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**ENERGY FOR THE FUTURE:
RENEWABLE SOURCES OF ENERGY**

**White Paper for a Community Strategy
and Action Plan**

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Chapter 1 Setting the Scene

1.1 The General Framework

1.1.1 Introduction

Renewable sources of energy are currently unevenly and insufficiently exploited in the European Union. Although many of them are abundantly available, and the real economic potential considerable, renewable sources of energy make a disappointingly small contribution of less than 6% to the Union's overall gross inland energy consumption, which is predicted to grow steadily in the future. A joint effort both at the Community and Members States' level is needed to meet this challenge. Unless the Community succeeds in supplying a significantly higher share of its energy demand from renewables over the next decade, an important development opportunity will be missed and at the same time, it will become increasingly difficult to comply with its commitments both at European and international level as regards environmental protection.

Renewable energy sources are indigenous, and can therefore contribute to reducing dependency on energy imports and increasing security of supply. Development of renewable energy sources can actively contribute to job creation, predominantly among the small and medium sized enterprises which are so central to the Community economic fabric, and indeed themselves form the majority in the various renewable energy sectors. Deployment of renewables can be a key feature in regional development with the aim of achieving greater social and economic cohesion within the Community.

The expected growth in energy consumption in many third countries, in Asia, Latin America and Africa, which to a large extent can be satisfied using renewable energies, offers promising business opportunities for European Union industries, which in many areas are world leaders as regards renewable energy technologies. The modular character of most renewable technologies allows gradual implementation, which is easier to finance and allows rapid scale-up where required. Finally, the general public favours development of renewables more than any other source of energy, very largely for environmental reasons.

1.1.2 The Current Situation

Five years after the Rio Conference, Climate Change is again at the centre of international debate in view of the upcoming "Third Conference of the Parties to the United Nations Framework Convention on Climate Change" to be held in Kyoto in December 1997. The European Union has recognised the urgent need to tackle the climate change issue. It has also adopted a negotiating position of 15% greenhouse gas emissions reduction target for industrialised countries by the year 2010 from the 1990 level. To facilitate the Member States achieving this objective, the Commission, in its communication on the Energy Dimension of Climate Change¹ identified a series of energy actions - including a prominent role for renewables.

The Council of Ministers endorsed this when inviting the Commission to prepare an action programme and present a strategy for renewable energy. In preparation for the international climate change conference in Kyoto, the Commission confirmed

¹ COM (97) 196 final, 14 May 1997, "The Energy Dimension of Climate Change

the technical feasibility and economic manageability of the Union's negotiating mandate. In a recent Communication², the Commission analysed the consequences of reducing CO₂ emissions significantly, including the implications for the energy sector. In order to achieve such a reduction, the Union will require major energy policy decisions, focusing on reducing energy and carbon intensity. Accelerating the penetration of renewable energy sources is very important for reducing carbon intensity and hence CO₂ emissions, whatever the precise outcome of the Kyoto Conference.

The EU's dependence on energy imports is already 50% and is expected to rise over the coming years if no action is taken, reaching 70% by 2020. This is especially true for oil and gas which will increasingly come from sources at greater distances from the Union, often with certain geopolitical risks attached. Attention will therefore increasingly focus on security of supply. Renewable energies as indigenous sources of energy will have an important role to play in reducing the level of energy imports with positive implications for balance of trade and security of supply.

Much progress has been achieved towards completion of the Internal Energy Market. Agreement has been reached in the Council of Ministers on the first phase of liberalisation of the electricity sector and negotiations in the gas sector are well under way. Opening the markets for the network-bound energies will bring market forces into play in sectors which until recently were for the most part dominated by monopolies. This will provide a challenging new environment for renewable energies, providing more opportunities but also posing the challenge of a very cost-competitive environment. Suitable accompanying measures are needed in order to foster the development of renewables.

Renewable energy sources still make an unacceptably modest contribution to the Community's energy balance as compared with the available technical potential. There are signs, however, that this is changing, albeit slowly. The resource base is better understood, the technologies are improving steadily, attitudes towards their uses are changing, and the renewable energy manufacturing and service industries are maturing. But renewables still have difficulties in "taking off", in marketing terms. In fact many renewable technologies need little effort to become competitive. Moreover, biomass, including energy crops, wind and solar energy all offer a large unexploited technical potential.

