per MWh for installations commissioned before 2005 and vary between 73 € and 81 € per MWh for new or renovated power plants. The Ministry of Industry estimates total small hydraulic installed capacity for 2005 at 276,7 MW.

During the last few years, the figures for installed capacities have evolved very little because, in spite of a real potential still to be harnessed, all new projects come up against complex administrative processes and almost systematic regulatory barriers. In other respects, there is a strong potential for rehabilitation and overall of existing sites to increase capacity and yield. More than two-thirds of present installations are more than 40 years old.

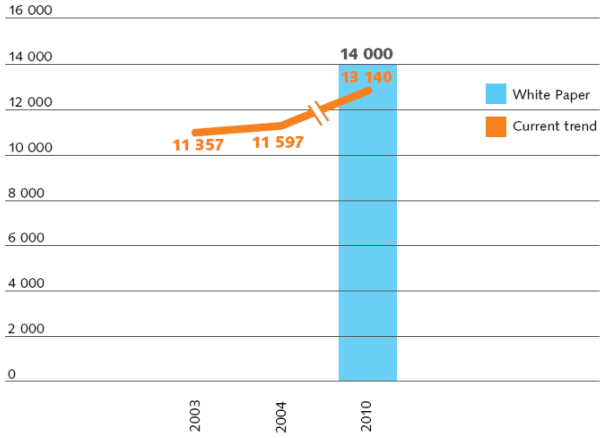
It should be noted however that sector growth rates in the ten new countries of the European Union are on the average higher than those of the countries of the older 15 member EU. This is especially due to

Poland, which has increased its capacity by more than 17% between 2003 and 2004 but now has reduced its growth to a 11,6%.

2.8 CONCLUSIONS

In spite of the new boost brought by the new member countries to sector dynamism, it will still not be able to attain the objective of 14.000 MW installed capacity by 2010. Current average annual growth rate (2% for the 25 member EU) will bring the European Union up to approximately 13.140 MW by 2010.

Furthermore, the objective of the "Sustainable Energy Europe" campaign that targets 2.000 MW of new installations in the 25 member European Union for 2006 will also be very difficult to keep to. Without strong political determination to lift administrative barriers and create a regulatory environment favourable for the sector, the potential risks remaining unexploited for a long time to come (Small Hydropower Barometer, 2006).



EXAMPLES OF REPRESENTATIVE FIRMS OF THE SMALL HYDRAULIC INDUSTRY

Entreprises/ *Firms*	Pays/ *Countries*	CA 2006/*Turnover 2005* (en milliers d'euros/ *in thousand euros*)	Nombre d'employés/ *Employment (2005)*	Type de turbines ou centrales/ *Type of turbines or plants*
Mavel a.s.	Rep. tchèque/*Czech Rep.*	10 500	165	Centrales jusqu'à 25 MW
Hydrolink s.r.o	Rep. tchèque/*Czech Rep.*	12 800	75	Centrales jusqu'à 10 MW
Gugler Hydro Energy	Autriche/*Austria*	7 500	53	Turbines de 1 kW à 10 MW
THEE	France/*France*	2 500	20	Centrales entre 10 et 400 kW
Ossberger	Allemagne/*Germany*	n. c.*	n. c.	Turbines de 1 kW à 2 MW
Alstom Power Hydro	France-RU/*France-UK*	n. c.*	n. c.	Turbines de 5 à 30 MW
VA Tech Hydro/Andritz	Autriche/*Austria*	n. c.*	n. c.	Turbines de 50 kW à 15 MW
Voith Siemens Hydro	Allemagne/*Germany*	n. c.*	n. c.	Turbines de 100 kW à 10MW

* non communiqué/*not communicated*

SOURCE : EUROBSERV'ER 2006

3. STATUS OF SOLAR THERMAL ENERGY

A new record for panel installation was established in 2004 (1.693.004 m^2 vs. 1.537.070 m^2 in 2003). This level was possible in particular through participation of the 10 new EU countries. While they may appear to be very high, these figures nevertheless represent a modest share of the world market (approximately 10%), China alone represents a market of more than 10.000.000 m^2 per year (more than 7.000 MWth) according to the ESTIF (EuropeanSolar Thermal Industry Federation).

The objective of the Campaign for Take-Off was finally reached a year later than planned, with a 25 member EU installed capacity of 15.361.824 m^2. The ten new member countries contributed to this result by bringing an additional 820.267 m^2.

The European Union cumulated figure includes both glazed technologies (flat glazed collectors and vacuum collectors) as well as unglazed collectors.

This total expresses the number of collectors actually in operation, that is to say after de-listing of the oldest installations.

At the individual country level, Germany continues to have the biggest capacity of the European Union with a cumulated installed surface of 6.199.000 m^2.

	In 2004	
	in m^2	in MWth
Germany	6 199 000	4 339.3
Greece	2 826 700	1 978.7
Austria	2 399 791	1 679.9
France	792 500	554.8
Netherlands	503 829	352.7
Italy	457 711	320.4
Cyprus	450 200	315.1
Spain	440 151	308.1
Denmark	328 380	229.9
Sweden	224 774	157.3
United Kingdom	176 160	123.3
Portugal	109 200	76.4
Slovenia	101 500	71.1
Poland	94 587	66.2
Slovak Rep.	56 750	39.7
Belgium	52 015	36.4
Czech Rep.	50 000	35.0
Hungary	48 000	33.6
Malta	15 360	10.8
Finland	12 250	8.6
Luxemburg	11 500	8.1
Ireland	7 596	5.3
Latvia	1 650	1.2
Lithuania	1 650	1.2
Estonia	570	0.4
E.U. 25	15 361 824	10 753.5

German growth in 2004 was lower than expected (+4% with respect to 2003 vs. 39% growth in 2003). The diminution of the installation subsidy premium (from 125 euros per m^2 to 110 euros per m^2) that took effect on January 1st 2004 does not explain all of this. According to Bsi (*Bundesverband Solarindustrie*, Berlin), the strong increase in photovoltaic purchase price decided by the new law on renewable energies effected the solar thermal market. Many households have preferred to invest in photovoltaic energy and so temporarily limit solar thermal growth prospects.

Greece remained second in the EU in 2004 with 2.826.700 m^2 in front of Austria with a total solar thermal surface of 2.399.791 m^2. These three leaders represent three quarters (74,4%) of European solar thermal surface.

In 2004, the Greek market once again became the second biggest market in the EU with an additional installed capacity of 215.000 m^2 (151 MWth) vs. 161.000 m^2 (113 MWth) in 2003. This growth can be explained by the significant number of systems that were damaged during winter 2003-2004, which was exceptionally harsh with below-zero temperatures and heavy snowfalls. Thermosiphon systems, which represent the bulk of Greek installations, have only a primary system and are more greatly exposed to climatic conditions. Financial assistance is still not at a very high level in Greece. The only incentive for private individuals consists of a tax deduction equal to 20% of investment costs.

Austria installed 191.494 m^2 (134 MWth) in 2004, i.e. 8,3% growth in its national market (176.820 m^2 en 2003). Austrian market growth therefore remained regular with regard to that of 2003 (+ 8,1% with respect to 2002). Flat glazed collectors represent the main part of the Austrian market with a 94% share (180.000 m^2 or 126 MWth) vs. 4,6% for unglazed collectors (8.900 m^2 or 6,2 MWth) and 1,4% for vacuum collectors (2.594 m^2 or 1,8 MWth).

Financial assistance and subsidies for private individuals are directly managed by the regions (Länder). In this way, in Upper Austria, subventions amount to 1.100 euros for each installation, plus 75 euros per m^2 of flat plate collectors or 110 euros per m^2 of vacuum collectors, and this for a maximum of 3.000 euros or 50% of total installation cost. The region of Vienna offers a subvention of 500 euros per

installation plus a bonus premium of 200 euros per m^2 of flat plate collectors or 250 euros per m^2 of vacuum collectors limited at 30% of investment costs.

Spain installed 90.000 m^2 (the equivalent of 63 MWth) in 2004, i.e. an 8,1% growth in its market. Future solar market growth will depend on new building regulations (Código Técnico de la Edificación) being adopted in the coming months. These regulations should make the installation of solar (photovoltaic or solar thermal) elements obligatory in new or restored buildings. The solar decrees implemented in forty municipalities (including Barcelona) are already in advance of the CTE in terms of the obligation to integrate solar energy in buildings. This very favourable legislation should make it possible for

Spain is to install more than 150.000 m^2 this year (2006). The current incentive system continues to be valid. It consists in granting low-interest loans from the ICO (Instituto de Crédito Oficial) credit institution concurrently with the IDAE (Spanish Institute for Energy Savings and Diversification) subventions representing 30% of installation costs.

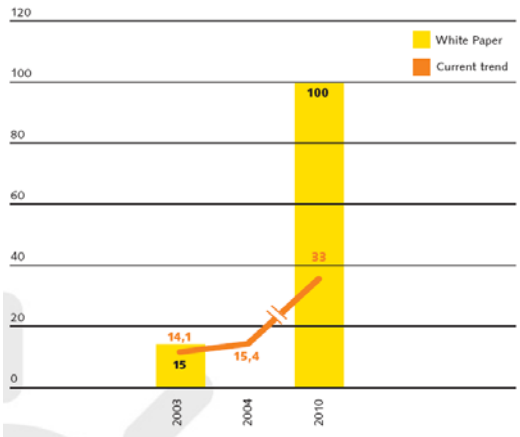
3.1 Conclusions

Even though it did have a third consecutive year of growth, the sector is not presently at the rate needed to reach European Commission objectives. This situation is due to the fact that the European market is supported by a minority of countries. Germany, Austria, Greece and the very active Cyprus represent 77,3% of European thermal solar capacity for 22,5% of EU population. These countries alone can not bring the European Union up to the objectives that have been set.

Furthermore, markets like those of France and Spain, where the desire to develop the thermal solar sector is clearly seen, have not reached market levels capable of supporting the European leaders in a sustained manner. In this way, these different trends have led us to estimate European Union installed surface area at 33 million m^2, i.e. one third of White Paper objectives.

The objectives of the "Sustainable Energy Europe" campaign of an additional 35 million m^2 between 2005 and 2008 will not be met either.

Restoring dynamism to the solar thermal sector by ensuring a strong and coherent European legislative framework is now the priority put forward by the industrial actors.



In this direction, ESTIF is encouraging, along with EREC (European Renewable Energy Council), the establishment of a heating and cooling directive like the directive that exists on production of electricity from renewable energy sources and the directive on biofuels (Solar Thermal Barometer, 2005).

THE EUROPEAN UNION THERMAL SOLAR SECTOR IN 2004

Entreprises	Pays	Types de technologies	Chiffres d'affaires (en millions d'euros)	Production ou vente de capteurs et d'absorbeurs (en m²)
Buderus/GmbH BBT Thermotechnik	Allemagne	Fournisseurs d'équipement de chauffage dont systèmes solaires	2 400**	95 000*
Viessmann	Allemagne	Fournisseurs d'équipement de chauffage dont systèmes solaires	1 150**	115 000*
Ritter Solar	Allemagne	Capteurs sous-vide	65	40 000
Wagner Solartechnik	Allemagne	Capteurs plan vitré et sous-vide	50	85 000
Sonnenkraft	Autriche	Capteurs plan vitré et sous-vide	38	100 000
GREENoneTEC	Autriche	Capteurs plan vitré, sous-vide et absorbeurs	28	242 000 (dont 12 000 capteurs sous-vide)
Clipsol	France	Capteurs plan vitrés, non vitrés	7,2	12 000
FOCO S.A.	Grèce	Capteurs plan vitrés	n.c.	110 000
Thermomax	Irlande du Nord	Capteurs sous-vide	15,1*	50 000*
Sunstrip AP	Suède	Absorbeurs	4,2	85 000

Données 2003.* * Chiffre d'affaires du groupe.*

EurObserv'ER 2005

4. Status of Photovoltaics

The European market showed all of its strength and soundness in 2005. Nearly 645 MWp of solar cells were installed in the countries of the European Union vs. 546 MWp in 2004 (+ 18,2%). This growth could have been even greater if the market had not been continually curbed by a lack of raw materials.

4.1 Germany

Germany alone installs 603 MWp and has remained the leading photovoltaic market in the world in 2005, positioned far ahead of Japan and the USA, with more than 600 MWp installed. This unabashed success has inspired both Spain and Italy, which have set up conditions in order to rapidly develop their own photovoltaic sectors.

Another lasting trend is the predominance of grid connected applications (solar roofs, facades and power plants) with a 98,1% market share in 2004. The grid connected segment now represents 91% of total installed European capacity.

The importance of the German market and the multiplicity of the power network operators make it difficult to provide precise figures for this sector. As was the case for the year before, there is a dispute between provisional figures published by the industrialists and figures resulting from the annual survey made by Photon International magazine.

The new German solar industry association (BSW-Bundesverband Solarwirtschaft), which results from the merging of the BSi (Bundesverband Solarindustrie) and the UVS (Unternehmensvereinigung solarwirtschaft), announced a 2005 market equal to at least 600 MWp, i.e. the equivalent of 200.000 connected households. For its part, Photon International magazine announced a 2005 market of 870 MW in its March 2006 issue. This figure is based on the production of inverters intended for the German photovoltaic market.

However, as in 2004, the reliability and strength of the German market can be explained by the revalorisation of the purchase price adopted in the new renewable energies law (applicable since

August 1st 2004). This law requires power grid operators to purchase photovoltaic system origin electricity according to the following tariffs:

- Free surfaces: 45,7 c€/kWh;
- Roofs < 30 kW: 57,4 c€/kWh;
- Roofs between 30 and 100 kW: 54,6 c€/kWh;
- Roofs > 100 kW: 54 c€/kWh;
- Facades < 30 kW: 62,4 c€/kW;
- Facades between 30 and 100 kW: 59,6 c€/kWh;
- Facades > 100 kW: 59 c€/kWh.

These tariffs are valid for a period of 20 years and are subject to a 5% annual depreciation rate.

4.2 Spain

The Spanish market has passed the 20 MWp mark and the photovoltaic market is still growing. The first estimates of the IDAE (Institute for Energy Diversification and Savings) show a 2005 market amounting to 20,2 MWp (18,7 MWp connected to the power grid and 1,5 MWp not connected to the grid), which grew by 90,8% with respect to the 2004 market. IDAE now forecasts a 26 MWp increase in 2006, with the objective being to reach the 400 MWp benchmark by the year 2010. This growth can be explained by the improvements in photovoltaic origin electricity purchase conditions resulting from Royal Decree 436/2004 of March 2004. This new decree guarantees the purchase of photovoltaic origin electricity for a period of 25 years (5 years longer than in Germany). Beyond this period, the law guarantees purchases at 80% of the tariff until the end of system life. Article 33 of the royal decree specifies, however, that the tariff system can be modified when the photovoltaic origin capacity on the grid will have reached 150 MWp.

PHOTOVOLTAIC POWER INSTALLED IN EUROPEAN UNION DURING THE YEAR 2004-2005 (IN MWP)

Pays/*Countries*	Marché/*market* 2004			Marché/*market* 2005*		
	réseau/ *on grid*	hors réseau/ *off grid*	Total	réseau/ *on grid*	hors réseau/ *off grid*	Total
Allemagne/*Germany*	500,000	3,000	503,000	600,000	3,000	603,000
Espagne/*Spain*	9,241	1,348	10,589	18,700	1,500	20,200
France/*France*	4,180	1,050	5,230	5,800	0,567	6,367
Italie/*Italy*	4,200	0,800	5,000	4,500	0,500	5,000
Royaume-Uni/*United Kingdom*	2,197	0,064	2,261	2,400	0,100	2,500
Autriche/*Austria*	1,833	0,514	2,347	1,730	0,520	2,250
Pays-Bas/*Netherlands*	5,540	0,120	5,660	2,000	0,100	2,100
Grèce/*Greece*	0,150	1,151	1,300	0,156	0,745	0,900
Portugal/*Portugal*	0,103	0,528	0,631	0,100	0,500	0,600
Belgique/*Belgium*	0,336	0,000	0,336	0,502	0,000	0,502
Danemark/*Denmark*	0,360	0,085	0,445	0,300	0,050	0,350
Suède/*Sweden*	0,000	0,285	0,285	0,060	0,250	0,310
Finlande/*Finland*	0,030	0,270	0,300	0,030	0,270	0,300
Chypre/*Cyprus*	0,105	0,050	0,155	0,235	0,045	0,280
Irlande/*Ireland*	0,000	0,020	0,020	0,000	0,200	0,200
Slovénie/*Slovenia*	0,005	0,028	0,033	0,112	0,004	0,116
Rép. tchéque/*Czech Rep.*	0,069	0,017	0,086	0,111	0,003	0,114
Pologne/*Poland*	0,022	0,105	0,127	0,016	0,067	0,083
Luxembourg/*Luxembourg*	8,030	0,000	8,030	0,066	0,000	0,066
Hongrie/*Hungary*	0,030	0,008	0,038	0,030	0,008	0,038
Malte/*Malta*	0,000	0,000	0,000	0,009	0,000	0,009
Estonie/*Estonia*	0,000	0,000	0,000	0,000	0,001	0,001
Lettonie/*Latvia*	0,000	0,000	0,000	0,000	0,001	0,001
Slovaquie/*Slovakia*	0,000	0,000	0,000	0,000	0,000	0,000
Lituanie/*Lithuania*	0,000	0,000	0,000	0,000	0,000	0,000
Total U.E.	**536,431**	**9,443**	**545,873**	**636,857**	**8,430**	**645,287**

* *provisoire/preliminary.*

SOURCE : EUROBSERV'ER 2006

4.3 ITALY

Italy have a purchase tariff of up to 500 MWp. The new purchase price system adopted by decree on 15th July 2005 became quickly over-extended with requests already amounting to 311 MWp for connection to the power grid as of the end of 2005, while the purchase price was only valid for the first 100 MWp. In order to meet expectation of investors, the Italian government promulgated a new decree on 26th July that raises the ceiling to 500 MWp (with 360 MWp of systems lower than 50 kWp and 140 MWp of systems included between 50 kWp and 1 MWp). On the other hand, the government limited the annual number of authorisations at 85 MWp per year (with 60 MWp of systems lower than 50 kWp and 25 MWp of systems included between 50 kWp and 1 MWp). The characteristics of this purchase price, which only concerns installations with capacities between 1 kWp and 1 MWp, are the following:

- 45,5 c€/kWh for systems lower than 20 kWp;
- 46 c€/kWh for systems between 20 and 50 kWp;
- 49 c€/kWh for systems higher than 50 kWp;
- + 10% for systems integrated in building façades.

