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Renewable Energy Snapshots 2007

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PREFACE

The Council endorsed at its Meeting in Brussels on 8/9 March 2007 a binding target of a 20% share of renewable energies in the overall EU energy consumption by 2020 and a 10% binding minimum target to be achieved by all Member States for the share of biofuels in overall EU transport petrol and diesel consumption.

Renewable Energies are a very dynamic field with high growth rates and therefore it is of great importance to base decisions on the latest information available as otherwise important development trends might be missed. For certain renewable energy technologies the development of effective policy measures is not yet possible due to the lack of robust, consistent and up to date data.

The JRC's Scientific Technical Reference System on Renewable Energy and Energy End-use Efficiency defines and applies quality criteria for the assessment of technologies, implementation actions and policy measures.

These Renewable Energy Snapshots are based on various data providers including *grey data sources* and tries to give an overview about the latest developments and trends in the different technologies. Due to the fact that unconsolidated data are used there is an uncertainty margin which should not be neglected. We have cross checked and validated the different data against each others, but do not take any responsibility about the use of these data. Nevertheless, we try to update the data as frequent as possible and would be most grateful for any update of information, if outdated or incorrect information are observed.

Ispra, August 2007

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CONTENT

STATUS OF BIOENERGY AND NATIONAL BIOMASS ACTION PLANS IN THE EUROPEAN UNION

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Bioenergy status in 2005 – electricity from biomass, bioheat and biofuel production in the EU

Bioelectricity production reached 80.2 TWh in 2005 in the EU-25 (Fig. 1)[1]. Electricity production from biomass steadily increased in the EU-25 between 1990 and 2005, with an average rate of 11% (average of annual % increase). The growth rate was in 2004 19% and in 2005 17%, whereas in 1991 it was 5%.

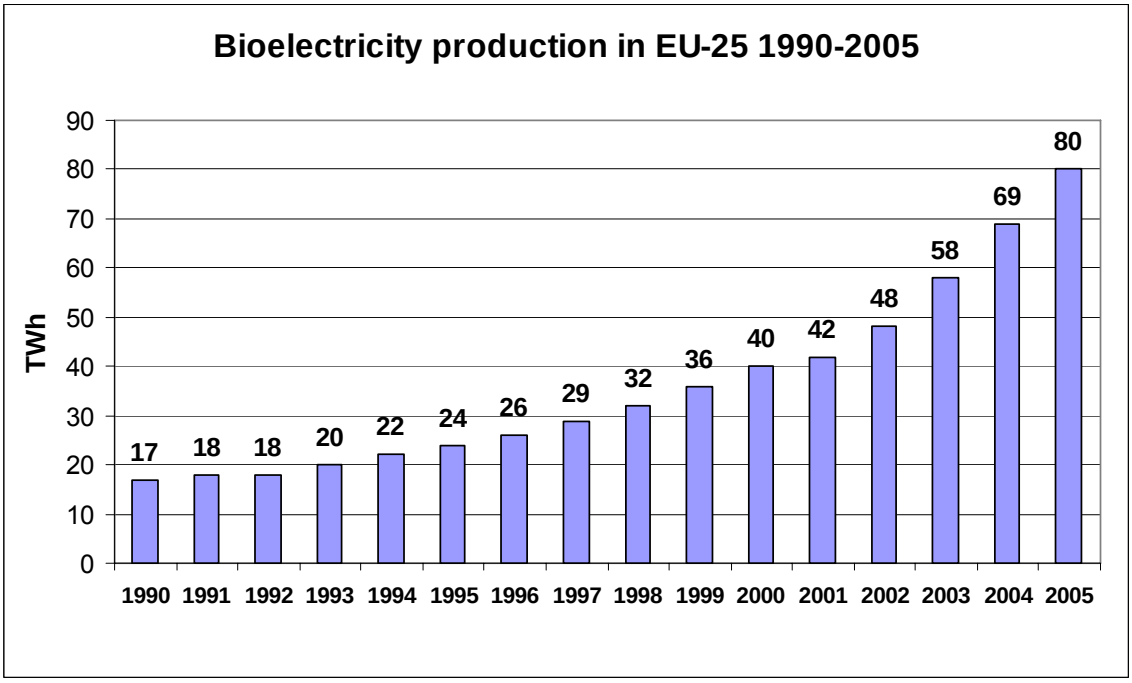

Figure 1: Bioelectricity production in EU-25 from 1990 – 2005 (Eurostat 2006 and 2007).

In 2005, the largest contributors to the total electricity generation from biomass in the EU-27 were Germany, the United Kingdom and Finland. Germany was clearly the leader with the production of 16.6 TWh, municipal solid wastes forming 40% of the generated bioelectricity. In the UK, majority (49%) of the bioelectricity came from biogas, whereas in Finland 96% of bioelectricity was woody biomass (Fig. 2)[2].

[1] Includes total electricity production figures of biomass-fired power stations, using wood and wood wastes, municipal solid wastes (both biodegradable and non-biodegradable fractions) and biogas. Source: Eurostat (combination of 2006 and 2007 bioelectricity values received directly from Eurostat).
[2] Includes total electricity production figures of biomass-fired power stations. The data broken down by source were used to show the share of biomass categories for the three largest bioelectricity producers. Largest values are capped for data visibility. Source: Eurostat (2007).

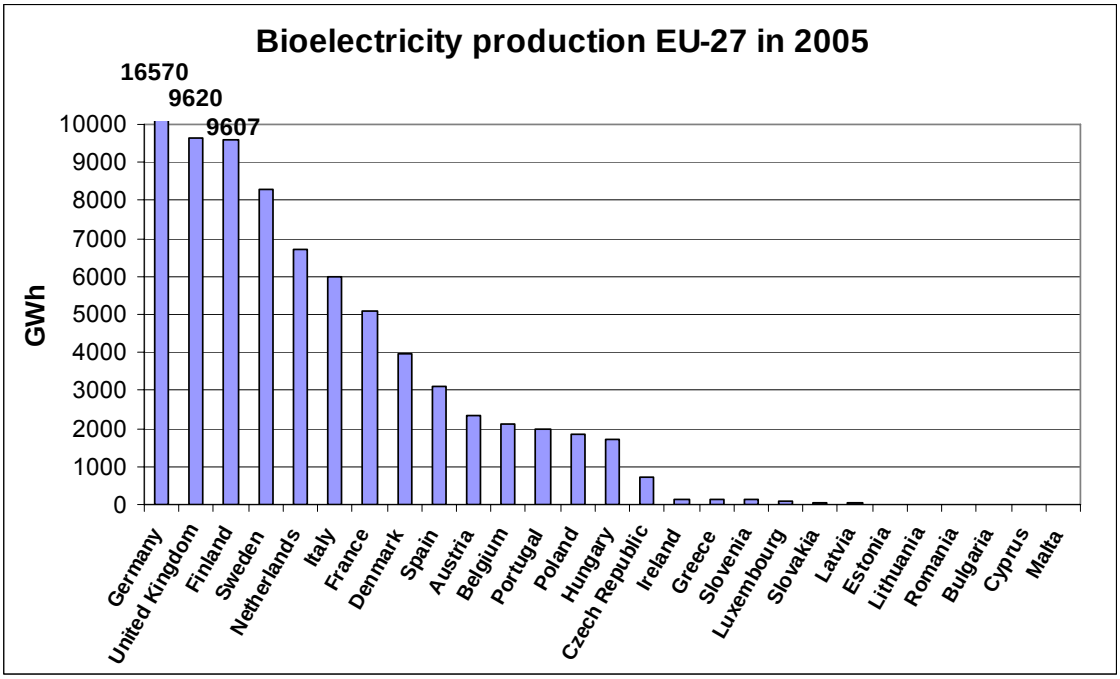

Figure 2: Bioelectricity production EU-27 in 2005 (Eurostat 2007).

The total biomass power capacity totalled 17.0 GW in 2005 in the EU-27 (Fig. 3)[3]. Germany contributed to this the most, its installed biopower capacity being 3.3 GW. Sweden had the second largest bioelectricity capacity (2.9 GW), whereas Italy was ranked as the third with the bioelectricity capacity of 2.0 GW.