Current trends show that considerable technological progress related to renewable energy technologies has been achieved over recent years. Costs are rapidly dropping and many renewables, under the right conditions, have reached or are approaching economic viability. The first signs of large-scale implementation are also appearing as regards wind energy and solar thermal collectors. Some technologies, in particular biomass, small hydro and wind, are currently competitive and economically viable in particular compared to other decentralised applications. Solar photovoltaics, although characterised by rapidly declining costs, remain more dependent on favourable conditions. Solar water heaters are currently competitive in many regions of the Union.

Under prevailing economic conditions, a serious obstacle to greater use of certain renewables has been higher initial investment costs. Although comparative costs for

² COM (97) 481 final, 1 October 1997, "Climate Change - The EU Approach to Kyoto"

many renewables are becoming less disadvantageous, in certain cases quite markedly, their use is still hampered in many situations by higher initial investment costs as compared with conventional fuel cycles (although operational fuel costs are non-existent for renewables with the exception of biomass). This is particularly the case due to the fact that energy prices for conventional fuel cycles do not currently reflect the objective full cost, including the external cost to society of environmental damage caused by their use. A further obstacle is that renewable energy technologies, as is the case for many other innovative technologies, suffer from initial lack of confidence on the part of investors, governments and users, caused by lack of familiarity with their technical and economic potential and a general resistance to change and new ideas.

Globally, Europe is at the forefront for several renewable energy technologies. Significant employment is associated with the industries concerned in the European Union, involving several hundred companies, mainly small and medium-sized enterprises, in primary assembling/manufacturing alone, without taking into account other service and supply needs. For the new renewable energy technologies (i.e. not including large hydro-electric power stations and the traditional use of biomass) the world-wide annual turnover of the industry is estimated to be higher than ECU 5 billion, of which Europe has more than a one third share.

1.1.3 The Need for a Community Strategy

Development of renewable energy has for some time been a central aim of Community energy policy, and as early as 1986 the Council³ listed the promotion of renewable energy sources among its energy objectives. Significant technological progress has been achieved since then thanks to the various Community RTD and demonstration programmes such as JOULE- THERMIE, INCO and FAIR which not only helped in creating a European renewable energy industry in all sectors of renewables but also in achieving a world-wide leading position. This technological leadership will be maintained by the contribution of the 5th RTD framework programme in which the renewable energy technologies will have a central role to play. With the ALTENER programme⁴, the Council for the first time adopted a specific financial instrument for renewables promotion. The European Parliament for its part has constantly underlined the role of renewable energy sources and in a recent Resolution⁵ strongly advocated a Community action plan to advance them. In its White Paper, "An Energy Policy for the European Union"⁶ the Commission put forward its views as regards Community energy policy objectives and instruments to achieve them. Three key energy policy objectives were identified, viz. improved competitiveness, security of supply, and protection of the environment. Promotion of renewables is identified as an important factor to achieve these aims. A strategy for renewable energy sources was proposed, and specifically cited in the 'indicative work programme' attached to the Energy Policy White Paper.

At the same time some Member States have introduced some measures to support RES and related programmes. Some have set up plans and targets aimed at developing RES in the medium and long term. The share of renewable energies in the gross inland energy consumption differs widely between Member States, from less than 1% to over 25% (see table 1). A Community strategy will provide the

³ OJ C 241 of 25.9.1986, p.1

⁴ OJ L 235 of 18.9.1993, p.41

⁵ PE 216/788; fin

⁶ COM(95) 682 of 13.12.1995, "An Energy Policy for the European Union"

necessary framework and bring added value to national initiatives increasing the overall impact.