Valid for a duration of 20 years, these prices are subject to an annual 5% depreciation as well as an adjustment for inflation, beginning in 2007.

4.4 LUXEMBOURG

The leading photovoltaic country in terms of per capita capacity (58,2 Wp per inhabitant in 2005), Luxembourg installed practically nothing during 2005 (66 kWp according to the electricity distributor

Cegedel). Grid connection capacity represented 8,03 MWp in 2004 and 13,58 MWp in 2003. This situation can be chiefly explained by the suppression in 2005 of the photovoltaic origin purchase price (45 c€/kWh in 2004) as well as by a considerable decrease in investment aids. The subvention for private individuals that amounted to 50% of installation cost dropped to 15% in 2005 and 2006 with a premium of 900 € per kWp limited at 2 KWp, plus 1 additional kWp for each member of the household older than 18.

4.5 New member countries

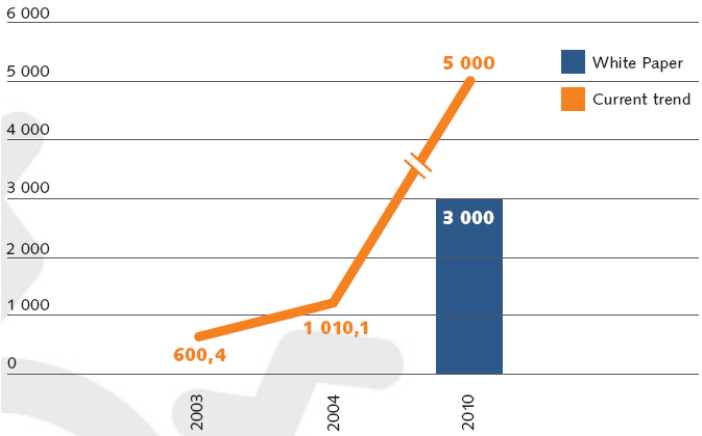
The photovoltaic market is only little developed in the new member countries (+0,269 MWp in 2004), principally due to the absence of "solar roofs" type programmes. Poland was the main market (+0,127 MWp) in 2004. The Czech Republic has the largest total installed photovoltaic capacity of the 10 new member countries (0,363 MWp at the end of 2004).

4.6 Conclusions

Overall, prospects for growth in the European market remain good. Situations are favourable in Germany, where the BSi is already anticipating 20% annual growth for 2005 and 2006, and in Spain where purchase prices justify photovoltaic sector investments.

Nevertheless, Europe needs all of its members to move more to the forefront. This is why expectations are also high for Italy where the imminent arrival of an attractive purchase price should relaunch the Italian market.

In a joint publication with Greenpeace entitled "Solar Generation", edited in September 2005, the EPIA estimates that the European Commission objective of 3.000 MWp for the end of the year 2010 could be widely exceeded and that 5.000 MWp capacity at this date is entirely possible.



Due to strong growth in the German market, EPIA's optimism does not appear excessive. Taking this new trend into consideration, the forecast for the year 2010 has been re-evaluated entirely (4.500 MWp). This updated forecast is based on 20% growth in the German market in 2005 and 2006, followed by stabilisation until 2010 (taking electoral uncertainty into consideration).

Furthermore, by the year 2008, the "Sustainable Energy Europe" programme has the goal of installing an additional 1.500 MWp between 2005 and 2008. Which, in light of the present trend, seems completely feasible and attainable. However, this growth presupposes that the photovoltaic industry will be able to guarantee supplies of silicon with manufacturers of this semi-conductor (Photovoltaic Barometer, 2006).

TOP 12 MANUFACTURERS OF PV CELLS (IN MWP)

Entreprises/ *Companies*	2004	2005	Croissance en %/ *Growth in %*	Part de marché 2005/ *Market share*
Sharp	324,0	428,0	32,1 %	24,8 %
Q-Cells	75,0	160,0	113,3 %	9,3 %
Kyocera	105,0	142,0	35,2 %	8,2 %
Sanyo	65,0	125,0	92,3 %	7,2 %
Mitsubishi	75,0	100,0	33,3 %	5,8 %
Schott Solar	63,0	95,0	50,8 %	5,5 %
BP Solar	85,0	90,0	5,9 %	5,2 %
Suntech	28,0	80,0	185,7 %	4,6 %
Motech	35,0	60,0	71,4 %	3,5 %
Shell Solar	72,0	59,0	-18,1 %	3,4 %
Isofotón	53,0	53,0	0,0 %	3,1 %
Deutsche Cell	28,0	38,0	35,7 %	2,2 %
Autres industriels/*Other industrials*	187,0	297,0	58,8 %	17,2 %
Total	**1 195,0**	**1 727,0**	**44,5 %**	**100,0 %**

SOURCE : PV NEWS MARCH 2006

5. STATUS OF BIOFUELS

In 2005, 3,9 million tons of biofuel was produced in the European Union, marking a 65,8% growth in production. Biodiesel continued to be the biofuel that Europeans prefer (representing 81,5% of total production) in the same way that conventional diesel fuel is. The bioethanol sector also performed very well, with production growing by 70,5% between 2004 and 2005.

In 2004, 2,4 million tons of biofuels were produced in the European Union versus 1,9 tons in 2003 (including new member countries), i.e. a 26,6% growth.

5.1 BIODIESEL SECTOR

The European Union counted 20 producer countries in 2005 (vs. only 11 producer countries in 2004) Production surpassed 3,1 million tons compared with approximately 2 million tons in 2004 and 1,5 million tons in 2003 (including new member countries) i.e. a 64,7% growth in a single year.

Germany once again confirmed its place as leading producer with 1.669.000 tons in 2005 (an additional 634.000 tons), i.e. a 61,3% growth rate. Germany alone represents more than half (52,4%) of EU biodiesel production. This spectacular growth in Germany's market can be explained by very favourable legislation that provides a total tax exemption for biofuels, whether they be pure or mixed. However, beginning on August 1st 2006, Germany is going to re-introduce a 0,10 € by litre tax on biodiesel that is used in its pure form and a 0,15 € by litre tax on biodiesel that is intended to be mixed in refineries. The government justifies this tax by the strong increase in petroleum products. At the same time, the German government announced that the oil companies will gradually be forced to raise the biodiesel incorporation rate up to 5,75%. At present, the incorporation rate can go up to 5% but without obligation for the oil companies in this.

BIODIESEL PRODUCTION IN EUROPEAN UNION IN 2004 AND IN 2005 (ESTIMATES IN TONS)

Pays/*Countries*	2004	2005	Différence/*Difference*	Croissance 04/05/*Growth*
Allemagne/*Germany*	1 035 000	1 669 000	634 000	61,3 %
France/*France*	348 000	492 000	144 000	41,4 %
Italie/*Italy*	320 000	396 000	76 000	23,8 %
Rép. tchèque/*Czech Rep.*	*60 000	133 000	73000	121,7%
Pologne/*Poland*	0	100 000	100 000	–
Autriche/*Austria*	57 000	85 000	28 000	49,1 %
Slovaquie/*Slovakia*	15 000	78 000	63 000	420,0 %
Espagne/*Spain*	13 000	73 000	60 000	461,5 %
Danemark/*Denmark*	*70 000	71 000	1 000	1,4 %
Royaume-Uni/*UK*	9 000	51 000	42 000	466,7 %
Slovénie/*Slovenia*	0	8 000	8 000	–
Estonie/*Estonia*	0	7 000	7 000	–
Lituanie/*Lithuania*	5 000	7 000	2 000	40,0 %
Lettonie/*Latvia*	0	5 000	5 000	–
Grèce/*Greece*	0	3 000	3 000	–
Malte/*Malta*	0	2 000	2 000	–
Belgique/*Belgium*	0	1 000	1 000	–
Suède/*Sweden*	1 400	1 000	-400	-28,6 %
Chypre/*Cyprus*	0	1 000	1 000	–
Portugal/*Portugal*	0	1 000	1 000	–
Total UE/*EU*	**1 933 400**	**3 184 000**	**1 250 600**	**64,7 %**

Sujet à une marge d'erreur de +/- 5 %/Subject to a +/- 5% margin of error.

** Sujet à une marge d'erreur de +/- 10 %/Subject to a +/- 10% margin of error.*

SOURCE : EBB 2006

French production, which has continually decreased since 2001 (the year when France was the leading European producer), finally recovered and received a boost in 2005 with a 41,1% increase in production (a total of 492.000 tons). France has established an ambitious biofuel plan running until the year 2015. France plans on reaching European Directive goals by 2008 and is planning on a 7% incorporation rate for 2010 and a 10% rate in 2015. To achieve its 2008 objective, France launched a call for candidatures published in the Official journal of the European Union concerning 1.335.000 tons of biodiesel (and 380.000 tons of bioethanol). A new call for candidature will then be launched at the end of the year for a further 950.000 tons of biodiesel (and 150.000 tons of bioethanol) in order to meet the 2010 target. For the year 2006, the reduction of the domestic tax on mineral oil products that biofuels have benefited from has been modified and is now set at 25 €/hl (33 €/hl in 2005) for biodiesel and at 33 €/hl for bioethanol that is intended for transformation into ETBE (38 €/hl in 2005). Furthermore, the rate of the general tax on polluting activities applied on the marketing of petrol and diesel oil has been modified and set at 1,75% for 2006, and will then be increased by 1,75 point in 2007, by 2,25 points in 2008, by 0,5 point in 2009 and finally by 0,75 in 2010 (i.e. amounting to a 7% tax at this date).

Italy has also increased its production during 2005. Finally, the decrease in the level of approval for biodiesel production in Italy (from 300.000 tons down to 200.000 tons) did not affect production, with Italy exporting part of its production. Italy increased biodiesel export by 76.000 tons in 2005 (i.e. a total of 396.000 tons).

At the end of 2005, the Italian government decided to launch a new call for candidature for an approval amounting to 200.000 tons in 2006. Poland (100.000 tons) and the Czech Republic (133.000 tons) are the two new member states to have emerged among the largest EU producer countries.

5.2 BIOETHANOL SECTOR

Is estimated European Union bioethanol production in 2005 at 720.927 tons, i.e. an increase of 70,5%. It constitutes a very strong acceleration in terms of production vs. that of previous years (an average of +12,8% between 2000 and 2004). This growth is due in part to the doubling (+108% between 2004 and 2005) of bioethanol production from Community wine alcohol (181.391 tons in 2005).

ETHANOL PRODUCTION IN THE EUROPEAN UNION IN 2004 AND 2005 (IN TONS)*

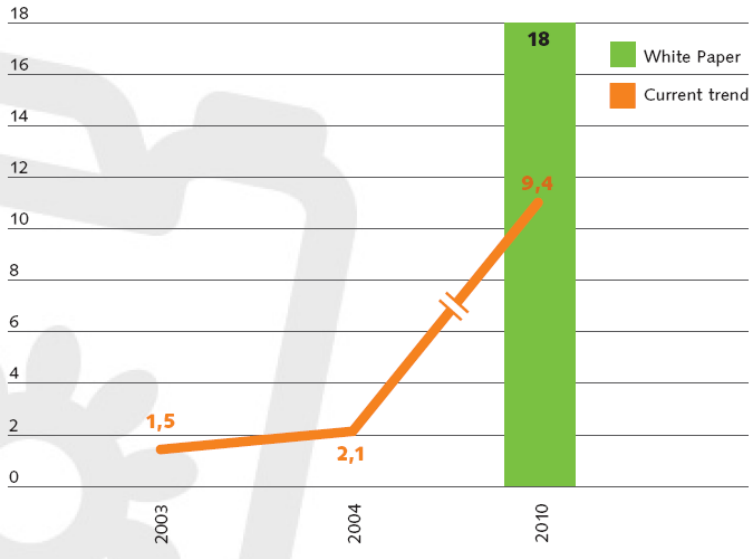
Pays/*Countries*	2004	2005
Espagne/*Spain*	202 354	240 000
Suède/*Sweden*	56 529	130 160
Allemagne/*Germany*	20 000	120 000
France/*France*	80 887	99 780
Pologne/*Poland*	38 270	68 000
Finlande/*Finland*	3 768	36 800
Hongrie/*Hungary*	–	11 840
Lituanie/*Lithuania*	–	6 296
Pays-Bas/*Netherlands*	11 146	5 971
Rép. tchèque/*Czech Rep.*	–	1 120
Lettonie/*Latvia*	9 800	960
Total UE/*EU*	**422 754**	**721 927**

**Inclus la production d'éthanol à partir de l'alcool vinique vendue par la Commission/*Included ethanol production from wine alcool sold by European Commission.*

Source : EBIO pour 2004, UEPA pour 2005 (sauf Pays-Bas et France)/EBIO for 2004, UEPA for 2005 (except Netherlands and France).

At the countries level, production's been multiplied by six in Germany, i.e. a total of 120.000 tons. Growth has also been significant in Spain, with production estimated at 240.000 tons. The increase in bioethanol production can also be explained by the appearance of new producer countries like Hungary (11.840 tons), Lithuania (6.296 tons) and the Czech Republic (1,20 tons).

Strong growth in bioethanol production is only expected this year in France. The SNPAA (National Union of Agricultural Alcohol Producers) established bioethanol production during the 2004-2005 campaign (September 1st – August 31st) at 99.780 tons (61.360 tons from beets and 38.420 tons using wheat) vs. a production of 102.000 tons for the 2003-2004 campaign. The official figures of the Ministry of Industry are surprisingly lower for the year 2004, with a production of 80.897 tons.



Among the other countries, Sweden can be cited, whose 2005 figures are stable with respect to 2004 and Poland which is waiting for a law on biofuels that was voted in November 2003 but which has still not been ratified to re-launch its sector.

5.3 Conclusions

The biofuels market is unlike others because its development is closely tied to its total or partial exemption from the tax on petroleum products. Moreover, numerous member countries have not yet indicated by what means they are going to implement changes to abide by the directive on biofuels.

If the current trend is compared with European Commission objectives, it would seem that the objective of 5,75% biofuels in the transport sector by the year 2010 will not be reached.

In order to respect the directive, the Joint Research Centre of the European Commission estimates biofuel consumption at 5,9 million toe in 2005 and 18,2 million toe in 2010, i.e. very close to the White Paper objectives for 2010 (18 Mtoe)..

The same can be said for the objectives of the "Sustainable Energy Europe" programme that targets multiplying ethanol production by five and biodiesel production by three for the end of 2008, figures that are too ambitious with respect to current efforts (Biofuels Barometer, 2006).