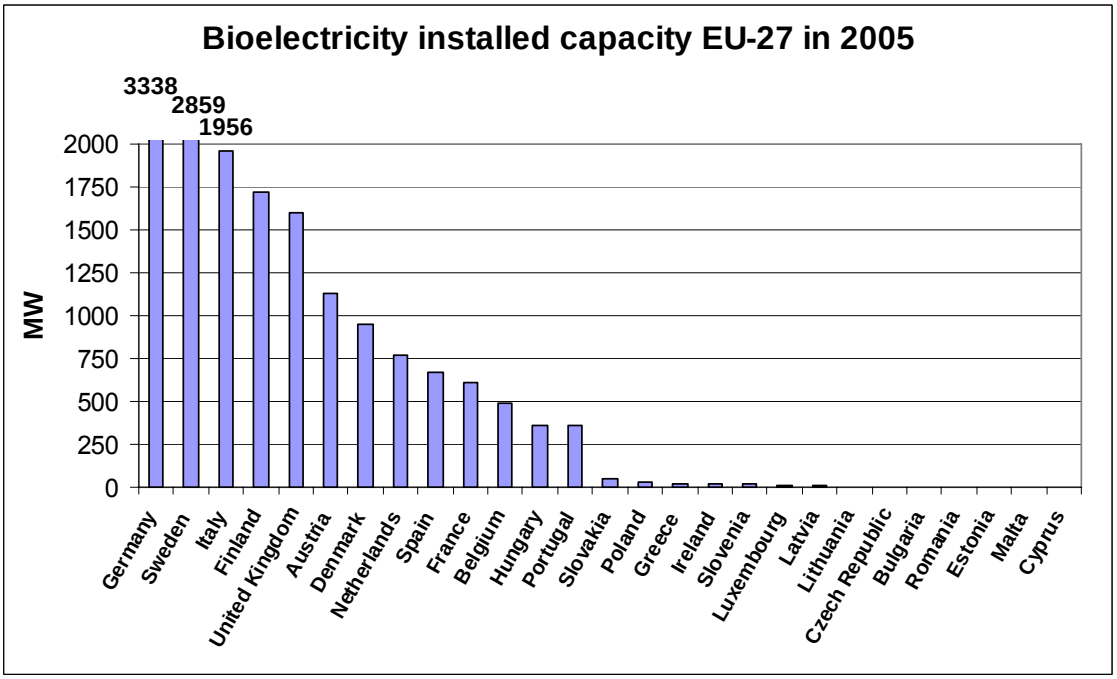

Figure 3: Installed bioelectricity capacity EU-27 in 2005 (Eurostat 2007).

[3] The data includes the sum of breakdown by bioenergy source (municipal solid wastes, wood and wood wastes and biogas). There were no data available for Czech Republic, Bulgaria, Cyprus, Estonia and Malta; therefore they are presented here with zero installed capacity. Source: Eurostat (2007).

Heat from biomass in the EU-25 totalled 7.7 Mtoe in 2005/2006 (Fig. 4)[4]. This graph combining figures from 2005 and 2006 shows that Sweden lead the heat from biomass with 2.5 Mtoe, solid biomass being the main source of bioheat.

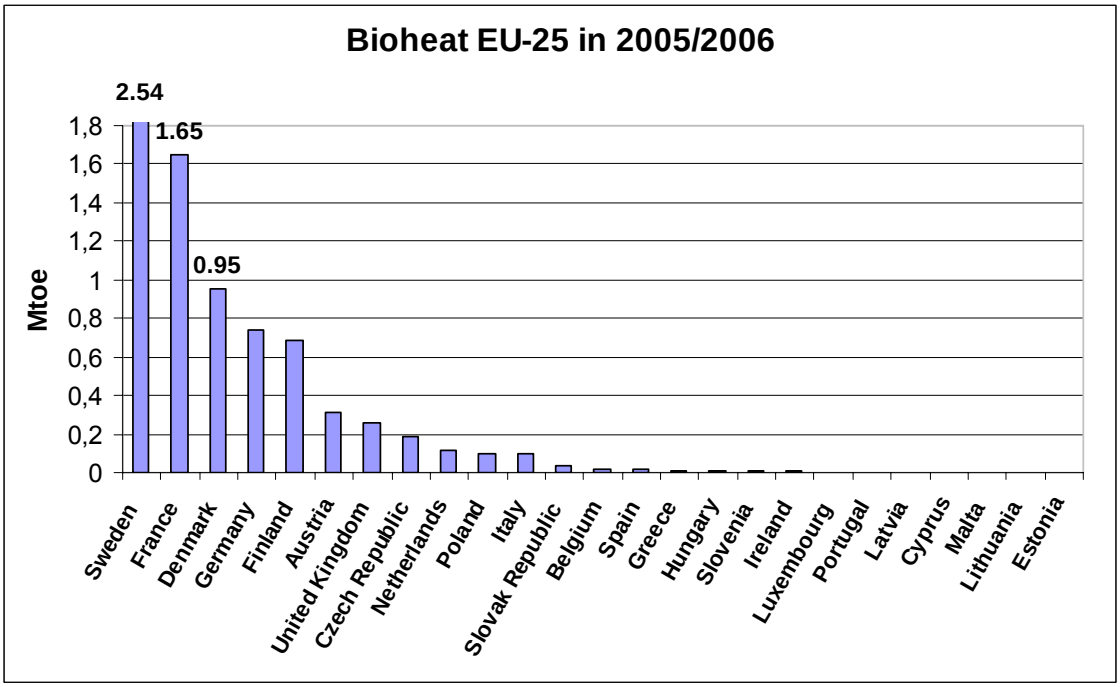

Figure 4: Bioheat production EU-25 in 2005/2006 (Eur'ObservER 2007).

Production of transport biofuels in the EU-25 totalled 3.3 Mtoe in 2005 (Fig. 5)[5]. Germany was the largest biofuel producer with 1.6 Mtoe. France and Italy were the next biggest producers, with the production of 0.5 Mtoe and 0.4 Mtoe, respectively.

[4] Note: because of the data availability, this graph includes solid biomass and renewable municipal waste values from 2005 and biogas values from 2006. Largest values are capped for data visibility. Source: EurObserv'ER (Interactive GIS Barometer, July 2007).

[5] Largest values are capped for data visibility. Source: EurObserv'ER (Interactive GIS Barometer, July 2007).

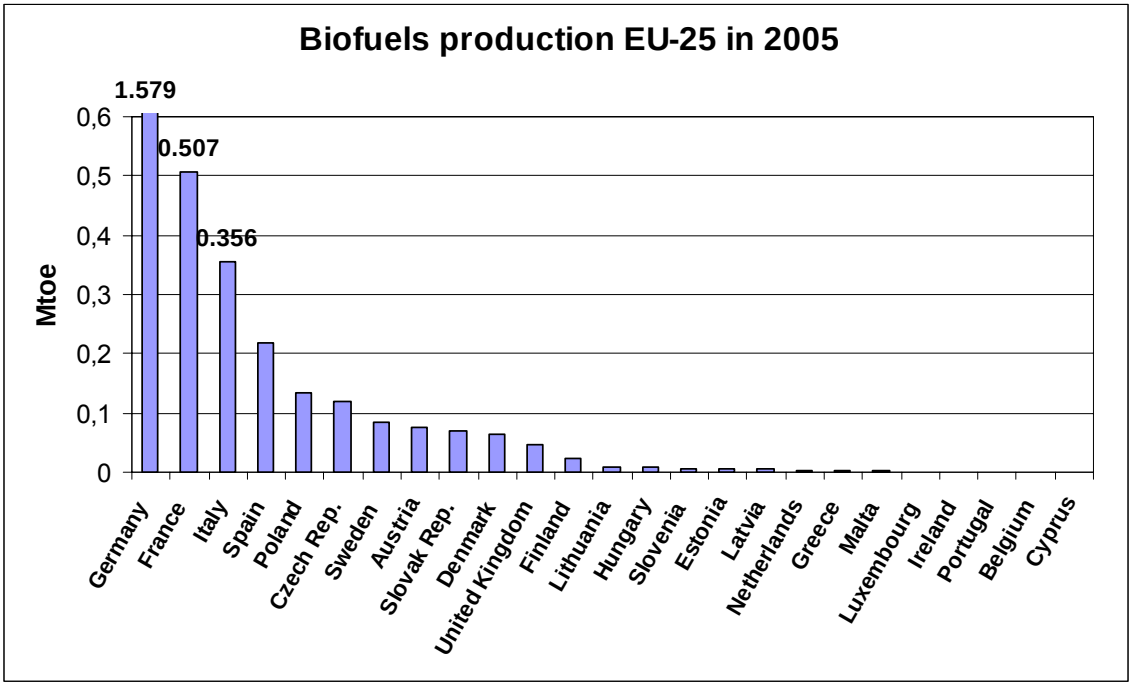

Figure 5: Biofuels production EU-25 in 2005 (Eur'ObservER 2007).