A comprehensive strategy for renewables has become essential for a number of reasons. First and foremost, without a coherent and transparent strategy and an ambitious overall objective for renewables penetration, these sources of energy will not make major inroads into the Community energy balance. Technological progress by itself can not break down the several non-technical barriers which hamper the penetration of renewable energy technologies in the energy markets. At present, prices for most classical fuels are relatively stable at historically low levels and thus in themselves militate against recourse to renewables. This situation clearly calls for policy measures to redress the balance in support of the fundamental environmental and security responsibilities referred to above. Without a clear and comprehensive strategy accompanied by legislative measures, their development will be retarded. A long-term stable framework for the development of renewable sources of energy, covering political, legislative, administrative, economic and marketing aspects is in fact the top priority for the economic operators involved in their development. Furthermore, as the internal market develops, a Community-wide strategy for renewables is required to avoid imbalances between Member States or distortion of energy markets. The leading position of the European renewable energy industry world-wide can only be maintained and strengthened on the basis of a significant and growing home market.

A policy for the promotion of renewables requires across-the-board initiatives encompassing a wide range of policies: energy, environment, employment, taxation, competition, research, technological development and demonstration, agriculture, regional and external relations policies. A central aim of a strategy for renewable energy will be to ensure that the need to promote these energy sources is recognised in new policy initiatives, as well as in full implementation of existing policies, in all of the above areas. In fact, a comprehensive action plan is required to ensure the necessary co-ordination and consistency in implementing these policies at Community, national and local levels.

The role of Member States in the implementation of the Action Plan is crucial. They need to decide on their own specific objectives within the wider framework, and develop their own national strategies to achieve them. The measures proposed in this White Paper must also be adapted to the particular socio-economic, environmental, energy and geographic situation of each Member State as well as to the technical and physical potential of RES in each Member State.

With a view to illustrating the potential effects of specific policy initiatives in the renewable energy field, the Commission sponsored an exercise referred to as TERES. The TERES II study⁷ builds on one of the scenarios previously developed in the Commission's European Energy to 2020⁸ report but goes further by adding various specific renewable energy policy assumptions to form three additional scenarios. These scenarios predict the contribution of renewable energy sources to gross inland energy consumption to be between 9.9% and 12.5% by 2010. The technical potential, however, is much larger.

⁷ TERES II, European Commission, 1997

⁸ European Energy to 2020. A Scenario Approach, European Commission, 1996

The various scenarios clearly illustrate that renewable energy sources can make a significant contribution to the energy supply of the European Union. On the other hand the renewable energy component of the energy mix is very sensitive to changing policy assumptions. Unless specific incentives are put in place, the large potential for renewable energy will not be exploited and these sources will not make a sufficient contribution to the European energy balance.

1.2 The Debate on the Green Paper

As a first step towards a strategy for renewable energy the Commission adopted a Green Paper on 20 November 1996⁹ A broad public debate took place during the early part of 1997 focusing on the type and nature of priority measures that could be undertaken at Community and Member States' levels. The Green Paper has elicited many reactions from the Community institutions, Member States' governments and agencies, and numerous companies and associations interested in renewables. The Commission organised two conferences during this consultation period where the issues were extensively discussed.

The Community Institutions have delivered detailed comments on the Green Paper as well as opinions on what should be the essential elements and the major actions to be undertaken for a future Community strategy on renewable energy sources and the role of the Community in this process. The Council in its Resolution¹⁰ on the Green Paper, affirms that adequate action on renewables is vital for achieving sustainable economic growth, the aim being a strategy that would lead to improved competitiveness and a substantial share of renewables in the long term. Thus, it confirms that Member States and the Community should formulate indicative targets as a guideline for this ambitious indicative target of doubling the overall share of renewable in the Community by 2010. The Council Resolution states that such a comprehensive strategy should be based on certain basic priorities: harmonisation of standards concerning renewables, appropriate regulatory measures to stimulate the market, investment aid in appropriate cases, dissemination of information to increase market confidence with specific actions to increase customer choice. It also takes the view that adequate provision for the support for renewables in the Fifth Framework Programme for Research, Technological Development and Demonstration is required, as well as effective co-ordination and monitoring of progress in order to optimise available resources.