CAPACITY OF EUROPEAN FUEL ETHANOL PRODUCERS FOR FUEL IN EUROPE (IN TONS)

Producteurs/ *Producers*	Nationalité/ *Nationality*	Capacité de production (en tonnes)/ *Production capacity (in tons)**
Abengoa	Espagnole/*Spanish*	345 800
Sauter	Allemande/*German*	245 000
Südzucker	Allemande/*German*	205 000
Cristal Union	Française/*French*	95 000
Sekab	Suédoise/*Swedish*	79 300
Brasco	Portugaise/*Portuguese*	79 300
Tereos	Française/*French*	39 650
Cargill	Portugaise/*Portuguese*	39 650
Agroetanol	Suédoise/*Swedish*	39 650
Kraul & Wilkening u. Stelling	Allemande/*German*	23 790
Saint Louis Sucre	Française/*French*	11 900
Total		**1 204 040**

** Estimation/Estimation.*

SOURCE : ABENGOA 2006

6. STATUS OF WOOD ENERGY

	2003	2004	Croissance/growth (in %)
France	9.002	9.180	2.0%
Sweden	7.927	8.260	4.2%
Finland	6.903	7.232	4.8%
Germany	5.191	6.263	20.7%
Spain	4.062	4.107	1.1%
Poland	3.921	3.927	0.2%
Austria	3.222	3.499	8.6%
Portugal	2.652	2.666	0.5%
Latvia	1.240	1.300	4.8%
United Kingdom	1.084	1.231	13.6%
Denmark	1.071	1.113	3.9%
Italy	1.015	1.083	6.7%
Czech Rep.	0.895	1.007	12.5%
Greece	0.909	0.927	1.9%
Hungary	0.777	0.805	3.6%
Netherlands	0.561	0.720	28.2%
Lithuania	0.672	0.697	3.7%
Slovenia	0.422	0.422	0.0%
Belgium	0.346	0.382	10.4%
Slovak Rep.	0.300	0.303	1.1%
Estonia	0.150	0.150	0.0%
Ireland	0.145	0.144	- 0.6%
Luxemburg	0.015	0.015	0.0%
Cyprus	0.006	0.006	0.0%
Malta	0.000	0.000	-
Total E.U. 25	**52.488**	**55.439**	**5.6%**

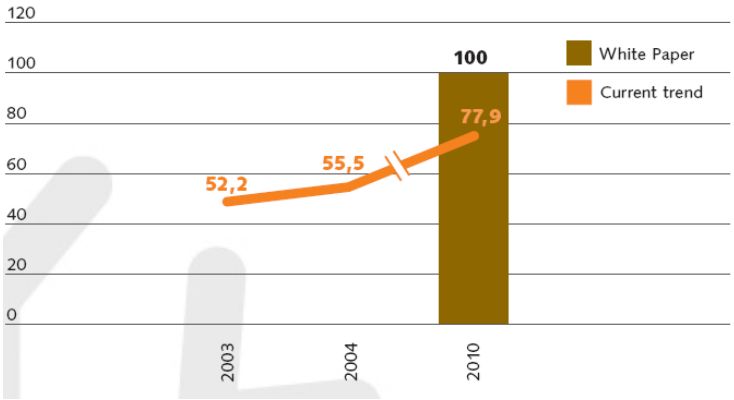
The high price of petrol and its chronic tendency to rise is arousing more and more market interest for wood energy. All the more so now that even more innovative and efficient materials are found on the market, available for private individuals as well as collectives or industries.

Primary production of wood energy (in the large sense of the word including wood waste, black liquors and solid agricultural crop residues) in the European Union has clearly increased during 2004. 55,4 million tons oil equivalent (Mtoe) was produced, i.e. 3 Mtoe more than the year before (+5,6%).

The share of wood energy in total EU primary energy consumption was established at 3,2% in 2004 (3,0% in 2003). Use of wood and wood by-products to produce electricity is growing rapidly (+23,5% with respect to 2003, i.e. 34,6 TWh in 2004) in particular due to development of combined heat and power (CHP) plants in certain

EU countries. The use of wood energy is logically greater in large forestry countries like Sweden, Finland and Austria where activity sectors linked to biomass are especially significant (slushing, furniture wood, building wood). In European countries of large size and with the largest populations like France, Germany and Spain, use of wood energy is especially localised in forestry regions.

Development of the wood energy industry is far from being homogenous in the European Union countries.



Many are only just beginning to exploit their potential (like Poland, Czech Republic, Slovak Republic and the Baltic States) while others, like Finland and Sweden, have already developed a high-tech industry (especially by combined heat and power (CHP) installations) and have already largely made use of their potential.

The 1997 White Paper does not provide a specific objective for wood energy for the year 2010. There is a 135 Mtoe objective that concerns biomass taken as a whole. By deducting the objectives of the other biomass sectors (biofuel and biogas), it has been determined that the wood energy share should amount to 100 Mtoe.

The projection of 77,9 Mtoe by the year 2010 takes into consideration different national objectives, estimations made by experts and the growth observed in the various countries. The results show that we are not advancing at the right rate to reach this objective.

The stated objective of the European "Sustainable Energy Europe" is an additional 450 combined heat and power (CHP) installations and 13.000 new wood heating units (collective heating or district heating networks) by the year 2008. Even though it is very difficult to monitor the details of the number of installations in Europe, it can be seen that these objectives will be very difficult to keep because they set the mark particularly high.

In this way, the figure of 450 combined heat and power (CHP) wood installations represents approximately ten times the present installed capacity of Finland which is the leader for this type of applications.

To develop the sector more, the European Commission has created a specific think tank on the role of wood energy. A work group stemming from the European Economic and Social Committee (EESC) is involved in the challenges of "wood as energy source for the 25 member European Union". Its objective is to evaluate current wood sector participation in the European energy mix and to pinpoint future technological choices that will permit wider use of the sector. A biomass action plan should also propose measures to boost this sector (Wood Energy Barometer, 2005).

WOOD ENERGY SECTOR INDUSTRIALISTS IN 2004

Entreprise *Company*	Pays *Country*	Type de produit *Type of product*	Gamme de puissance *Power Range* (kW)	Chiffre d'affaires 2004 *Turnover 2004* (millions d'euros)
Kvaerner Power	Norvège/Suède Norway/Sweden	Solutions for municipalities & industrial sites, i.e. for large buildings & (small) DH systems	20 – 300 MWth 50 – 600 MWth up to 550 MWe	350
Fröling Heizkessel und Behälterbrau GesmbH	Autriche/Austria	Boilers & burners for homeowners & small entreprises	5 – 1 000 kWth	62
Wärtsila Biopower Oy	Finlande/Finland	Solutions for municipalities & industrial sites, i.e. for large buildings & (small) DH systems	3 – 17 MWth up to 5,3 MMe	30,5
HDG Bavaria GmbH	Allemagne/Germany	Boilers & burners for homeowners & small entreprises	10 – 200 kWth	23
KWB	Autriche/Austria	Boilers & burners for homeowners & small entreprises	10 – 150 kWth	20,5
ETA Heiztechnik GmbH	Autriche/Austria	Boilers & burners for homeowners & small entreprises	20 – 90 kWth	14
Ökofen Heiztechnik GmbH	Autriche/Austria	Boilers & burners for homeowners & small entreprises	2 – 64 kWth	13
TPS Termiska Processer AB	Suède/Sweden	Boilers & burners, specialty in retrofit, complete solution for DH	up to 25 MWth/ 300 – 12 000 kWth	11,2
Thermia Oy	Suède/Finlande Sweden/Finland	Boilers & burners for homeowners & small entreprises	10 – 3 000 kWth	10
Schmid AG Holzfeuerungen	Suisse/Switzerland	Boilers & burners for homeowners & small entreprises	15 kWth – 20 MWth	9
Weiss France	France/France	Solutions for municipalities & industrial sites, i.e. for large buildings & (small) DH systems	0,5 – 20 MWth	6,2
Nolting	Allemagne/Germany	Boilers & burners for homeowners & small entreprises	10 – 3 000 kWth	3,5

7. STATUS OF WIND POWER

Pays/ *Countries*	2004	2005
Allemagne/*Germany*	16 628,8	18 427,5
Espagne/*Spain*	8 263,0	10 027,9
Danemark/*Denmark*	3 124,0	3 128,0
Italie/*Italy*	1 265,8	1 717,4
Royaume-Uni/*United Kingdom*	890,4	1 337,2
Pays-Bas/*Netherlands*	1 077,7	1 219,0
Portugal/*Portugal*	522,0	1 021,6
Autriche/*Austria*	606,2	819,0
France/*France*	382,3	756,0
Grèce/*Greece*	472,6	573,3
Suède/*Sweden*	442,0	492,0
Irlande/*Ireland*	326,9	480,2
Belgique/*Belgium*	96,0	167,4
Finlande/*Finland*	82,0	82,0
Pologne/*Poland*	68,1	71,8
Luxembourg/*Luxembourg*	35,3	35,3
Estonie/*Estonia*	5,7	32,0
Lettonie/*Latvia*	24,0	24,0
Rép. tchèque/Czech Rep.	16,5	20,3
Hongrie/*Hungary*	3,3	17,5
Slovaquie/*Slovakia*	5,1	5,1
Lituanie/*Lithuania*	0,9	0,9
Chypre/*Cyprus*	0,0	0,0
Slovénie/*Slovenia*	0,0	0,0
Malte/*Malta*	0,0	0,0
Total E.U à 25/*Total EU 25*	34 338,5	40 455,4

The European Union, remains the leading region of the world for wind power.

The German market declined on 2005 for the third straight year. According to the BWE (German Wind Energy Association), the market reached 1.807,8 MW (2.036,9 MW in 2004, 2.645 MW in 2003 and 3.240 MW in 2002), bringing Germany's total installed capacity up to 18.427.5 MW. According to the German association, the main cause of this decrease is the new law on construction authorising local authorities to stop or delay wind power projects when a modification of zoning regulations is involved.

The BWE also cites the very slow extension of the electric power grid, which prevents construction of new wind parks in the most promising regions, as a further reason. In the end, the arrival of the new German

government did not challenge the new renewable energies law that took effect on August 1st 2004. It is true that this law had already decreased the onshore electricity purchase price using a sliding scale with an annual decrease of 2% as from January 1st 2005 (i.e. 5,39 c€/kWh + a premium of 3,14 c€/kWh in 2005). The offshore purchase price (6,19 c€/kWh + 2,91 c€/kWh) will only have a sliding scale beginning on January 1st 2008, with the first German offshore wind park being foreseen in 2007 near the island of Borkum.

On the year 2004 German market decreased for the second consecutive year (+2.036,9 MW in 2004 vs. +2.645 MW in 2003 and + 3.240 MW in 2002). This drop could be explained in part by new financial and administrative constraints. New regulations are less favourable to wind power projects and the new law on renewable energies (EEG), which became effective on August 1st 2004, lowered the purchase price of wind origin electricity.

However, Spain seems ready to take over from Germany in the future. Spain installed 1.764,9 new megawatts in 2005 vs. 2.301,1 MW in 2004, bringing Spain's installed capacity up to 10.027,9 MW. This decrease, which can be explained by delays in many projects in 2003 leading to an amplification of installation volume in 2004, is not going to last. The new Renewable Energies Plan approved last summer by the Spanish government is unequivocal in its policy to develop wind energy. It anticipates a wind power objective of 20.000 MW for 2011, which is largely sufficient to reassure investors. The objective of this plan, foreseen for a period of five years and funded with 8 billion euros, is to double the contribution of renewable energies to reach 12,1% of primary energy production in 2010.

Furthermore, since 2004, the wind power market has evolved in new conditions of clarity for investors. The incentive system consists of choosing either a set purchase price or a premium that is added on to the market price. For the year 2005, the price of electricity was established, for onshore installations with capacities greater than 5 MW, at 6,60 c€/kWh for the first five years, 6,23 c€/kWh from the 6th to the 15th year and then 5,86 c€/kWh for the years after this. The premium, whose level is decided on each year, is added on to the market price. It was set at 2,93 c€/kWh in 2005, making it especially attractive taking the current price of electricity into consideration.

Once again, the green certificate system set up in Italy at the beginning of 2004 has proven its effectiveness. According to the ENEA (Italian Agency for New Technologies, Energy and the Environment), 451,7 new MW were installed in 2005 vs. 357 MW in 2004. In this way, Italy reinforced its forth place rank in the EU with a cumulated capacity of 1.717,4 MW.

Growth in the wind power market has also been very steady and buoyant in the United Kingdom. According to the BWEA (British Wind Energy Association), the UK installed 446,8 MW in 2005, including the 90 MW capacity Kentish Flats offshore wind farm, off the coast of Kent. This allowed the UK to increase total installed capacity by 50,2% in one year, bringing it up to 1.337,2 MW.

Aid to renewable energies in the United Kingdom is supported by four types of incentive: a green certificate system, based on a consumption quota (set at 17,7 TWh in 2005/2006, which will then reach 33,6 TWh in 2010/2011, i.e. approximately 10% of the electricity supplied in 2010), a guaranteed capital system, especially valid for offshore installations, an exemption from the tax on conventional energy (Climate Change Levy) and tax cuts for companies that invest in renewable energies.

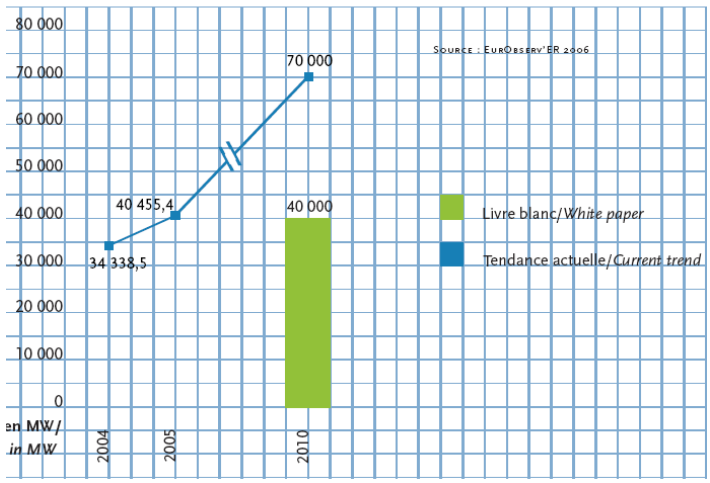
Only two of the new member States have increased their production capacities in a significant manner: Estonia which advanced by 26,3 MW in 2005 for a cumulated total of 32 MW and Hungary which, with an additional 14 MW, brings its total installed capacity up to 17,5 MW.

Finally, concerning the new EU countries, the greatest wind power capacity is found in Poland (68,1 MW at the end of 2004), but its market is still low (6,9 MW in 2005).

The German market decrease did not result in a decrease in the EU wind power market. Other countries like Spain, Italy, United Kingdom and Portugal have significantly increased their production capacities. The progressive lifting of administrative barriers and a better understanding of national particularities on the part of developers have been very favourable elements in wind power market expansion.

In the future, prospects of growth of the Spanish, French and Italian markets, associated with the confirmation of the offshore market (already with 400 MW of calls for tenders launched in Denmark, 500 MW in France and more than 8.200 MW in United Kingdom) will open new perspectives for the wind power sector.

COMPARISON BETWEEN CURRENT TREND AND WHITE PAPER OBJECTIVES (IN MW)



All these elements have pushed to revise the forecasts upwards for 2010 with a projected installed EU capacity of 72.060. The 75.000 MW objective (including 10.000 MW offshore) presented by the EWEA (European Wind Energy Association) for this same date seems to be completely feasible and attainable insofar as current growth rates can be maintained. As for the specific objective of the "Sustainable Energy Europe" programme, which targets commissioning an additional 15.000 MW by the year 2008, it could be reached at the end of 2007, one year ahead of schedule (Wind Energy Barometer, 2006).

TOP TEN OF MANUFACTURERS IN 2004

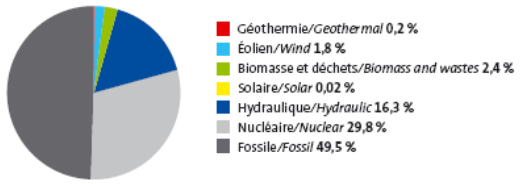
Entreprise/ *Company name*	Pays/ *Countries*	MW vendus en 2004/ *MW sold in 2004*	Part de marché/ *Market share*	CA 2004 en M€/ *2004 turnover in M€*	Employés 2004/ *Employees*
Vestas	Danemark/*Denmark*	2 784	32,5 %	3,2 - 3,4	9 449
Gamesa	Espagne/*Spain*	1 474	17,2 %	1,105	2 215
Enercon	Allemagne/*Germany*	1 343	15,7 %	1,299	n.c.
GE Wind	États-Unis/*United States*	918	10,7 %	n.c.	n.c.
Siemens	Allemagne/*Germany*	507	5,9 %	n.c.	n.c.
Suzlon	Inde/*India*	322	3,8 %	n.c.	n.c.
REpower	Allemagne/*Germany*	276	3,2 %	0,150	577
Ecotècnia	Espagne/*Spain*	214	2,5 %	0,183	530
Mitsubishi	Japon/*Japan*	214	2,5 %	n.c.	n.c.
Nordex	Allemagne/*Germany*	186	2,2 %	0,214	726
Autres/*Others*		**334**	**3,9 %**		

Source : EurObserv'Er 2006

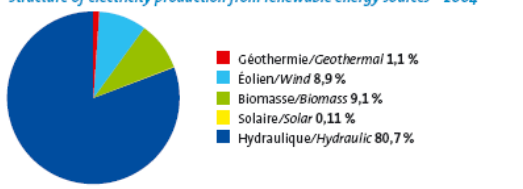
8. Status of Renewable Energies in Western Europe

Third biggest region for electrical production in the world behind North America and East and Southeast Asia, Western Europe has an electrical system that depends less on the use of fossil fuels (49,5% vs. 65% in North America and 76,1% in East and Southeast Asia). On the contrary, Western Europe's nuclear sector is much more developed (29,8%) with a 2004 production level slightly higher than that of North America (983,1 TWh vs. 903,8 TWh). Hydraulic power (16,3%) is the third large source of regional electricity.

