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COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, xxx  
COM(2006) 848 final

**COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE  
EUROPEAN PARLIAMENT**

**Renewable Energy Road Map**  
**Renewable energies in the 21st century: building a more sustainable future**

**{SEC(2006) zzzz}**

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# COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

## Renewable Energy Road Map Renewable energies in the 21st century: building a more sustainable future

### 1. INTRODUCTION

The EU and the world are at a cross-roads concerning the future of energy. Climate change, increasing dependence on oil and other fossil fuels, growing imports, and rising energy costs are making our societies and economies vulnerable. These challenges call for a comprehensive and ambitious response.

In the complex picture of energy policy, the renewable energy sector is the one energy sector which stands out in terms of ability to reduce greenhouse gas emissions and pollution, exploit local and decentralised energy sources, and stimulate world-class high-tech industries.

The EU has compelling reasons for setting up an enabling framework to promote renewables. They are largely indigenous, they do not rely on uncertain projections on the future availability of fuels, and their predominantly decentralised nature makes our societies less vulnerable. It is thus undisputed that renewable energies constitute a key element of a sustainable future.

The European Council of March 2006<sup>1</sup> called for EU leadership on renewable energies and asked the Commission to produce an analysis on how further to promote renewable energies over the long term, for example by raising their share of gross inland consumption to 15% by 2015. The European Parliament has by an overwhelming majority called for a 25 % target for renewable energies in the EU's overall energy consumption by 2020<sup>2</sup>

This Road Map, an integral part of the Strategic European Energy Review, sets out a long-term vision for renewable energy sources in the EU. It proposes that the EU establish a mandatory (legally binding) target of 20% for renewable energy's share of energy consumption in the EU by 2020, explains why it is necessary, and lays down a pathway for mainstreaming renewables into EU energy policies and markets. It further proposes a new legislative framework for the promotion and the use of renewable energy in the European Union. In doing so, it will provide the business community with the long term stability it needs to make rational investment decisions in the renewable energy sector so as to put the European Union on track towards a cleaner, more secure and more competitive energy future.

The objectives set out can only be achieved by significantly increasing the contribution from renewable energy sources in *all* Member States in electricity and transport and in the heating and cooling sector. The challenge is huge, but the proposed target can be achieved with determined and concerted efforts at all levels of government assuming the energy industry plays its full part in the undertaking.

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<sup>1</sup> Council Document 7775/1/06 REV10.

<sup>2</sup> European Parliament resolution of 14 December 2006.

Reaching the target will generate major greenhouse gas emissions savings, reduce annual fossil fuel consumption by over 250 Mtoe by 2020, of which approximately 200 Mtoe would have been imported, and spur new technologies and European industries. These benefits will come at an additional cost of between €10-18bn per year,<sup>3</sup> on average between 2005 and 2020, depending on energy prices. With a conducive regulatory framework, heavy investment has been made in the past in conventional energy sources, notably coal and nuclear energy. The time has now come to do the same for renewable energy sources.

Pursuing an ambitious Energy Policy for Europe, including a more vigorous and ambitious promotion of renewable energy sources, will require changes in policy. It will entail action at all policy and decision making levels. This Road Map sets out a framework for such action.

## 2. CURRENT CONTRIBUTION OF RENEWABLE ENERGY

In 1997, the European Union started working towards a target of a 12% share of renewable energy in gross inland consumption by 2010<sup>4</sup> representing a doubling of the contribution from renewable energies compared with 1997. Since then, renewable energies have increased their contribution by 55% in absolute energy terms<sup>5</sup>.

In spite of this progress, current projections indicate that the 12% target will not be met. The EU looks unlikely to reach a contribution from renewable energy sources exceeding 10% by 2010. The current contribution from renewable energy in each Member State is set out in the Annex.

There are several reasons for this. Even though the cost of most renewable energy sources is declining - in some cases quite dramatically - at the current stage of energy market development renewable sources will often not be the short term least cost options<sup>6</sup>. In particular, the failure to systematically include external costs in market prices gives an economically unjustified advantage to fossil fuels compared with renewables.

There are other important reasons why the EU will not meet its objectives for renewable energy. The complexity, novelty and decentralised nature of most renewable energy applications result in numerous administrative problems. These include unclear and discouraging authorisation procedures for planning, building and operating systems, differences in standards and certification and incompatible testing regimes for renewable energy technologies. There are also many examples of opaque and discriminating rules for grid access and a general lack of information at all levels including information for suppliers,

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<sup>3</sup> The additional costs range between €1.5 billion in 2006 to €2 and €31 billion in 2020 (Green-X model, least cost and Balanced scenario, 2006). A more detailed analysis of the cost and benefits related to attaining the objectives set forth in this Road Map is provided in the Commission Staff Working Document: Renewable Energy Road Map: Impact Assessment – SEC(2006)1719.

<sup>4</sup> COM(1997)599 final "Energy for the Future – Renewable Sources of Energy. White paper for a Community Strategy and Action Plan".

<sup>5</sup> From 74.3 Mtoe by 1995 up to 114.8 Mtoe of primary energy by 2005. For a detailed account of progress made in the use of renewable energy in the electricity and in the biofuels sectors, please see Communication from the Commission on the report on progress in renewable electricity COM(2006)849 and report on the progress made in the use of biofuels and other renewable fuels in the Member States of the European Union COM(2006)845.

<sup>6</sup> See section 4.3 for details.

customers and installers. All of these factors have contributed to inadequate growth in the renewable energies sector.

The development recorded so far is made up of generally patchy and highly uneven progress across the EU, highlighting that national policies have been inadequate for achieving the EU target. While ambitious policies creating investor certainty have been adopted in some Member States, national policies have proven vulnerable to changing political priorities. The absence of legally binding targets for renewable energies at EU level, the relatively weak EU regulatory framework for the use of renewables in the transport sector, and the complete absence of a legal framework in the heating and cooling sector, means that progress to a large extent is the result of the efforts of a few committed Member States. Only in the electricity sector has substantial progress been made, on the basis of the Directive on renewable electricity<sup>7</sup> adopted in 2001, and the targets set will almost be met. The differences in the regimes for electricity, biofuels and heating and cooling established at EU level are reflected in the development of the three sectors: clear growth in electricity, the recent start of solid growth in biofuels, and slow growth rates for heating and cooling (cf. figure 1).