The European Parliament in its Resolution¹¹ on the Green Paper recognises the important role that renewable energy can play in combating the greenhouse effect, in contributing to the security of energy supplies and in creating jobs in small and medium enterprises and rural regions. It believes that the European Union urgently needs a promotion strategy which will tackle the issues of tax harmonisation, environmental protection and standards, internalisation of external costs, and ensure that the gradual liberalisation of the internal energy market will not place renewables at a disadvantage. It proposes a goal of a 15% share of renewables for the European Union by the year 2010. It calls on the Commission to submit specific measures to facilitate the large-scale use of renewable energy sources and advocates certain specific measures. These include the setting of targets per Member State, the concept of a common energy-related tax model, free non-discriminatory access to the grid combined with a minimum payment by the utilities

⁹ COM(96)576 of 20.11.1996, "Energy for the future : renewable sources of energy"

¹⁰ Council Resolution n° 8522/97 of 10 June 1997

¹¹ PE 221/398.fin

for the electricity supplied from renewable energies, the main features of a plan to establish a European fund for renewable energies, a strategy for a common programme to promote renewable energies to include a further 1,000,000 photovoltaic roofs, 15,000 MW of wind and 1,000 MW of energy from biomass.

Parliament's Resolution also calls for a buildings directive, a plan for greater use of structural funds, a strategy for the better utilisation of agricultural and forestry biomass and an export strategy for renewable energy technologies. It reaffirms its belief in the need to increase the Community budgetary appropriations in support of renewable energy sources to the level currently used for nuclear research. It also proposes the constitution of a new Treaty for the promotion of renewable energy sources. The Committee on Agriculture and Rural Development of the Parliament has also issued an Opinion in which it considers that the contribution of biomass-derived energy to the primary energy mix could reach 10% by 2010. It also calls for a better co-ordination of European Union energy policy and the common agricultural policy and emphasises the need to make the necessary arable land available under the latter.

The Economic and Social Committee¹² and the Committee of the Regions¹³ have also presented detailed comments on all chapters of the Green Paper, which also stress, analyse, and support the overall goals relating to sustainability and the different ways the potential contribution of renewables can be maximised. Furthermore, these contributions set out ways in which the role and responsibilities of regional and local public authorities and other bodies could be best harnessed to facilitate renewables support and market penetration. Given the predominantly decentralised implementation of most renewable technologies, practical measures in this direction would allow recourse to the subsidiarity principle, in the framework of a Community Strategy and Action Plan, facilitating local authorities in their decision-making power and environmental responsibility. Moreover, this context is a prime example where energy policy aims and those of structural and regional policy can synergise with one another to great effect, as illustrated by the case of rural, island, or otherwise isolated communities where sustainable development and the maintenance of a population base can be actively supported by replacement of inefficient small-scale fossil fuel use by renewables plants. That leads to better living standards and job creation.

More than 70 detailed written reactions have been received from Member State agencies, industries, professional associations, regional associations, institutes and non-governmental organisations following the publication of the Green Paper. The extensive public debate on the Green Paper and the many contributions received have provided valuable input for the Commission in drafting this White Paper and in proposing the Action Plan.

1.3 Strategic Goals

1.3.1 An Ambitious Target for the Union

In the Green Paper on Renewables the Commission sought views on the setting of an indicative objective of 12% for the contribution by renewable sources of energy to the European Union's gross inland energy consumption by 2010. The overwhelmingly positive response received during the consultation process has confirmed the

¹² CES 462/97 of 23-24 April 1997, Opinion of the Economic and Social Committee

¹³ CdR 438/96.fin, Opinion of the Committee of the Regions

Commission's view that an indicative target is a good policy tool, giving a clear political signal and impetus to action. The strategy and action plan in this White Paper therefore, are directed towards the goal of achieving a 12% penetration of renewables in the Union by 2010 - an ambitious but realistic objective. Given the overall importance of significantly increasing the share of RES in the Union, this indicative objective is considered as an important minimum objective to maintain, whatever the precise binding commitments for CO₂ emission reduction may finally be. However, it is also important to monitor progress and maintain the option of reviewing this strategic goal if necessary.