National biomass action plans (nBAPs)

In the light of the EU Biomass Action Plan (COM(2005)628final) encouraging Member States to establish national biomass action plans (nBAPs), snapshot examination of the status of national biomass action plans was made.

In conclusion, *six* EU-27 Member States currently have an existing national biomass action plan (Denmark, Estonia, Ireland, the Netherlands, Slovenia and the United Kingdom). *Seven* Member States can be considered to have national BAP in preparation phase (Austria, Bulgaria, Czech Republic, France, Germany, Latvia and Slovak Republic), whereas no national BAP have *fourteen* EU countries (Belgium, Cyprus, Finland, Greece, Hungary, Italy, Lithuania, Luxembourg, Malta, Poland, Portugal, Spain, Romania and Sweden). The definition of 'no national BAP' does not take into account other organised bioenergy activities in the country, such as in Spain or in Poland, and includes countries with no information on the current situation on nBAP development (such as Italy and Malta). See Annex 1 for more details on national biomass action plans and country targets for bioenergy and renewable energies. Also recent highlights on renewable energy and/or bioenergy are presented by country.

Annex 1.

Country	Status of the nBAP	Highlights on RE and bioenergy	Targets for RES and bioenergy
Austria	**In preparation** - Ministry for Agriculture, Forestry, Environment and Water Management published a proposal for an Austrian Biomass Action Plan in September 2006 with a prognosis for the development of the biomass market until 2010 and 2020. The nBAP prestudy was made by the Austrian Energy Agency and it is still under review.		**Near term targets** • increase the share of RES in primary energy by 1% per year; the aim is 30% share of RES by 2010 • increase the share of RES-E up to 78.1% by 2008, • increase the contribution of biomass by 75% by 2010 • indicative targets for biofuels 2.5% in 2005, 4.3% in 2007 and 5.75% in 2008 **2020 targets** • double the share of RES from 23 % in 2004 up to 45 %, • increase the share of RES in the electricity sector from 65 % up to 85 %, • increase the share of RES in the transport sector from 3 % up to 20 %, • improve energy efficiency by at least 20 % until 2020
Belgium	**No nBAP** - No official nBAP or indications of developing one	The Walloon Plan for Sustainable Management of Energy (1995-2010) is the most advanced bioenergy strategy in the country.	• National RES-E target: 6% of gross electricity consumption by 2010; Regional targets: in the Walloon region 7% by 2007 (also the target for CHP), in Flanders 6% by 2010, and in Brussels 2.5% by 2006. • Biofuel target: 5.75% biofuel by energy content by 2010. • The Belgian Biomass Association (ValBiom) has defined new targets based on regional targets in Wallonia and Flanders for 2010.
Bulgaria	**In preparation** - A 3-year nBAP activity started which shall form a part of a wider long-term national programme until 2020.	With an existing national long term RES programme until 2015 and a new law on RES (Renewable and Alternative Energy Sources and Biofuels Act adopted in June 2007), alternative energy sources and biofuels have been put forward as well as activities on the more efficient use of RES in heating and electricity. The new act introduced a feed-in law for renewables.	• The Bulgarian National Energy Strategy is aiming at a RES market share of 10,2% by the year 2010. • RES-E target in 2010 is about 11% for electric energy consumption.
Cyprus	**No nBAP** - No specific nBAP under development.	The general action plan for RES and national support schemes have been recently internally assessed.	• The Action Plan for the Promotion of RES determines that the contribution of RES to the total energy consumption of Cyprus should rise from 4.5% in 1995 to 9% in 2010. • The RES-E target to be achieved in 2010 is 6%. • 1% biofuel by energy content in 2005 (an indicative target)
Czech Republic	**In preparation** - Czech Biomass Association has prepared the first version of a national biomass action plan for the Ministry of Agriculture. Czech BAP should be finished by October 2007.	Act No. 180/2005 provides 15-year guarantee of fixed feed-in tariffs for RES-E, differentiated by technology. The share of biofuels in total transport fuels consumption was in 2005 only 0.05% and the estimations for 2006 are at the same level. The Ministry of Industry and Trade (MPO) is set to begin its most ambitious subsidy program for the renewable energy sector in the second half of 2007.	• The National Programme for Energy Efficiency and Use of Renewable and Secondary Energy Sources: 6% of total primary energy consumption by 2010. • The RES-E target for 2010 is 8%. • Long-term target: The State Energy policy (2004) set targets of 15-16% contribution of RES to TPES and 17% for the share of RES-E in electricity consumption to be achieved by 2030. • National indicative targets for biofuels are: 1,78% in 2006; 1,63% in 2007; 2,45% in 2008; 2,71% in 2009 and 3,27% in 2010. • Between 2007 and 2012, country aims for a total volume of 4,2 Mt biofuel to be available on the Czech market.
Denmark	**Existing nBAP** - Biomass Agreement since 1993; no work has been done on the Danish nBAP (situation in March 2007), current situation unknown.	Energy Strategy 2025 is government's long term strategy on energy policy (adopted in 2005).	• The Biomass Agreement set a target that from 2000 onwards 1.4 million tons of straw and wood (1.2 Mt straw and 0.2 Mt wood, totalling around 20 000 TJ) were to be used annually for electricity production, which would substitute 6% of coal (meaning that the exploitation of straw is doubled and the use of wood is increased by 15-20 %). • The RES-E target from the EU Directive is 29% by 2010. • For biofuels, Denmark has set 0.1% by energy content in 2006 (a very low target).

Country	Status of the nBAP	Highlights on RE and bioenergy	Targets for RES and bioenergy
Estonia	**Existing nBAP** - Estonian biomass and bioenergy development plan "Development Plan 2007−2013 for enhancing the use of biomass and bioenergy, 'BBDP'" was accepted by the government in January 2007 and it will be implemented in two stages; stage I (2007-2008) and stage II (2009-2013).	New RES-E regulation in force since 1st of May 2007 includes three support options (feed-in tariff, premium and certificate of origin) and is valid for RES-E production from facilities with capacity less than 100MW; Rural Development Plan 2007-2013 supports the nBAP	• RES-E target is 5.1% in 2010. • Biofuel target is 2% in 2006. BBDP goals for 2013: • The share of CHP produced electricity from biomass 3% of domestic consumption (0,2% in 2005), • Share of district heating from RES of total district heating production 33% (in 2005 21%), biofuels share of total consumption 6% (0% in 2005) • Vision for 2025: 100% of heat and 6% of electricity produced from biomass.
Finland	**No nBAP** - No indications of nBAP development. National Bioenergy Programme has been suggested to be part of the new government programme by the Bioenergy Association of Finland (FINBIO).	Feed-in tariff for biogas plants is in the agenda of the current government; it is planned to start in 2008 and to include plants up to 20 MW.	• Targets are to increase the use of renewable energy at least up to 25% by 2015 and up to 40% until 2025; growth in the use of forest chips, energy crops, biogas and small-scale use of wood is targeted to reach 65% by 2015 and 80% by 2025. • RES-E target by 2010 is 31,5%; 33% by 2025 • Transport biofuel targets: 2,0% (2008), 4,0 (2009) and 5,75% (2010) (0,1 % in 2004) • no heat target
France	**In preparation** - Draft plan includes three supplementary strategic plans for transport biofuels, heat and electricity and for industrial uses of biomass; involved ministries are the ministries of agriculture, forestry, environment, energy, industry and finance.	The multiannual plan for heat investments will set an ambitious target for heat from biomass. Objectives of the energetic law will be updated in 2008.	• The RES-E Directive target is 21%. • Targets set by the energetic law (2005): o Increase renewable heat production by 50% between 2005 and 2010 o Increase RES-E consumption to 21% by 2010 • National targets for biofuels have been set at 2% by 2005, 5.75% by 2008, 7% by 2010, and 10% by 2015. • The multiannual plan for electricity investments (2006-2015) sets a specific target for electricity from biomass: 1.000 MWe in 2010 • Industrial uses of biomass target is 15% in 2015 (Currently RES represent 7% of raw materials in chemical industry).
Germany	**In preparation** - nBAP development process ongoing (situation in March 2007); it is a joint exercise of two ministries (environment and agriculture). However, substantial uncertainties about the contents and the structure of the nBAP (biomass use for chemical industry/material use as well as sustainability/ certification issues). Preparation of a first outline was in February 2007, Cabinet decision should be taken in the summer 2007.	German Advisory Council on the Environment (SRU) published in July 2007 a report on climate change mitigation by biomass ("Klimaschutz durch Biomasse").	**2010 targets** The Federal Government of Germany is aiming by 2010 at a RES market share • of 4.2% in primary energy consumption, • of 12.5% in electricity generation and • a 5.75% share of biofuels in the transport sector • Targets for the RES heat market don't exist. **2020 targets** By 2020 RES targeted to represent • 14% of the energy used in heat production • 17% of transportation fuels • 27% of electricity generation
Greece	**No nBAP** - No dedicated nBAP under development. However several ongoing activities in several ministries (Ministry of Development, Ministry of Rural Development and Food, Ministry of Environment, Physical Planning and Public Works, Ministry of Finance), which supplement the comprehensive picture of bioenergy activities.	It is expected that by 2007-2008, 8% of the total electricity generation in Greece could come from wind, small hydro and biomass plants.	• The RES-E Directive for Greece is 20.1% in 2010; this corresponds approximately to 14 TWhe or to about 2500 MWe of RES installations; the capacity needs to be thus eightfold over the current installed RES capacity of about 320 MWe. • For biofuels, the following national targets have been set: 0.7% by 2005, 3% by 2007, 4% by 2008, 5% by 2009 and 5.57% by 2010.
Hungary	**No nBAP** - A national strategic development programme for the wide-scale practical application of biomass energy technologies has been planned to be prepared for some years in Hungary.	Hungarian Government drafted a new Renewable Energy Strategy and an Energy Efficiency Strategy and Action Plan in July 2007, according to the strategy 'Hungary can achieve renewable energy production equal to 15 % of total output by 2020 given the proper policies and using energy efficiency measures'; RES-E target of 2010 for Hungary was achieved already last year and the main contribution was made by biomass.	• RES-E Directive target is 3.6% of total electricity consumption. • This is equivalent to about 1400 GWh, of which 700 GWh is estimated to be supplied by biomass, 400 GWh waste incineration and 50 GWh of sewage treatment. • The Energy Saving and Energy Efficiency Action Programme (2000-2010) aims to double the share of RES in total primary energy supply to 5-7% by 2010 (from 28 PJ/year to 50 PJ/year). • Hungary aims at a biofuel share of 0.6% in 2005 and 5.75% in 2010.