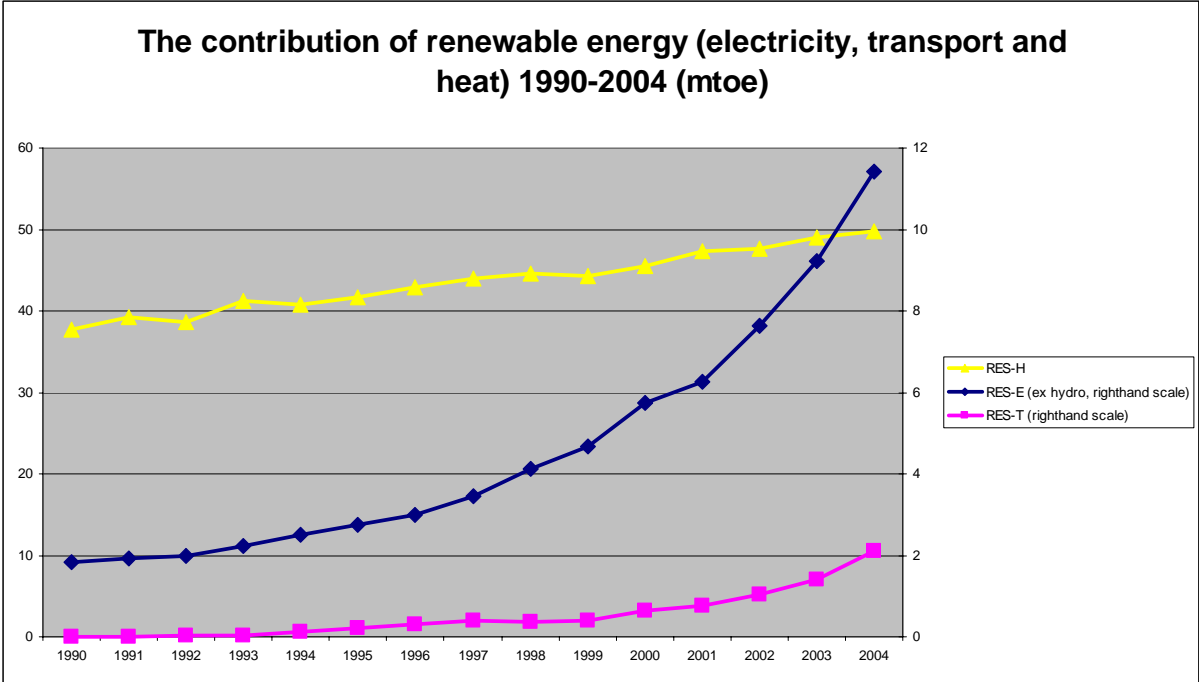


Figure 1: The contribution of renewable energy (electricity, transport and heat) 1990 -2004 (Mtoe)

As a further explanation, it should be noted that energy efficiency has not been as high as expected and that overall energy consumption therefore has been higher than expected. A considerably bigger contribution from renewable energy sources to reach the 12% target, which is expressed as a percentage of overall energy consumption (as opposed to a share of overall energy production) is thus required. Also, the fact that the 12% objective is expressed

<sup>7</sup> Directive 2001/77/EC on the promotion of electricity produced from renewable sources of energy in the internal market, O.J. L 283/33 of 27.10.2001.

as a percentage of primary energy, penalises the contribution of wind energy<sup>8</sup>, a sector which has experienced by far the most significant growth during the period in question.

A more detailed account of the situation in the various sectors is set out below.

## 2.1. Electricity

In accordance with Directive 2001/77/EC, all Member States have adopted national targets for the proportion of electricity consumption from renewable energy sources. If all Member States achieve their national targets, 21% of overall electricity consumption in the EU will be produced from renewable energy sources by 2010.

With current policies and efforts in place, and unless current trends change, the European Union will probably achieve a figure of 19% by 2010. While this can only be considered a partial success, the European Union will nonetheless come close to its target for renewable electricity by 2010. Since the last Commission report two years ago<sup>9</sup>, renewable electricity (non-hydro) has increased by 50%.

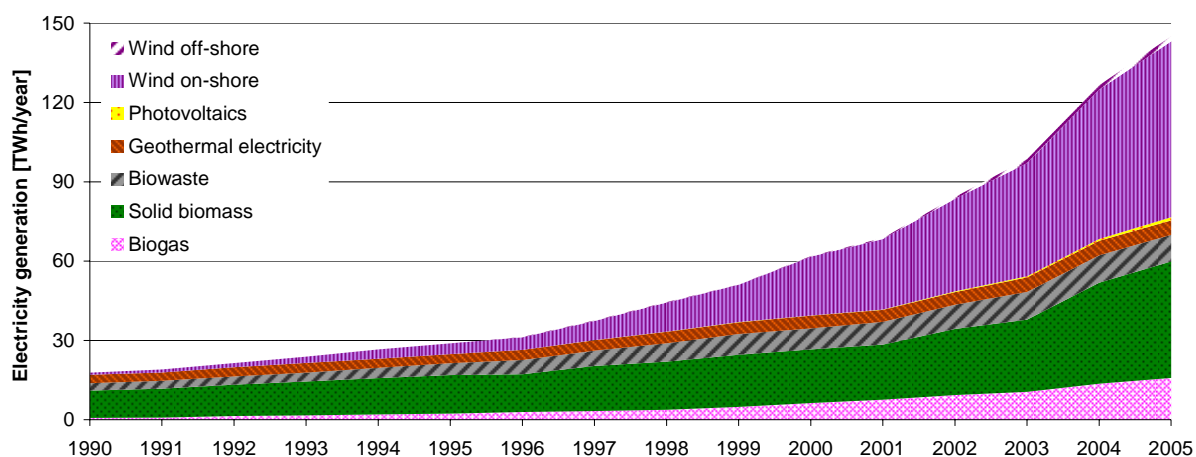


Figure 2: Non-hydro renewable electricity generation in EU-25 (1990-2005)

Nine Member States<sup>10</sup> are now fully on track to reach their target, with some of them reaching the target early. Wind energy, in particular, has made good progress and has broken through the target of 40 GW by 2010<sup>11</sup> five years ahead of schedule. Biomass electricity has gone from a yearly growth rate of 7% in previous years to 13% in 2003 and 23% in 2005. Biomass in 2005 contributed 70 TWh, which means a saving of 35 Mt of CO<sub>2</sub> and 14.5 Mtoe less fossil fuel consumption.

<sup>8</sup> When the target was established in 1997 it was expected that a much smaller proportion of it would be realised by the contribution of wind compared to biomass. As biomass is a thermal process and wind is not, one unit of final energy produced from biomass counts 2.4 times more than one unit of final energy produced from wind and counted in primary energy.

<sup>9</sup> COM (2004) 366 final, "The share of renewable energies in the EU".

<sup>10</sup> Denmark, Germany, Finland, Hungary, Ireland, Luxembourg, Spain, Sweden and the Netherlands.

<sup>11</sup> This 40GW target was set in the Commission's White Paper on Renewable Energy in 1996 (COM(1997)599 final). The European Wind Energy Association (EWEA) has now adjusted the target upward and has set a target of 75 GW for 2010.

Notwithstanding the progress made, this is not the time for self-congratulations. The majority of Member States are still significantly lagging behind in their efforts to achieve the agreed targets<sup>12</sup> Much more needs to be done.