Structure de la production d'électricité – 2004 / *Structure of electricity production – 2004*



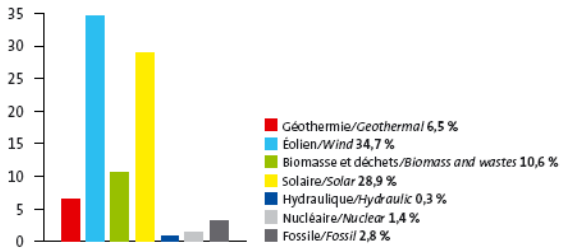
Structure de la production électrique d'origine renouvelable – 2004
Structure of electricity production from renewable energy sources – 2004



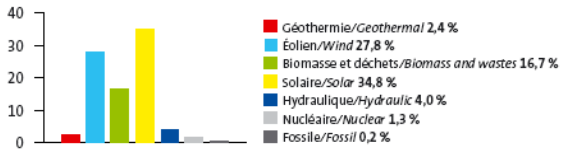
All the other renewable energy sectors (3,9% of total) are represented in Western Europe. In 2005, biomass origin electricity (58 TWh) came out ahead of wind origin electricity (56,9 TWh). Wind power is particularly developed in this region and produced 69,8% of world production.

Western Europe also has geothermal power plants (7,1 TWh) located primarily in Italy and Iceland. Photovoltaic energy (0,67 TWh) is mainly developed in the grid-connected power segment (particularly in Germany). However, this regional structure hides great heterogeneity between the different countries, with each having different policies (the place of nuclear power and of renewable energies) and their own proper potentialities (technologies and energy resources). France (with 78,4% nuclear power), Norway (with 99% hydraulic power) and Ireland (with 93,5% fossil fuels) perfectly express the singularity of the different production systems found in this region.

Taux de croissance annuel moyen 1994-2004 / *Average annual growth rate 1994-2004*



Taux de croissance 2003-2004 / *Growth rate 2003-2004*



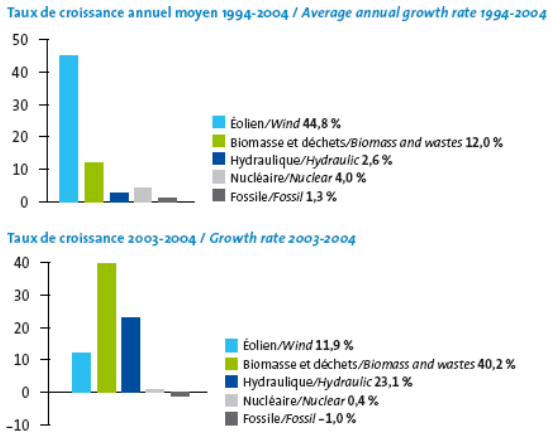
A few trends can nevertheless be drawn from these results. Among the large sectors, the biggest contribution comes from fossil fuels + 374,3 TWh) due to a sustained and continuous growth in their use for production (an average of + 2,8% per year). Growth of the nuclear sector is slower (an average of + 1,4% per year), explaining a contribution that is three times lower (+ 122,3 TWh). Practically zero hydroelectric sector growth (an average of +0,3% per year) hides a relative irregularity in production levels (490,6 TWh in 1996 and 559,6 TWh in 2000 for the extremes).

Growth of the other renewable energy sectors shows the desire and will of this region of the world to limit its greenhouse gas emissions. Among these renewable sectors, the most remarkable growth can be seen for wind power (an average of + 34,7% per year, i.e. an additional contribution of 54 TWh). Biomass has also had double-digit growth (an average of + 11,5% per year, + 38,4 TWh). Geothermal energy, whose production passed a new benchmark in 2003 (+ 10,1% with respect to 2002), contributed an additional 3,3 TWh. Solar energy growth (an average of + 28,9% per year) chiefly results from grid connected photovoltaic development programmes. In the end, strong growth in renewable origin

electricity in 2004 (+ 7,1% with respect to 2003) made it possible to stop the decline in the share of renewable energies that began in 2001.

9. Status of Renewable Energies in Central Europe

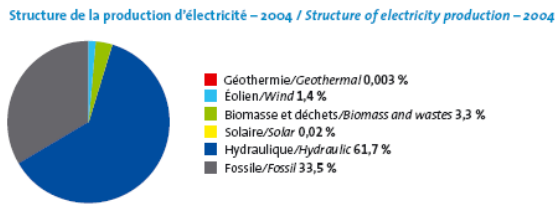
The Central European countries (including the Baltic States) have an electricity production structure based on three main sectors. Fossil fuels are at the origin of more than two thirds of regional electricity production (67,1% in 2004), followed by nuclear power (18,6%) and hydraulic power (13,8%). The other sectors present in Central Europe are "biomass and waste" (0,5%) and wind power (0,04%).



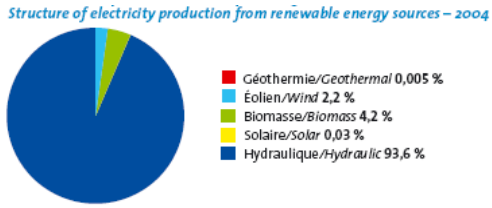
Among the renewable energy sectors, the most significant contribution was made by "biomass and waste" (+ 1,8 TWh, i.e. an average annual growth rate of 11,1%). The much more sizeable growth in wind power (an average of + 44,8% per year) is characterised by a its status of a newly created sector and by the very low level at which it started. After having reached its lowest level in 2003, the share of renewable origin electricity once more passed the 14% mark in 2004 (Seventh Inventory, 2005).

10. Status of Electricity production from Renewable Energy in Austria

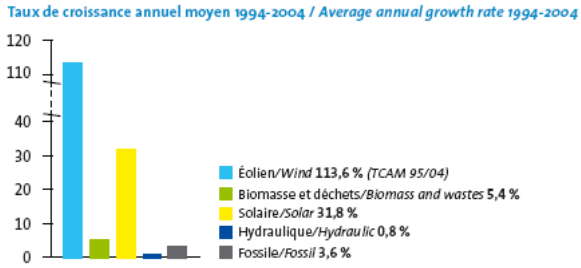
Austria is the second ranking country in the European Union (after Latvia) in terms of its share of renewable origin electricity production (66,0% of production, i.e. 42,7 TWh produced in 2004).

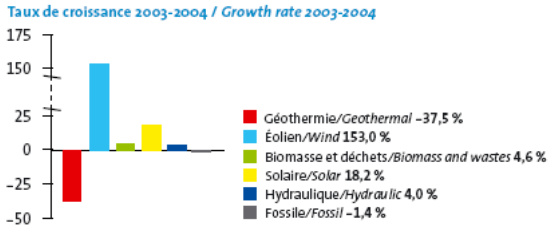


This renewable origin production is mainly ensured by the hydroelectric sector (93,6%). The biomass (4,2%) and wind power (22%) sectors make up the rest to a lesser degree.



In the absence of nuclear power, the fossil fuels sector meets 33,5% of Austrian electrical production, with the remainder (0,5%) corresponding to non-renewable waste.
The photovoltaic sector shows sizeable average annual growth over the period 1994- 2004 (+ 31,8%) and gained 12 GWh in 2004 with respect to 1994. Even though it was only created in 2002, Austria's new geothermal sector underwent a drop in growth in 2004 (-37,5%). The hydraulic sector (which already exploits 70% of its technically feasible potential) maintained its level for the period (an average annual growth rate of + 0,8%), but the share of pump storage has tended to increase (an average of + 7,9% per year).



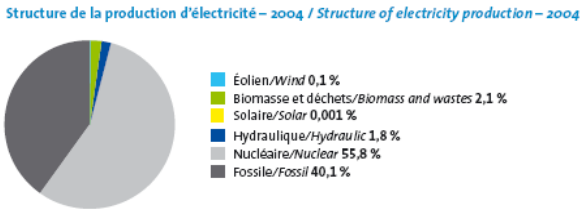


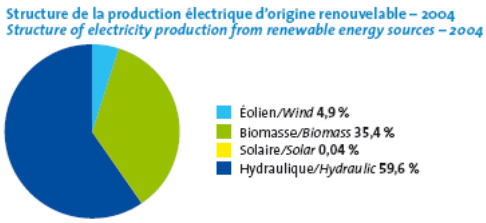
Installation of 277 MW in 2003 resulted in very strong growth in wind power origin production in 2004 (+ 153%). This sector's excellent average annual growth for the period (+ 113,6%) should continue (+ 192 MW installed in 2004, bringing Austrian installed capacity up to 606,2 MW).

However, renewable origin production increased less quickly overall than production using fossil fuels did and lost 5,5 points between 1994 and 2004 (Seventh Inventory, 2005).

11. Status of Electricity production from Renewable Energy in Belgium

Belgium is differentiated by a high level of conventional electrical production. The nuclear sector supplied 55,8% of electricity production in 2004 and fossil fuels 40,1%.

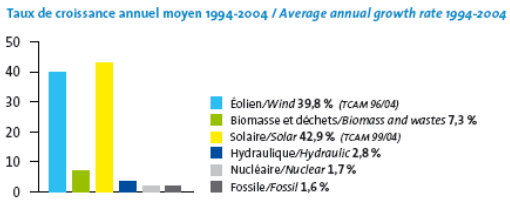


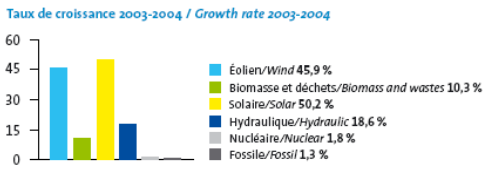


This "flat country" has a low level of hydraulic potential, but it was exploited for 75% of total resources in 2004. Hydraulic power is the leading source of renewable electricity in Belgium (59,6%) in front of biomass (35,4%). Pump storage represents 80,1% of this hydraulic sector. Belgium also has a wind power sector (0,1% of total production) that produced 128 GWh in 2004.

Belgian wind power is a dynamic sector and has increased by 39,8% since 1996, with high growth between 2003 and 2004 (+ 45,9%). Wind power production went from 9 GWh in 1996 up to 128 GWh in 2004.

Since its start up in 1999, the solar sector has grown each year by an average of 42,9%, but this rate is not sufficient to give it a real existence (1 GWh in 2004).





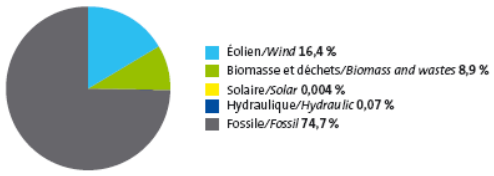
Hydroelectricity production increased for the period, mainly due to growth in pump storage (an average of +4,1% per year).

In total, renewable origin electricity production increased on the average three times more quickly than conventional production did between 1994 et 2004 (+ 5,9% for renewable electricity vs. 1,7 for conventional electricity). It succeeded in gaining 1 point in its share of total production during this period (Seventh Inventory, 2005).

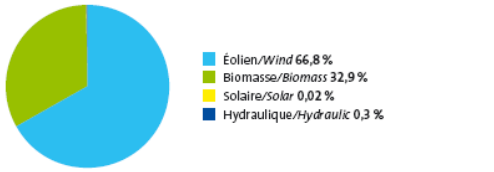
12. STATUS OF ELECTRICITY PRODUCTION FROM RENEWABLE ENERGY IN DENMARK

The main portion of Denmark's electrical production is ensured by fossil fuels (74,7% of total production), followed by wind power (16,4%) and then by biomass to a lesser degree (8%, i.e. 32,9% of renewable origin production). Along with USA, Denmark has been a forerunner in terms of wind power with establishment of a purchase price as early as 1976 that was later reinforced by a wind power energy law in 1992.

Structure de la production d'électricité – 2004 / *Structure of electricity production – 2004*



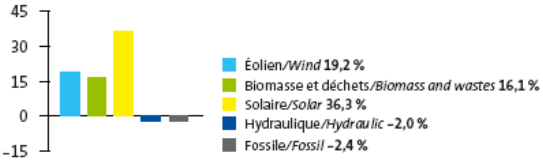
Structure de la production électrique d'origine renouvelable – 2004
Structure of electricity production from renewable energy sources – 2004



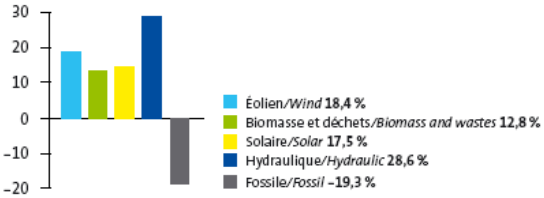
This support system made it possible for a high-tech industry to develop in Denmark that is number one in the world today.

In this way, Denmark ranks first in the European Union in terms of wind power contribution to its electrical production, and is in third place with its wind origin production of 6,58 TWh in 2004. Moreover, Denmark has confirmed its status as pioneer in offshore wind power (204 MW of wind capacity installed in 2003) since the Danish Minister of Energy launched two calls for tenders in 2004 that each represent 200 MW of offshore capacity (for the extension of the Horns Rev and Roedsand wind parks).

Taux de croissance annuel moyen 1994-2004 / *Average annual growth rate 1994-2004*



Taux de croissance 2003-2004 / *Growth rate 2003-2004*

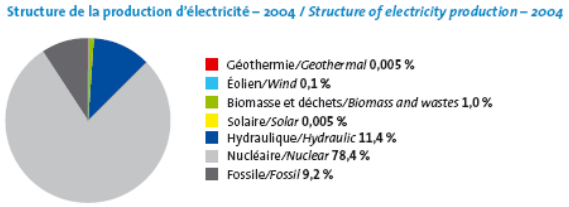


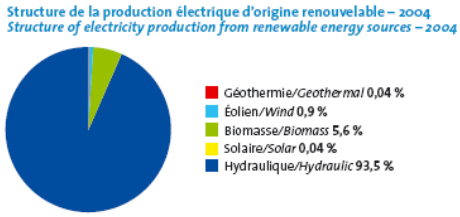
Fossil fuels have decreased in a nearly constant way by an average of – 2,4% per year for the period 1994-2004. Denmark's topography generates only minimal hydroelectric resources that do not make it possible for Denmark to develop its hydraulic sector (0,3% of renewable origin production in 2004 and an average 2% growth rate per year for the period). The solar sector has grown an average of 36,3% each year since 1994, but this rate is not high enough to give the sector true existence (1,6 GWh in 2004).

The dynamism of the wind power and biomass sectors is the origin of the very strong increase in the renewable energy share in Denmark (+ 19,8 points between 1994 and 2004). These sectors had appreciable increases (+ 5,45 TWh for wind power and + 2,55 TWh for biomass) and steady progressions (an average of + 19,2% per year for wind power and + 16,7% for biomass) for all of the period. High performances that should be underlined in the current European context (Seventh Inventory, 2005).

13. STATUS OF ELECTRICITY PRODUCTION FROM RENEWABLE ENERGY IN FRANCE

France is the second biggest producer of electricity in the European Union (behind Germany) with 571,8 TWh in 2004. 78,4% of this production is ensured by nuclear power, i.e. 448,2 TWh in 2004, which places this French sector in second place worldwide after USA.

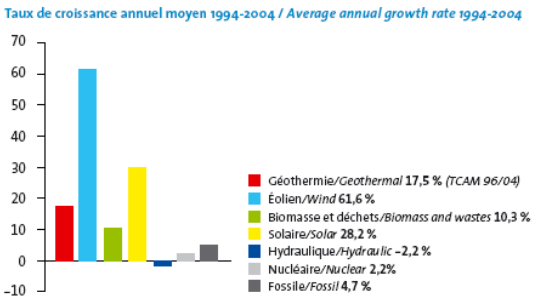


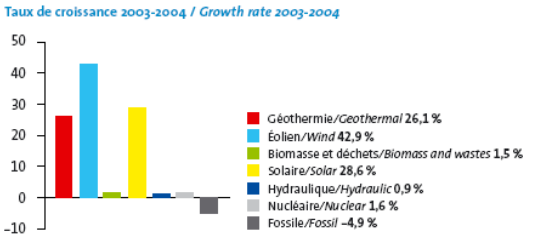


France's share of fossil fuel originating electricity in one of the lowest in Europe (9,2% of production, i.e. 52,5 TWh). In 2004, French hydroelectricity was ranked number one in the European Union (in front of Sweden) with 64,9 TWh (including 5,19 TWh pump storage) produced in 2004 (i.e. 11,4% of total production). It is also the primary renewable energy sector in France (93,5% of renewable origin production).

To a lesser degree, renewable origin electricity is produced by the biomass sector (for 5,6%, i.e. 3.877 GWh in 2004), the wind power sector (for 0,9%, i.e. 606 GWh), the geothermal sector (for 0,04%, i.e. 29 GWh) and the photovoltaic sector (for 0,04%, i.e. 27 GWh).

Hydraulic production, which depends on hydraulicity, was irregular for the period but decreased overall (an average of – 2,2% per year). Pump storage growth (an average of + 8,0% per year for the period) was not sufficient to maintain its level. It lost 16.1 TWh in 2004 with respect to 1994 and seems to have stabilised at around 65 TWh since 2002.

