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Biomass Energy for Heating and Hot Water Supply in Belarus

Financial Support for Bioelectricity in the EU

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Financial support for Bioelectricity in the EU

Colophon

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1 INTRODUCTION

This document presents an overview of the financial support framework that has been put into place in the European Union and its Member States to support renewable energy sources (RES).

It first describes the policy framework developed by the European Commission to promote RES. Of particular relevance is the Directive on the promotion of electricity from renewables energy sources (RES-E). The Renewables Directive was groundbreaking as for the first time the European RES strategy was cast into a legislative instrument. The issue of a similar Directive on renewable heating and cooling was announced in December 2005.

The Renewables Directive requires Member States amongst others to put into place a scheme that financially supports the market uptake of RES-E. The Renewables Directive does not indicate which kind of policy measures would be favourable, due to which Member States continue to develop their own national mix of policy instruments to support RES-E. The dominating RES-E support schemes in use in the EU and their respective pros and cons are introduced in the report.

The remainder of the report focuses on a single type of RES-E i.e. bioelectricity. An overview of the characteristics of the feed-in and other support schemes used by the 25 EU Member States is given. The mechanisms of various national schemes vary significantly, and in many countries the degree of financial support might not be high enough to effectively stimulate bioelectricity production.

In a recent Communication, the European Commission assessed the effectiveness of different RES-E support systems. The report presents the Commission findings where these concern the bioelectricity sector.

In the last chapter short case studies of three EU Member States (Germany, Finland and Sweden) are presented. Although these countries use rather different national support schemes they have all had significant success promoting bioelectricity.

It should be noted that some support schemes (in particular those that involve a quota obligation, typically in combination with tradable green certificates) have only been in place for a short period, and as such it is too early to judge which type of system is the most effective in the longer term.

2 THE EU POLICY FRAMEWORK FOR RENEWABLE ENERGY

The renewable energy policy of the European Commission has taken firm shape over the last decade or so. A large number of policy documents, legislative instruments (Directives) and other communications dealing with renewable energy issued have been issued since 1995. A selection of EU documents relevant to the promotion of bioheat and bioelectricity is listed in Annex A. Below the most relevant and most recent Commission documents are introduced.

The 1997 White Paper for a Community Strategy and Action Plan on Renewable Energy Sources COM(97)599 constitutes the strategic basis for EU support for renewable energy sources (RES or RE). The document sets out three main drivers for the Community's renewable energy policy:

- Environmental protection, especially as regards greenhouse gas emissions and compliance with the Kyoto protocol;
- Reducing dependency on energy imports and increased security of supply;
- Contribution to job creation, especially local employment and facilitation of regional development and greater social and economic cohesion (Lisbon Agenda);

The White Paper also sets quantitative targets for RE overall i.e. doubling the share in primary energy supply from 6% in 1997 to 12% in 2010. It also specifies targets for each RE source, and biomass is to provide a large contribution. The aim is to triple bio-energy supply from 45 Mtoe in 1995 to 135 Mtoe in 2010 and to reach a 10-fold increase of bioelectricity supply, from 23 TWh in 1995 to 230 TWh in 2010.

In 2001, Directive 2001/77/EC on the promotion of electricity from renewable energy sources was published. This Renewables Directive was groundbreaking as for the first time the European strategy for developing renewables was cast into a legislative instrument. The Renewables Directive aims to promote the generation of electricity from renewable energy sources (RES-E) through:

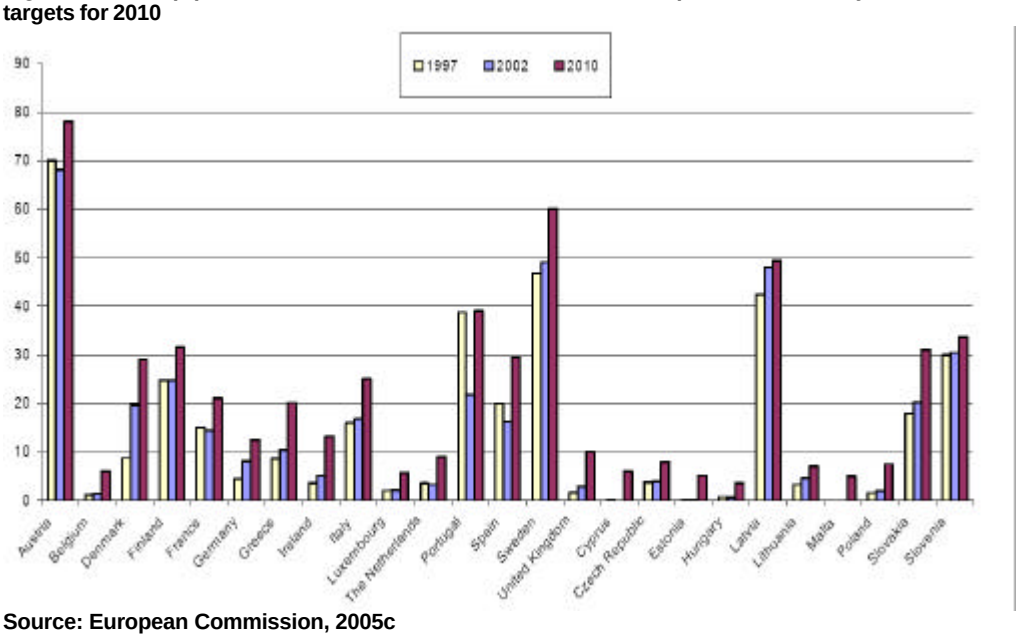
- Quantified indicative national targets for consumption of electricity from RES.
- National support schemes
- Simplification of national administrative procedures for authorisation
- Guaranteed access to transmission and distribution of electricity from RES

For the 15 EU Member States (EU15) the target was set to increase RES-E production from 14.0 % in 1997 to 22.1 % in 2010. When 10 new countries acceded to the EU the target for 2010 was revised to 21.0% for the enlarged EU. Indicative national targets for each of the 25 Member States were also set. A table listing the indicative national targets is attached as Annex B. A graph illustrating progress made toward achieving the targets is given in Figure 1.

The 25 EU Member States (EU25) are required to implement the Renewables Directive in their national legislation, and thus to put into place a scheme that financially supports the market uptake of RES-E. In October 2003 the then 15 Member States implemented the Renewables Directive, followed in May 2004 by the 10 new Member States. Following

the principle of subsidiarity, the Renewables Directive leaves it to Member States to decide on the specific support schemes aimed at achieving the indicative targets.

Figure 1 Share (%) of RES-E in the EU Member States consumption of electricity cvs. national targets for 2010



Source: European Commission, 2005c

In May 2004 the Commission adopted a Communication on the progress of the different EU Member States towards the target. This Communication concluded that although a few Member States are on track, the 21% target will not be achieved unless additional policies are put in place. The Communication observed that in particular biomass energy was lagging behind.

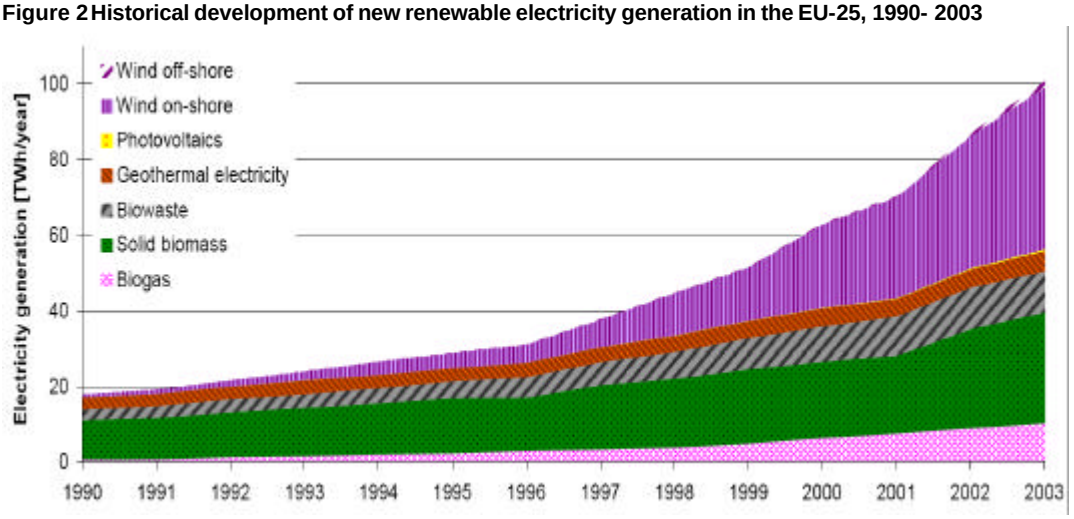
In December 2005 the Commission published an analysis of the different support systems in use in the EU Member States and their success in increasing the share of renewable electricity. The Commission report found that in the year 2003, 108 TWh electricity was generated from new renewable energy sources (excluding large hydropower), equivalent to the combined overall electricity production in Portugal, Denmark and Slovenia. Figure 2 shows the historical development and the composition of new renewable electricity production in the Member States.

At the same time the Commission adopted the Biomass Action Plan. The main objective of the Action Plan is to double the use of bio-energy sources (wood, wastes, agricultural crops) in the EU energy mix by 2010. Currently, the EU meets about 4% of its energy needs from biomass. The plan outlines 31 measures to promote biomass in heating and cooling, electricity production and transport (biofuels). One of the measures to be taken is the issue of new legislation on the use of renewable energy, including biomass for heating and cooling, in 2006. The complete list of measures is attached as Annex C.

In the absence of a EU Directive, most Member States have yet to formulate a support system for renewable heat, including bioheat. There are few if any examples of EU countries that financially support bioheat *generation.* Financial support to *investments* in bioheat equipment, however, are more common. Examples are Austria and Germany.

The level of such investment support for bioheat equipment can differ between the regions within a single country. Because of the limited financial support that is given to bioheat generation and the absence of a good inventory of such support systems bioheat is not further discussed in this report, which in the remainder will focus on bioelectricity.

Figure 2 Historical development of new renewable electricity generation in the EU-25, 1990- 2003



Source: European Commission, 2005c

3 FINANCIAL SUPPORT SCHEMES FOR RES-E IN EU25

Two principal ways, which a Government can adopt to financially support the deployment of renewable energy, are:

- RD&D support to RES-E technologies, with a view to facilitate technological maturity, cost reduction and dissemination of information
- Support to market uptake of specific RES-E technologies

The analysis in this report is focused on the second category of support.

In the case of biomass energy technologies financial support can be given for three different cost categories: for fuel provision (e.g. the raising of energy crops), for generation equipment (e.g. capital grants) or for energy flows. The current chapter mainly looks at the financial support for energy flows. In the case studies the other costs categories are also considered.

3.1 Existing support systems

To encourage the development and investments in the production of renewable electricity, there are several policy instruments and support mechanisms in use in Member States. The RES-E Directive does not indicate which kind of policy measures would be favourable, due to which Member States continue to develop their own national mix of policy instruments to stimulate renewable electricity. There are a range of different support systems in use in the EU which can broadly be classified into four groups: feed-in tariffs, quota obligations (green certificates), tendering systems and tax incentives.