The calculations of increase in RES needed to meet the indicative objective of 12% share in the Union's energy mix by 2010 is based on the projected energy use in the pre-Kyoto scenario (conventional wisdom, European Energy to 2020, see footnote 8) It is likely that the projected overall energy use in the EU 15 may decrease by 2010 if the necessary energy saving measures are taken post Kyoto. At the same time, the enlargement of the Union to new Member States where RES are almost non-existent will require an even greater overall increase. It is therefore considered at this stage, that the 12% overall objective cannot be refined further. It is in any case, to be emphasised that this overall objective, is a political, and not a legally binding tool.

1.3.2 Member States Targets and Strategies

The overall EU target of doubling the share of renewables to 12% by 2010 implies that Member States have to encourage the increase of RES according to their own potential. Targets in each Member State could stimulate the effort towards increased exploitation of the available potential and could be an important instrument for attaining CO₂ emission reduction, decreasing energy dependence, developing national industry and creating jobs. It is important, therefore, that each Member State should define its own strategy and within it propose its own contribution to the overall 2010 objective, indicate the way it expects different technologies to contribute and outline the measures it intends to introduce to achieve enhanced deployment.

Nevertheless, it should be emphasised that both the Community and the Member States have to build on existing measures and strategies, as well as tackle new initiatives. Some Member States have developed national Plans for RES and set objectives for 2010, 2020 or even 2030. Annex III outlines the plans and actions of Member States for renewables development. Member States are indeed already making efforts to develop RES and the Community Strategy will provide a framework to encourage those efforts and to ensure their cross-fertilisation. Action at the level of the Community can provide added value in terms of the sharing and transfer of successful technological and market experiences.

1.3.3 Possible Growth of RES by Sector

Achievement of the average 12% overall indicative objective for the Union clearly depends on the success and growth of the various individual renewable technologies. Views expressed during the consultation process on the Green Paper confirmed that it is important to analyse how the overall objective can be achieved by a contribution from each sector, and hence to estimate the contribution each renewable source is likely to make. The potential sectoral growth of RES suggested in this Strategy has to be considered as a first attempt to identify a possible combination of renewable technologies that could allow the EU to reach the overall target, within technical, practical and economic limitations. However, renewable energy technologies may well evolve differently, depending on many factors, including market developments, options chosen by Member States and technical developments. The estimate share of different technologies are clearly indicative and will serve to help monitor progress

and ensure that each technology makes its optimal contribution, within a clear policy framework.

The current share of renewables in the energy mix of approximately 6% includes large-scale hydro, for which the potential for further exploitation in the European Union, for environmental reasons, is very limited. This means that the increases in the use of other renewables will have to be all the more substantial.

In Annex II a set of indicative estimated contributions from each renewable energy source as well as for each market sector are outlined, as a projection of one way in which the overall desired growth of RES can be achieved. According to the particular, scenario outlined, the main contribution of RES growth (90 Mtoe) could come from biomass, tripling the current level of this source. Wind energy, with a contribution of 40 GW is likely to have the second most important increase. Significant increases in the solar thermal collectors (with a contribution of 100 million m² installed by 2010) are also anticipated. Smaller contributions are foreseen from photovoltaics (3 GWp), geothermal energy (1 GWe and 2.5 GWth) and heat pumps (2.5 GWth). Hydro power will probably remain the second most important renewable source, but with a relatively small future increase (13 GW), keeping its overall contribution at today's level. Finally, passive solar could have a major contribution in reducing the heating and cooling energy demand in buildings. A 10% contribution in this sector, representing fuel savings of 35 Mtoe, is considered feasible. If the sectoral growth outlined in the scenario is achieved then the overall doubling of the current share of renewables can be achieved, as shown in the tables in Annex II. As far as the market sectors are concerned, the doubling of the current electricity and heat production from renewables plus a significant increase of biofuel in transport fuel use by 2010 are important elements in the scenario for achieving the overall Union objective.

1.4 Preliminary Assessment of some of the Costs and Benefits

In order to assess the feasibility of achieving the overall Community objective, the necessary costs have to be estimated. Equally important, however, is the estimation of the related benefits. The doubling of the current market penetration of renewable energies by 2010 will have beneficial effects among others in terms of CO₂ emissions; security of supply and employment. In table 6 of Annex II the estimated investment costs required to achieve the target together with the estimated benefits are presented. The total capital investment needed to achieve the overall target is estimated at 165 billion ECU for the period 1997-2010. What is more relevant, however, is the net investment which is estimated at 95 billion ECU¹⁴. However, it must be underlined that there are very significant avoided fuel costs.