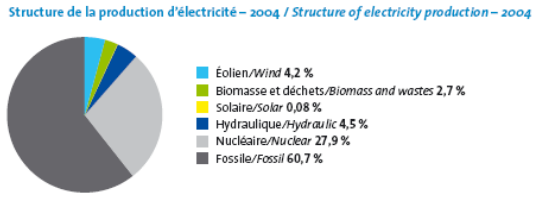


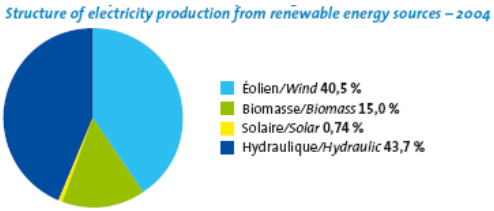


The other renewable energy sectors show positive dynamism. The 2004 start up of the Bouillante II power plant (Guadeloupe) has begun to bear fruit and has made it possible for the geothermal sector to produce an additional 6 GWh. Wind power has continued its growth with + 42,9% in 2004 with respect to 2003 and an average annual growth rate of + 61,6% between 1994 and 2004. Biomass has grown continually over the period (an average of + 8% per year) and gained 2.074 GWh in production. Finally, the initially low starting level for solar energy has given this sector sustained growth for the period (an average of + 28,2% per year). In total, due to the importance of hydraulic power in French energy balance, renewable energy production lost 13,4 TWh between 1994 and 2004. Combined with the increased use of the conventional sectors, its share in total production lost 5,2 points between 1994 and 2004. Since 2003, its level has been maintained in the region of 12% (Seventh Inventory, 2005).

14. STATUS OF ELECTRICITY PRODUCTION FROM RENEWABLE ENERGY IN GERMANY

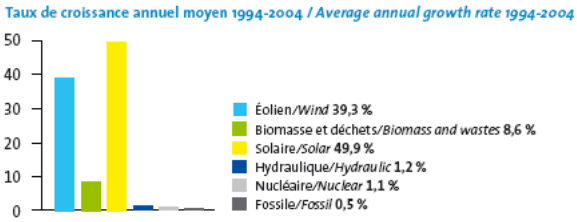
The main part of German electricity is produced from fossil fuels and nuclear power (respectively 60,7% and 27,9%).The remaining 11,4% of electrical production is divided between the different renewable sectors and waste.

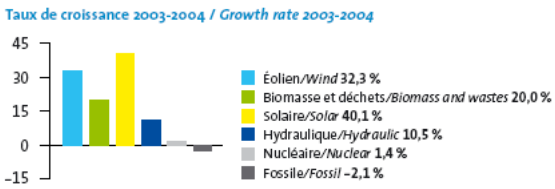




Hydroelectricity remains the principal source of renewable originating electricity (43,7% of renewable production, i.e. 27 TWh in 2004, including 23,7% pump storage).

The wind power sector follows right on its heels (with 40,5% of renewable origin production) and produced 25 TWh in 2004. In this way, Germany has conserved its title of leading wind power producer country in the world. With 459 GWh produced in 2004, the photovoltaic sector can also boast of a good title, being first in the European Union and third worldwide (after the Japanese and American solar sectors). The biomass sector produced 9,3 TWh in 2004 (i.e. 15% of renewable origin production). Geothermal origin production appeared in 2004 with a low temperature production pilot experiment.





The beneficial effects of the new EEG law that came into force on August 1st 2004 can be seen in the results for 2004. This law intensified support for renewable energies, in particular with respect to purchase price for photovoltaic and biomass origin electricity. In this way, biomass grew by an average annual rate of 17,3% for the period and had a peak in 2004 (production of 9,3 TWh, i.e. a 40,1% increase with respect to 2003).

The photovoltaic sector had very strong growth for the period (an average of +49.9% per year).Wind power also grew very strongly during the period (an average of + 39,3% per year). It is a question here of sustained steady growth for an already very well developed sector (+ 2.036,9 MW installed in 2004, bringing wind power capacity up to 16.628,8 MW).With approximately 70% of its technically exploitable potential developed in 2004 (i.e. 8.903 MW installed, including 4.378 MW pump storage).

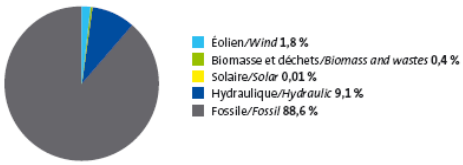
The hydraulic sector progressed little for the period (an average of + 1,2% per year). But 2004 figures as having been one of the good years with 27 TWh supplied .The dynamism shown by all of the renewable sectors (an average of + 8,8% per year) made it possible to produce an additional 35 TWh between 1994 and 2004. Overall, renewable origin production gained 5,2 points for the period, which is exceptional in the European context (Seventh Inventory, 2005).

15. Status of Electricity production from Renewable Energy in Greece

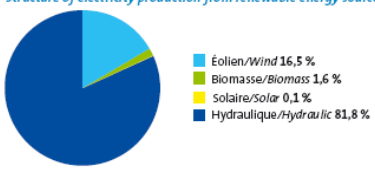
Greece principally produces electricity from fossil fuels (88,6% of production). This represents a high share in comparison with the other countries of the European Union.

Renewable origin electricity (wastes not included) thus represents 11,1% of production in Greece. This renewable production is ensured by hydraulic power for 81,8% (i.e. 5,2 TWh in 2004), wind power for 16,5% (i.e. 1,041 TWh), and, to a lesser degree, biomass for 1,6% (i.e. 100 GWh) and photovoltaic energy for 0,1% (i.e. 4,7 GWh).

Structure de la production d'électricité – 2004 / *Structure of electricity production – 2004*



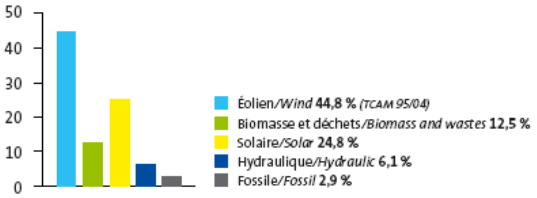
Structure de la production électrique d'origine renouvelable – 2004
Structure of electricity production from renewable energy sources – 2004



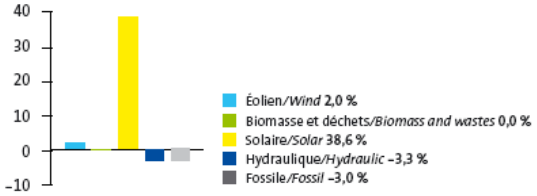
The biomass sector was created in 2001 but still remains very modest. An encouraging average annual growth rate since 1994 (+ 24,8%) is not sufficient for the photovoltaic sector to have a real existence (4,7 GWh produced in 2004). The wind power sector has provided high performance with an average annual growth rate of 44,8% since 1995. The slack period of 2004 (+ 2% growth with respect to 2003) should end in 2005. Installed wind power capacity grew in 2004, going from 375 MW up to 465 MW.

Greece's hydroelectricity was irregular for the period 1994-2004, but the sector has become dynamic since 2003 and produced approximately 5,2 TWh per year.

Taux de croissance annuel moyen 1994-2004 / *Average annual growth rate 1994-2004*



Taux de croissance 2003-2004 / *Growth rate 2003-2004*

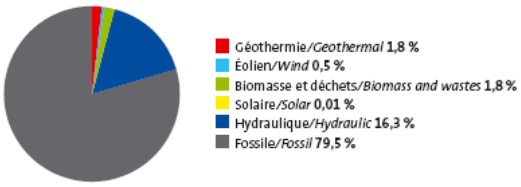


One third of its technically exploitable potential has been developed (i.e. 3.079 MW installed in 2003, including 699 MW for pump storage). And the 700 MW under construction leads us to predict that this sector will evolve positively after 2008. The good condition of the renewable sectors can be seen in renewable origin production that more than doubled between 1994 and 2004, and by a share relative to total production that gained 4,1 points during this period (Seventh Inventory, 2005).

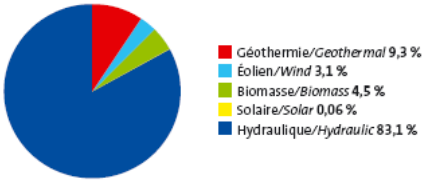
16. Status of Electricity production from Renewable Energy in Italy

Italy's electrical production is primarily supplied by the fossil fuels sector (79,5%) and to a lesser degree by the hydroelectric sector (16,3% of total production and 83,1% of renewable origin production). Pump storage supplies 15,4% of hydroelectric production. With 1,8% of Italy's total

Structure de la production d'électricité – 2004 / *Structure of electricity production – 2004*

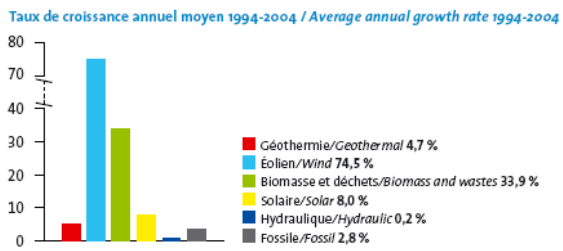


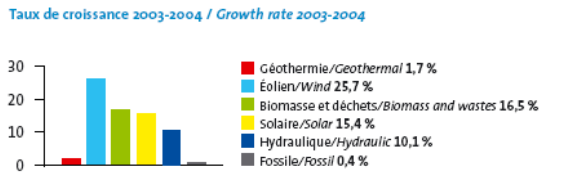
Structure de la production électrique d'origine renouvelable – 2004
Structure of electricity production from renewable energy sources – 2004



electrical production coming from geothermal energy (i.e. 5,4 TWh in 2004), Italy has conserved its title of European leader in this field and is ranked fifth worldwide after USA, Philippines, Indonesia and Mexico.

This is also the case for the photovoltaic sector that represented 0,01% of total production in 2004, that is to say 34 GWh, and in this way ranks third in Europe behind Germany and Spain. In adding the 2,6 TWh resulting from the biomass sector and the 1,8 TWh supplied by the wind power sector, 19,6% of Italy's electrical production is of renewable origin.



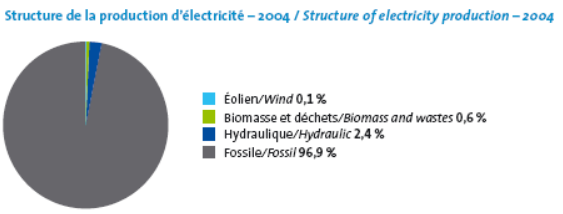


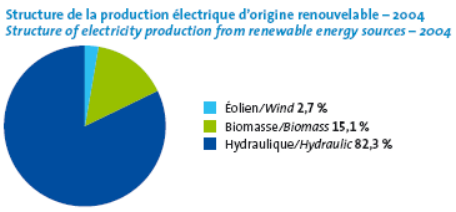
With approximately 67% of Italy's hydraulic potential already exploited, mean hydroelectric production has hardly grown (+ 0,2%) during the period 1994-2004, even though pump storage, for its part, grew by 9,3%.

In spite of the considerable growth in production for the other renewable energy sectors (an average of + 74,5% per year for the period for wind power, + 33,3% for biomass, + 8% for solar energy and + 4,7% for geothermal energy), the very strong increase in electrical production supplied by the fossil fuels sector (which gained 57,6 TWh for the period) did not make it possible for the renewable origin production share of total production to increase for the period (- 2,5 points).

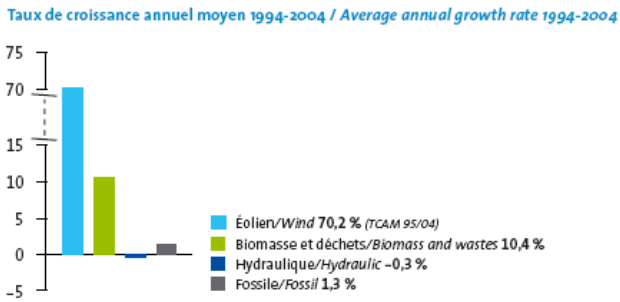
Overall, average annual growth for the period was two times lower for renewable origin production (+ 1,3%) than for conventional electricity production (+ 2,9%). Finally, it is the increased use of fossil fuels that ensured the increase in Italy's total electrical production (+ 67,4 TWh for the period) (Seventh Inventory, 2005).

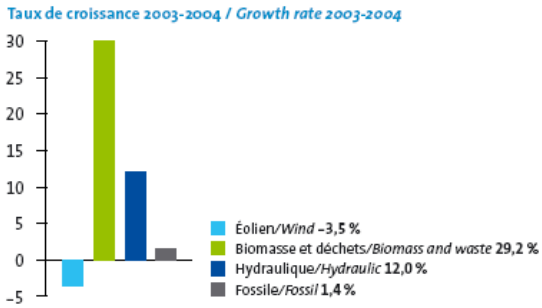
17. Status of Electricity production from Renewable Energy in Poland





The fossil fuels sector produced 96,9% of Poland's electricity in 2004, i.e. 149,6 TWh, and left only little place for the renewable





energy sectors (2,9% of production, i.e. 4,5 TWh). The hydraulic sector (with 44% pump storage) is the main renewable energy source (3,69 TWh of production), followed by biomass (676 GWh) and lastly wind power (120 GWh).

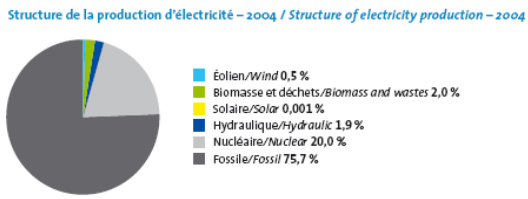
The biomass sector has grown steadily (an average of + 29.7% per year since 1994, and + 48,9% in 2004 with respect to 2003) but remains at a low level. The average annual growth rate for hydroelectricity is almost zero (- 0,3% for the period 1994-2004) and yet only 19% of this sector's technically exploitable potential has been developed (i.e. a 2003 capacity of 2.273 MW including 1.366 MW for pump storage).

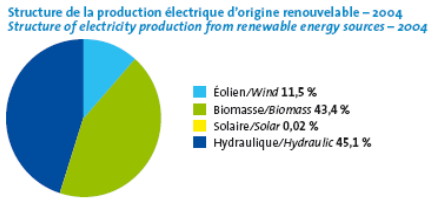
The wind power sector seems to have taken on a wider dimension at the end of the period. In spite of its wind power installations of very modest scale, Poland has the biggest installed capacity (68,1 MW in 2004, i.e. a production of 120 GWh) of the new countries of the European Union. The year 2005 has seen the installation of Poland's biggest wind farm (50 MW at Tymien in the north of Poland). The appearance of a still minor photovoltaic production since 2001 should be pointed out.

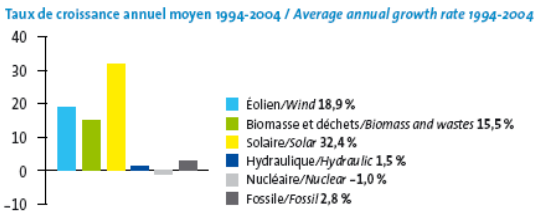
In the end, the activity of the renewable energy sector (an average of + 1,6% per year for the period 1994-2004) was only enough to maintain its share in overall production (approximately 3%). The steady (an average of + 1,3% per year) and sizeable (+ 19,1 TWh in 2004 with respect to 1994) increase in Poland's production was ensured by the fossil fuels sector (+ 18,4 TWh for this period) (Seventh Inventory, 2005).

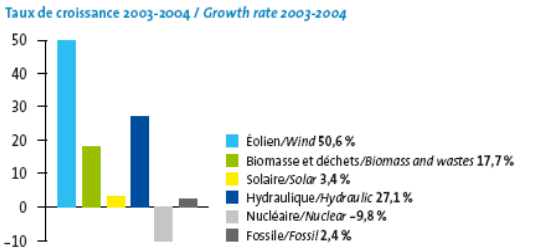
18. Status of Electricity production from Renewable Energy in United Kingdom

Representing respectively 75,7% and 20,0% of total production, fossil fuels and nuclear power supply the essential part of electricity production in the United Kingdom. The 4,2% of renewable origin electricity is divided principally between hydraulic power (with 7,6 TWh, including 2,6 TWh pump storage) and biomass (7,3 TWh).









The British wind power sector showed its maturity with 1.935 TWh produced in 2004. In terms of the conventional sectors, nuclear production decreased for all of the period and that the increase in UK production was ensured by fossil fuels.

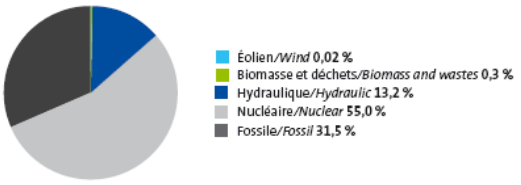
Wind power and biomass had the steadiest growth for the whole of the period 1994-2004 (18,9% and 17%). Wind power went from 344 GWh in 1994 up to 1.935GWh in 2004, and biomass from 1,5TWh to 7,3 TWh for the same period. A strong increase in wind power origin electrical production (+ 50,6%) can be seen between 2003 and 2004. The hydraulic sector grew by an average of 1,5% per year for the period, mainly thanks to pump storage. The solar sector showed a high average annual growth rate (+32,4%) between 1994 and 2004, which can be explained by transition from practically nonexistent

production in 1994 (0,2 GWh) to 4 GWh production throughout 2004.