- **Feed-in tariffs (Renewable feed-in tariff, or REFIT)** exist in the majority of Member States and have the advantages of investment security, possible fine-tuning as well as the promotion of mid- and long-term technologies. On the other hand, they are difficult to harmonise at EU level and may be challenged under internal market principles. A more market-oriented variant of the REFIT is the **premium**, where a fixed amount is paid on the top of the fluctuating electricity price. This system is implemented in Denmark and partially in Spain.
- **Green certificates (Tradable Green Certificates, or TGCs)** are market-based instruments and, at least in theory, have the advantage of yielding the best value per Euro invested, favouring a single European market and posing a lower risk of over-compensation. They exist in Sweden, United Kingdom, Italy, Belgium and Poland. However, green certificates may create a higher risk for investors and long-term technologies are not easily developed under such schemes.
- **Pure tendering procedures** have existed in two Member States (Ireland and France). France has recently changed its system to a REFIT combined with tendering system in some cases and Ireland has just announced a similar move. Theoretically, tendering systems make optimum use of market forces, but they have a stop-and–go nature not conducive to stable conditions. Such support scheme also involves the risk that low bids may result in projects not being implemented.
- **Pure tax incentives** are applied in Malta and Finland. In most cases (e.g. Cyprus, UK and the Czech Republic), however, this instrument is used as an additional policy tool.

The above categorisation into four groups is a fairly simple presentation of the situation. There are several systems that have mixed elements, especially in combination with tax incentives. Some details on the systems are listed in Annex D. Pro's and con's of the main systems are discussed in the next paragraph.

3.2 Pros and cons of the main RES-E support systems

REFIT

Given attractively set tariffs, the strongest points of REFIT are, in particular, its perceived simplicity and effectiveness in stimulating RES-E as well as its positive impact on technology diversity, permitting strategic support for technologies that are still far away from market maturity.

The weakest points of the REFIT model are the lower level of competition between producers than is the case with TGCs and tendering system.

REFIT also supports technologies such as photovoltaic solar energy with a higher cost than wind or biomass. These are seen and criticised as "more expensive" by some stakeholders and considered beneficial by others in the long term.

Although there could be a risk of over-compensation, analysis shows that both effectiveness and efficiency are currently highest with this type of schemes.

TGC

The strongest points of the TGC model are the compatibility with the internal European market and the competition between the different RES-E producers.

The setting of the yearly quotas also need intermediate yearly targets and the fixing of penalties is not a simple task and considerably influences the outcome of the system.

The existence of dominant market players can complicate the development of a TGC market, but a well-designed system can overcome this situation.

The main drawback of the current TGCs is that the complexity and risks associated with these support schemes transfers a higher cost to the consumer. TGC systems have considerable administrative costs.

Premium

This is an extra premium or bonus paid on top of the spot electricity market price.

The premium system has historically been considered as a kind of feed-in tariff. It has the advantages of REFIT: its perceived simplicity and effectiveness in stimulating RES-E as well as its positive impact on technology diversity, thus permitting strategic support for technologies that are still far away from market maturity. In addition, it is better integrated in the internal electricity market than a pure REFIT system.

Investment risks with the premium system are higher than with the REFIT system –as the total prices fluctuates with the electricity prices– but investment risk with the premium are lower than with TGCs.

Tendering

For the renewable sector as a whole, experiences with tendering systems around Europe have not been good. If competition is too strong, the prices offered are too low and there is a risk of projects not being implemented. It has the advantages of fast deployment in order to kick-start the market in one specific technology sector (e.g. off-shore wind). However, it is not well suited for a large and rapidly growing market due to its high administrative costs, the risk of unrealistic bids and the potential for creating administrative barriers.

Table 1 summarises the advantages and disadvantages of the main RES-E support systems.

Table 1: (Dis)advantages of the main RES-E support systems

	Advantages	**Disadvantages**
REFIT (Feed-in tariffs)	• Highly effective. • Highly efficient due to the low risk for investors. • Permits strategic support for technology innovation.	• More difficult compatibility with the internal market. • Needs regular adjustment.
Premium	• Highly effective. • Efficient due to the medium risk for investors. • Good compatibility with the • internal market.	• Risk of over-compensation in the case of high electricity prices without appropriate adjustment.
TGCs (Green certificates)	• Good compatibility with the internal market. • Competition between generators. • Supports the lowest-cost technologies.	• Currently less efficient due to higher risks and administrative costs. • Not very appropriate for developing medium- to long-term technologies.
Tendering	• Fast development with political will	• Stop-and-go nature causing instabilities. • If competition is too severe, development is blocked.
Investment subsidy	• Good complement for some technologies.	• Inefficient as a main instrument.
Fiscal measures	• Good secondary instrument.	• Good results only in countries with high taxation and for the most competitive technologies.

4 FINANCIAL SUPPORT SCHEMES FOR BIOELECTRICITY IN EU25

All EU Member States have implemented policy instruments to support the use of biomass. At least eight of them have set national targets for biomass use, though only a few have indicative targets for production of electricity specifically from biomass.

4.1 Bio-electricity support schemes in the EU

A detailed overview of the dominating support mechanisms or schemes for **bioelectricity** is listed in Annex 4 (status late 2003). Feed-in tariffs are in place as a dominating instrument in 18 Member States, whilst six countries have adopted an obligation quota system (in the case of Poland and without an associated green certificate systems supporting the quota). Ireland has developed a tendering/bidding scheme as the main instrument and Finland with its energy tax refund complemented with investment subsidy is a unique example of its promotion scheme in the EU.

Although feed-in tariffs are widely in use throughout the Member States, the mechanisms of these schemes vary significantly. Characteristics of national feed-in tariff systems are summarised in Table 2. Usually there is a technology specific payment for RES and at least a short-term guarantee for payment. As seen from Table 2 bioelectricity prices differ greatly between countries, and tariffs depend on issues such as: date of start-up, source of electricity or the type of technology, size of facility or a time of generation.

The key issues especially in the case of new Member States are that the prices do not adequately cover the costs and guarantee period is too short to ensure price security for investors. As a result, the degree of support might not be high enough to stimulate bioelectricity production in these countries.

There is evidence that those countries which have chosen to implement stable, long-term feed-in tariffs also have the highest RES-E deployment rates. Quoted more than once as an excellent example for providing a strong incentive for renewable electricity, the feed-in law in Germany has supported bioelectricity since 2000. At present, fairly high feed-in tariffs are combined with reasonable investment subsidies and exemption from environmental tax, and these have generated a considerable RES market in Germany.

Bioelectricity deployment is also said to be benefiting from feed-in laws, although the use of biomass has essentially increased in Finland and Sweden even without this measure. It has to be noted that in Finland this has occurred even without governmental support measures because of the cheap price of wood waste in electricity production. In these two countries heavy taxation of competing fossil fuels, electricity taxes and quota-based system (in Sweden) are seen to be the most effective policy instruments promoting bioenergy, and their experience may direct the way also for other countries.

Industrial policies can have a great influence on the use of biomass and the production of bioelectricity. Black liquor and other concentrated liquors originating from the pulp and paper industry in Finland contribute considerably to the consumption of renewables, 42 % in 2001 and solid biomass accounted for 11% total electricity production in the same

year. This source of biomass has a significant potential also elsewhere, e.g. in Germany. In Europe, Finland and Sweden are leading the energy use of industrial black liquors (135 PJ/a and 125 PJ/a, respectively). Other industrial candidates for power production from biomass in addition to the pulp and paper industry or other forest product industries are municipal wastewater treatment plants (biogas recovery) as well as district heating by biomass and landfills (biogas).

Table 2: Feed-in tariffs in the EU countries for bioelectricity

Country	Tariff margin € cents/kWh [1]	Technology specific payment [2]	Guarantee [3]	Favourable payment [4]
Austria	3,0-16,5	X	X	X
Belgium	2.0-2.5	X	X	(X)
Denmark	1,0-4,0	X	X	
Finland	No feed-in tariff			
France	3,5-5,5	X	X	(X)
Germany	6,6-9,9	X	X	X
Greece	7,0-7,8		-	(X)
Ireland	No feed-in tariff			
Italy	No feed-in tariff			
Luxembourg	2,5	X	X	
Netherlands	2,9-8,2	X	X	X
Portugal	6,2	X	-	
Spain	6,7-7,1	X	X	
Sweden	No feed-in tariff			
United Kingdom	No feed-in tariff			
Cyprus	6,3	X	-	-
Czech Republic	6,2-7,7	X		(X)
Estonia	(4,9-) 5,2		X	
Hungary	7,3		X	(X)
Latvia	5,0-5,9	X	X	(X)
Lithuania	5,7-5,8	X		
Malta	No feed-in tariff			
Poland	No feed-in tariff			
Slovak Republic	3,0-3,5			
Slovenia	6,8-7,0	X	X	(X)

Source: Jäger-Waldau, 2004. Notes: (X) = probably favourable; -: data not available

1) Tariff margin includes the price variation for bioelectricity inside the country and in some cases variation based on different sources (e.g. Belgium, Estonia), not including premiums
2) Technology specific among other RES
3) Guarantee does not necessarily mean long-term security
4) Favourable payment i.e. is the degree of the support considered high enough to stimulate bioelectricity (cost-covering)

Effective use of biomass for energy purposes depends not only on market developments but also on a successful integration of energy, environment and in particular agricultural and forestry policies as well as waste, industry, rural development and trade policies. Bioelectricity promotion schemes must thus take these into account.

5 BIOELECTRICITY SUPPORT LEVELS AND EFFECTIVENESS

In a recent communication (2005a), the European Commission undertook an effort to determine the effectiveness of the different RES-E support systems used throughout the EU Member States. The assessment was made sector-wise, with effectiveness being defined as the electricity delivered in GWh compared to the potential in a country over a given period. In the case of electricity generated from biomass and forestry residues the assessment covered the period 1998-2003. The assessment was complicated due to the wide variety in bio-energy systems capacities, feedstock, configurations etc. as the sector includes small CHP systems, pulp and paper industry, co-firing of wood residues, etc.

Figure 3 and Figure 4 show the differences between support schemes around EU-15 and also the variation in generation costs.

Figure 3: Price ranges (average to maximum support) for supported biomass electricity production from forestry residues in EU-15 Member States (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs).

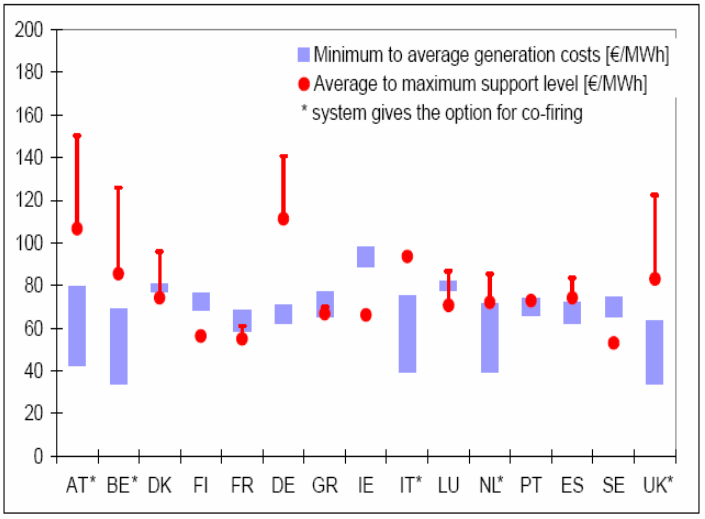


Figure 4: Price ranges (average to maximum support) for supported biomass electricity production from forestry residues in EU-10 Member States (average tariffs are indicative) compared to the long-term marginal generation costs (minimum to average costs).