Country	Status of the nBAP	Highlights on RE and bioenergy	Targets for RES and bioenergy
Ireland	**Existing nBAP** - nBAP was published in March 2007 by a ministerial task force on bioenergy. NBAP consists of comprehensive strategies for three sectors: electricity, transport fuels and heating sectors are included with revised sectoral targets and measures.	Energy White Paper entitled "Delivering a Sustainable Energy Future for Ireland" was published in March 2007, setting the energy policy framework for 2007-2020. The government has presented policy proposals to significantly increase the use of biomass in electricity generation, by cofiring it in peat-fired power stations.	• 33% target for renewable electricity for 2020 (13,2% by 2010) • 12% renewable share in the heating sector for 2020 (5% by 2010) • 30% co-firing in peat stations with biomass by 2015 • Transport fuel sector: a biofuel target of 10% for road transport fuel for 2020 (5.75% by 2010; 0.06% in 2005, 1.14% in 2006, 1.75% in 2007 and 2.24% in 2008.)
Italy	**No nBAP -** Current situation is unknown.	The Italian government position paper of September 2007 states that renewables displaced 6.7 million tonnes of oil equivalent (mtoe) in 2005, and that production could theoretically be increased to nearly 21mtoe by 2020 – equivalent to 15% of primary energy consumed.	• RES-E share of 25% of gross electricity consumption by 2010. • Nationally, producers and importers of electricity are obliged to deliver a certain percentage of renewable electricity to the market every year. • No official RES-H targets exist. • For biofuels, Italy's Decree 128/2005 set a reference value of 1% by 2005.
Latvia	**In preparation** - nBAP is under preparation and the Ministry of Agriculture is the responsible authority.	The Renewable Resources Use Strategy for the years 2006 - 2013 appointed in 2006 the main political and strategial goals for the wider use of RES including biomass.	• RES-E target is 49.3% by 2010. There will also be a target for the green electricity by 2020. • Following the March European Council, there's a 10% target for biofuels by 2020. • An 8% share in the total green electricity production to be covered by electricity generated in a highly efficient cogeneration mode and produced from biomass has to be achieved by 2016.
Lithuania	**No nBAP** - A programme for promotion of biofuel production and use for 2004-2010 is planned to be updated (situation in March 2007), this could be regarded as nBAP.	The national energy strategy was updated in late 2006, and the Lithuanian government has confirmed plans to build a new nuclear power station by 2015. The strategy predicts that the share of renewable energy and the use of biofuels will both increase by 20% by 2025.	• National RES share of country's total energy consumption should reach 12% by 2010. • The RES-E Directive target is 7% by 2010. • For biofuels, the national targets are 2% by 2005, and 5.75% by 2010.
Luxembourg	**No nBAP** - Ongoing studies can form the basis for the development of strategies and action plans - current situation unknown.		• The RES-E Directive target is 5.7% by 2010. • The objective of the country is to double the share of RES in final electricity consumption from 2.5% in 1997 to 5% by 2010 and to double the contribution of wood in the final energy consumption by (0.5% to 1%) 2010. • Additionally, objective has been set to increase the share of co-generation in the final electricity consumption from 7% in 1997 to 15% in 2010. • The national biofuel targets: 2.75% (by energy content) by the end of 2006, and 5.75% by the end of 2010.
Malta	**No nBAP** - Current situation is unknown.		• The RES-E Directive target is 5% of gross electricity consumption in 2010. However, the aim has been decided to be 0.31%, excluding large wind farms and waste combustion plants, or 1.31% in the event of a land based wind farm implementation. • Biofuel target is fixed to 0.30% biofuel per energy content.
Netherlands	**Existing nBAP** - Biomass Action Plan published in 2003 for 2003-2005; the Duch biomass action plan of 2003 has not been updated.	There are no specific national targets for electricity & heat from biomass, while at the moment the new government is preparing its plans to achieve more ambitious targets for the year 2020, but no details are yet available. So-called "Biomass Transition" project launched in the Netherlands by the Ministry of Economic Affairs in 2002.	• The RES-E Directive target is 9% in 2010. • The government aims to increase the share of renewable energy in the total energy consumption to 5% in 2010 and 10% by 2020. The target of 2020 is equivalent to approximately 17% of total electricity consumption by that time. Energy from biomass and waste are expected to contribute to this target with 120 PJ. • There's also a long-term vision for bioenergy supply in the country to be 30% of the total energy consumption by 2040 (600-1000 PJ). • Biofuel targets are 2% by energy content in 2005 and 5.75% in 2010.