## 2.2. Biofuels

Biofuels are the only available large scale substitute for petrol and diesel in transport. Given the precarious security of supply situation for oil (and thus for the transport sector), in 2003 the EU adopted the biofuels directive (2003/30/EC), with the objective of boosting both the production and consumption of biofuels in the EU. Since then the Commission has set out a comprehensive strategy for developing the biofuels sector.<sup>13</sup>

The biofuels directive established a reference value of a 2% share for biofuels in petrol and diesel consumptions in 2005 and 5.75% in 2010. This should be compared to their share of 0.5% in 2003. The indicative targets set by Member States for 2005 were less ambitious, equating to an EU share of 1.4%. The share achieved was even lower, at 1%. Progress was uneven, with only three Member States<sup>14</sup> reaching a share of more than 1%. One Member State, Germany, accounted for two thirds of total EU consumption.

In addition to the cost factor, there are three main reasons for the slow progress. First, appropriate support systems were not in place in most Member States. Second, fuel suppliers have been reluctant to use bioethanol (which accounted for only 20% of total biofuel consumption) because they already have an excess of petrol, and the blending of bioethanol with petrol makes this worse. Third, the EU regulatory framework for biofuels is underdeveloped, particularly in relation to the need for Member States to translate their objectives into action.

Member States are due to adopt national indicative targets for 2010 in 2007. Some have already done so. Most of these have followed the reference value set in the directive (a 5.75% share). Nevertheless, taking into account the disparities between the targets that Member States announced for 2005 and the low shares that many achieved, the 2010 target is unlikely to be achieved with present policies.

From a trade perspective, the EU maintains significant import protection on some types of biofuels, notably ethanol which has a tariff protection level of around 45% ad valorem. Import duties on other biofuels - biodiesel and vegetable oils - are much lower (between 0 and 5%).<sup>15</sup> If it would appear that supply of sustainable biofuels to the EU is constrained, the EU should be ready to examine whether further market access would be an option to help the development of the market.

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<sup>12</sup> The Commission has initiated infringement proceedings against six Member States for not fulfilling their obligations under the renewable electricity Directive.

<sup>13</sup> An EU Strategy for Biofuels (COM 2006/34 of 8.2. 2006).

<sup>14</sup> Germany, France and Sweden.

<sup>15</sup> It is at this stage unclear whether any worldwide liberalisation will take place in the near future that would reduce this protection, due to the uncertainties surrounding the World Trade Organisation Doha Round. Free Trade Area negotiations are ongoing in parallel, inter alia with Mercosur, where the question of increased access to our markets for certain competitive ethanol producers is under negotiation. ACP (Africa, Caribbean and Pacific) and least developed countries as well as countries benefiting from the EU's "GSP+" schemes (Generalised system of preferences) have unlimited duty-free access to the European market already.

In any event, the key EU trade policy challenge is to find ways to promote those international exports of biofuels that unambiguously contribute to greenhouse gas reduction and avoid rain forest destruction. In this respect, complementing the incentive/support system described in section 3.5 below, certification schemes elaborated together with exporting trading partners or producers could be a way forward. But this requires further study and discussion.

### **2.3. Heating and cooling**

The heating and cooling sector accounts for approximately 50% of overall EU final energy consumption and offers a largely cost-effective potential for using renewable energies, notably biomass, solar and geothermal energy. However, with renewables today accounting for less than 10% of the energy consumed for heating and cooling purposes, this potential is far from being exploited.

The Community has not so far adopted any legislation to promote heating and cooling from renewable sources. However, the 12% overall target for renewable energy sources set in 1997 created an implicit target for heating and cooling of an increase from approximately 40 Mtoe in 1997 to 80 Mtoe in 2010<sup>16</sup>. Whilst the directive on the promotion of cogeneration (the CHP Directive<sup>17</sup>) and the Energy Performance of Buildings Directive<sup>18</sup> promote efficient heating, renewable energy in heating has grown only slowly. Biomass use dominates renewable heating consumption and the bulk of this is in domestic wood heating. Little growth has occurred in the use of efficient wood-burning stoves and boilers, or biomass CHP (for industrial use), despite their potential for reducing emissions. Several European countries have promoted other types of renewable heating, with some success. Sweden, Hungary, France and Germany make the greatest use of geothermal heat in Europe; Hungary and Italy lead with low-energy geothermal applications. Sweden has the largest number of heat pumps. Solar thermal energy has taken off in Germany, Greece, Austria and Cyprus. That said, policies and practices vary widely across the EU. There is no coordinated approach, no coherent European market for the technologies, and no consistency of support mechanisms.

As a result of the inertia in the heating and cooling sector, even where some of the technologies are cost competitive, the lack of an appropriate policy including targets and the inability to remove administrative barriers and provide consumers with information on available technologies and inadequate distribution channels very little progress has been achieved in this sector. As a consequence, the contribution that the heating sector should have provided towards meeting the 12% overall renewable target in 2010 is insufficient.

### **2.4. Overall progress towards reaching the targets for renewable energy**

The 12% target for the contribution from renewables to overall EU energy consumption by 2010 is unlikely to be met. Based on current trends, the EU will not exceed 10% by 2010. This can only be considered a policy failure and a result of the inability or the unwillingness to back political declarations by political and economic incentives. Furthermore, the progress that has been achieved is largely due to efforts made by a relatively small number of Member States. This is not equitable and risks distorting the functioning of the internal market.

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<sup>16</sup> Based on the targets for electricity and biofuels, heating would have to contribute 80 Mtoe by 2010 in order for the 12% overall renewable energy target to be met.

<sup>17</sup> Directive 2004/8/EC on the promotion of cogeneration (OJ L52/50, 21.2.2004).

<sup>18</sup> Directive 2002/91/EC on energy performance of buildings (OJ L1/65, 4.1.2003).

The European Union has made most progress in the electricity sector. Here, with policies and measures currently in place, the European Union will probably achieve a share of 19% in 2010. However, progress has been uneven across the EU, with Member States with a stable regulatory framework performing best.

In transport biofuels, there has been some progress, particularly since the adoption of the Directive, but not enough to reach the targets adopted. In the use of renewable energy sources for heating and cooling there has been hardly any progress since the 1990s.

### **3. THE WAY FORWARD**

For renewables to become the "stepping stone" to reaching the dual objective of increased security of supply and reduced greenhouse gas emissions, it is clear that a change in the way in which the EU promotes renewables is needed. Strengthening and expansion of the current EU regulatory framework is necessary. It is, in particular, important to ensure that all Member States take the necessary measures to increase the share of renewables in their energy mix. Industry, Member States, the European Council and the European Parliament have all called for an increased role for renewable energy sources as stated in the introduction. This section explores a possible way forward to achieve this

#### **3.1. The principles**

On the basis of the experience gained, a number of key principles for the future renewable energy policy framework need to be established. With a view to significantly increase the share of renewable energy sources in the EU's energy mix, the Commission considers that such a framework should:

- be based on long term mandatory targets and stability of the policy framework
- include increased flexibility in target setting across sectors
- be comprehensive, notably encompassing heating and cooling
- provide for continued efforts to remove unwarranted barriers to renewable energies deployment,
- take into consideration environmental and social aspects
- ensure cost-effectiveness of policies, and
- be compatible with the internal energy market.