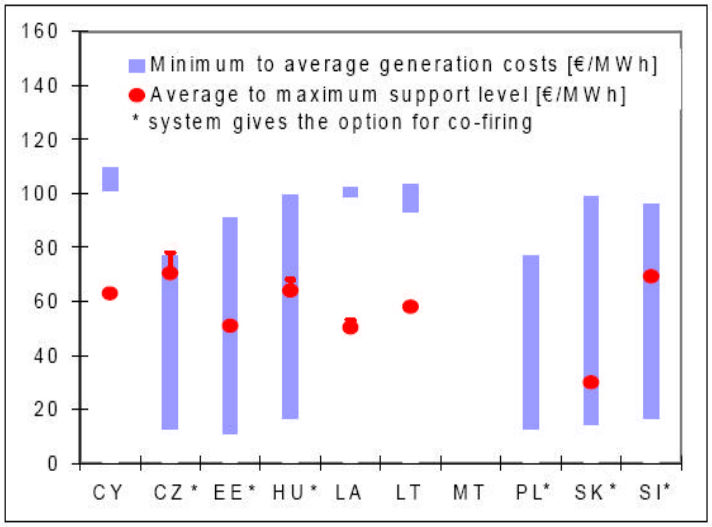


Figure 5 and Figure 6 show the effectiveness of RES support for electricity produced from **solid biomass**. The first conclusion is that, at EU-15 level, only a small part of the available potential was exploited on an annual basis during the period 1998-2003. The effectiveness indicator for solid biomass electricity is significantly lower that the one for wind exploitation. This confirms the conclusion of the Communication of May 2004 that the development of biomass electricity is lagging behind expectations at EU level.

Figure 5: Effectiveness indicator for biomass electricity in EU-15 Member States in the period 1998-2003. The relevant policy schemes during this period are shown in different colour codes.

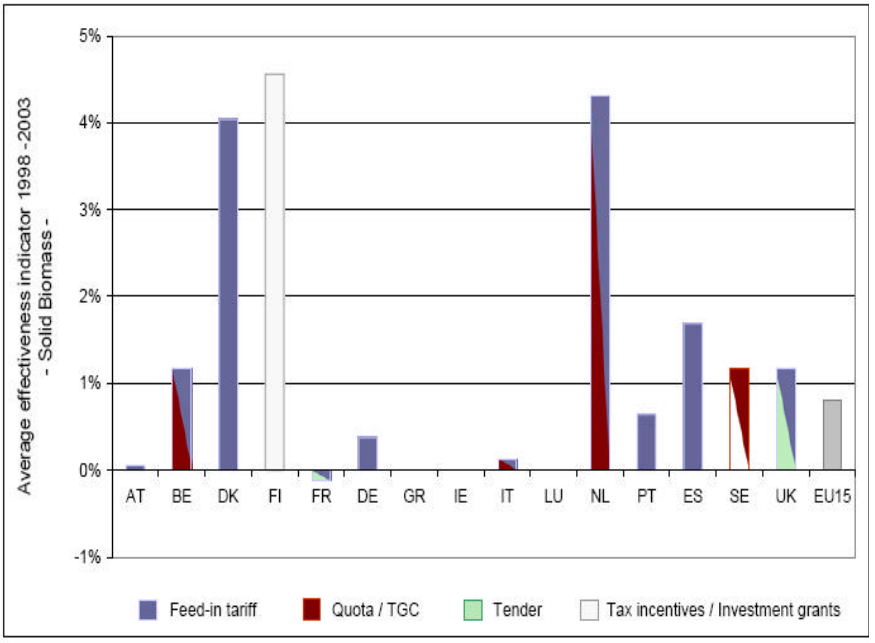
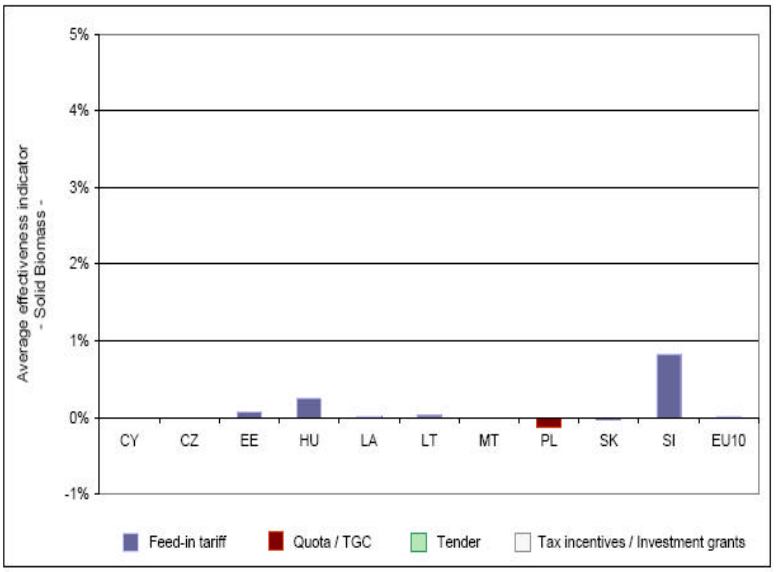


Figure 6: Effectiveness indicator for biomass electricity in EU-10 Member States in the period 1998-2003. The relevant policy schemes during this period are shown in different colour codes.



It must be clarified that, for Denmark, Figure 5 covers not only forest residues, but also straw, which represents half of their solid biomass market. The figure for the Netherlands also includes the co-firing of palm oil, which in 2003 represented 3% of the total solid biomass market.

Denmark saw strong growth in biomass until 2001 with large centralised CHP plants, initiated by the relatively high feed-in tariffs and a stable policy framework.

In the Netherlands, the partial tax exemption passed in July 2003 to a feed-in tariff system. Additional support was given by investment grants. Co-firing is the main technology in the Netherlands.

In Finland, the tax refund for forestry chips has been the main driver of market growth in recent years. An additional 25% investment incentive is available for CHP plants based on wood fuels. The key element in the success of this mix of tax relief and investment incentives is the important traditional wood and paper industry.

In 2002, Sweden switched from investment grants to a TGC system and tax refunds.

Austria and Germany have chosen a policy of medium and small–scale biomass installations, which has higher costs but is driven not only by energy policy but also by environment and rural development considerations.

The new German support system shows a larger gap between support and generation costs. This new level was adopted in August 2004. Effectiveness in the biomass forestry sector still needs to be demonstrated in this country.

The main barriers to the development of this RES-E source are both economic and infrastructural. Denmark, Finland and the Netherlands show the best effectiveness and a smaller gap between support and generation costs. Denmark and the Netherlands have implemented feed-in tariffs and Finland has tax relief as the main support scheme. The common characteristic in these three countries is that centralised power stations using solid biomass attract the largest share of RES-E investment.

Nevertheless, biomass features a large band of options, uses and costs. The promotion of large biomass installations should not ignore promising technology options with a significant potential for technology learning.

To conclude:

- In the United Kingdom, Belgium, Italy and to some extent Sweden, the level of support is just enough. Nevertheless, it looks like that the biomass sector is not yet able to cope with the risk of green certificate schemes.
- Denmark, Finland and the Netherlands show the best effectiveness and the smallest gap between support and generation costs. Denmark and the Netherlands have implemented feed-in tariffs and Finland has tax relief and 25% investment support. Centralised power stations using solid biomass attract the largest share of RES-E investment.

- In France, Greece, Ireland, Luxembourg, Portugal and Spain, the feed-in tariff support is not enough to bring about a real take-off in the biomass sector.
- Secondary instruments, especially small plant support and tax relief, are good catalysts for kicking off biomass. They also have the advantage of less interference with the wood market.
- CHP support is very good for biomass development, adding higher energy efficiency.
- Good management of agriculture and forest residues is an important factor for good biomass exploitation.

6 CASE STUDIES [1]

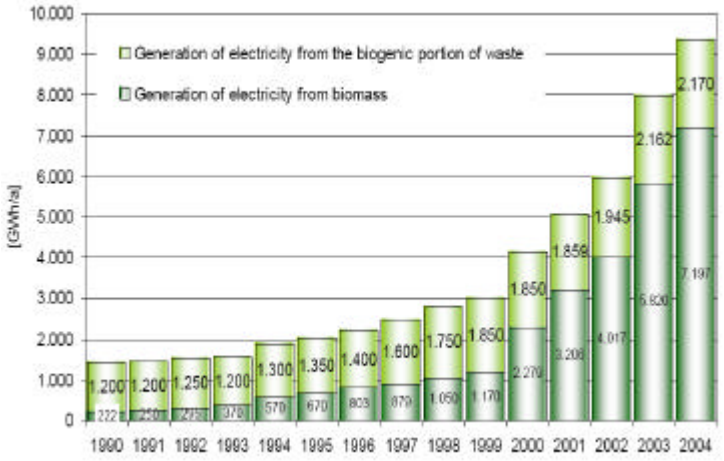
This section presents brief case studies discussing the bioenergy support mechanisms in place in the three EU Member States having the largest bioelectricity production i.e. Germany, Finland and Sweden. Finland and Sweden have supported biomass energy since decades and are worldwide frontrunners in modern bioenergy use. Germany has seen an impressive growth in bioelectricity production in recent years as a result of the renewable energy sources act issued in March 2000.

The dominating bioelectricity production support systems in the three countries vary considerably. In Germany a high feed-in rate is paid for qualifying bioelectricity. Depending on the feedstock, the technology and the valorisation of the generated heat a guaranteed price of up to 21.5 €ct/kWh is paid. In Finland bioelectricity is supported through a combination of energy taxation and biofuel provision support. In Sweden the combination of a high level of energy taxation and a quota obligation/green certificate supports bioelectricity generation. In all three countries bioelectricity generation support systems are complemented with investment subsides, bioenergy R&D support, information programmes etc.

6.1 Germany

In 2001, the German bioelectricity sector already accounted 1271 registered installations with a combined capacity of approx. 700MW$_e$ producing 2.4 TWh of bioelectricity. Since 2001 the contribution of bioelectricity has accelerated. At the end of 2004, there were 2280 biomass installations, including 110 biomass (heating and) power stations using solid biofuels, with an electrical capacity of approx. 810 MW$_e$; 2100 biogas installations (247 MW$_e$) and 150 district heating power stations (12 MW$_e$) fuelled by vegetable oil. All bio-energy plants combined produced approx 9.4 TWh. In 2004 biomass contributed 93% of the heat and around 17% of the power generated from renewables (BMU, 2005).

Figure 7: Development of bio-energy use in Germany, 1990-2004.



Source: BMU, 2005

[1] Loosely based on Bauen, 2004, supplemented with info from other sources

The large growth, particularly of installations <20MW$_e$ is the result of strong linkage between energy policy and climate protection programmes and economic incentives, making biomass an increasingly attractive renewable option. Key policies include:

- **Production support** through the renewable energy sources act ("EEG") of March 2000, which builds on the successful feed-in law ("StrEG") of 1991. Thee EEG guarantees the producer of renewable electricity a fixed feed-in tariff and obliges the grid operators to buy all the renewable electricity produced by plants fulfilling the EEG requirements. The feed-in tariffs are high, ranging from 8.4 to 21.5 €ct/kWh, and are guaranteed for 20 years (see Table 3). The update in 2004 brought the EEG into alignment with the Renewables Directive. The amendment also brought higher feed-in tariffs, specifically for small installations. Clarification of the required definition of biomass and approved processes are given in the Biomass Ordinance ("Biomasse Verordnung") of June 2001, last updated in August 2005 as a result of new EU provisions. Qualifying types of biomass include wood, specifically cultivated energy crops, biowaste, manure and other substances of plant and animal origin. Ecological tax reform, as a result of inter-ministry efforts to reduce CO_2 in 2000, introduced a step-wise increase in the prices of fossil fuels.