Country	Status of the nBAP	Highlights on RE and bioenergy	Targets for RES and bioenergy
Poland	**No nBAP** - Novel long term plans for biomass use in heating and electricity as well as for biofuels are under discussion in the national ministries (situation March 2007); together these plans may be regarded as "something like" a nBAP.	New support plans for bioenergy include energy crop plantation subsidy (act of January 2007), biocomponents and biofuels act (of August 2006), long-term programme for biofuels promotion (of July 2007) and support for afforestation of agricultural land within Rural Development Program.	• The RES-E Directive is 7.5% by 2010. • Ministry degree in 2006 set the share for RES-E to be bought e.g. in 2007: 5.1%, from 2010-2014: 10.4% yearly. • The Development Strategy for Renewables (adopted in 2001) has set a target to increase the share of renewables in total primary energy balance to 7.5% by 2010 and to 14% by 2020 (from 2.5% in 1999). • Biofuels should make up 0.50% by energy content in 2005, 1.50% by 2006, 2.30% by 2007, and 5.75% by 2010.
Portugal	**No nBAP** - No specific nBAP under development; instead several activities are ongoing on RES-electricity and biofuels.	Portuguese government has approved in September 2007 new incentives for the micro-generation of renewable electricity, part of a package unveiled in January to reduce carbon emissions; micro-generation tariff is €650/MWh for an initial five-year period. By 2015 national micro-generation capacity will be around 200 MW.	• The RES-E target to be achieved in 2010 is 39%. • New targets published by the government in the beginning of this year are: o RE 2010: 45% of the electricity will be from RE; o Biofuels 2010: 10% of the total fuel in transport should be biofuel.
Romania	**No nBAP** - The Ministry for Economy and Finance will finance a project for the defining of a strategy on biofuels and biomass use promotion in Romania. The project will end in 9 months.	The Romanian Government approved in September 2007 the energy strategy for the period 2007-2020. The strategy calls among others for the upgrading and retooling of hydro-power plants having a total installed power of 2,328 MW.	• The RES target to be achieved is 11% of gross energy in 2010. • The RES-E Directive target is 33% in 2010. • The main objective of the Strategy for the use of renewable sources of energy (from 2003) regarding biomass is the assurance of a 3.347,3 tep equivalent consumption until 2010. • According to the new energy strategy document issued in July 2007, the biofuel quota is 2% and in 2010 5.75%; the biofuel target for 2020 is 10%.
Slovak Republic	**In preparation** - National BAP will be drafted by the end of September 2007; this draft plan will be followed-up by inter-ministerial discussion and final approval.	A document "Strategy of Higher Utilisation of RES in Slovak Republic" was approved in April 2007.	• Target of 6% renewable energy from primary energy consumption by 2010. • The RES-E Directive target is 31% by 2010. • Biofuels: the target of 5.57% biofuels by energy content by 2010; interim targets are 2.5% in 2006, 3.2% in 2007, 4% in 2008 and 4.9% in 2009.
Slovenia	**Existing nBAP** - National BAP has just been developed and it is a joint exercise of four ministries and four sub-programmes, each have their own specific objectives, target groups, measures and financial inputs; the plan encompasses a six-year period and supports implementation of the National Developmental Programme 2007-2013.	Since 2002, the Ministry of Environment and Spatial Planning implemented an international project: "GEF Removal of Barriers to Increased Use of Biomass as Energy Source", the project ended in June 2007.	• A target to increase the share of RES in total primary energy consumption from 8.8% in 2001 to 12% by 2010 has been set. • The RES-E Directive target to be achieved in 2010 is 33.6%. • The National Energy Programme (2004) has set the goal of increasing the share of renewable energy for heating from 22% in 2002 to 25% in 2010. • The targets for biofuels have been set as follows: 0.65% in 2005, 1.2% in 2006, 2% in 2007, 3% in 2008, 4% in 2009 and 5% in 2010.
Spain	**No nBAP** - No specific nBAP, but several biomass related activities and ministerial working groups.	The Spanish Government passed in May 2007 a new renewable energy legislation (Royal Decree 661/2007), which increased the tariffs for renewables from June 2007 forward; increase in tariffs varies between 50% and 100% for biomass, and for biogas between 16% and 40%.	• The Spanish “Plan de Energías Renovables 2005-2010” sets the goal of 12% of total energy consumption RES in 2010. • The target to be achieved in 2010 under the RES-E Directive is 29.4%. • The revised Plan de Energías Renovables of 2005 sets a biomass capacity target of 1,695 MW for 2010. • The national biofuel target was 0.40% of energy content by the end of year 2005 (no further biofuel targets have been set).
Sweden	**No nBAP** - No official nBAP or indications of developing one.	The governmental Commission on Oil Independence formulated in 2006 ambitious national objectives for 2020 to reduce fossil fuels in heating, road transport and industry .	• The RES-E Directive target is 60% of gross electricity consumption by 2010. • There is an absolute target to increase the consumption of electricity produced from RES by 10 TWh compared with its 2002 level by 2010; this corresponds to a RES-E share of about 49.5-50.5 % in 2010.This target was amended to increase the production of RES-E by 17 TWh from 2002 and 2016. • The biofuels target is 5.75% in 2010. Other than the target of 3% by the end of 2005, no interim targets have been set at a national level.
United Kingdom	**Existing nBAP** - UK Biomass Strategy was published in May 2007, and it includes heat and power sector, transport fuels and industrial products; also published Biomass Action Plan for Scotland (April 2007).	Waste Strategy for England was published in May 2007; Woodfuel Strategy for England was announced in March 2007.	• The RES-E target for 2010 is 10 % of gross electricity consumption. An indicative target for RES-E of 20% for 2020 has been set. • No formal targets exist for heat from renewables. • National biofuel targets are 1.7% in 2008, 2.6% in 2009 and 3.5% in 2010 (assuming 50:50 split between biodiesel and bioethanol).

CONCENTRATED SOLAR THERMAL ELECTRICITY (CSP)

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Solar thermal electric power plants are generating electricity by converting concentrated solar energy to heat, which is converted to electricity in a conventional thermal power plant. The two major concepts used today are *Parabolic Trough* power plants and *Power Towers*. Other concepts including the *Dish Design* with a Stirling engine are researched as well, but so far no commercial plant has been realised.

After more than 15 years, the first new major capacities of Concentrated Solar Thermal Electricity Plants came online with Nevada One (64 MW, USA) and the Andersol Tower I (11 MW, Spain) in the first half of 2007. In Spain the Royal Decree 436/2004 dated 12 March 2004 is a major driving force for the current CSP plant constructions and the ambitious expansion plans. The guaranteed feed-in tariff is 0.21 €/kWh for 25 years. In the *Plan de Energías Renovables en España* (PER) (2005 – 2010) a total capacity of 500 MW is foreseen.

In order to satisfy the growing demand for the concentrating mirrors of parabolic trough receivers, Schott Solar is currently building its second manufacturing plant for the special glass receivers near Seville, operating already one in Germany

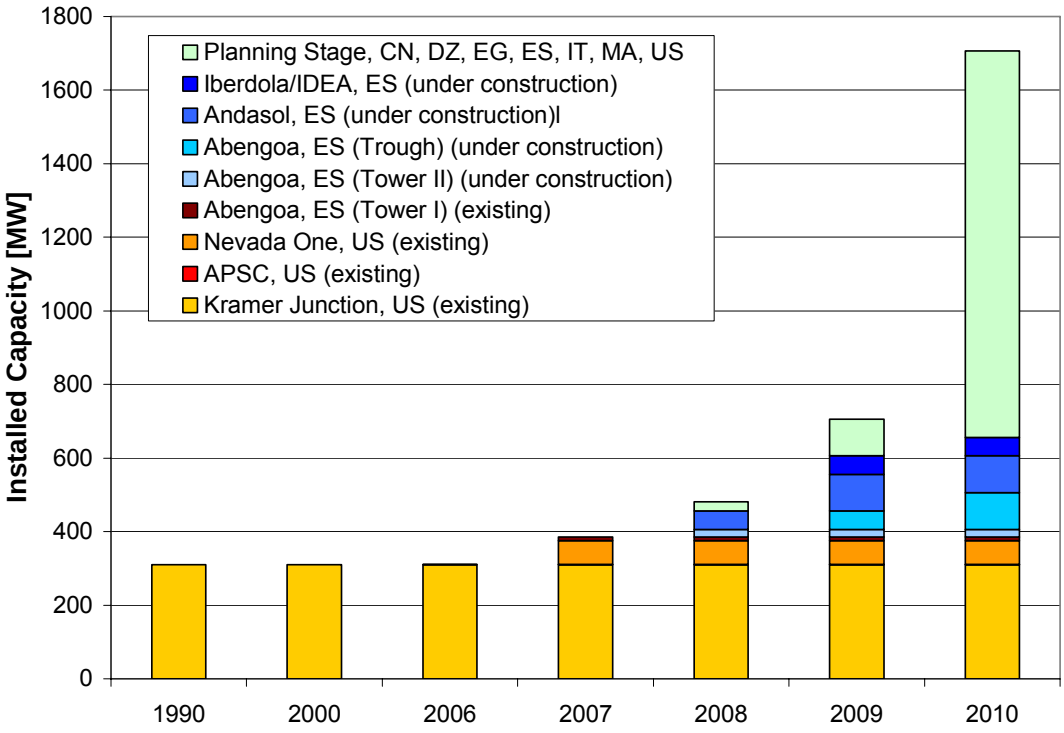

Figure 6: Installed and planned Concentrated Solar Thermal Electricity Plants (1990 to 2010)

The current average investment costs for the solar part are given in various projects at around € 4/W. Depending whether the plant has a backup in the form of a fossil fired gas turbine and/or a thermal storage the project costs can increase up to € 6/W.