In table 5 of Annex II these figures are compared with the total investment of the energy sector for the same period, as projected by the Conventional Wisdom scenario of the "European Energy to 2020" study of the Commission. If we consider that in this scenario an amount for investments in renewable energies is already included, the additional net investment needed if the action plan is to have its full effect is then equal to 74 billion ECU. In the same table, it can be seen that the doubling of the share of renewables may require an increase of approximately 30% in the total energy sector investment but it could create an estimated gross figure of 500,000 - 900,000 new jobs, save annually (in 2010) 3 billion ECU in fuel costs and a total of 21 billion ECU for the period 1997-2010,

¹⁴ It has been calculated by taking the total investment and subtracting the investment that would have been needed if the energy from renewables was provided by fossil fuel technologies

reduce the imported fuels by 17.4% and the CO₂ emissions by 402 million tonnes/year by 2010.

This amount of CO₂ savings represents a significant contribution towards the CO₂ reduction needed to successfully combat climate change. The calculation of the figures in the table needs some clarification. In the recent Communication from the Commission "Climate Change - the EU approach to Kyoto"¹⁵ it is estimated that the 800 million tonnes CO₂ emission reduction potential can be achieved with an annual compliance cost of 15 to 35 billion ECU and with a total (primary and secondary) benefit which might range from 15 to 137 billion ECU per year. From the analysis presented in Annex II, it is shown that doubling the share of renewables can reduce the CO₂ emissions by 402 million tonnes per year with respect to 1997. This corresponds to an additional reduction possibility of 250 million tonnes of CO₂ with respect to the 2010 "business as usual" Pre-Kyoto scenario used in the Climate Change Communication and one third of the expected CO₂ reduction target. The difference between figures (402 and 250) is due to the fact that in the scenario for 2010, an increase of 30 Mtoe in the use of renewable between 1995-2010 is assumed which corresponds approximately to annual savings of 150 million tonnes of CO₂ by 2010. Therefore, the estimates of CO₂ emission reduction from RES cited in this White Paper results from a technical assessment and represents the full expected reduction from a doubling of the current share of RES, whereas in the policy communication on Kyoto, the figure cited is the additional reduction in CO₂ emissions to be attained to reach a specific reduction target, over and above what may have been attained under the specific Conventional Wisdom pre-Kyoto scenario for 2010.

Net employment figures in the renewable energy sector are difficult to predict and calculate. Real figures exist in the sectors that have reached a certain level of development. Wind energy, for example, has already created more than 30,000 jobs in Europe. Each renewable energy technology has its own characteristics as far as the quality and the kind of employment generated. Biomass has the particularity of creating large numbers of jobs for the production of raw material. Photovoltaics creates a large number of operational and maintenance jobs, since PV installations are small and dispersed. Hydro is not expected to create more jobs than those already existing in Europe.

Detailed estimations of net employment have been made in the TERES II study using the SAFIRE market penetration model developed under the JOULE II programme. The model predicts for 2010 a net employment of 500,000 jobs directly created in the renewable energy sector and indirectly in the sectors that supply the sector. This is a net figure allowing for losses of jobs in other energy sectors. Sectorial studies performed mainly by the industry give much larger employment figures. The European Wind Energy Association (EWEA)¹⁶ estimates that the jobs to be created in 2010 by the wind sector will be between 190,000 and 320,000, if 40 GW of wind power is installed. The European Photovoltaic Industry Association (EPIA) estimates¹⁷ that a 3 GWp installed power in 2010 will create approximately 100,000 jobs in the PV sector. The European Biomass Association (AEBIOM)¹⁸ believes that the Biomass employment figures in the TERES II study are underestimated and that employment in the sector will increase by up to 1,000,000 jobs by 2010 if the biomass potential is fully exploited. The European Solar Industry Federation (ESIF) estimates that 250,000 jobs will be created in order to meet

¹⁵ COM(97)481 final - see footnote 2

¹⁶ EWEA Strategy Paper '97, ALTENER publication, 1997.