Table 3: EEG feed-in rates for German biomass plants put into operation in 2004.

Base payment rates	**Eurocent/kWh**
Up to 150 kW	11.5
Up to 500 kW	9.9
Up to 5 MW	8.9
Up to 20 MW	8.4
Bonuses	**Eurocent/kWh**
Biomass bonus until 0.5 MW	6
Biomass bonus 0.5-5 MW	4 (for wood: 2.5)
Innovative technology	2
Combined heat and power (cogeneration)	2

Note: For new plants the base payment is reduced each year by 1.5% starting 1.1.2005

- **Investment support** and cheaper credit through low interest loans from institutions such as the Kreditanstalt für Wiederaufbau (Credit Institute for Restructuring) and the Deutschen Ausgleichsbank (Federal service and special purpose bank for SME entrepreneurs) have been offered through a market incentive programme since 1999. These significantly improved the framework conditions for the use of biomass. Limited grants are available through various federal and regional institutions. Support targeted at renewable energy and rational use of energy has risen slowly over the last ten years with €100 million paid out from Federal sources in 2000. Regional efforts provide an additional 25-30%.
- **Market introduction measures** including credit guarantees administered through the regions received financial support in 2001 of ~€39.1million, those at a federal level totalled ~€91.5million. EU funding also contributes at a rate of about 35% for approved demonstration projects. Targeted support for R&D, always conditional on

high quality results, has proven well placed and a thriving home market and high quality technical capabilities are a strong basis for increasing exports.

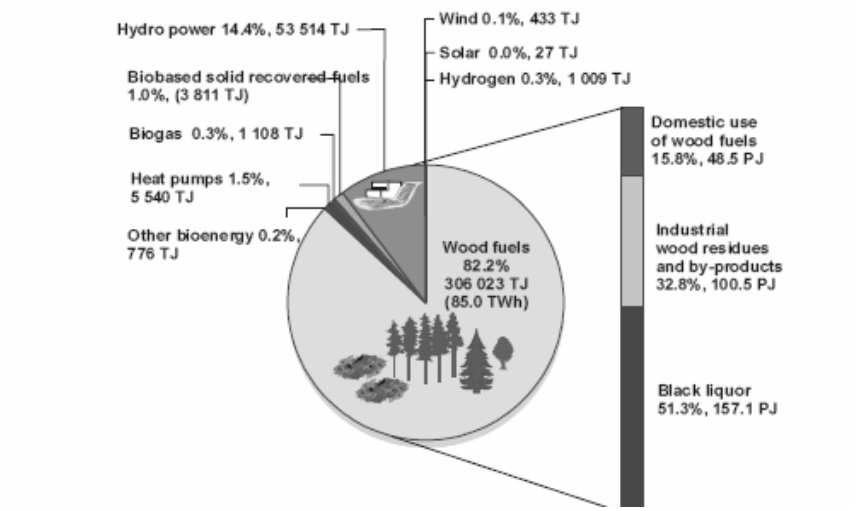
- **Research and development subsidies** play a key role in the development of new, innovative technologies.
- **Biomass Information Centres** also provide information on technologies, available resources and sources of financial support.
- Other measures at both federal and regional level, including standards work by the VDI (German Society of Engineers) are aimed at removing the non-technical barriers to the use of biomass for electricity generation.

6.2 Finland

Finland's extensive forests, totalling 24.4 million hectares, mean that it has significant biomass resource available as both by-product and wastes from its strong forestry, paper and pulp industries. In addition, these industrial activities utilise a good proportion of this resource as a local and highly desirable energy resource.

Renewable energy use in Finland is dominated by biomass, as is illustrated in Figure 8 Total use of renewables reached 372.2PJ (103.4 TWh) in 2004, equivalent to 25% of primary energy consumption.

Figure 8: Renewable energy sources, Finland (2004)



Finland's large installed bioelectricity capacity (1300 MW) and its very high percentage of total capacity (8.1%) show that this natural resource is being well used for bioelectricity. 50% of Finland's population is connected to a district heating network, some of these plants use biomass co-firing, and many of the plants produce, in addition to heat, a significant proportion of the local area's electricity needs.

However the high bioelectricity figures are also testament to the outcome of many years of targeted actions by the Finnish government. There exists a political will to increase national energy security, promote the industry and to meet Kyoto targets. This has been translated into successful public support measures, including:

- **National plan**. Political will supporting bioelectricity at the highest level is reflected in the existence of a national biomass strategy, launched in 1994. It was followed by a renewable energy action plan in 1999 with targets to increase the consumption of renewable energy sources 50% (from 3 to 6.1Mtoe) by 2010 compared with 1995 levels. In 2002 the Action Plan was updated and the 2010 target increased to 9.8 Mtoe, with 85% to be achieved by using biomass (see Figure 9).
- **Fiscal incentives**. Finland has a history of taxes that aid bioenergy uptake. In 1990 a CO_2 tax on fossil fuels was introduced. This was superseded in 1994 by a combined CO_2 and energy tax based on carbon content of the fuel with an exemption for renewable energy. The rate of taxation for fossil fuels used in heat generation is 18 €/t CO_2. Since 1997 electricity is taxed at the distribution level. At the same time production support (refund) for electricity produced from renewable sources was introduced. The production support amounts to 6.9 €/MWh for forest chips and 4.2 €/MWh for other wood (see Figure 10). Small scale <1MW plants are entitled to reduced VAT on plant purchases.
- **Fuel provision support:** a subsidy is available for harvesting energy wood from young stands. The subsidy is 6.7 €/m^3 solid (approx. 3.36 €/MWh) for harvesting and forest haulage plus 1.68 €/m^3 loose (approx. 1.87 €/MWh) for chipping.
- **Investment grants** for the implementation of biomass heating stations at farms (€ 6.3m per year during 2000-2006) and for the market introduction of new technology and to decrease CO_2 emissions (€31m for RES and energy conservation in 2003) are available. Biofuel heating and power plants can get max. 40% investment grant.
- **R&D investment** is provided mainly through Tekes, Finland's national technology agency, with companies offered part-funding for research (about 50%). Demonstration of new technology and systems and combining demonstration with research is promoted. This has assisted a thriving home and export industry especially in combustion technology and emissions control. Forestry and associated equipment is also successfully developed in Finland. For example, the Tekes wood energy technology programme (1999-2003, with Tekes funding €11.5m out of a total of €35m) was implemented to reduce the cost of wood chip supply by introducing mass-produced, purpose designed technology to enable transport of baled bundles instead of chips, with eventual chipping at the user site (i.e. the power plant). The overall aim of the programme was to increase the use of wood chips fivefold primarily in power plants, and to improve the quality of those wood chips.
- **Information programme**. Finland has several information/education mechanisms including regional energy management agencies. These operate on a local level to increase the use of renewable energy sources, energy conservation and energy efficiency through promotion of new energy-saving technologies and methods and the exchange of experience and know-how.

Figure 9: Targets set in the Revised Action Plan (2002) for Renewable Energy Sources

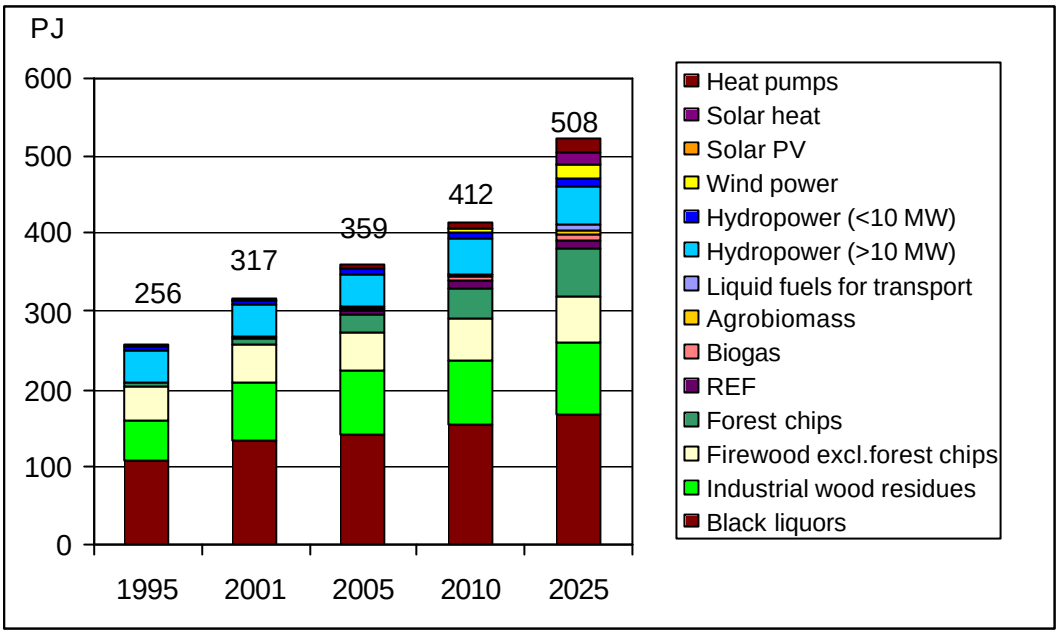
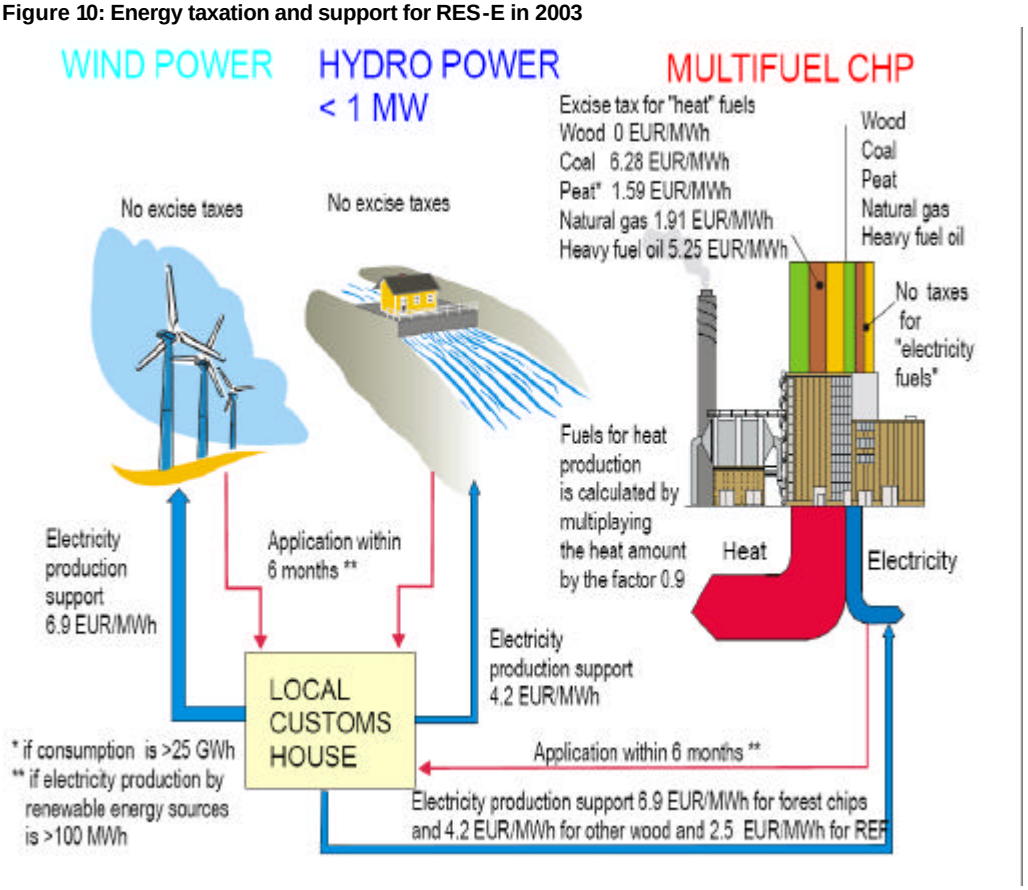


Figure 10: Energy taxation and support for RES-E in 2003



6.3 Sweden

The annual use of bioenergy in Sweden has increased from 40 TWh to 100 TWh in less than 30 years. Today bioenergy covers 17% of the total energy supply. The main users are the pulp and forestry industry, the district heating plants, detached houses and electricity production plant. The main drivers for this positive development have been the early implementation of CO_2-taxes, the increased use of black liquors in the pulp industry and the building of district heating networks in almost all towns. Today more than 50% of the district heating supply is covered by biomass and the use of wood fuels has more than quadrupled since 1990.