In June 2007 Abengoa's subsidiary Abener (Spain) signed an agreement with ONE, Morocco's national electricity office, which gave the Spanish company the go ahead to build a 470 MW power

station with a 20 MW solar thermal component at Beni Mathar. Two other projects in Egypt (150 MW total, 65 MW solar) and Algeria (155 MW total, 25 MW solar) are still in the pre-selection phase. More than 30 projects are currently in the planning phase mainly in Spain, North Africa and the USA.

Table 1: List of projects currently under construction or finance plans decided

Name of Project and Consortium	Technology	Capacity [MW]	Start of construction and/or operation	Investment Volume
Abengoa/Schott Solar (Seville, Spain)	Solar tower	20	construction: 2006, operation 2008	n.a.
Abengoa/Schott Solar (Seville, Spain)	parabolic troughs	50	construction: 2007, operation 2009	€ 200 million
Abengoa/Schott Solar (Seville, Spain)	parabolic troughs	50	construction: 2007, operation: 2009/10	€ 200 million
Andasol 1 (Granada) ACS/Cobra-Group/ Solar Millenium AG (Spain)	parabolic troughs; solar (90%) + gas + thermal storage	50	construction: June 2006, operation 2008	€ 300 million
Andasol 2 ACS/Cobra-Group/ Solar Millenium AG (Spain)	parabolic troughs; solar (90%) + gas + thermal storage	50	construction started February 2007, start of operation 2009	€ 300 million
Andasol 3 EDP/Solar Millenium AG (Spain)	parabolic troughs; solar (90%) + gas + thermal storage	50	planning phase	€ 300 million
Extremadura Hidrocantábrico Group/Solar Millenium AG (Spain)	parabolic troughs	50	letter of intent 2006	n.a.
Puertollano Iberdola/IDEA (Spain)	parabolic troughs	50	construction started 05/2007	€ 200 million
Badajoz Ener-tGlobal/Grupo Enhol (Spain)	parabolic troughs	50	start of construction 2007	n.a.
Beni Mathar, ONE/Andersol (Morocco)	Gas fired power station + parabolic troughs	470 with 20 solar	Contract signed 2007	€ 469 million

At the moment CSP is at a crossroad from niche markets to market deployment. Until now the learning curve for this technology is dominated by R&D and not by production volume. Therefore, predictions of price or cost reduction are very vague and speculative. Only after the currently planned projects are operational reliable production data can be expected and consequently learning curves to forecast future cost reductions.

Important!

The amount of delivered electricity of a solar thermal power plant strongly depends whether or not the plant has a thermal storage and/or a fossil – generally gas – back-up. The solar fraction of electricity production in southern Spain and the projects in California and Nevada are expected to be between 2000 and 2100 KWh annually per kW installed capacity.

Data Sources:
Company press releases and own investigations.

Technical Annex:

Trough Systems

The sun's energy is concentrated by parabolically curved, trough-shaped reflectors onto a receiver pipe running along the focal plane of the curved surface. This energy heats oil or another medium flowing through the pipe and the heat energy is then used to generate electricity in a conventional steam generator.

Power Tower Systems

The sun's energy is concentrated by a field of hundreds or even thousands of mirrors called *heliostats* onto a receiver on top of a tower. This energy heats molten salt flowing through the receiver and the salt's heat energy is then used to generate electricity in a conventional steam generator. The molten salt retains heat efficiently, so it can be stored for hours or even days before being used to generate electricity.

Dish/Engine Systems

A dish/engine system is a stand-alone unit composed primarily of a collector, a receiver and an engine. The sun's energy is collected and concentrated by a dish-shaped surface onto a receiver that absorbs the energy and transfers it to the engine's working fluid. The engine converts the heat to mechanical power in a manner similar to conventional engines—that is, by compressing the working fluid when it is cold, heating the compressed working fluid, and then expanding it through a turbine or with a piston to produce work. The mechanical power is converted to electrical power by an electric generator or alternator.

EUROPEAN PHOTOVOLTAICS IN WORLD WIDE COMPARISON

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In 2006, the photovoltaic industry produced world-wide some 2,500 MWp of photovoltaic modules and has become a € 12 billion business (Fig. 7). In the past 5 years, the yearly growth rate was an average of more than 40%, making new production facilities an attractive investment for industry.

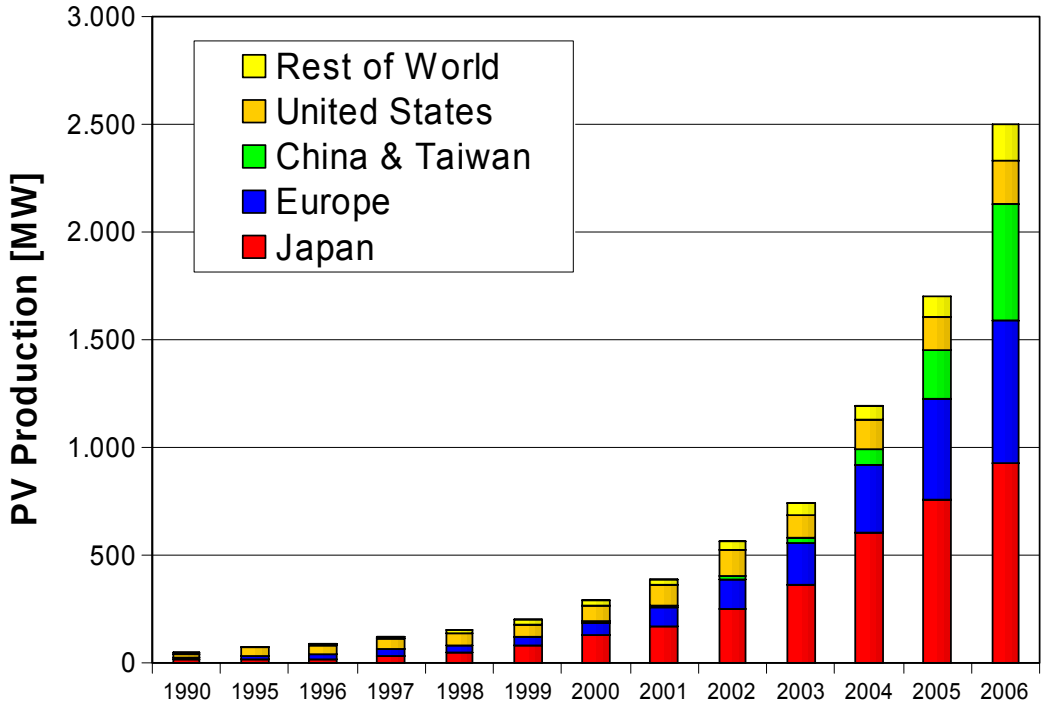

Figure 7: World-wide PV Production from 1990 to 2006
Data Source: PV News [1]

Besides the general exponential increase of the world market, the rapid increase of the Chinese and Taiwanese production capacities is of particular interest. If the announced production increases can be realised, China and Taiwan will represent about 32% of the worldwide 23 GW [1,2,3,4,5]. Europe will then be second with almost 31% and Japan third with 16% (Fig. 8).

However, it is of high importance to note, that the Japanese industry is much more careful and conservative with their announced capacity increases than China and Taiwan. Another important factor is the actual utilisation rate of the production capacities. In 2006, Japan had a Capacity to announced Production ratio of 77%, Europe of 61% and China of 35%.

The installation figures for 2006 indicate that Europe surpassed the 2010 White Paper Target of 3,000 MW cumulative installed PV system capacities in 2006!

The second interesting fact is that Thin Film solar modules are finally on the way to mass production. The first 100 MW factories will become operational in 2007 and if all expansion plans are realised, thin films production capacity will be around 6 GW or 26% of the total 23 GW in 2010 (Fig. 9) [1,2,3,4,5].