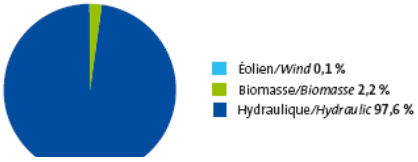
In conclusion, the growth of the renewable energy sectors for the period 1994-2004 (an average of + 7,2% per year) was four times greater than that of the convention electricity production sectors (+ 1,9%), which made it possible for the share of renewable origin production to go from 2,6% in 1994 up to 4,2% in 2004 (Seventh Inventory, 2005).

19. Status of Electricity production from Renewable Energy in Slovakia

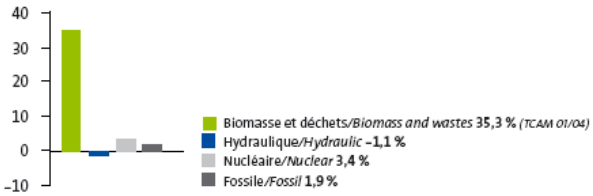
Structure de la production d'électricité – 2004 / *Structure of electricity production – 2004*



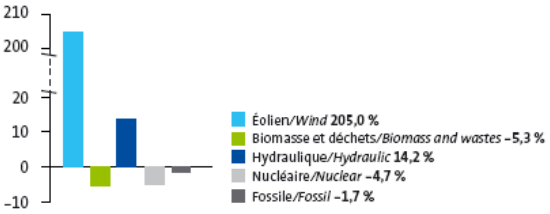
Structure de la production électrique d'origine renouvelable – 2004
Structure of electricity production from renewable energy sources – 2004



Taux de croissance annuel moyen 1994-2004 / *Average annual growth rate 1994-2004*

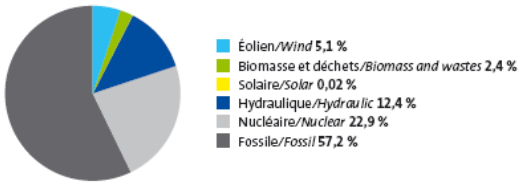


Taux de croissance 2003-2004 / *Growth rate 2003-2004*

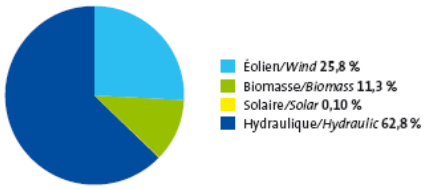


The conventional sectors occupy an important place in the Slovak Republic's electrical production system (nuclear power 55% and fossil fuels 31,5%). The renewable energy sectors produce 13,5% of the electricity. Hydraulic power (97,6% of renewable origin electricity) clearly differentiates itself from the other renewable sectors in the Slovak Republic: biomass (2,2%) and wind power (0,1%). The solar sector is starting up (48 MWh in 2004).

Structure de la production d'électricité – 2004 / *Structure of electricity production – 2004*



Structure de la production électrique d'origine renouvelable – 2004
Structure of electricity production from renewable energy sources – 2004



The new renewable energies have also appeared in the Slovak Republic. The biomass sector is recent and yet it still lost one third of its production since 2001 (94 GWh in 2004 vs. 154 GWh in 2001). Wind power origin electrical production for the past two years (2004-2005) can now also be noted.

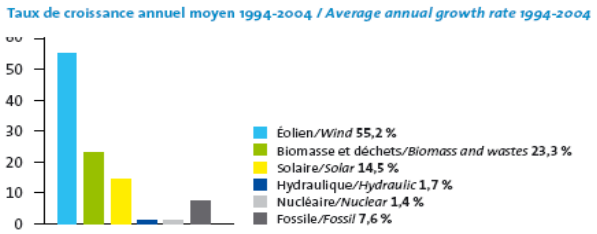
Hydroelectricity, dependent on unforeseeable climatic factors, has barely made up for the bad year it had in 2003 (3.582 GWh vs. 4.090 GWh in 2004). 57,5% of its technically usable potential has been developed and this figure should reach 60% for 2010. The Slovak Republic exploited 2.507 MW in 2003, including 919 MW in pump storage. It installed an additional 140 MW as well as 600 MW in pump storage in the Ipel River basins that will be operational for 2008-2014.

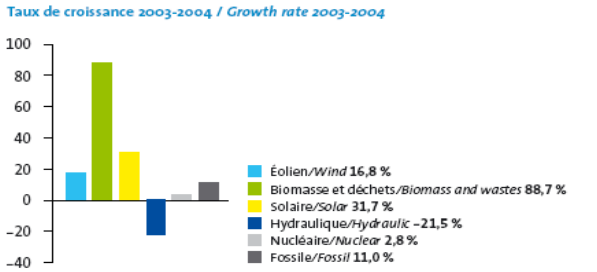
In the end, total production increased for the period 1994-2004 (an average of 2,3% per year), due to an increased use of the nuclear sector, while renewable origin production decreased (an average of 0,8% per year) and its share lost 4,9 points (Seventh Inventory, 2005).

20. Status of Electricity production from Renewable Energy in Spain

Fossil fuels (57,2% of electrical production in 2004) and nuclear power (22,9%) are the two main sources of electricity in Spain. The share of renewable origin production (19,7%) is composed of hydroelectricity for 62,8%, wind power for 25,8%, biomass for 11,3% and lastly solar energy for 0,1%. And with 54 GWh produced by the photovoltaic sector in 2004, Spain now ranks second in the European Union (behind Germany) in the field of solar origin electricity production.

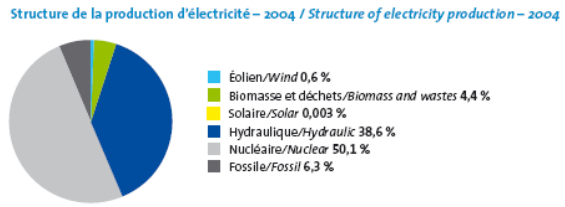
The wind power sector has grown in a very steady and sizeable way since 1994 (an annual average of + 55,2% in electrical production for the period). It supplied an additional 14 TWh in 2004 with respect to 1994. In this way, it now ranks second internationally (after Germany). It can be seen that Spain's hydroelectric production was very irregular during the period due to a large dependence on hydraulic electricity. Its average annual growth rate was weak for the period (+ 1,7%). These production drops were compensated for by a greater use of the fossil fuel sector. In this way, Spain stabilised its overall average annual growth for the period at a high rate (+ 5,6%).

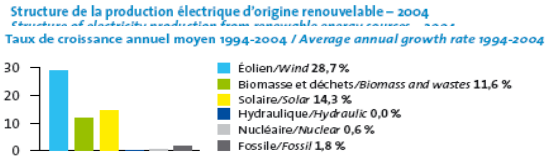


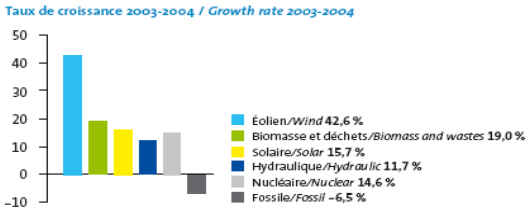


In conclusion, the share of renewable origin electrical production has increased of 1,2 point for the period (Seventh Inventory, 2005).

21. Status of Electricity production from Renewable Energy in Sweden







Nuclear energy (50,1%) and hydraulic power (38,6%) are the two main sources of electrical production in Sweden. Fossil fuel origin electricity production (6,3%) is one of the lowest in the European Union, barely higher than that of biomass (4,2%). With a production of 900 GWh, wind power represented 0,6% of Swedish production in 2004.

In spite of a marked upturn in total electrical production in 2004 (+ 12,2%), the average annual growth rate for the period is very modest (+ 0,8% per year since 1994). In 2004, the nuclear and hydraulic sectors nearly conserved their 1994 production levels, it can be noted that hydraulic power experienced production peaks between 1998 and 2001 (from 59,5 TWh in 1994 and 2004 to 79,1 TWh in 2001). Biomass

growth was significant for all of the period (an average of 11,1% per year). The strong increase in wind power in 2004 (+ 42,6% with respect to 2003) confirmed this sector's development in Sweden since 1994 (an average of + 28,7% per year).

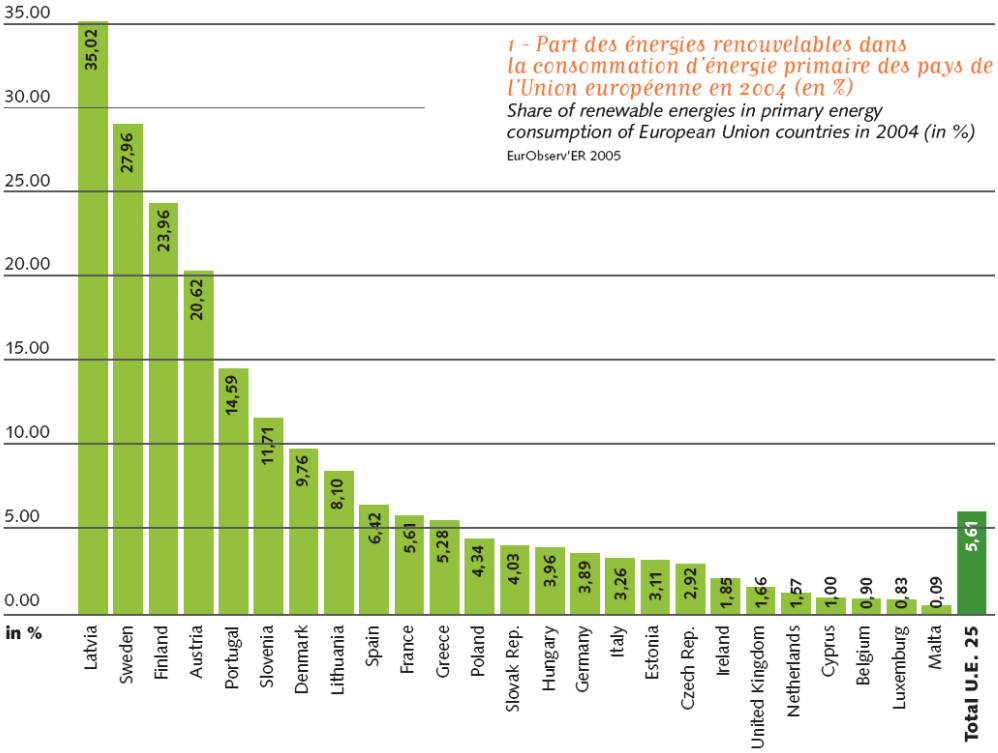
In the end, the share of renewable origin electricity production has remained at the same level between 1994 (43,2%) and 2004 (43,3%) (Seventh Inventory, 2005).

22. SUMMARY OF PRIMARY ENERGY PRODUCTION FROM RENEWABLE ENERGIES

The Annual Assessment on renewable energies would not be complete without an update on the two main objectives of the European Commission which are:

1. Meet the share of renewable energies in European primary energy consumption and
2. Increase the share of renewable energies in electricity generation

The following figure presents the situation of the share of renewable energies in primary energy consumption of the countries of the European Union in 2004.



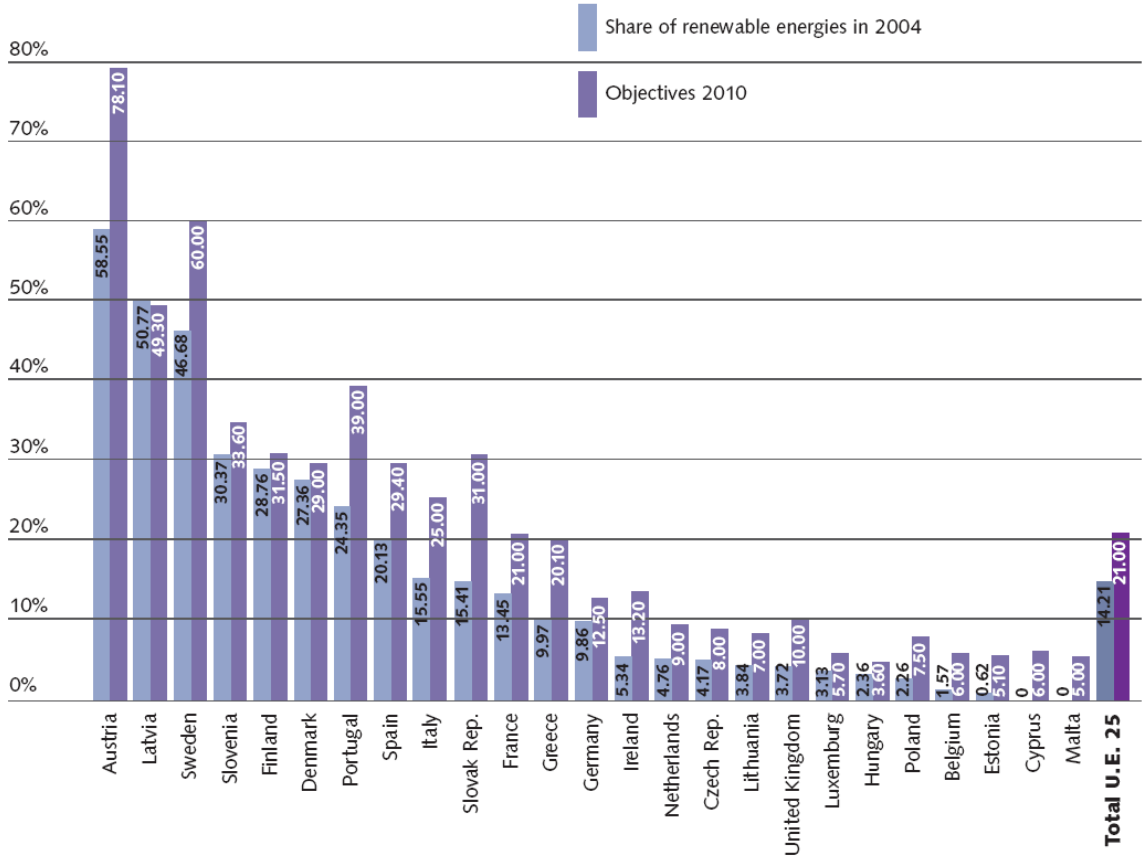
Like the thematic status published this year, the annual assessment barometer reviews the situation of the present 25 member countries. Renewable energies participation is estimated at 5,61% for an objective of 12% for 2010. The first observation that can be made is that this group of energy sources has stagnated over the past four years.

Estimation of this ratio was 5,6% in 2001, 5,1% in 2002 and then 5,5% in 2003. It's thus obvious that the European Union will not attain its objective of 12% at this rate. This observation has been integrated by the European Commission which, in its communication report to the Council and to the European Parliament, now anticipates a total of 9% in 2010. Only five countries (Latvia, Sweden,

Finland, Austria and Portugal) have reached or passed the 12% mark in their national energy mix. Among the 20 other European countries, 14 are below the 5% threshold and 7 under that of 2%.

The average share of renewable energies participation in the energy mixes of the 10 new member countries that joined the European Union on May 1st 2004, amounts to 4,9%. In comparison, the countries of the "old" 15 member EU present an average share of 5,71% for 2004. The breakdown of renewable origin primary energy according to the different sectors is very appreciably the same between 2003 and 2004. The arrival of the 10 new member countries did not change the fact that biomass is by far the leading renewable energy source used in the European Union.

Share of renewable energies in gross electrical consumption in European Union countries in 2004 (in %)
EurObserv'ER 2005



22.1 Electricity Production

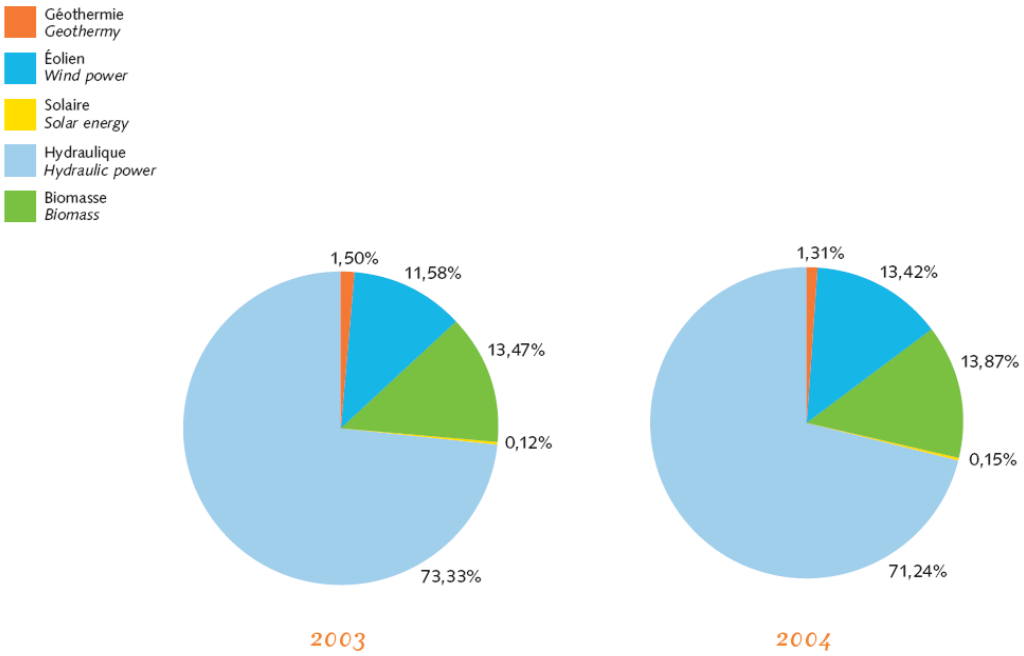
The second European objective is relative to the share of renewable energies in gross electrical consumption. The European rate is estimated at 14,21% in 2004, which marks a 0,67 point regression with respect to 2003. Overall, the trend to be retained on this ratio's evolution is one of stagnation because in 1997 (year the White Paper on development of renewable energy sectors was published) the share amounted to 13,9%.The European objective of 21% in 2010 for all of the member countries has thus grown a little more remote.