¹⁷ EPIA, "Photovoltaics in 2010", European Commission, 1996.

¹⁸ Statement of AEBIOM on the Green Paper of the European Commission, February 1997.

the solar collector 2010 market objective. While it is not possible to reach any hard conclusions as is the likely cumulative level of job creation which would derive from investments in the various forms of renewable energy sources, it is quite clear that a proactive move towards such energy sources will lead to significant new employment opportunities.

An important additional economic benefit not included above is the potential growth of the European renewable energy industry in international markets. In most technical areas, European industry in this field is second to none in its ability to provide the equipment and technical, financial and planning services required for market growth. This offers therefore, significant business opportunities for exports and possibilities for expansion of the European renewable technologies industry. A 17 billion ECU annual export business is projected for 2010, creating potentially as many as 350.000 additional jobs.

Considering all the important benefits of renewables on employment, fuel import reduction and increased security of supply, export, local and regional development, etc. as well as the major environmental benefits, it can be concluded that the Community Strategy and Action Plan for renewable energy sources as they are presented in this White Paper are of major importance for the Union as we enter the 21st century.

Chapter 2 Main Features of the Action Plan

2.1 Introduction

Without a determined and co-ordinated effort to mobilise the Union's renewable energies potential, this potential will not be realised to a significant extent, resulting in missed opportunity to develop this sector and to reduce greenhouse gas emissions significantly. If pro-active steps are not taken in a co-ordinated way within the Union, renewable energies are only likely to emerge slowly from today's niche markets to become more widely used and hence fully cost competitive in around 2020, with full market penetration perhaps still years beyond. The Action Plan set out below aims at providing fair market opportunities for renewable energies without excessive financial burdens. Increasing the current share of renewables significantly will not be an easy task, but the benefits to be obtained justify a major effort.

Investments will have to be made both by the private and public sectors, but these will provide multiple dividends as Europe's industry and service companies demonstrate their technological leadership in a globally competitive market. At the same time, the increasingly liberalised and globalised energy markets present a new situation, which will have to be used in a positive sense to provide new opportunities, while new obstacles to RES growth in the electricity sector will have to be avoided.

The Community Strategy and Action Plan should be seen as an integrated whole, to be further developed and implemented in close cooperation between the Member States and the Commission. The challenge facing us requires a concerted and co-ordinated effort by the various players over time. Measures should be taken at the appropriate level according to the subsidiarity principle within the coordinated framework provided by this Strategy and Action Plan. It would be incorrect and unrealistic to assume that actions need only be taken at Community level. The Member States have a key role to play in taking the responsibility to promote Renewables, through national action plans, to introduce the measures necessary to promote a significant increase in renewables penetration, and to implement this strategy and Action Plan in order to achieve the national and European objectives. Legislative action will only be taken at EU level when measures at national level would be insufficient or inappropriate and when harmonisation is required across the EU. The Strategy and Action Plan must be flexible and be updated over time in the light of experience gained and new developments including international commitments undertaken to reduce CO₂ emissions. For this reason, a system of continuous review is proposed.(see section 4.1. below).

2.2 Internal Market Measures

The following is a list of priority measures aimed at overcoming obstacles and redressing the balance in favour of renewables, in order to reach the indicative objective of 12% penetration by 2010.

2.2.1 Fair Access for Renewables to the Electricity Market

Electricity is the single most important energy sector as it accounts for about 40% of gross energy consumption in the EU15. Access for renewables to the electricity networks at fair prices is therefore a critical step for their development. The basis for a Community legal framework largely exists and its implementation will have to

provide for the necessary degree of legislative harmonisation. Experience of liberalisation elsewhere has shown that it can form the basis for a dynamic and secure role for renewables so long as adequate market-based instruments are provided.