Many factors have influenced the success of bioenergy including Sweden's cold climate, well-established urban district heating, vast areas of forest and correspondingly large related industries, and a planned move away from nuclear power. In 2002 ~24 of the ~150 biomass fired DH plants operate on a CHP basis and combined with many industrial biomass fired plants resulted in 1508 MW_e installed bioelectricity generating capacity. This represents approx. 4.6% of total power generation capacity.

Key policy objectives that may lead to a further increase in bioelectricity use in future:

- The phasing-out of nuclear power
- Meeting the national indicative renewables targets of 60% in 2010.

Sweden also has a policy objective to replace electric domestic heating with CHP or district heating, preferable with biomass or natural gas fuelled CHP district heating.

Biomass use is well established and accepted in Sweden. Farmers and forest companies are supportive due to the extra income potential, and wood users e.g. sawmills benefit from an additional market for wood waste. In addition, high levels of environmental awareness in Sweden, especially regarding alternatives to fossil fuel energy sources make biomass and bioelectricity relatively acceptable to the public.

In the 1980s and 1990s, government funding for biomass RD&D amounted to some SEK 100 million (€10 million) per year, with funding also coming from electricity companies and other industries. Areas targeted include fuel production and supply, combustion and other conversion technologies, small-scale combustion and ash recycling.

Investment grants are available for up to 25% of investment in biomass-fired CHP.

Exemption from energy tax, CO_2 tax (approx. €0.39-0.64/kWh) and SO_x tax (approx. €0.11-0.21/kWh). Some coal fired CHP plants have changed to fire biomass as a direct result of the introduction of these taxes. Small generators (<25 GWh/y generated using all fuels) are exempt from a NO_x levy (currently at approx. €4.65/Kg NO_x).

In addition to these tax rebates, the economics of bioelectricity generation is improved vis-à-vis fossil fuel based generation in recent years as a result of the introduction of a quota obligation / green electricity certificate system in May 2003 and the introduction of the EU Emission Trading Scheme in January 2005.

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B. NATIONAL INDICATIVE TARGETS FOR RES-E

Table 4: National indicative targets for the consumption of electricity produced from RES

		RES-E TWh in 1997	RES-E %in 1997	RES-E % in 2010
EU 15	Austria	39.05	70.0	78.1
	Belgium	0.86	1.1	6.0
	Denmark	3.21	8.7	29.0
	Finland	19.03	24.7	31.5
	France	66.00	15.0	21.0
	Germany	24.91	4.5	12.5
	Greece	3.94	8.6	20.1
	Ireland	0.84	3.6	13.2
	Italy	46.46	16.0	25.0
	Luxembourg	0.14	2.1	5.7
	Netherlands	3.45	3.5	9.0
	Portugal	14.30	38.5	39.0
	Spain	37.15	19.9	29.4
	Sweden	72.03	49.1	60.0
	United Kingdom	7.04	1.7	10.0
EU 10	Cyprus	0.00	0.0	6.0
	Czech Republic	2.20	3.7	8.0
	Estonia	0.01	0.1	5.1
	Hungary	0.22	0.7	3.6
	Latvia	2.96	42.4	49.3
	Lithuania	0.42	4.0	7.0
	Malta	0.00	0.0	5.0
	Poland	1.96	1.6	7.5
	Slovakia	4.14	15.9	31.0
	Slovenia	3.32	31.1	33.6
EU 25		**353.64**	**12.9**	**21.0**

Source: European Commission, 2005a

Note: The reference year for EU-10 countries is 1999-2000 and not 1997.

C. PROPOSED MEASURES IN THE EU BIOMASS ACTION PLAN

Biomass for heating and electricity

The Commission will:

1. Work towards a proposal for Community legislation in 2006 to encourage the use of renewable energy, including biomass, for heating and cooling;
2. Examine how the directive on energy performance of buildings could be amended to increase incentives for the use of renewable energy;
3. Study how to improve the performance of household biomass boilers and reduce pollution, with a view to setting requirements in the framework of the eco-design directive; encourage district heating scheme owners to modernise them and convert them to biomass fuel;
4. Encourage Member States that apply a reduced VAT rate to gas and electricity to apply such a rate to district heating too;
5. Pay close attention to the implementation of the directive on electricity from renewable energy sources;
6. Encourage Member States to harness the potential of all cost-effective forms of biomass electricity generation;
7. Encourage Member States to take into account, in their support systems, the fact that, in combined heat and power plants, biomass can provide heat and electricity at the same time.

Transport biofuels

The Commission will:

1. Bring forward a report in 2006 in view of a possible revision of the biofuels directive. This report will address the issues of: (a) setting national targets for the share of biofuels; (b) using biofuels obligations on fuel suppliers; and (c) ensuring, through certification schemes, that the biofuels used to meet the targets satisfy minimum sustainability requirements.
2. Encourage Member States to give favourable treatment to second-generation biofuels in biofuels obligations.
3. Bring forward a legislative proposal promoting public procurement of clean and efficient vehicles, including those using high blends of biofuels.
4. Examine how biofuel use can count towards the CO2 emission reduction targets for car fleets.
5. Pursue a balanced approach in ongoing free trade agreement negotiations with ethanol producing countries/regions. The EU must respect the interests of domestic producers and EU trading partners, within the context of rising demand for biofuels.
6. Propose amendments to the “biodiesel standard” to facilitate the use of a wider range of oils, including imported oils, to produce biodiesel, and allow ethanol to replace methanol in biodiesel production.

7. Assess the impact of options to address the issues of limits on the content of ethanol, ether and other oxygenates in petrol; limits on the vapour content of petrol; and limits on the biodiesel content of diesel.
8. Ask the relevant industries to explain the technical justification for practices that act as barriers to the introduction of biofuels and monitor the behaviour of these industries to ensure that there is no discrimination against biofuels.
9. Support developing countries by helping them to produce biofuels and by maintaining market access conditions that are no less favourable than those provided by the trade agreements currently in force.
10. Bring forward a communication dealing specifically with biofuels early in 2006.

Cross-cutting issues

The Commission will:

1. Assess the implementation of the energy crop scheme.
2. Finance a campaign to inform farmers and forest holders about the properties of energy crops and the opportunities they offer.
3. Bring forward a forestry action plan in which energy use of forest material will play an important part.
4. Review the impact of the energy use of wood and wood residues on forest based industries.
5. Consider how the waste framework legislation could be amended to facilitate the use of clean wastes as fuel.
6. Review how the animal by-products legislation could be amended in order to facilitate the authorisation and approval of alternative processes for the production of biogas and other biofuels
7. Encourage the European Committee for Standardisation to speed up work on standards for the quality of biomass fuels.
8. Explore how to develop a European spot market in pellets and chips.
9. Encourage Member States to establish national biomass action plans.
10. Encourage Member States and regions to ensure that the benefits of biomass are taken into account when preparing their national reference frameworks and operational plans under the cohesion policy and the rural development policy.

Research

The Commission will:

1. Continue to encourage the development of an industry-led "Biofuel technology platform".
2. Consider how best to take forward research into the optimisation of agricultural and woody crops for energy purposes, and biomass to energy conversion processes.
3. Give a high priority to research into the "bio-refinery" concept, finding valuable uses for all parts of the plant.
4. Give a high priority to research into second-generation biofuels, with an aim of improving their efficiency and cost-effectiveness; a substantial increase in Community funding is expected.

D. INVENTORY OF SUPPORT SCHEMES FOR RES-E

Support for renewable electricity is now well established across the EU-15. Every member state provides a specific combination of price support through feed-in tariffs, obligations or competitive tenders, together with a wide range of capital subsidies and tax mechanisms.

The following main mechanisms are used across the EU:

(a) Capital subsidies, as a form of investment support for investments in bio-energy production capacity
(b) Feed-in tariffs, as a form of exploitation support per kWh of bioelectricity production. Feed-in systems may differ per country. In Germany, the system is grounded by legislation (law), while in the Netherlands, for example, the feed-in tariff actually is a subsidy
(c) Obligations in combination with and based on certificates, used by Belgium, the UK and Sweden
(d) Competitive tenders, where companies can bid on bio-energy production capacity to be developed / installed. The UK uses such a system
(e) Fiscal mechanisms, mainly as a form of investment support. Investment deductions are an important instrument in this context
(f) Bio-energy being exempted from taxes on fossil fuel. For example Finland uses this system successfully

Investment subsidy: Subsidies intended to help overcome the barrier of a high initial investment. This type of subsidy is commonly used to stimulate the sales of less economic RE technologies. Investment subsidies are usually 20-50% of eligible investment costs. Some EU countries support renewable electricity investments by means of the fiscal system. These schemes may take different forms, ranging from rebates on general energy taxes, rebates from special emission taxes, proposals for lower VAT rates, tax exemption for green funds, to fiscal attractive depreciation schemes. Investment subsidies can be effective if combined with other incentives as it is seen in the UK.

Fixed Feed-in Tariffs: Mechanisms based on fixed feed-in tariffs (FIT) have been widely adopted throughout Europe. Operators of biomass plants are paid a fixed price for every kWh of electricity they feed into the grid. The extra cost of the mechanism, if defined by the difference between the level of the tariff and the market price of electricity, is borne by the taxpayers or the electricity consumers.

The level of the feed-in tariff is commonly set for a number of years to give investors security on income for a substantial part of the project lifetime. If the value of the tariff remains constant, the amount of support will change as a result of changing wholesale electricity prices. Historically, feed-in tariffs have been the most effective mechanism, in terms of installed capacity, to encourage investments in renewable energy technologies.

FIT is not associated with a formal Power Purchase Agreement (PPA) and has no definite term. In principle, therefore, the level of the tariff can be changed at any time or removed by repealing the Law.

The main disadvantage of FIT is the risk that the government will reduce the tariff if biomass power becomes cheaper as the technology develops, or will not take action if a feed-in tariff is no longer sufficient to attract investments under the overall economic climate. Investors can only guess for how long the tariff will continue and at what level. As a result, investors in RES-E plant have to include a risk premium when planning the financial soundness of projects, which eventually leads to higher cost to the consumer than in a situation with less political risk.

Fixed premiums: A Fixed Premium or "Environmental Bonus" mechanism is often confused with fixed feed-in tariffs. However, there are fundamental differences between the two, especially in terms of its compatibility with conventional power markets. Rather than fixing the total price per kWh paid to the renewable electricity producers, government fixes a premium to be added to the electricity price. Thus, the total payment per kWh produced fluctuates with the level of the power price.