#### **3.2. An overall EU target**

A policy on renewable energies is a cornerstone in the overall EU policy for reducing CO<sub>2</sub> emissions. Since the 1990s the EU has taken various measures aimed at promoting renewable energy, be it in the shape of technology programmes or specific policy initiatives. Policy measures have been adopted in the form of targets, either in a political context such as the 12% renewables target of 1997, or under sector-specific legislation, such as the biofuels and renewable electricity Directives, which also provide a set of measures aimed at facilitating the achievement of the targets set.

In many sectors of the economy, targets are used to provide clarity and stability to industry, to allow them to plan and invest with a higher degree of certainty. Providing targets at the European level augments this stabilising impact: EU policy generally has longer time horizons and avoids the destabilising effects of short term domestic political changes. To be effective, targets have to be clearly defined, focussed and mandatory. The "12% renewables" target is a good political target, but has proven insufficient to develop the renewable energy sector.

The Commission believes that an overall legally binding EU target of 20% of renewable energy sources in gross inland consumption by 2020 is feasible and desirable. Such a share would be fully in line with the level of ambition expressed by the European Council and by the European Parliament.

### **3.3. A target for biofuels**

Biofuels cost more than other forms of renewable energy. But they are currently the only form of renewable energy which can address the energy challenges of the transport sector, including its almost complete reliance on oil and the fact that greenhouse gas reductions in this sector are particularly difficult to obtain. Therefore the Commission proposes to include, in the new framework, legally binding minimum targets for biofuels. A clear indication of the future level of these targets is needed now, because manufacturers will soon be building vehicles that will be on the road in 2020 and will need to run on these fuels.

The minimum target for biofuels for 2020 should, on the basis of conservative assumptions, related to the availability of sustainably produced feedstocks, car engine and biofuel production technologies, be fixed at 10%<sup>19</sup> of overall consumption of petrol and diesel in transport.

To ensure a smooth implementation of this target, the Commission, in parallel, intends to propose the appropriate modifications to the fuel quality directive (98/70/EC) including the means of accommodating the share of biofuels.

### **3.4. National targets and Action Plans; putting policy into practice**

Given the largely national basis for support measures in renewable energy, the overall EU target will need to be reflected in mandatory national targets. The contribution of each Member State to achieving the Union's target will need to take into account different national circumstances. Member States should have flexibility to promote the renewable energies most suitable to their specific potential and priorities. The precise way in which Member States plan to achieve their targets should be set out in National Action Plans to be notified to the Commission. These Action Plans should contain sectoral targets and measures consistent with achieving the agreed overall national targets, demonstrating substantial progress compared to the agreed 2010 renewable energy targets. In implementing the national targets in practice, Member States will need to set their own specific objectives for electricity, biofuels and heating and cooling, which would be verified by the Commission to ensure that the overall target is being met.

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<sup>19</sup> The Impact Assessment prepared for this Road Map, SEC(2006)1719 and the Commission Staff Working Document accompanying the Biofuels Progress Report SEC(2006)1721 analyse the impact of various biofuel shares. The Impact Assessment explains why a 10% share in 2020 is appropriate.

Proposals for legislation on the overall target and the minimum target for biofuels, together with provisions to facilitate a higher uptake of renewable energies in the three sectors, including the necessary monitoring mechanisms will be put forward in 2007. This process should ensure that the overall EU target is met in a fair and equitable manner and should clearly strengthen the existing political and legal framework.

*How do we get there?*

*The share of renewable energy in overall energy consumption has been growing, but too slowly. Having carefully examined the feasibility and the technical and economic potential including variant breakdowns between the renewable energy subsectors, the Commission has come to the conclusion that the overall objective of a 20% contribution of renewable energy to the EU energy mix is possible and necessary. Meeting this target will require a massive growth in all three renewable energy sectors, but it is feasible<sup>20</sup>.*

*Electricity production from renewables could increase from the current 15% to approximately 34% of overall electricity consumption in 2020. Wind could contribute 12% of EU electricity by 2020. One third of this will more than likely come from offshore installations. This is feasible, for example, currently 18% of electricity consumption is covered by wind in Denmark. In Spain and Germany this is 8% and 6% respectively. The biomass sector can grow significantly using wood, energy crops and bio-waste in power stations. The remaining novel technologies, i.e. photovoltaic (PV), solar thermal power, wave & tidal power, will grow more rapidly as their costs come down. PV costs, for example, are expected to fall by 50% by 2020. An illustration of a projection for the electricity sector is set out in the annex.*

*To meet the overall target in 2020, the contribution from renewables in the heating and cooling sector could more than double, compared with the current share of 9%. Most of the growth could come from biomass and will involve more efficient household systems and highly efficient biomass-fired combined heat and power stations. The rest could come from geothermal and solar installations. Sweden for example has over 185,000 installed geothermal heat pumps, half of the total number installed in Europe. If the rest of the Union followed this rate of installation, geothermal sources would provide a further 15 Mtoe in Europe. Similarly, German and Austrian levels of solar heating installations applied across the EU could lead to a contribution of 12 Mtoe. In other words, a large proportion of the targets can be reached by applying current best practices. An illustration of a projection for the heating and cooling sector is set out in the Annex.*

*Biofuels could contribute 43 Mtoe, corresponding to 14% of the market for transport fuels. The growth would come both from bioethanol (which in Sweden has already achieved a 4% share of the petrol market and in Brazil, the world leader, more than 20%) and from biodiesel, which in Germany, the world leader, has already achieved a 6% share of the diesel market. Domestically grown cereals and tropical sugar cane would be the main ethanol feedstocks, later complemented by cellulosic ethanol from straw and wastes. Rapeseed oil, both domestically grown and imported, would remain the main biodiesel feedstock, complemented by smaller quantities of soy and palm oil and later by second-generation biofuels, i.e. Fischer-Tropsch diesel mostly from farmed wood.*

<sup>20</sup>

The impact assessment for this Road Map SEC(2006)1719 provides the details of the different costs, feasibility, sensitivities and compares scenarios including different mixes of renewable energies. The approach followed here, called the "Green-x balanced scenario", is discussed in the Impact Assessment.