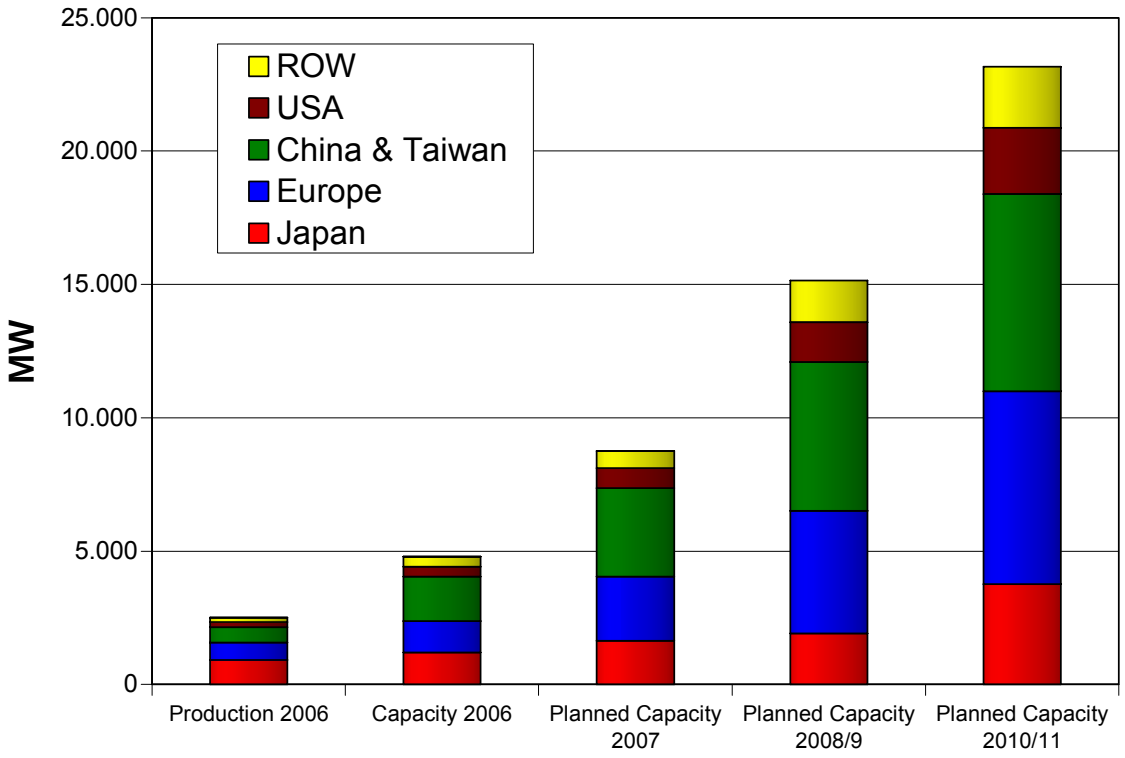

Figure 8: World-wide PV Production 2006 and planned production capacity increases

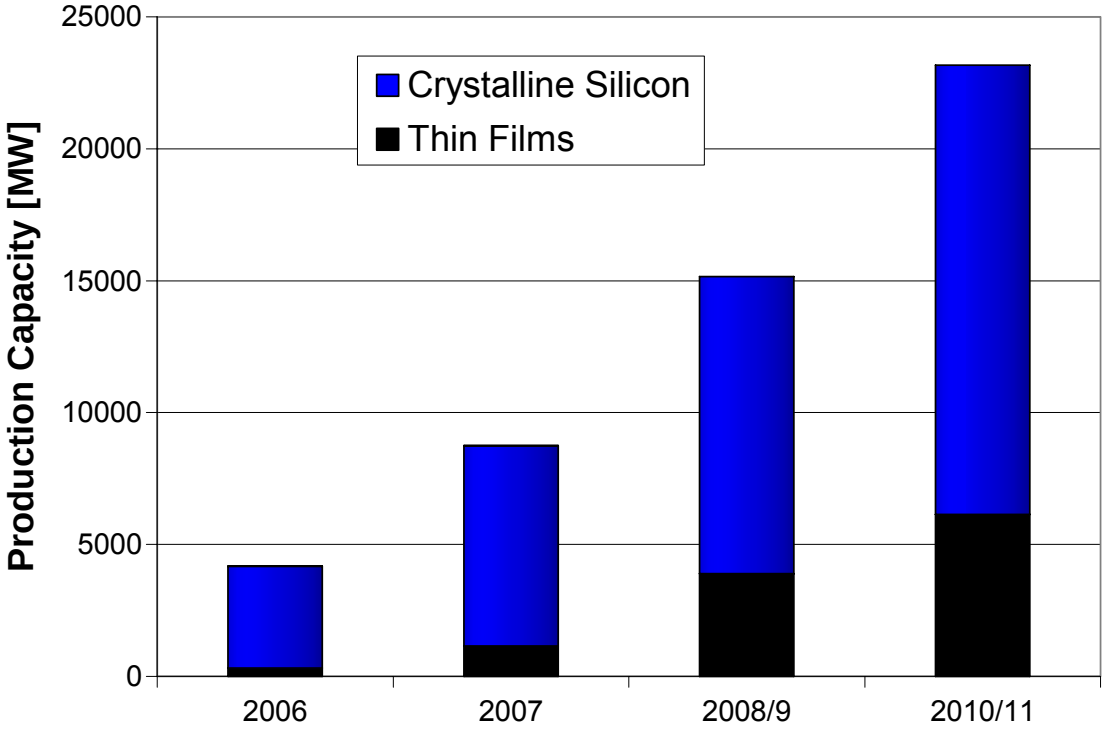

Figure 9: PV Production 2006 and planned production capacity increases.

It is interesting to note that since 1999, the majority of investments in solar cell production facilities in Europe were made in Germany and Spain – the two countries that offered so far the most stable and realistic legal framework conditions for citizens investing in a PV system. In 2006 the employment

figures in Photovoltaics for the European Union is estimated to be 50,000 to 55,000. These figures are estimated from over 40,000 jobs reported for Germany [6] and 6,300 for Spain [7]. The PV systems installed in Germany produced around 2 TWh in 2006 and it is estimated that they will produce 2.6 TWh in 2007 [8].
According to an industry survey, amongst renewable energy companies in Germany, every second company plans to increase the number of employees by 30 to 100% within the next 5 years. Photovoltaic companies are amongst the most optimistic ones and in total expect a doubling of employment by 2010. In 2006 Photovoltaics accounted for a turnover in Germany of € 4.8 billion and 70% of the added value remained inside Germany.

During the extreme heat wave in July 2006, peak purchase prices on 27 July 2006 on the European Electricity Exchange (EEX) spot market exceeded the feed-in tariff (0.406 €/kWh – 0.518 €/kWh) paid in Germany between 10:00 and 16:00.
Purchase prices (€/kWh) and trade volume (MWh): 10:00 – 11:00: 0.998 €/kWh / 10,361 MWh; 11:00 – 12:00: 1.399 €/kWh/ 10,114 MWh; 12:00 – 13:00: 0.699 €/kWh / 10,216 MWh; 13:00 – 14:00: 0.699 €/kWh / 10,199 MWh; 14:00 – 15:00: 0.800 €/kWh / 10,045 MWh; 15:00 – 16:00: 0.693 €/kWh / 10,094 MWh.

Important!

1) Please note, that the quoted numbers for 2006 production are preliminary figures and over the last few they had an uncertainty of ± 10% (most years they were too low).
2) Please note that the announced production capacity increases have quite an uncertainty due to the fact that some companies quote maximum capacity (4 shifts 365 days/year) and others are only quoting capacity under real operation conditions. Also the time when they actually start operating are quite different. Some companies annonce the time of ready installation, others only when they are fully operational.
3) Production output of the announced production capacity depends a lot on the availability of raw material. Not all companies have secured their raw material for the announced expansions yet. This might the lead to lower capacity to production ratios or delays in the actual start up.
4) On Average, 1,000 MW of PV systems produce 1 TWh of electricity annually.

Data Sources:

[1] PV News 2007, published by The Prometheus Institute, ISSN 0739-4829
[2] Sun & Wind Energy 1/2007
[3] ENF European and Chinese Solar Cell & Panel Manufacturer Market Survey 2006
[4] Company Web-sites and Press Releases
[5] Data received from Companies during personal visits.
[6] Bundesverband Solarwirtschaft, Statistische Zahlen der deutschen Solarwirtschaft, February 2007
[7] IEA Annual report 2005, Spain; http://www.iea-pvps.org/ar05/index.htm
[8] VDN (German grid operator association)

EUROPEAN WIND ENERGY IN WORLD WIDE COMPARISON

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In 2006, 15,167 MW of new wind turbine capacity went into operation bringing the world wide total installed wind capacity to 74,223 MW (Fig. 10). The total value of new generation equipment installed in 2006 reached € 18 billion.

The 2005 to 2006 growth rate was almost 26%, two percent up from the 24% from 2004 to 2005. The European Union added 7,611 MW and reached a total installed capacity of 48,062 MW.

Already in 2005 the installed wind power capacity in the EU exceeded the 2010 White Paper Target of 40,000 MW or 80 TWh/annually.