From the perspective of a biomass plant owner, the total price received per kWh (electricity price plus the premium) is less predictable than under a feed-in tariff, since the total changes with electricity market conditions. Being a variant of the FIT system, the political risks associated with fixed premium systems are similar.

Tendering systems / Auction: Developers of renewable electricity projects are invited to bid for a limited capacity or electricity production in a given period. The companies that bid to supply electricity at the lowest costs win the contracts to do so. Power purchase agreements (PPA) of 15-25 years duration are entered into. The difference in price between these contracts and the price of conventional power represents the additional costs of producing green electricity. Governments may choose to establish 'technology bands' in order to protect technologies from strong competition by lower cost options.

To work effectively, the model should be combined with a performance bond and meaningful penalties for failing to meet the contract. If designed correctly, tendering systems may work.

One of the main attractions of the model is that the PPA's that bidders compete for are enforced under civil law. From an investor risk perspective, long contracts are very attractive, since it minimises risk. A second attraction of a well-designed tendering system is that the government, (as well as electricity users and taxpayers) do not have to make best guesses about the cost development of producing biomass power. The political risk of not controlling subsidies with tendering systems is less than with fixed price systems. However, investors are faced with another risk element under tendering. All developers that enter a bid risk losing the planning costs if the bid is not accepted or if planning permission is not eventually given for the development project. Of course, other mechanisms can also have long-term contractual arrangements, which is always favourable.

Tradable Green Certificate Systems (TGC): A quota system setting a minimum amount or share of renewable electricity in the power mix. Demand for renewable

electricity is thus created, and it is up to the market forces to determine a price high enough to ensure continued development. Green certificates are issued to producers in proportion to their production. Green certificates represent the additional costs of producing renewable energy compared to the power price of conventional electricity sources. Certificates are sold on a separate financial market for green certificates. The electricity is sold on the conventional power market. In theory, the price of the certificate and the expected price of electricity will add up to long-term marginal cost of producing renewable electricity.

For biomass plant owners and their financiers, it is of paramount importance that any payment system allows reasonable certainty for cash flow projections. In support systems based on fixed price, this tends to be less of a problem. But with selling of both power and certificates on spot markets with fluctuating prices, it could become a problem, which increases the risk and thereby the cost of producing RES-E. Financial long-term contracts would limit this problem through the establishment of well-functioning futures or options markets. By selling electricity and certificates on long term futures or options contracts, the risk (and the price) can be reduced.

Table 5: Overview of the main policies for renewable electricity in EU-15 (status: 2005)

Country	Main electricity support schemes	Comments
Austria	Feed-in tariffs (now terminated) combined with regional investment incentives.	Feed-in tariffs have been guaranteed for 13 years. The instrument was only effective for new installations with permission until December 2004. The active period of the system has not been extended nor has the instrument been replaced by an alternative one.
Belgium	Quota obligation system / TGC combined with minimum prices for electricity from RES.	The Federal government has set minimum prices for electricity from RES. Flanders and Wallonia have introduced a quota obligation system (based on TGCs) with the obligation on electricity suppliers. In Brussels no support scheme has been implemented yet. Wind offshore is supported at federal level.
Denmark	Premium feed-in tariffs (environmental ladder) and tender schemes for wind offshore.	Settlement prices are valid for 10 years. The tariff level is generally rather low compared to the previously high feed-in tariffs.
Finland	Energy tax exemption combined with investment incentives.	Tax refund and investment incentives of up to 40% for w ind, and up to 30% for electricity generation from other RES.
France	Feed-in tariffs.	For plants <12 MW feed-in tariffs are guaranteed for 15 or 20 years (hydro and PV). For plants >12 MW a tendering scheme is in place.
Germany	Feed-in tariffs.	Feed-in tariffs are guaranteed for 20 years (Renewable Energy Act). Furthermore soft loans and tax incentives are available.
Greece	Feed-in tariffs combined with investment incentives.	Feed-in tariffs are guaranteed for 10 years. Investment incentives up to 40%.

Ireland	Tendering scheme. (will be replaced by a feed-in tariff Scheme)	Tendering schemes with technology bands and price caps. Also tax incentives for investment in electricity from RES.
Italy	Quota obligation system / TGC. A new feed-in tariff system for solar photovoltaic is valid since 5 August 2005.	Obligation (based on TGCs) on electricity suppliers. Certificates are only issued for new RES-E capacity during the first eight years of operation.
Luxembourg	Feed-in tariffs.	Feed-in tariffs guaranteed for 10 years (for PV for 20 years). Investment incentives also available.
Netherlands	Feed-in tariffs.	Feed-in tariffs guaranteed for 10 years. Fiscal incentives for investment in RES are available.
Portugal	Feed-in tariffs combined with investment incentives.	Investment incentives up to 40%.
Spain	Feed-in tariffs.	Electricity producers can choose between a fixed feed-in tariff or a premium on top of the conventional electricity price, both are available over the entire lifetime of a RES power plant. Soft loans, tax incentives and regional investment incentives are available.
Sweden	Quota obligation system / TGC	Obligation (based on TGCs) on electricity consumers. For wind energy, investment incentives and a small environmental bonus are available.
UK	Quota obligation system / TGC	Obligation (based on TGCs) on electricity suppliers. Electricity companies which do not comply with the obligation have to pay a buyout penalty. A tax exemption for electricity generated from RES is available (Levy Exemption Certificates which give exemption from the Climate Change Levy).

Source: European Commission, 2005a

Table 6: Overview of the main policies for renewable electricity in EU-10 (status: 2005)

Country	Main electricity support schemes	Comments
Cyprus	Grant scheme for the promotion of RES (since Feb 2004) financed through an electricity use tax of 0.22 E/kWh (since Aug. 2003).	Promotion scheme is fixed only for a 3-year period.
Czech Republic	Feed-in tariffs (since 2002) supported by investment grants. Revision/improvement of the tariffs in Feb 2005.	Relatively high feed-in tariffs with 15-year guaranteed support. Producer can choose between a fixed feed-in tariff and a premium tariff (green bonus). For biomass cogeneration, only the green bonus applies.
Estonia	Feed-in tariff system with purchase obligation	FIT paid for up to 7 years for biomass and hydro and up to 12 years for wind and other technologies. All support schemes are scheduled to end in 2015. Together with relatively low feed-in tariffs this makes renewable investments very difficult.
Hungary	Feed-in tariff (since Jan 2003) combined with purchase obligation and tenders for grants.	Medium tariffs (6 to 6.8 ct/kWh) but no differentiation among technologies. Actions to support RES are not coordinated, and political support varies. All this results in high investment risks and low penetration.
Latvia	Quota obligation system (since 2002) combined with feed-in tariffs.	Frequent policy changes and the short duration of guaranteed feed-in tariffs result in high investment uncertainty.
Lithuania	Relatively high feed-in tariffs combined with a purchase obligation. In addition good conditions for grid connections and investment programmes.	Closure of the Ignalina nuclear plant will strongly affect electricity prices and thus the competitive position of renewables as well as renewable support. Investment programmes limited to companies registered in Lithuania.
Malta	Low VAT rate for solar.	Very little attention to RES-E so far.
Poland	Green power purchase obligation (targets specified until 2010). In addition renewables are exempted from the (small) excise tax.	No penalties defined and lack of target enforcement.
Slovak Republic	Programme supporting RES and energy efficiency, including feed-in tariffs and tax incentives.	Very little support for renewables. The main support programme runs from 2000, but there is no certainty as to the time frame or tariffs. The low support, lack of funding and lack of longer-term certainty make investors very reluctant.
Slovenia	Feed-in system combined with long-term guaranteed contracts, CO_2 taxation and public funds for environmental investments.	None

Source: European Commission, 2005a

E. BIO-ELECTRICITY SUPPORT MECHANISM IN THE EU

Table 7: Bio-electricity support mechanisms in the EU-15 (status: early 2004)

Country	Dominating support mechanism for bioelectricity	Other instruments available
Austria	**Feed-in tariff:** for solid biomass and waste with large biogenic fraction: 10.2–16.0 ct/kWh (10–2 MW), 6.5 ct/kWh (hybrid plants); fuels incl. Biogenic wastes: 6.6 - 12.8 ct/kWh (10 - 2 MW), 4.0 - 5.0 ct/kWh (hybrid plants); liquid biomass < 200 kW 13.0 ct/kWh, >200 kW 10.0 ct/kWh; biogas 10.3 -16.5 ct/kWh; sewage and landfill gas 3.0 - 6.0 ct/kWh	Investment subsidy of about 30% on project basis
Belgium	**Green certificate/quota obligation system or minimum feed-in tariff**: minimum prices are for biomass 8 ct/kWh [EC 2004]/ 2.5 ct/kWh [Vri 2003]; projects implemented before 2003 receive support for 10 years	Fiscal measures and investment support schemes
Denmark	**Feed-in tariff**: a settlement price for solid biomass is 4 ct/kWh and it is guaranteed for a period of 10 years, additionally as a guarantee these plants receive 1 ct/kWh in compensation for an RE certificate; for biogas the settlement price is 4 ct/kWh and for waste 1 ct/kWh	Investment subsidies, political obligations have been imposed on power utilities to use certain amounts of biomass
Finland	**Energy tax refund** for biomass 4.2 €/MWh (0.42 ct/kWh)	Investment subsidy of 30% for new investments
France	**Feed-in tariff** guaranteed for 15 or 20 years: installations <12 MW for biomass: standard rate of 4.9 ct/kWh, premium up to 6 ct/kWh; sewage and landfill gas: standard rate of 5.5 ct/kWh, premium up to 6 ct/kWh; MSW standard rate of 3.5 ct/kWh, premium up to 4 ct/kWh; installations >12 MW tender system & feed-in tariff	Also investment compensation schemes in place
Germany	**Feed-in tariff** for biomass: 1) up to 0.15 MW 11.5 ct/kWh, 2) 0.15-0.5 MW 9.9 ct/kWh, 3) 0.5-5 MW 8.9 ct/kWh, 4) 5-20 MW 8.4 ct/kWh; Additional payments between 2 and 8 ct/kWh are possible under certain conditions, e.g. type of biomass fuel used, use in CHP plants etc.) Landfill and sewage gas: up to 500 kW 7.67 ct/kWh, 501 kW - 5 MW 6.65 ct/kWh. For new plants the quoted minimum tariffs are reduced each year by 1.5% starting 1.1. 2005.	Investment subsidy
Greece	**Feed-in tariff:** 7.8 ct/kWh on the islands and 7 ct/kWh on the mainland	Investment subsidies of about 30 (~50) %
Ireland	**Tendering/bidding scheme:** current biomass support level (bid price) is ranging 6.4 -7 ct/kWh (biomass 6.412 ct/kWh up to 8 MW, biomass-CHP 7.0 ct/kWh up to 28 MW and biomass-AD 7.0 ct/kWh up to 2 MW)	
Italy	**Tradable green certificate/quota system** with obligated targets: relatively favourable certificate prices up to 8.4 ct/kWh (certificates are only issued for plants with production >of more than 50 MWh/year)	Investment subsidies ranging within 30-40%