### 3.5. Promotional policies and flanking measures

In addition to the legislative measures outlined above and their application by Member States, the Commission will take the following action:

- propose strengthening the legal provisions to **remove any unreasonable barrier** to the integration of renewable energy sources in the EU energy system. Conditions for grid connections and extensions must be simplified. Some Member States have a panoply of permission procedures to be complied with in order to construct renewable energy systems. This must be reduced. Building codes normally ignore renewable energies. Red tape for innovative small and medium-sized enterprises must be eliminated. To this effect, the Commission will continue to stringently apply the Renewable Electricity Directive;
- propose legislation to address the barriers to growth in the use of renewable energies in the heating and cooling sector including administrative obstacles, inadequate distribution channels, inappropriate building codes and lack of market information;
- take further action to improve the functioning of the internal electricity market considering the development of renewable energies. Improved transparency, unbundling, higher inter-connectors capacity, all improve the opportunity for new innovative renewable energy players to enter the market;
- re-examine, in 2007, the situation concerning Member States' **support systems for renewable energies** with a view to assessing their performance and the need to propose harmonising support schemes for renewables in the context of the EU internal electricity market. While national schemes for renewable energy in electricity may still be needed for a transitional period until the internal market is fully operational, harmonised support schemes should be the long term objective;
- promote a proposal for an incentive/support system for biofuels that, for instance, discourages the conversion of land with high biodiversity value for the purpose of cultivating biofuel feedstocks; discourages the use of bad systems for biofuel production; and encourages the use of second-generation production processes;
- continue to promote the use of renewable energy sources in public procurement for fostering clean energies, in particular with regard to transport;
- continue to pursue a balanced approach in ongoing free trade negotiations with ethanol-produced countries/regions, respecting the interests of domestic producers and EU trading partners, within the context of rising demand for biofuels;
- continue to co-operate closely with grid authorities, European electricity regulators and renewable industry to enable a **better integration of renewable energy sources into the power grid**, with particular attention paid to the special requirements related to much larger deployment of off-shore wind energy, notably as regards cross-border grid connections. Opportunities provided by the TEN-E scheme should be examined and work on a European offshore super-grid should be initiated;
- exploit fully the possibilities offered by the Community's **financial instruments** – notably the Structural and Cohesion funds, the Rural Development funds, and the financial support

made available through the Community's international co-operation programmes to support the development of renewable energy sources in the EU and beyond;

- continue to promote the exchange of best practices on renewable energy sources, using different information and debate platforms, such as the existing Amsterdam Forum<sup>21</sup>. In the context of the Commission initiative on Regions for Economic Change, the Commission will also establish networks of regions and cities to boost the sharing of best practices for sustainable energy use.
- continue to internalise external costs of conventional fossil energy (*inter alia* by means of energy taxation) ;
- reap all the opportunities offered for renewable energy by the result-oriented actions of the forthcoming **European Strategic Energy Technology Plan (SET-Plan)**;
- promote the use of renewable energy sources in its external energy policies<sup>22</sup> and favour opportunities for sustainable development in developing countries;
- fully implement the Biomass Action Plan adopted by the Commission in December 2005<sup>23</sup>. Biomass offers great potential and major benefits in other Community policies;
- continue to use the **Intelligent Energy for Europe** programme to help bridge the gap between successful demonstration of innovative technologies and effective market entrance to achieve mass deployment and to boost large-scale investment across the EU in new and best performing technologies and to ensure that renewable energy is given the highest priority in the sustained efforts to maximise the use of the **EU research and technology development** programmes in support of zero- or low carbon energy technologies whilst developing synergies with Member States involved in similar development.

In addition to these Commission initiatives, it should be underlined that Member States, regional and local authorities have to make a significant contribution towards increasing the use of renewables. Currently, Member States use various policy tools to promote renewables, including feed-in tariffs, premium systems, green certificates, tax exemptions, obligations on fuel suppliers, public procurement policy and research technology and development. To make progress towards the proposed new targets, Member States will have to make further use of the range of policy instruments at their disposal, in compliance with the provisions of the EC Treaty.

Member States and/or local and regional authorities are in particular called upon to:

- ensure that authorisation procedures are simple, rapid and fair with clear guidelines for authorisation including as appropriate, appointing one-stop authorisation agencies responsible for coordinating administrative procedures related to renewable energy sources;

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<sup>21</sup> <http://www.senternovem.nl/amsterdamforum/>

<sup>22</sup> It is noteworthy that actions plans agreed in the context of the European Neighbourhood Policy already include actions to this effect.

<sup>23</sup> COM(2005)628.

- improve pre-planning mechanisms whereby regions and municipalities are required to assign suitable locations for renewable energies;
- integrate renewable energies in regional and local plans.

#### **4. ASSESSMENT OF THE IMPACT OF ACHIEVING THE TARGET FOR RENEWABLES.**

The impact assessment, which accompanies this Road Map, provides a detailed account of the various impacts of the measures set out above and compares the impacts of various alternative policy options.

This section of the Road Map provides a brief overview of the findings.

##### **4.1. Impact on greenhouse gas emissions and other environmental impacts**

The importance of climate change has never been greater. The Environment Council of 10<sup>th</sup> March 2005 concluded that "reduction pathways by the group of developed countries in the order of 15-30% by 2020 compared to the 1990 baseline envisaged in the Kyoto Protocol should be considered."

Greenhouse gas emissions, including CO<sub>2</sub> emissions, from renewable energy sources are either low or zero. Increasing the share of renewables in the EU fuel mix will therefore result in significantly lower greenhouse gas emissions. The additional renewable energy deployment needed to achieve the 20% target will reduce annual CO<sub>2</sub> emissions in a range of 600-900 Mt in 2020<sup>24</sup>. Considering a CO<sub>2</sub>-price of 25 €/per tonne<sup>25</sup>, the additional total CO<sub>2</sub> benefit can be calculated at a range of €150-€200 billion. Actual CO<sub>2</sub> prices will depend on the future international climate regime. The breakdown of the CO<sub>2</sub> emissions avoided is set out in the annex.

Replacing fossil fuels also has generally positive air quality benefits. These are especially positive in the electricity sector.

##### **4.2. Security of energy supply**

Renewable energy contributes to security of supply by increasing the share of domestically produced energy, diversifying the fuel mix, diversifying the sources of energy imports and increasing the proportion of energy obtained from politically stable regions. The EU will strengthen its position on all these measures of security of supply if it achieves the proposed share of renewable energy. Benefits are seen in all sectors and are particularly marked in transport. One way to sum up the benefits is to look at the quantity of fossil fuels displaced by renewable energies. Assuming the EU achieved 20% deployment of renewables, the annual reduction in fossil fuel demand can be calculated to be 252 Mtoe from 2020 onwards. This figure is equivalent to the total combined energy consumption of the UK, Latvia and Lithuania. About 200 Mtoe of this saving would come from imports, including 55 Mtoe of oil and 90 Mtoe of gas, predominantly from the Middle East and CIS countries.

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<sup>24</sup> Source: Green-X model, balance scenario and. Energy Economics Group, Fraunhofer ISI, Ecofys and PRIMES model. See Commission Staff Working Document: Renewable Energy Road Map: Impact Assessment – SEC(2006)1719.

<sup>25</sup> Actual market prices (for 2006 EU Allowances) have fluctuated between 7 and 30 €/t in the period January-July 2006, with averages fluctuating roughly between 15 and 20 €/t.

### 4.3. Cost and competitiveness

In contrast to conventional energy sources, there has been a continued and significant reduction in the cost for renewables over the last 20 years. As an example, the cost of wind energy per kWh has fallen by 50% over the last 15 years while at the same time the size of the turbines has increased by a factor of 10. Solar photovoltaic systems today are more than 60% cheaper than they were in 1990.