On this point, like the situation in terms of primary energy, the European Commission has also integrated EU tardiness and is now aiming for 18% rather than 21%. Only four countries of the

European Union are presently near to their objectives for 2010 (Latvia, Slovenia, Finland and Denmark). Latvia has now even succeeded in exceeding its objective (50,7% vs. 49,3%). However, these levels can quickly evolve especially when they are based to a great extent on hydraulic production whose producible volume is influenced by variations of climatic conditions (drought or high amounts of rainfall).

Integration of the 10 new member countries has not caused any significant evolution in the distribution observed in 2003 in terms of participation of the different renewable energy sectors. Hydraulic power is still the principal renewable source used, but the growth in wind power should also be noted.

Share of each ressource in the electicity generation from renewable sectors in the European Union in 2003 and 2004 (in %) EurObserv'ER 2005



To better perceive each country's dynamic trends, it is necessary to correctly distinguish data for installed capacities from the energy production figures which are affected by climatic uncertainties. The success of the objectives will be effectively judged in terms of production levels that are reached (in MWh), but the best possible monitoring of efforts is made using production capacities (in MW). Installed capacity for each renewable energy sector has grown with the passing years. These energies have gained ground in terms of absolute figures even if the indicators of relative shares do show certain stagnation (European Barometer, 2005).

Production électrique par source / *Electric production by source*

TWh	1994	2001	2002	2003	2004	TCAM/*AAGR* 94/04	TC/*GR* 03/04
Géothermie/*Geothermal*	2,0	2,8	2,9	2,8	2,5	2,1 %	-8,5 %
Éolien/*Wind*	0,001	0,137	0,156	0,147	0,249	73,6 %	69,4 %
Biom. et déchets/*Biom. and wastes*	0,511	0,395	0,570	0,530	0,603	1,7 %	13,8 %
(dont biomasse) *(biomass share)*	*0,511*	*0,395*	*0,570*	*0,530*	*0,603*	*1,7 %*	*13,8 %*
Solaire/*Solar*							
Hydraulique/*Hydraulic*	25,8	21,5	25,2	23,7	27,0	0,5 %	14,3 %
(dont turb. pomp.) *(pump storage share)*							
Nucléaire/*Nuclear*							
Fossile/*Fossil*	6,3	13,9	11,6	13,2	11,5	6,2 %	-12,8 %
Tot. renouvelable/*renewable*	**28,4**	**24,8**	**28,8**	**27,1**	**30,4**	**0,7 %**	**12,3 %**
Tot. conventionnel/*conventional*	**6,3**	**13,9**	**11,6**	**13,2**	**11,5**	**6,2 %**	**-12,8 %**
Total production	**34,7**	**38,7**	**40,4**	**40,3**	**41,9**	**1,9 %**	**4,1 %**
Part renouvelable/Renew. share	***81,8 %***	***64,1 %***	***71,3 %***	***67,3 %***	***72,6 %***		

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Solar Thermal Barometer (2005). Systèmes Solaires No. 168, EurObserv'ER Barometers.

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Wood Energy Barometer (2005). Systèmes Solaires No. 169, EurObserv'ER Barometers.

APPENDIX 1: OUTLOOK OF COMPETING RENEWABLE ENERGIES TO BIOGAS BY A BIOENERGY ENGINEERING COMPANY. ELBE BIOENERGY GMBH

Competition between energy crops for biogas production and energy crops for biodiesel or bioethanol production.

Due to the EU biofuel regulations the number of production sites for biodiesel and bioethanol are increasing in Germany. Thus, there is a growing competition between biofuel production and biogas production concerning cultivation areas available. Several German publications are available dealing with future biomass utilization routes in Germany and in Europe as well, for example:

- Fritsche UR et al.: Stoffstromanalyse zur Nachhaltigen energetischen Nutzung von Biomasse. Endbericht an das BMU, 2004
- Thrän D et al.: Nachhaltige Biomassenutzungsstrategien im europäischen Kontext. Bericht an das BMU, 2005
- Hofmann F, Scholwin F, Plättner, A: Potentiale und Voraussetzungen für eine wirtschaftliche Biogaseinspeisung. Situation in Sachsen-Anhalt. Gemeinschaftsveranstaltung “Biogas”, Bernburg, 06.04.2006

It is hard to decide how the agricultural land will be used in Germany in the future, since this is not only a question of efficiency and economical feasibility of different energy technologies but also of political programmes and of legislation as well.

Hofmann et al. presented data showing the following potentials:

Utilization route	Agricultural area available in 2005 (mio. ha)
Substrates - for biogas production and - for incineration	0,55
products for bioethanol production	0,15
products for biodiesel production	0,80
products for non-energetical industrial prod.	0,10
total cropping area	12

Of course biodiesel and bioethanol **do not** compete with biogas based on animal manure, wet agricultural residues and wet bio wastes, as these types of biomass can only be used effectively by biogas plants.

There is no competition between biogas on the one hand and biodiesel or bioethanol on the other hand on the German biofuel market, since biogas does not play a significant role as a biofuel in Germany. The first biogas fuel station in Germany, WEGAS Wendländer Biogas Tankstelle, managed by Jameln Raiffeisen-Warengenossenschaft eG Jameln (www.wendland-elbetal.de/index.php?id=57,91,0,01,0), has been opened in 2006.

Competition between agricultural biogas projects and other renewable energy systems. The German Renewable Energy Act not only caused a strong market development in the field of agricultural biogas plants but also pushed other renewable energy systems. In the agricultural sector this is true especially for **photovoltaic systems**, where additional financial support has been available in Germany during certain time periods. Thus, many farmers, agricultural co-operatives or agricultural companies had the alternative of investing in biogas plants or in photovoltaic systems. In many cases

the investment was used for a photovoltaic system especially due to the low operational expenditure of PV systems.

To a certain degree similar effects may have been caused by the development of **wind energy** projects. But since on shore wind energy currently is growing slowly in Germany, this may be true for a few biogas projects only.

In Germany there seems to be no competition between biogas projects and the remaining renewable energy technologies. **Solar thermal** and **geothermal systems** are mainly used in the field of house building, which is a market separated from agriculture. Since German biogas projects are based on electricity production, there is also no competition with **agricultural or municipal heating systems** based on wood, straw or other agricultural types of biomass. **CHP plants based on vegetable oil** still are not state of the art. Thus, only few CHP plant projects based on vegetable oil have been developed up to now.

Competition between biogas from energy crops and conventional cultivation systems.

In Germany the current agricultural biogas market is mainly driven by anaerobic digestion of animal crops, often combined with animal manure. Energy crop digestion (mainly maize or ray) is economically feasible since the German Renewable Energy Act (2004) defined a bonus for the production of electricity by energy crop digestion. Nevertheless, after a strong market growth from 2004 to 2006, at the end of 2006 the significant increase of market prices of corn, maize and rice caused a significant caution of farmers and agricultural enterprises concerning investments in biogas projects: Currently, economic yields are higher when cultivating crops for conventional use (food) in comparison to the cultivation of energy crops for anaerobic digestion. Thus, the current situation shows that energy crop digestion is depending significantly on international agricultural markets even if legislation defines favourable conditions.

Limitation of market development by limited equity capital.

During the first years (2000 to 2005) of the strong biogas market development in Germany equity capital has been a bottleneck, especially in the eastern part of Germany. In the meantime many private investors are interested in investments in biogas projects. Thus, in Germany there seems to be no current lack of equity capital. [Ralf Winterberg , Elbe bioenergy GmbH / 12.11.2006].

APPENDIX 2: ADDITIONAL INFORMATION ON ITALIAN RENEWABLE ENERGY SECTOR. REVIEW FROM THE EUROPEAN BIOMASS INDUSTRY ASSOCIATION (EUBIA)

Renewable Source Energy in Italy

Italy is characterised by 80% energy imports, one of the highest percentages among industrialised countries. This vulnerability in the energy sector has led to a policy directed at energy saving, development of domestic energy sources, diversification of energy sources and maintenance of international competitiveness of the energy sector. During the past years, attention for biomass issues has increased in Italy. Recently, the Italian government has set new ambitious goals for the generation of energy from biomass at 8-10 Mtoe/year in 2012, and to achieve a total installed capacity of 4000 MWe of biomass fuelled plants within the National Programme for Renewable Energy from Biomass (V.Bartolelli, R.Di Benedetto, 1999). This will significantly contribute to national energy independency and lead to substantial reduction in the reduction of greenhouse gases. A large number of energy crop initiatives have been developed, like research programmes, demonstration projects and commercial applications, covering the complete energy crop chain of cultivation, harvesting, conversion and utilization.

In the last years we can see a development of the AD plants, particularly in the North and Centre of the country where there is a huge concentration of pigs and animal husbandry with problems of sludges' selling off and reused. For example, in Alto Adige, under the influence of the german market, are diffused a lot of industrial plants and any cooperative plants. In Umbrai, Lombardia, and Veneto there are any cooperative plants which worked with an integrated cycle anaerobic-aerobic where the sludge of the digestion, after been treated for the biogas production, are used in compost production.
The motivations, which can influence the farmer to produce biogas, are various, linked to environment problematic or energetic yield with the possibility to valorise the no food crops (maize, herb, sorghum)

The majority of the Italian plants actually have been conceived and dimensioned according to the animal husbandry energetic saving rule, using all the energy produced in the digestion process to satisfy the energetic request of the animal husbandry and of the domestic uses too.

For this reason, have appeared cogeneretors which work "isolated", i.e. without the possibility of interface with the national energetic network for the transfer of the excess production.

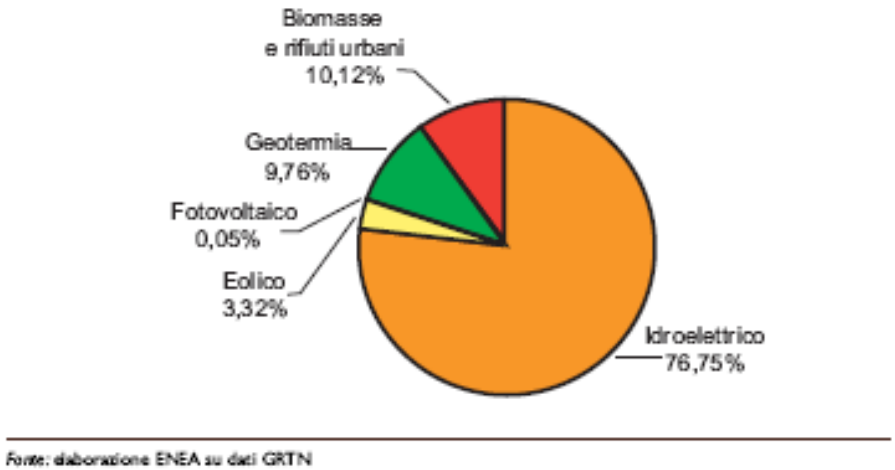
Nowadays the development of the new technologies and the possibility of digesting biomass, which have improved and raised the biogas production capacity, and the new energetic norms, which promote the production and the sale of renewable energy, have modified the new plants typologies conceptions and project

In 2004, the renewable energies have contributed to the internal gross consumption for near 7%. The Hydroelectricity supplies the most important quote. But we can note the very good increased of the biomass and waste production, since 2004.

Despite the positive trend, the contribution of the renewable energy production stays in scale lower than the other European countries.

The renewable electrical energy production is around 55TWh in 2004. We can note an increase of 16% in RE production. In addition to the 75% of renewable electricity produced by hydroelectrical source, Geothermic and Biomass both contribute to around 10%, the wind energy for 3 % and the photovoltaic only for 0.05% (Figure 1)

Figure 1: Production of electricity with renewable energy in Italy (2004)



Regarding to the production of bio fuels, in 2004 had been estimated a substitution of primary energy around 11700 TJ with the increase near of 10% more than in 2003.
This increase has been improved thanks to the abolition of the fiscal imposition on the bio diesel for heating, and fiscal incentive pay for the auto traction using fuel mix with bio fuel.
But Italy is still far of a real rise of the renewable energy, and the incentive mechanisms aren't able yet to get the target of 22% of the internal gross use in 2012.

Biomass and heat market for Energy

In Italy, the most interesting biomass resources include a) forestry biomass, b) residues from agricultural forestry, industrial wastes mainly from agro-food and wood industries, c) organic wastes and animal manure, and d) dedicated energetic crops.

As far as the forestry biomass is concerned, recent estimation (1998) performed by the Italian Institute of Statistics (ISTAT) evaluated 6.821.281 ha as forestry that represents 22,4 % of national territory.

The utilisation rate of forestry surface is roughly 1 m^3/ha/y while the growth rate is estimated to be 3 m^3/ha/y. Only 1,9% (127.316 ha) of the total surface is cut giving rise to 9 912 000 m^3/y divided as follows: 15,73% coniferous forest; 33.05% hardwood forest; 51.22% coppice. Only part of this annual production roughly 5,3 x 10^6 m^3/y has an energetic use as firewood and charcoal.

Lignocellulosic biomass is already highly competitive with fossil fuels for heating and for small-scale industrial use. Stoves, fireplaces, boilers with a thermal power ranging from 10 to 100 kW are currently commercialised.

Actually the cost of biomass kWh may be estimated 2 or 3 fold lower than fossil diesel. In 1998 INEA (National Institute of Agronomic Economy) estimated the amount of wood use as fuel in roughly 5 180 00 m^3 (≈ 3,8 Mt with a mean density of 0,743 t/m^3) corresponding to an energy production of 1,2 Mtoe/year. The estimated market cost of biomass being 64 €/m3. In addition, the domestic use of wood should be considered. Roughly 21 Mt per year should be the annual wood use by the Italian families as assessed in a survey carried out in 1999 by CRIM for ENEA.

A recent preliminary survey performed by Piemonte Region, within the PROBIO 2000 Programme, assessed that in the decade 1991-2001, 42 terminal plants are operated in Piemonte: 17 uses forestry wood residues and 18 uses agricultural woody residues. The total thermal power installed is about 34,14 MWt and 9,960 MWt were installed in 2000 (29,2% of the total installed power). It is very difficult to evaluate the total amount of biomass used. The study assessed that 21 676 tons of biomass was used in 27 plants producing 3,73 MWt which is roughly 13,8% of the total installed thermal power.

The heat production for industrial use was evaluated in a survey, carried out by ENEA in 1993, which assessed 1 300 plants, fed with lignocellulosic biomass woody residues and other solid residues. The annual produced heat (used almost exclusively for captive operations) was about 2,6 MWt.

The amount of agricultural, forestry and agro-industrial residues was never assessed on a National ground. However, as a pure estimate based on studies performed by AIGR, ENEA and ITABIA the available amount per year can be indicated as high as 17 000 000 $_{\text{t dry weight}}$.

The energetic crops of interest are the woody and herbaceous ones (both annual or perennial). The woody crops are species selected for their high biomass yield and for their capacity to grow fast after they have been cut. The SRF cultivation technique is under study for many species. It is important to notice that in Italy many of these crops are considered as potential cellulosic source for the paper industry. However, the cultures give rise, both in the agricultural and industrial phases, to a large quantity of co-products increasing the value-added to the whole chain. Full-scale plants using energetic crops are actually limited to the bio diesel production from rapeseed oil or sunflower oil. Bioethanol production from traditional cultures (sugar beets) or from alternative cultures (yet under investigation) has not yet found commercial applications in Italy.

SRF cultivation is still under development and the investigation still covers the genetic improvement, the optimisation of the productive cycle, the logistic, storage, the optimisation of advanced process for energetic conversion. The perspectives are of great interest and in the national context the potentiality are high. At the present time, roughly 40 ha are cultivated in Italy with SRF technique and this land extension should rapidly increase. The estimated land should rise up to 3 500/ 5000 ha within 2005. The species dedicated to this use could be those already adapted to Italian climate and used in bio diesel production (sunflower or rape) or potentially processed for industrial ethanol (sugar beets), and those by now processed for cellulose production. Poplar or willow could also be of interest if the cultivation technique shortens the rotation. A second class groups the spontaneous species with those from tropical or sub-tropical origin as well, that could find optimal climate conditions in southern Italy (High temperature, sunny weather, long vegetative season and poor annual rainfall).