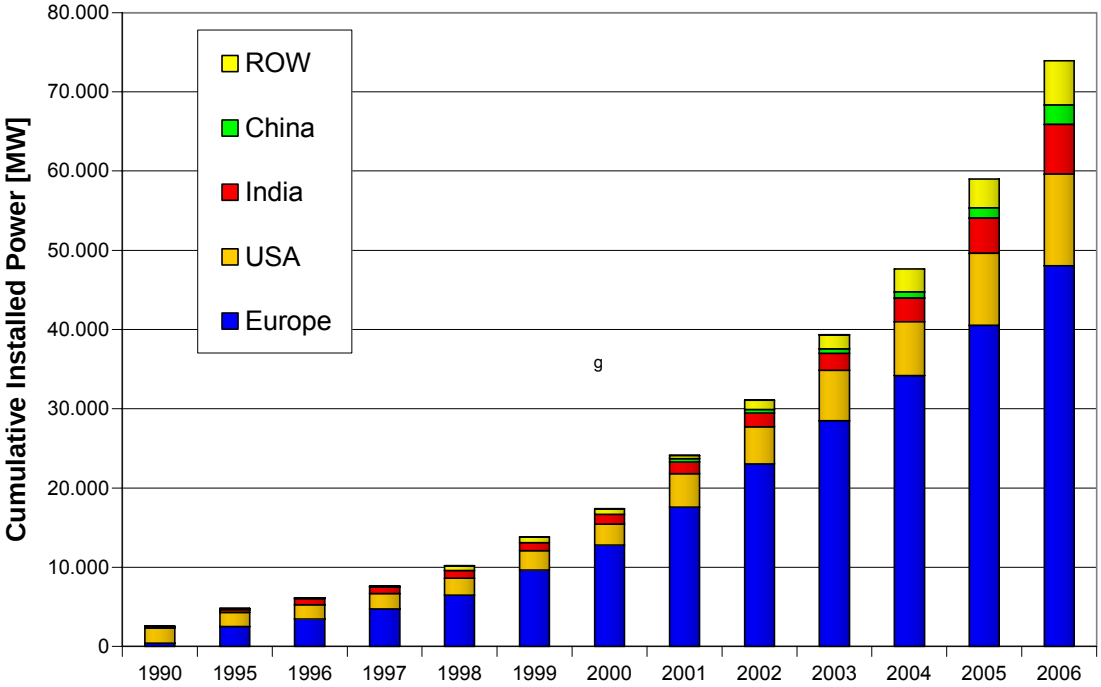

Figure 10: World-wide Wind Power Installation from 1990 to 2006
Data Source: GWEC, IEA, Wind Power India [1,2,3]

It is of interest to note that five countries added capacities of more than 1,000 MW in 2006: United States of America (2,454 MW), Germany (2,233 MW), India (1.840 MW), Spain (1,587 MW) and China (1,347 MW, 91% growth). Another five countries added more than 500 MW: France (810 MW, 107 % growth), Canada (768 MW, 112 %), Portugal (628 MW, 61 %) and the United Kingdom (610 MW, 45 %).

Europe is still the main market with roughly 50% or 7,611 MW newly installed capacity and 48,545 MW (EU 27: 48,062 MW) of installed capacity at the end of 2006, representing 65% of the global total. In 2006, the European wind capacity grew by 19%, which can produce approximately 100 TWh of electricity in an average wind year, equal to 3.1% of the total 2004 EU 27 electricity consumption.

Germany and Spain still represent 50% of the EU market, but there is a continuous trend towards less dependence on these two countries. In the EU, 3,755 MW were installed outside of Germany, Spain and Denmark in 2006 compared to 680 MW in 2002.
Despite a continuous healthy growth in Europe, the general trend shows that the wind energy sector is gradually broadening its market base and other regions are starting to increase the installation of wind energy capacities. In 2006 the European market accounted for about half of the total new capacity a significant percentage decrease from the three quarters in 2004.
Outside of Europe, Asia has experienced the strongest increase in installed wind power capacity. The addition of 3,679 MW (+53%) in 2006 is increasing the continent's total capacity to over 10,600 MW. The strongest market in Asia was India with over 1,840 MW followed by China with 1,347 MW.

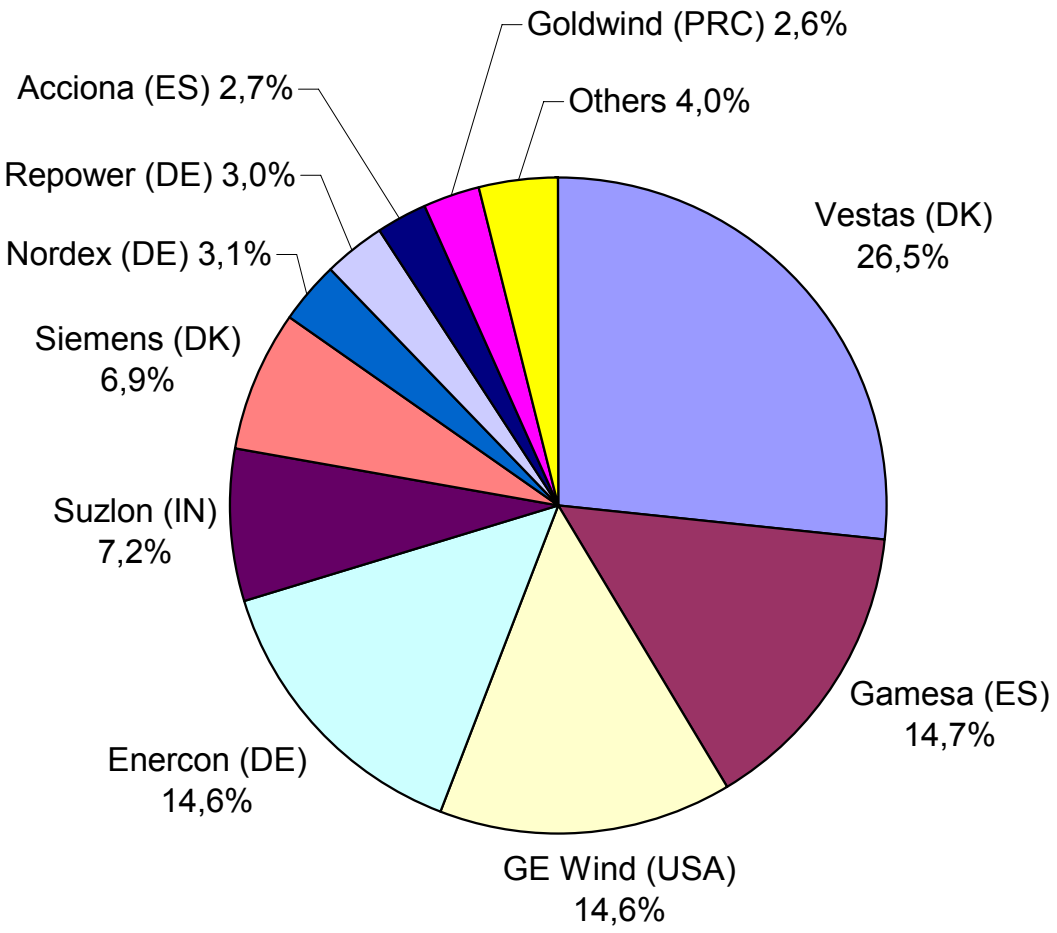

Figure 11: Market shares of manufacturers 2006 (16,003 MW sales) [4]

At the end of 2006 the wind sector in Europe employed more than 140,000 people (Germany 70,000, Spain 35,000, Denmark 21,000, UK 4,000, Italy more than 3,000, Austria 2,400 [5]).

Important!

1) In Europe the potential annual average electricity production of wind turbines with a nominal capacity of 1,000 MW is 2.2 TWh. This means that the cumulative installed capacity in EU 27 in 2006 could deliver 105.7 TWh or around 3% of Europe's electricity consumption. However, real production depends on the annual wind conditions and can vary by at least ± 10%.

Data Sources:

[1] Global wind Energy Council; http://www.gwec.net

[2] International Energy Agency, Renewables Information 2005

[3] Wind Power India, http://www.windpowerindia.com

[4] Sun & Wind Energy 2/2007, ISSN 1861-2741 74714

[5] Info of national wind associations

European Commission

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Abstract
These Renewable Energy Snapshots are based on various data providers including *grey data sources* and tries to give an overview about the latest developments and trends in the different technologies. Due to the fact that unconsolidated data are used there is an uncertainty margin which should not be neglected. We have cross checked and validate the different data against each others, but do not take any responsibility about the use of these data.

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