Despite this, as stated in section 2, the cost of renewable energies varies significantly according to the resource base and the technologies concerned, but generally still exceeds that of conventional energy sources at present. This is illustrated in the graph below.

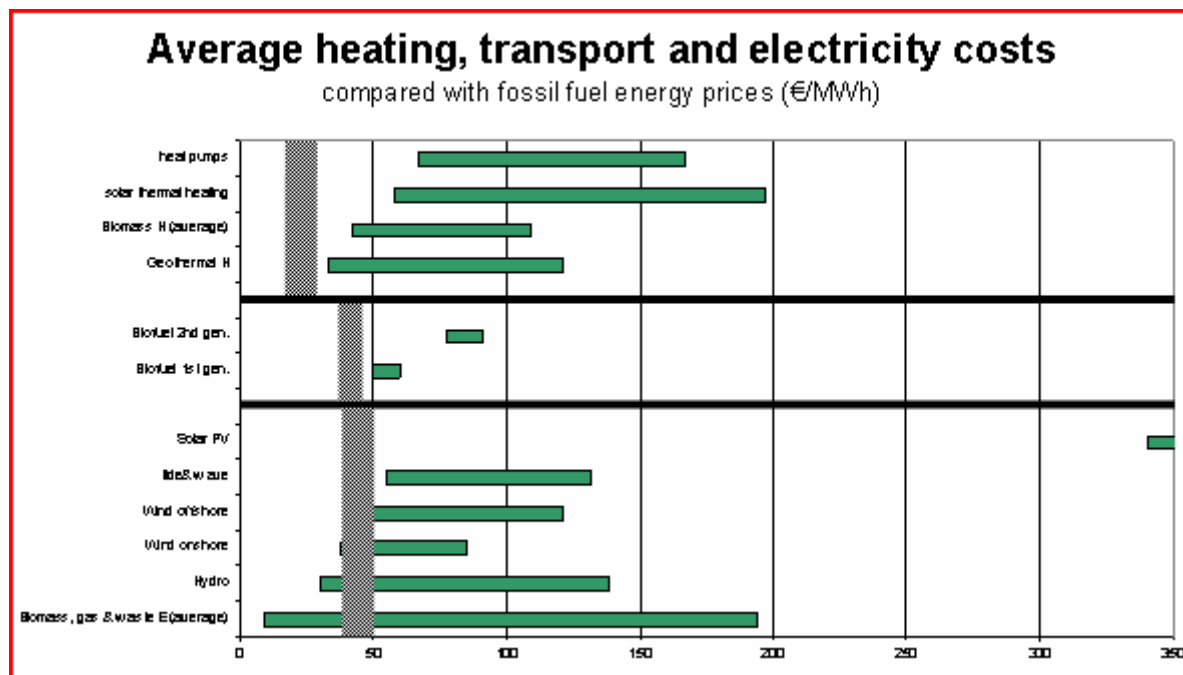


Figure 3: Average heating, transport and electricity cost (€/MWh)<sup>26</sup>

Energy market price signals remain distorted in favour of non-renewable energy sources<sup>27</sup>, in particular due to the continued failure to systematically internalise external costs. Although external costs are partially internalised through the EU's Emission Trading System, fiscal instruments or support frameworks for renewable energy sources, current market prices are still far from reflecting true cost. The Figure 5<sup>28</sup> below illustrates how many renewable energy technologies would be more able to compete with conventional fuels if external costs were reflected in prices.

<sup>26</sup> This graph as well as figure 5 is based on Green-X costs (for heating and electricity) and the JRC/EUCAR/Concawe well to wheel study (for transport).

<sup>27</sup> Reference to Energy enquiry DG COMP.

<sup>28</sup> Same source as Figure 4 with external cost from Extern-E study for the European Commission.

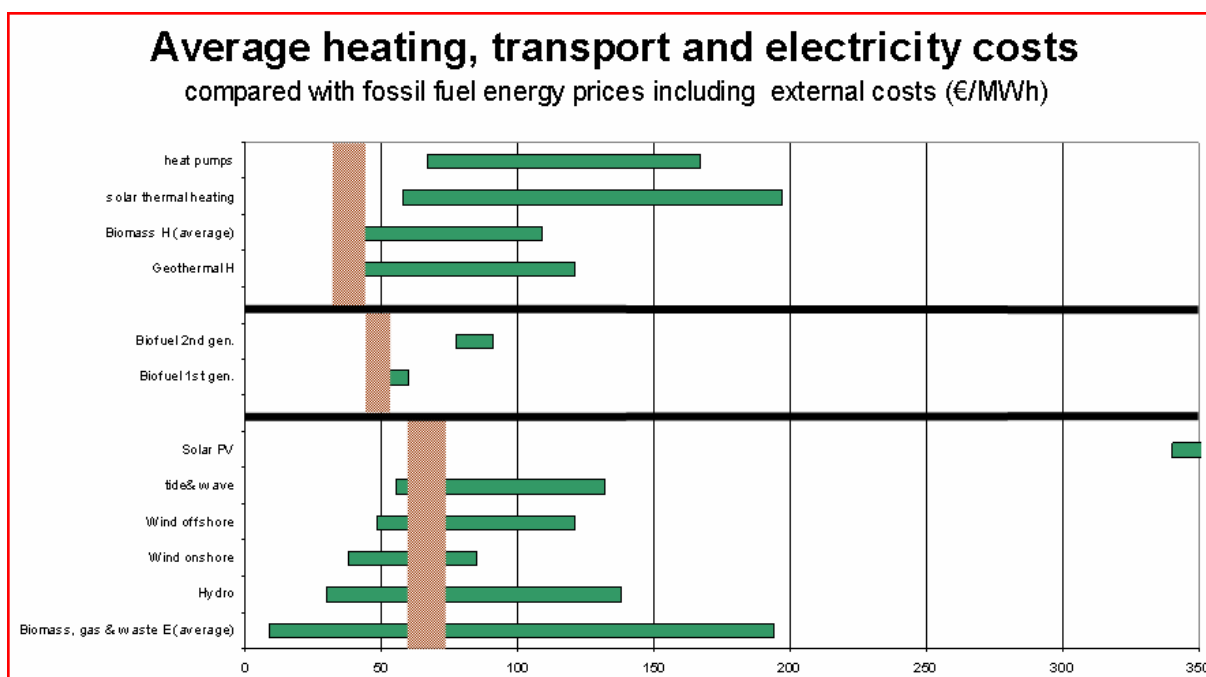


Figure 4: Average heating, transport and electricity cost including external cost (€/MWh)

Reaching the target for renewable energy in the EU by 2020 will entail additional cost. The size of this will depend on the finance mix, the technology choices made and the degree of competition in the sector. Above all, however, the cost will depend on international prices for conventional energy sources, notably oil. The *annual* additional cost of increasing the contribution of renewables to the proposed share by 2020 is defined as the total costs of generation of renewable minus the reference cost of conventional energy production. A balanced mix of renewable technologies, combined with low international oil prices (\$48), will result in an additional average annual cost of achieving the proposed share of renewable energy of approximately €18 bn<sup>29</sup>. Strong research and development efforts will certainly lower the costs of renewable energies and thus the overall cost of this policy. The exact choice of the technologies<sup>30</sup> could reduce this average cost by approximately €2 billion per year.