The cultivation of crops for energetic use can be envisaged by now only on two types of lands : 1) fruitful lands, in excess for food production demand, left in a set-aside regime ; 2) non-used lands neglected in the last decade for different environmental, social and structural reasons.

Electrical production

The electrical production by renewable energy is around 55 TWh in 2004 (16% of the internal gross use of electrical energy). So the increase is about 16% more than 2003. (Table 1).

Table 1 . Electrical energy from renewable energy (GWh) (2000-2004)

	1995	1998	1999	2000	2001	2002	2003	2004
Hydro electric	37 781	41 213	45 358	44 205	46 810	39 519	36 674	42 744
<10 MW	*7 440*	*8 320*	*8 602*	*8 117*	*8 657*	*8 048*	*7 192*	*8 859*
>10 MW	*30 341*	*32 893*	*36 756*	*36 088*	*38 154*	*31 472*	*29 483*	*33 885*
Wind	10	231	403	563	1179	1 404	1 458	1 847
Photovoltaic*	13	14	15	16	16	18	23	27
Geothermic	3 436	4 214	4 403	4 705	4 507	4 662	5 341	5 437
Solid Urban Wastes	168	464	653	804	1 259	1 428	1 812	2 277
Wood	116	271	587	537	644	1 052	1 648	2 190
Biogas	103	494	583	566	684	943	1 033	1 170
A – Total	41 627	46 901	52 002	51 396	55 100	49 027	47 989	55 692
B – Internal Gross Use (TWh)	279	301	308	321	327	336	345	349
A/B (%)	15	16	17	16	17	15	14	16

Source : ENEL (1995-1998), GRTN (1999-2004)
* estimation ENEA

In the electricity sector, the development targets provided by the White Book are the following:

Technologies	1997		2002			2006			2008-2012		
	MWe	Mtoe	MWe	Mtoe	Δ Mtoe	MWe	Mtoe	Δ Mtoe	MWe	Mtoe	Δ Mtoe
Hydro > 10 MW	13942	7.365	14300	7.550	0.186	14500	7.656	0.292	15000	7.920	0.556
Hydro < 10 MW	2187	1.787	2400	1.954	0.166	2600	2.116	0.329	3000	2.442	0.655
Geothermal	559	0.859	650	1.051	0.192	700	1.132	0.273	800	1.294	0.435
Wind	119	0.026	700	0.308	0.282	1400	0.616	0.590	2500	1.100	1.074
Photovoltaic	16	0.003	25	0.006	0.003	100	0.024	0.021	300	0.073	0.069
Biomass & Biogas	192	0.125	380	0.502	0.377	800	1.056	0.931	2300	3.036	2.911
Waste	89	0.055	350	0.385	0.330	500	0.550	0.495	800	0.880	0.825
Total	**17104**	**10.221**	**18805**	**11.756**	**1.35**	**20600**	**13.151**	**2.930**	**24700**	**16.744**	**6.524**

The electricity from RES in the next years will derive from the most promising and competitive RES technologies of today such as hydroelectric (mainly < 10 MW, including repowering), wind, biomass (solid and biogas), and from new and re-powered geothermal projects. While for PV systems a relatively greater diffusion should occur in the second five-year term, downstream the "10 000 photovoltaic roofs" programme.
The goals indicated are strongly linked to a few important factors which presently cannot be foreseen, since the new legislative framework now being applied and, for certain aspects, still not completely full defined. A first factor involves the trend that negotiations among electricity operators will have on the market of green certificates starting at 2002. A second factor is linked to the initiatives and relative influences on the market that the regional incentives (legislative decree 79/99) will have. Further third factor is the influence of the future directive of the European Union on the production of electricity from RES. Besides, an important factor is made up by the modalities with which market participation

of the actors will be regulated and limited - defaulting the obligation of 2%. Lastly, how much the oil market will influence the electricity market.
In the heat sector, the applications mainly regard the residential field and certain typologies of industries with thermal process heat needs, such as for example agri-foodstuffs ones. Thus, contribution may come from thermal solar, low enthalpy geothermal and from biomass (including waste) in individual plants, of co-generation and for district heating. The goals indicated by the White Book are those shown in the table below.

Table 3. – Development forecasts of RES for the heat sector

Technologies	1997	2002		2006		2008-2012	
	Mtep	Mtep	Δ Mtep	Mtep	Δ Mtep	Mtep	Δ Mtep
Biomass fuels	0.060	0.280	0.220	0.544	0.484	0.940	0.880
Solar thermal	0.008	0.056	0.048	0.111	0.103	0.222	0.214
Geothermal	0.213	0.250	0.037	0.300	0.087	0.400	0.187
Biomass & Biogas	1.070	1.400	0.330	1.600	0.530	1.750	0.680
Waste	0.096	0.120	0.024	0.160	0.064	0.200	0.104
Total	**1.447**	**2.106**	**0.659**	**2.715**	**1.268**	**3.512**	**2.065**

The legal structure of the energetic sector deeply evolved with the deregulation of the electric production and with the privatisation process of the National Energy Board (ENEL). The first privatisation act, operated by the Legislative Decree 333/92, was the transformation of ENEL in a stock company. The successive Ministry Decree of December 28, 1995 defined tasks and powers of ENEL in a concession regime, while the Ministry Decree DM of July 11, 1996 separated the accountancy from the productive activities, transport and distribution of energy.

The Directive 96/92/CE started the global organisation of the sector. At a National level the Legislative Decree N. 79 of March 16, 1999, known as Bersani Decree, was issued for the deregulation and reorganisation of the electric sector, and introduced provisions for the realisation of free internal electricity market, including norms for the generation of electricity from RES. This decree also promoted the use of renewable energy, energy saving, CO2-emission reduction, and the use of National energetic resources. Electrical Producers or Importers that produce or import electricity from fossil fuel for more than 100 GWh/y must bring in the National Electricity System 2% of electricity from RES. It is possible to fulfil this obligation either trough the direct production (in plants operating after April 1, 1999) of energy from RES, or with green certificates for green energy. The equivalent quota or the relative rights may be purchased from other producers or from the GRTN (National Transmission Grid Operator), instituted by this same law. The current prices of electric energy in Italy are reported in Table 4.

Table 4. Prices of electric energy on July 1, 2000			
	Tariff €/KWh	% variation respect 2000/99	Tariff €/kWh tax included
Domestic use			
1 200 kWh/year	0,078 (-36.2)	19,2	0,088 (-42,1)
3500 kWh/year	0.166 (61.5)	-2,0	0,210 (61,4)
Industrial Use			
2 GWh/year (500 kW, 4000 hours)	0,086 (36,8)	26,4	0,103 (54,3)

24GWh/year (4000kW, 6000 hours)	0,076 (49,7)	36,5	0,081 (49,7)
() Shift from the mean EU-tariff			

The Ministry Decrees of November 1999, with a three-year validity, gave the directives for the implementation of standards for electricity from RES, power plants in compliance with the L.D. 79/99. Definition, standards and certification concerning RES power plants were established together with rules for the green electricity market, including the emission and trade of green certificates. The electricity from RES in the next years will derive from the most promising and competitive RES technologies.

In a survey performed in 1998, which considered both auto-producers and companies, ENEA mentioned 23 on-grid plants fed with woody-fuels. The installed electric and thermal power are 154 MWe and 154 MWt respectively. The electricity produced is 2 706 GWh and the co-generated heat is 1 500 TJ. The estimated primary energy, based on a 20% yield on the total electricity produced, was estimated in 48,71 TJ

In 2001, the Bioenergy group of MiPAF (Ministry of the Agricultural and Forest Policy) performed another study and assesses 14 plants in Italy with an installed power ranging from 3 to 20 MW. The total installed power is about 107,6 MWe. The biomass used as fuel are woody residues and agricultural residues, the amount of which are roughly 1 Mt/y (containing 30/35 % humidity). Several other plants that plan to use lignocellulosic materials are nowadays under construction or waiting for local administration authorisation for a potential installed power of 153.4 MWe.

A summary of the power plants using biomass fuels is reported in Table 5.

Table 5. Electric power plants from biomass in Italy, MWe

Year	1997 (1)	1998 (2)	2000 (3)	2002 (4)
Biomass	192	24	220	2300
Biogas		83	180	
Wastes	89	43	287	800

Source : ENEA/CIRM, Italian White paper, ENER IURE PHASE III
(1) Total installed from Italian White Paper data
(2) Capacity coming from CIP6/92 according last data from Authority E.E. and Gas
(3) Total installed from GRTN(cogeneration included)
(4) Total expected according Italian White Paper

Biomass and urban waste electrical Energy

Like showing in the Table 4 below, we can see that the biogas in Italy is in expansion with a production of energy which have duplicated in five years.

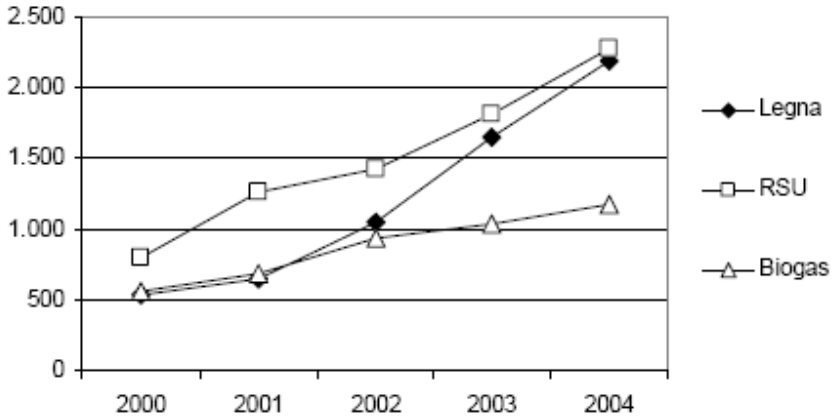
The production of electricity by Biomass is currently done according to three modalities :

- Thermotreatment of the solid urban wastes
- Use of the woody Biomass in plants linked to the electrical network
- Use of Biogas in plants linked to the electrical network

The Figure 2 describes the evolution of the electrical production by biomass and solid urban wastes compared in the last five years. We can note that the medium increase in 2004 is greater than the production of the year before (+ 20%). The production of Biogas is derivates of the garbage dump for more than 88 % of his production.

The Table 6 shows that it remains a huge possibility of growth in the agricultural production and in the waste water sectors.

Figure 2 : Production of electrical energy by Biomass, Biogas and SRU (GWh) from 2000 to 2004.



Fonte: GRTN

Table 6. Source Biogas – Production of electrical energy														
	1991	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Organic waste of garbage dump	7 700	11 300	9 700	24 386	88 900	193 800	360 360	478 800	566 400	551 300	664 600	822 000	910 500	1 038 400
Waste Water	900	2 000	2 400	2 443	3 000	3 200	2 900	4 800	6 300	6 100	4 600	2 800	2 700	1 200
Manure	1 300	500	400	6 305	8 100	7 600	6 900	5 700	5 900	4 900	9 800	16 300	13 200	18 500
Industrial Residues	0	0	0	2 511	2 600	2 400	2 400	4 500	4 100	3 900	5 300	101 900	106 500	112 100
Total production (MWh)	**9 900**	**13 800**	**12 500**	**35 645**	**102 600**	**207 000**	**372 800**	**493 800**	**582 700**	**566 200**	**684 300**	**943 000**	**1 032 900**	**1 170 200**
Source : ENEL (1990-1998), GRTN (1999-2004														

The possible destination of the energy produced are:

1) The market :

- Selling energy to a final appropriate customer o to a wholesale dealer through bilateral contract
- Selling the energy in stock exchange

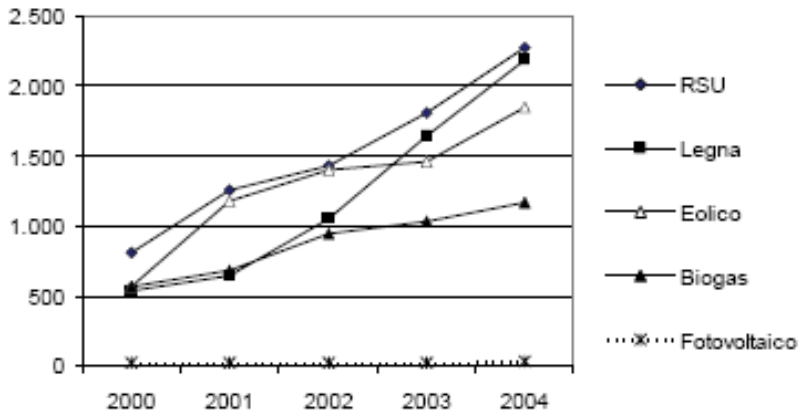
2)Requesting to the network manager to remove the electric energy produced.

A particular convention exists, stipulated of Federenergia, Enel Distribuzione, GRTN, unique purchaser and producer society which have the aim of defining the technical, economical, contractual modalities for removing the electric energy.
This convention is annual and could be renewed, The producer has to surrendering all the energy that don't use for auto consumed.

Other Renewable Source and electrical energy

In the Figure 3, is showed the evolution of the electrical production of renewable energy from 2000 to 2004 without hydroelectric and geothermic production. We can see that, except the Photovoltaic production, all the other sources, show increases with trend variability for each type of production.

Figure 3 : Electrical Energy of some renewable source (GWh) from 2000 to 2004



Fonte: elaborazione ENEA su dati GRTN

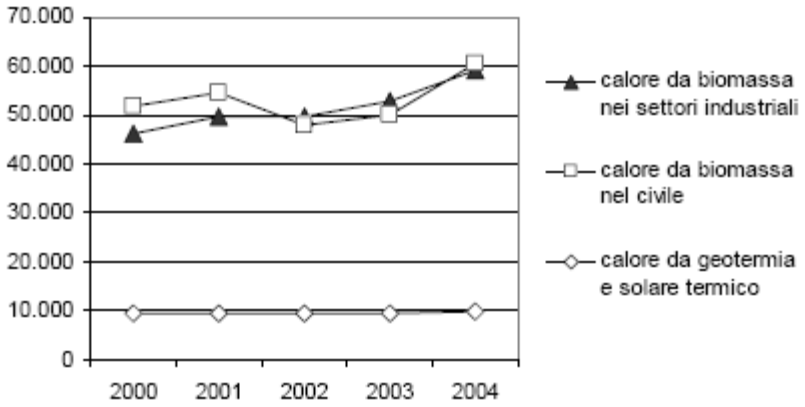
Heating production

Biomass and solid urban wastes heating production

The heat production by renewable source is estimated in 2004 to 59 000 TJ in the industrial plants (wood and cogeneration) and to 58 000 TJ in the civil sector (flare wood and biomass) (Figure 4). This information can be considered rounded down because it only takes into consideration the woody biomass commercialised and obtained of the national statistics but not the residential uses which are a huge part of the woody biomass and escape to the official survey.

The bringing in coming from the direct use of geothermic energy is more limited with 9 000 TJ. The thermic solar contribution in 2004 is lower than 800 TJ, it's one of the lower value of diffusion of this technology in the European Union.

Figure 4 :Heat production by renewable sources (TJ) 2000-2004



Fonte: elaborazione ENEA su dati di origine diversa

Other Renewable Source and heating production

Roughly 27 district heating systems are currently working in great towns of Italy. The comprehensive installed power capacity is about 600 MWe and 1400 MWt. Most of these systems are small-scale plants using wood, woody residues and solid residues.

The area of Bolzano is the most representative district heating system supplied with lignocellulosic biomass. In this district several plants are working and the grid system covers 65 km to satisfy 1 175 consumers. The comprehensive installed thermal capacity is about 40 MWt and the annual energy produced with 67 400 m3 of wood is 85 GWh/y.

There are some others 40 smaller heating plants fed with woody material and installed in different districts of Northern Italy with a 55 MWt of total heat power capacity, 45 km grid and 550 consumers. The total energy produced by these plants is about 37 GWh/y.

Table 7. Heat production from biomass in Italy in 2000

Sector	Typical Plants	Total power	Oil consumption avoided
Domestic use	20-30 kWt	n.a.	≈ 3,7 Mtoe
Wood and agricultural industry	0,5-20MWt	≈ 2 500 MWt	0,6 - 0,8
District heating	2-3 MWt	≈ 100 MWt	≈ 7ktoe

Source : ENEA/CIRM, Italian White Paper, ENER IURE PHASE III

Table 8. Heating production by renewable sources (TJ)

	1995	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
Thermic solar	293	404	411	456	507	586	673	774
Geothermic	8 916	8 916	8 916	8 916	8 916	8 916	8 916	8 916
Flared wood for residential sector[1]	39 013	44 045	50 367	48 316	51 657	44 656	47 395	57 820
Biomass teleheating	270	426	509	574	785	1 062	1 197	1 340
Wood used in industry	39 600	393600	39 600	39 600	39 600	39 600	39 600	39 600

Biofuels for heating use	2 155	620	1 800	2 880	2 160	2 160	1 440	1 440
Cogeneration	1 230	3 062	5 536	6 505	10 209	10 236	13 416	19 705
Total	91 477	97 073	107 139	107 247	113 834	107 216	112 636	129 595

Source : Elaborated by ENEA with datum from various origin
1 : It's not considered the no commercial biomass use obtained in the ENEA report.

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