Luxembourg	**Feed-in tariff:** for biomass and biogas 2.5 ct/kWh up to 3 MW for a period of 10 years	Investment subsidy up to 40 % of investments possible
Netherlands	**Feed-in tariff:** tariffs for mixed biomass and waste (in 2005) 2.9 ct/kWh), pure biomass large scale: 7.0 ct/kWh, small-scale biomass <50 MWe: 9.7 ct/kWh)	Tax incentives (
Portugal	**Feed-in tariff: for biomass in 2003 were 6.2 ct/kWh**	Investment subsidies (generally 40% of the investment) and tax rebates available
Spain	**Feed-in tariff:** generally specified for plants up to 50 MW, installations built after 28.3.04 must choose either to sell electricity to distribution company (regulated tariff up to 6.7 ct/kWh) or to sell it freely in the market (full market option up to 7.1 ct/kWh); existing plants before 28.3.2004 may choose the transitory regime (with certain premiums, prices up to 7.2 ct/kWh) or be fully covered by the new regime set out by the Royal Decree 436/2004	Investment subsidies and fiscal instruments
Sweden	**Green certificate/quota system**: Electricity certificates were introduced in May 2003. The system has created an obligation for end-users to buy a certain amount of renewable certificates as part of their total electricity consumption (increasing to 17% in 2010). Non-compliance leads to a penalty which is fixed at 150% of a year's average price. To secure a smooth transition, price guarantees are available for producers up to 2007. Within the system prices will be settled by supply and demand. Forecasts show expected prices in the range of 1.3 – 1.6 ct/kWh for certificates traded.	Investment subsidy to CHP plants based on biomass (of about 330 €/kWe or a max. of 25% of the total capital cost of the project) + energy tax exemption for small-scale RES-E producers
UK	**Green certificates/quota obligation:** non-compliance penalty/'buy-out' price for 2003-3004 is set at approx. 4.5 - 4.8 € ct/kWh (GBP 30.51) + Climate Change Levy: RES-E is exempted from the CCL on electricity of appr. 0.63 ct/kWh (0.43 pc/kWh)	

Source: Source: Jäger-Waldau, 2004

Table 8: Bio-electricity support mechanisms in the EU-10 (status: early 2004)

Country	Dominating support mechanism for bioelectricity	Other instruments available
Cyprus	**Feed-in tariff:** for biomass, landfill and sewage: 6.3 ct/kWh (3.7 cyp. cent/kWh) (a fixed purchase price for RES is 6.3 ct/kWh (3.7 cyp. cent/kWh). In addition to that there is a special premium depending on the technology used from a Special Fund, financed by a levy on electricity consumption.	Financial incentives (grants covering 30-40% of the investment) for investments in biomass, landfill and sewage waste systems
Czech Republic	**Feed-in tariffs:** for RES-E and cogeneration (annually adjusted minimum tariffs), minimum prices for 2004: for biomass and biogas plants commissioned before 1.1.2004 7.69 ct/kWh; biomass co-firing (with coal) 6.15 ct/kWh; biogas after 1.1.2004 7.38 ct/kWh + tax exemption up to 5 years for RE investments (quota obligation/green certificate system might be introduced earliest from the beginning of 2005). (Ex. rate 1€ = 32.5 CZK)	Bonus for decentralised production: 0.06 ct/kWh on 110 kV, 0.08 ct/kWh on high voltage, 0.02 ct/kWh on low voltage; investment subsidies from different funds (e.g. for RES CHP)
Estonia	**Feed-in tariff:** 5,2 ct/kWh (electricity price for all renewable energy is 1.8 times the residential price), price is paid for 7 years for biomass: 4.86 ct/kWh	0% VAT for renewable energies
Hungary	**Feed-in tariff:** in 2004 18.25 HUF/kWh = 7.3 eurocents/kWh (exchange rate 1 € = 248.4 HUF), it is guaranteed until 2010 and without differentiation between technologies (peak and off-peak price are different)	Investment subsidies, VAT on energy is 25 %
Latvia	**Feed-in tariff:** currently for power plants using waste or biogas equals to the average electricity sales tariff for 8 years period (up to 7 MW, operation started by 1.1.2008) = 5.23 ct/kWh + support scheme for biomass CHP (using peat or wood, other biomass or biogas): remuneration <0.5 MWe 5.86 ct/kWh, 0.5-4 MW_e 4.97ct/kWh	Quota system for RES-E (annual capacity limits for the installation of RES-E generation) + long-term loans on favourable conditions for projects in private and public sectors
Lithuania	**Feed-in tariffs:** prices for electricity produced from renewable energy sources are set by Resolution No. 7 of 11 February 2002, for power plants using biofuel 20 LTLc/kWh = 5.7 - 5.8 ct/kWh (calculated with a rate 1€ = 3.45 LTL; waste collection included), for other power plants using RE or waste energy sources the price is set by separate decision	
Malta	**No support scheme**	
Poland	**Quota system:** power utilities are required to maintain a renewable energy portfolio (of at least 2.65 % in 2003, and 7.5% in 2010 and in the following years) (not currently supported by a scheme of green certificates trading)	Environmental funds (with grants and loans) supporting RES as well as low interest credits; tax relief in agricultural production related using RES

Slovak republic	**Feed-in tariffs:** tariff level for all RES recently at the level of 3 ct/kWh (3.03 - 3.51 ct/kWh (no differentiation between technologies)	Investment subsidies for RES projects + VAT reduction (proposed from 14% to 10% on all RES equipment)
Slovenia	**Feed-in tariff:** for biomass up to 1 MW 6.98 ct/kWh; biomass above 1 MW: 6.76 ct/kWh (valid from April 2002); the qualified producer can choose instead market price + bonus (for biomass 3.50 - 3.28 ct/kWh OR they can choose a time-of-delivery tariff (or bonus)	CO_2-tax introduced in 1996 amounts to 15 €/t CO2: 13.5 ct/kWh (3 SIT/kg CO_2)

Source: Source: Jäger-Waldau, 2004

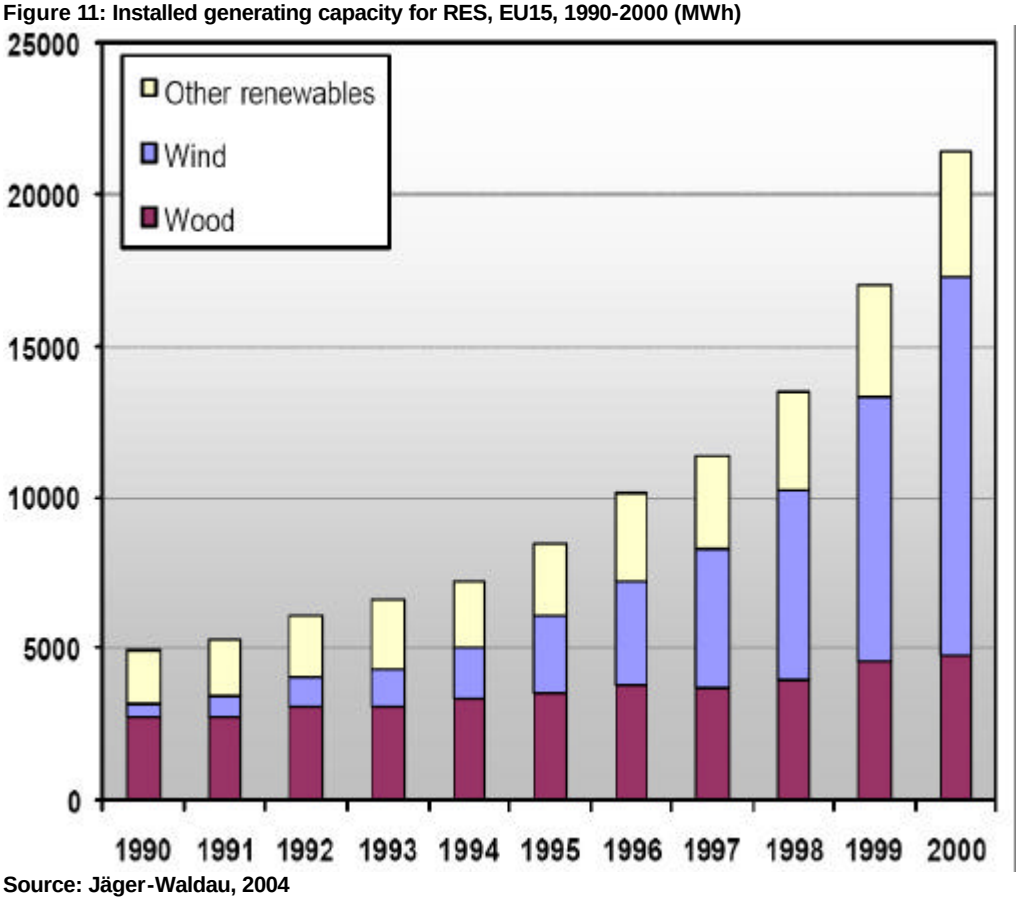
F. STATUS OF BIOELECTRICITY IN THE EU 25

The enlarged European Union consists of Member States with a variety of renewable energy mixes. Starting points of energy policies in Member States are often defined by domestic natural conditions, which differ largely across Europe. However, the differences between renewable energy use in Member States cannot be purely explained in terms of resource availability. Generally, new Member States have a considerable renewable energy and especially bioenergy potential, though most of it has remained untapped.

Current bioenergy use

Leading renewable energy sources in EU-25 are hydropower and biomass, whilst other types of renewables still represent a small share in energy production. For both EU-15 and EU-10 (= the 10 New Member States) the most significant contribution to the share of renewables from gross inland consumption over the period 1990-2000 was that of biomass, 62 % and 83 % respectively. In the EU-25, like in most OECD countries, production of bioelectricity is largely based on residues from forestry and wood processing industry. Agricultural residues and dedicated energy crops contribute significantly less to bioelectricity production.

Figure 11: Installed generating capacity for RES, EU15, 1990-2000 (MWh)

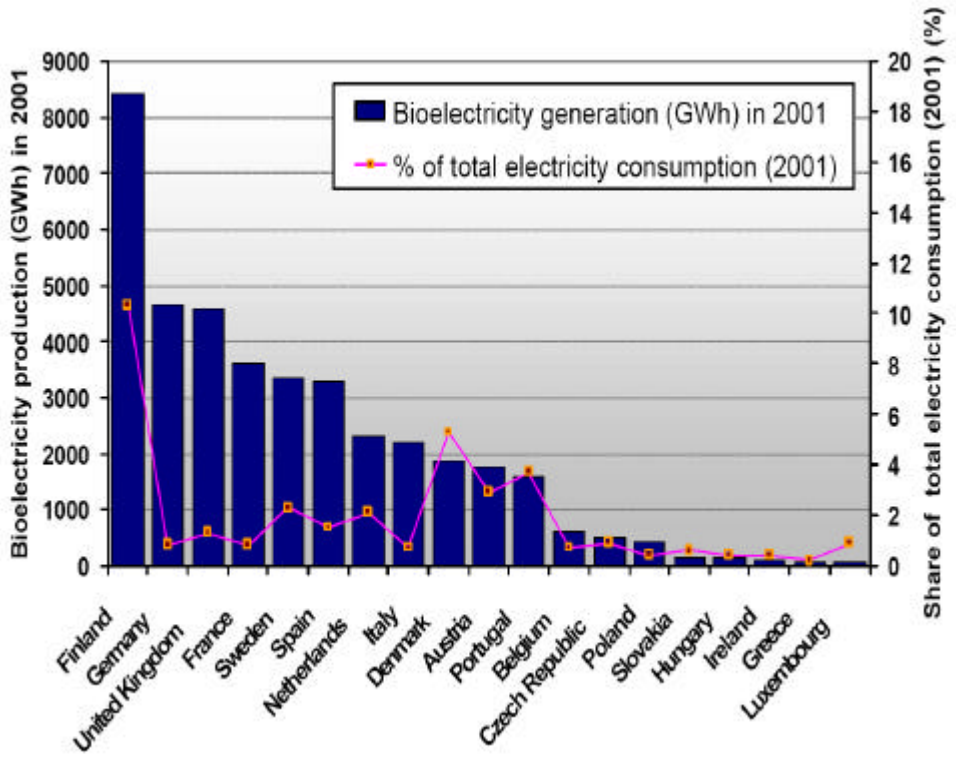


Source: Jäger-Waldau, 2004

The installed capacity for electricity generation from renewables in EU-15 increased by 21.7% between 1990 and 2000, mainly by wind power and wood-burning plants (Figure 11). Hydropower still clearly is the most dominant source of renewable energy, though the installed capacity of hydro plants increased only marginally in EU-15 in the 1990s. In the new EU New Member States other renewables than hydro represented just minimal or zero fraction of the installed capacity in the year 2000.