#### ***How much will society pay for a 20% share of renewable energies?***

*The cost of accelerated growth of renewable energy cited above should be seen in the context of projected total energy infrastructure investments before 2030, estimated at more than \$2 trillion. Some of this will be financed from profits, some from taxes, and some must clearly come from consumers, i.e. from higher energy bills.*

*It is important to note, that the main factor influencing the cost of a renewable portfolio is oil price. Under a scenario with oil prices at \$78/barrel by 2020, the additional average annual*

<sup>29</sup> World market oil prices have fluctuated between 55 and 78 \$ per barrel (2005 prices). Oil market prices and additional costs are throughout this document expressed in €2005.

<sup>30</sup> The cost of technology needs to be considered not as a static value but as a dynamic value. To encourage technology diversity presents economic benefits in the long term. But when referring to renewables, it has to be clarified that variations in costs are large: wind energy is in average at 65 €/MWh produced, PV is at 650 €/MWh. The cost of biomass technologies vary between 20 €/MWh and 180 €/MWh.

*cost would fall to €10.6 bn<sup>31</sup>. By comparison, the EU's total energy bill is expected to be about €350 bn that year.*

*Bearing in mind the significant greenhouse gas savings that will occur as a direct consequence of an accelerated fuel switch from fossil fuels to renewable energies<sup>32</sup>, carbon prices of €25 per tonne combined with high oil prices (78\$) would almost entirely cover the additional cost associated with reaching the proposed share of renewable energy.*

Marginal costs of renewable energies are often low compared to conventional energy sources, and therefore a gradual increase in renewable energies in the wholesale electricity market will reduce the wholesale market prices of electricity<sup>33</sup>. The net effect on power costs to consumers is thus constituted of two counteracting effects. For the electricity sector, based on the assumption of a reference spot price of €48.6 per MWh for electricity, consumer electricity prices could be 5% higher due to the extra investment in renewable energy.

Whether or not energy efficiency measures are applied is also of key importance and the range cited above assumes energy efficiency policies. Without these, the average annual additional cost would increase by more than €7 billion annually. Full details of the cost analysis can be found in the impact assessment report.

The European Council in March 2006 decided to refocus the Lisbon Strategy<sup>34</sup> on jobs and growth<sup>35</sup>. The renewable energy sector in the EU has achieved global leadership and has a turnover of €20 billion and employs 300,000 people<sup>36</sup>. In order to maintain this role, the EU needs to continue to expand the deployment of renewable energy technologies in the EU. Studies vary in their estimates of the GDP impact of increasing the use of renewable energy, some suggesting a small increase (of the order of 0.5%), and others a small decrease. Studies also suggest that support for renewable energy will lead to a small net increase in employment. Much of the economic activity generated by support for renewable energy is located in agricultural areas, often in peripheral regions.

Further business opportunities will arise from the export of renewable energy technology. Traditionally the EU wind industry has held a position as the global market leader. It currently holds a 60% world market share. Other renewable technologies are currently experiencing spectacular growth, for example, solar thermal appliances, for which the Chinese market has taken off and currently accounts for more than 50% of global solar thermal installations. Of the employment created in Germany by the wind energy sector – evaluated at 60.000 full time jobs – half is due to the export market.

With a strong renewable energy strategy the EU would be well placed to maintain its leading role in renewable energy research, and would benefit from increased opportunities for renewable energy technology exports.

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<sup>31</sup> This will correspond to approximately €20 annually per European citizen.

<sup>32</sup> Meeting the proposed target is estimated to lead to annual average greenhouse gas reductions of 419Mt

<sup>33</sup> "Beeinflussung der Spotmarktpreise durch Windstromerzeugung". Neurbarth et al, 2006. "On the impact of renewable energy support schemes on power prices" S.Bode, Hamburg Institute of International Economics (HWWI), 2006.

<sup>34</sup> The European Council of Lisbon of March 2000 agreed in its Conclusions on a "new strategic goal for the next decade: to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion".

<sup>35</sup> Presidency Conclusions of the European Council of 24 March 2006.

<sup>36</sup> European Renewable Energy Council "Renewable Energy Targets for Europe: 20% by 2020".

## 5. CONCLUSION

With this Road Map the Commission sets out an important part of its strategic vision for the energy future of Europe. It seeks to significantly accelerate the growth in renewable energy, and proposes that the EU achieve a contribution of 20% of its energy mix from renewable energy sources by 2020. The Commission requests the Spring Council and the European Parliament to endorse this target. This will require a substantial strengthening of the EU regulatory framework. Most importantly, the Commission is convinced that a legally binding target for the overall contribution of renewables to the EU's energy mix plus mandatory minimum targets for biofuels are now called for. This policy will be a major step along the road to sustainability.

Reaching this target is technically and economically feasible. Additional average costs compared to conventional supply options will depend on future innovation rates and conventional energy prices and would range between €10.6 to €18bn per year. The additional renewable energy deployment needed to achieve the 20% target will reduce annual CO<sub>2</sub> emission by approximately 700 Mt in 2020. The value of this significant reduction in greenhouse gas emissions would nearly cover the total additional cost under high energy prices. At the same time the EU will strengthen its position on security of supply reducing fossil fuel demand by over 250 Mtoe in 2020. Until this new legislation enters into force, the current legislative framework, notably for electricity and biofuels, will be vigorously enforced.

No-one can predict oil prices or gas prices over a 20 years period, but it would be imprudent not to start investing to reduce the uncertainties of the EU's energy future. To put the principles and proposals set out in this Road Map into practice, it will be followed by proposals for new legislation in 2007. New legislation will build on and strengthen the existing legislative framework for the post 2010 period. Member States should engage in a process to share the overall target in a fair and equitable manner, taking into account national circumstances and choices, while at the same time indicating the way in which they intend to make progress in all three sectors in accordance with the agreed target.