Leading bioenergy users in EU-15 are Finland, Sweden, Germany and France. The largest producers of electricity from biomass in 2001 amongst EU-15 were Finland, Germany, United Kingdom and France (Figure 12). In new Member States, the biggest amount of bioelectricity is generated by Czech Republic and Poland, though quantities are significantly smaller than in EU-15 countries.

Figure 12 Electricity production from biomass in 19 IEA Member States in 2001



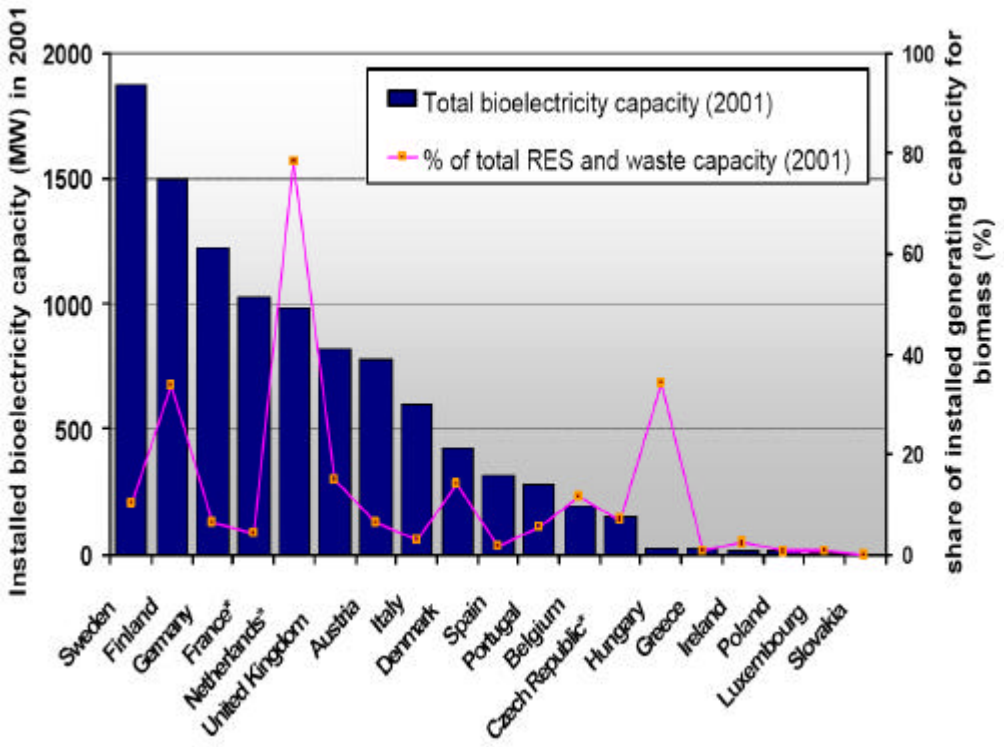
Source: Jäger-Waldau, 2004

There is a great variation in all Member States regarding the use of biomass and as already mentioned this is not necessarily related to natural resources of the country. In the new Member States, biomass contribution to electricity generation is far less than to heat production. Solid fuel wood is mostly used for heat production, e.g. in Latvia and Lithuania with small and generally inefficient domestic boilers. Electricity from biomass is mainly based on solid biomass and biogas, although its contribution to the total RES supply in each country is small. The majority of these countries have not yet established biofuel supply systems.

Bioelectricity capacity and production in the EU

The installed biomass generating capacity in EU-15 was 8,733 MW in 2001 representing 6.0% of the total installed capacity for RES and waste. Sweden, Finland and Germany have the largest capacity for biomass electricity production (Figure 13).

Figure 13 Installed bioelectricity capacity by country in 2001 in 19 IEA Member States



Source: Jäger-Waldau, 2004

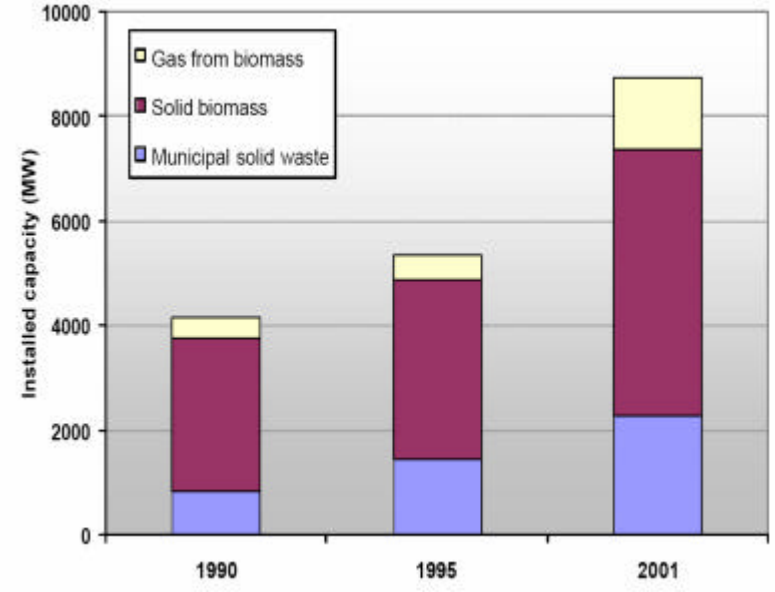
Bioelectricity capacity more than doubled amongst EU-15 between 1990 and 2001 (Figure 14). In 2001 bioelectricity production in EU-15 amounted to 28.3 TWh; combined with generation in New Member States of 12 TWh bioelectricity in EU-25 thus totalled 29.5 TWh. Bioelectricity's share of total electricity generation was 1.0% and bioelectricity contributed 6.9% of the total electricity generation from renewables in EU-25 (430 TWh in 2001).

In EU-15, biomass categories can be differentiated further: if renewable MSW is included, bioelectricity generation in 2001 totalled 38.5 TWh (Figure 13 shows per country account related to total electricity consumption in 2001), composition of which was 54.0% of solid biomass, 26.3% renewable MSW and 19.6% biogas.

Electricity production from biomass steadily increased between 1997 and 2002. However, growth in EU-15 is 59% compared to 102 % in four new Member States (Czech Republic, Hungary, Poland and Slovakia). Absolute amounts of generated bioelectricity are still very small in new Member States compared to EU-15 production.

In industrialised countries (IEA member countries), bioelectricity currently represents only a small fraction of electricity production, 126.6 TWh or 1.3% of total electricity production in 2001, but it has large growth potential.

Figure 14: installed capacity for bioelectricity by source, EU-15, 1990-2001.



Source: Jäger-Waldau, 2004

Solid biomass

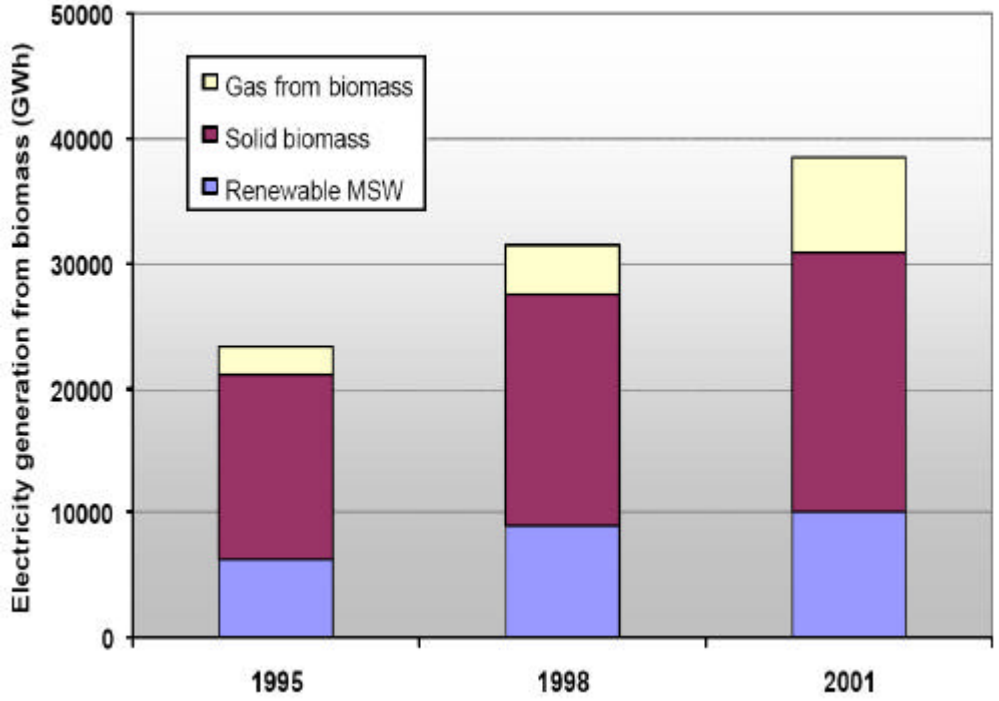
Electricity generation from solid biomass grew in EU-15 from 10.2 TWh_e to 20.8 TWh_e between 1990 and 2001, with an annual growth of 6.7% (Figure 15). Solid biomass accounted for 4.7% of renewable electricity generation and 54.0% of bioelectricity production in 2001. In the same year CHP plants produced most of the electricity from solid biomass (76.6%, electricity only plants therefore constituted 23.4%). The largest producer of electricity from solid biomass is Finland (8.2 TWhe in 2001), where it represents 37.3% of renewable electricity supply.

The electrical capacity for wood has increased gradually during the last decade. Figure 11 shows the trend compared to growing capacity of wind and other renewables in EU-15 between 1990 and 2000. Wood-burning capacity has grown by 74 % in 1990-2000, and average annual operating hours have simultaneously increased about 1000 hours. This is at least partly due to the fact that the use of solid biomass has increased in CHP plants and the overall output of electricity has grown. Capacity for solid biomass has grown 5.2% per year (Figure 14).

According to EurObserv'ER, electricity generated from wood (in EU-15) was 25.3 TWh in 2002. This accounted for approximately 59% of biomass generated electricity. The wood energy sector delivered over half of the primary energy production from renewables (44.06 Mtoe) in 2002, an increase of 2.7 % compared to the previous year, and contributed 12-14% of total electricity consumption in EU-15 countries.

Solid biomass is the leading source of bioelectricity in four new Member States (Czech Republic, Hungary, Poland and Slovakia). Czech Republic and Poland produce the largest amounts of electricity from solid biomass, totalling 381 GWh and 402 GWh, respectively in 2001.

Figure 15 Bioelectricity production by source in EU-15 between 1995 and 2001



Source: Jäger-Waldau, 2004