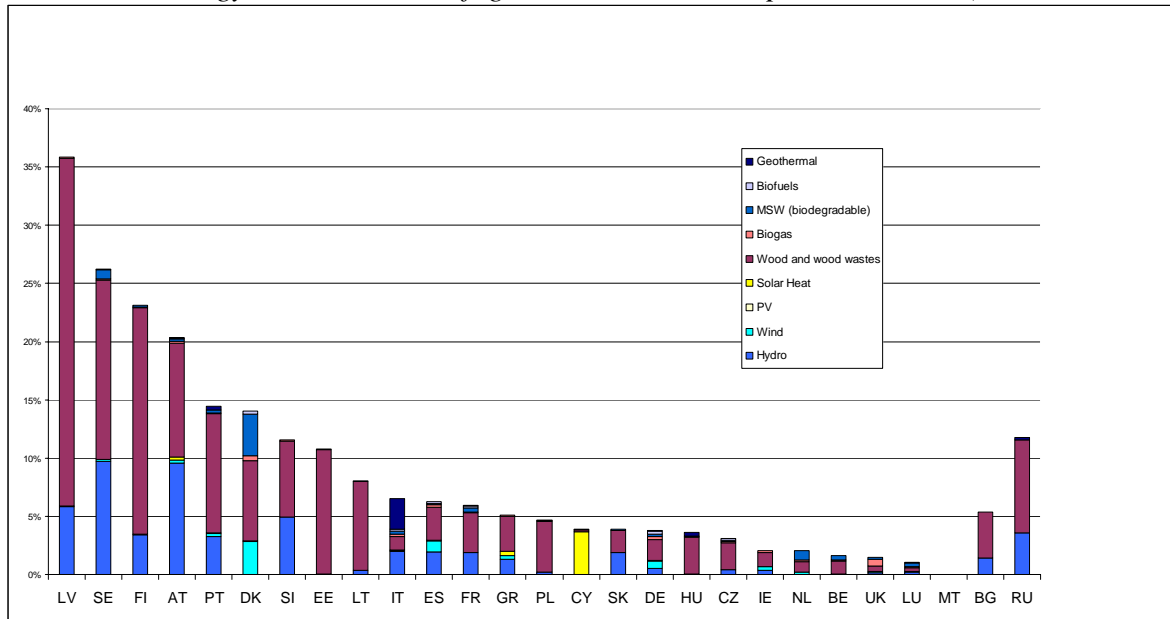
This policy aims to create a true internal market in which renewable technologies can thrive. It will provide the business community with the certainty and stability it needs to make its investment decisions while at the same time give Member States the flexibility they need to support this policy in line with their national circumstances.

The Road Map builds on the reputation and the leading role the EU renewable energy industry sector holds in the world. The objective is to confirm the EU as a world leader in this sector. In view of increased global competition and the fact that other key players are putting in place vigorous promotional policies on renewables, meeting this objective involves significant challenges for Europe. Failing to rise to this challenge, through inaction or lack of vision, would seriously endanger our leadership in this field, the importance of which reaches far beyond the energy sector.

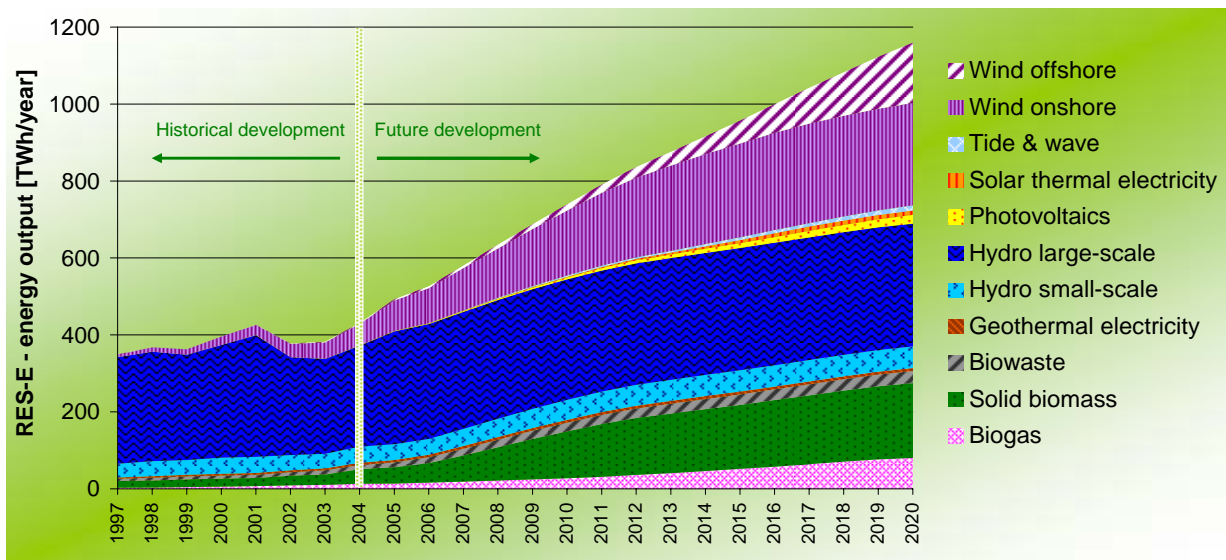
Most importantly, this Road Map provides EU citizens with the assurance they seek from their policy makers: that the serious problems of climate change and environmental degradation and of security of supply are being given equally serious answers.

## ANNEX

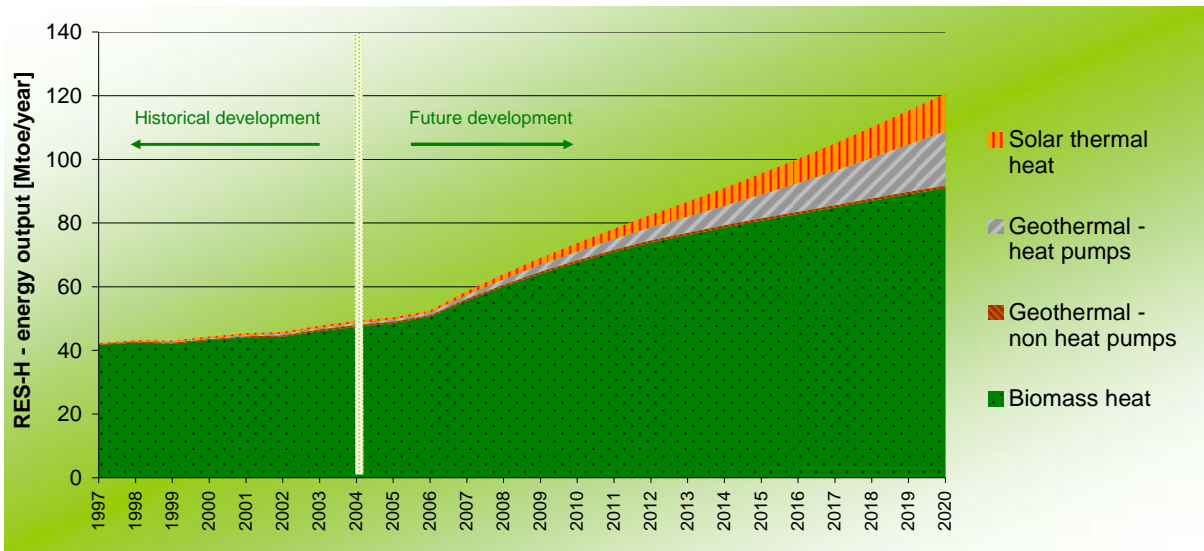
*Renewable energy source share of gross inland consumption in 2004 (Source: Eurostat)*



***Renewables growth: Electricity projections by 2020***



***Renewables growth: Heating and cooling projections by 2020***



*Avoided CO<sub>2</sub> emissions due to new RES deployment up to 2020 in the EU-25*