At present Member States are transposing the internal market in electricity Directive¹⁹ into national law. The Directive, in Article 8(3), permits Member States to require electricity from renewable sources to be given preference in dispatching. Further schemes for the promotion of renewables may also be compatible with the Directive, pursuant to Article 3 and/or Article 24. Most or all Member States are planning to include such schemes in their transposition of the Directive. The Commission is examining closely the different schemes proposed or introduced by the Member States in order to propose a Directive which will provide a harmonised framework for Member States to ensure that renewable energies make up a sufficient contribution to overall electricity supply, both at the EU and at national level. Different preference schemes for electricity from renewables will be considered in this context.

Such an approach is an important element towards the creation of a true single market for electricity. Where significant differences exist between Member States regarding the extent to which renewable energy is supported and, possibly, the manner in which any consequent support measures are financed, this may result in significant trade distortions not related to efficiency.

Other issues to be addressed will include the following :

- the way in which transmission system operators should accept renewable electricity when offered to them, subject to provisions on transport in the internal market in electricity Directive;
- the guidelines on the price to be paid to a generator from renewable sources which should at least be equal to the avoided cost of electricity on a low voltage grid of a distributor plus a premium reflecting the renewables' social and environmental benefits²⁰ and the manner in which it is financed : tax breaks, etc.;
- on which categories of electricity purchases such measures fall;
- with regard to network access, avoiding discrimination between electricity produced from solar radiation, biomass (below 20 MWe), hydroenergy (below 10 MWe) and wind.

2.2.2 Fiscal and Finance measures

The environmental benefits of renewable energies²¹ justify favourable financing conditions. The so-called "Green tariffs" already offered in certain Member States by appealing to voluntary environmental solidarity on the part of those consumers -

¹⁹ Directive 96/92/EC of the European Parliament and of the Council of 19 December 1996 concerning common rules for the internal market in electricity. JO L 27, 30.1.1997, p.20

²⁰ This premium could be above 20% of that avoided cost which is about equivalent to the average tax on electricity in the European Union. The avoided cost introduced here above refers to the cost at the "city gate", i.e. the wholesale price at which the grid operator of a municipal low voltage grid buys electricity from the transmission network. The premium is put equivalent to the tax rebate or tax exemption of renewable energy as it is currently implemented in those European Union Member countries which have introduced CO₂ tax. Renewable energy tax exemption is also requested in a recent Commission proposal modifying the Directive on taxation of energy products

²¹ Environmental benefits as established by the EXTERNE project (see also Annex II.11)

domestic or corporate - able and willing to pay higher rates are not sufficient, nor appropriate in all cases.

The Commission has already made or will make the necessary additional proposals for legislation and amendments to existing Directives before the end of 1998, including tax exemption or reduction on RES energy products on behalf of Member States "prerogatives" under art. 13 to 16 of the proposed Directive "Restructuring the Community Framework for the Taxation of Energy Products"²²;

In some cases it will be appropriate and sufficient for Member States' authorities to enact the necessary legislation or other provisions, in areas such as

- flexible depreciation of renewable energies investments;
- favourable tax treatment for third party financing of renewable energies;
- start up subsidies for new productions plants, SME's and new job creation.
- financial incentives for consumers to purchase RE equipment and services;

The Commission however will also make a survey of the progress made throughout the Union in this regard by the end of the year 2000, and if this indicates a remaining need for Union-level measures in certain of the areas listed, the necessary proposals will be put forward.

Other financial measures, which are proving their value in some Member States, will also be examined and promoted more widely as appropriate such as:

- so-called "golden" or 'green' funds addressed to capital markets. Such funds are financed from private bank accounts which in this case attract lower interest rates. The margin consented by the lower interest rate paid to the account holder is passed on by the bank to the renewable energies investor in the form of discount rates;
- public renewable energy funds, managed by regulated agencies. The facilities offered could include revolving funds as well as credit guarantees (renewable energies bonds) and should in any case conform to the Treaty provisions;
- soft loans and special facilities from institutional banks (see Section 2.5.3)

2.2.3 New Bioenergy Initiative for Transport, Heat and Electricity

Specific measures are needed in order to help increase the market share for *liquid biofuels* from the current 0.3% to a significantly higher percentage, in collaboration with Member States.. The overall environmental effect varies from biofuel to biofuel and depends, amongst others, on the crop cultivated and the crops replaced. Promotion of biofuels has to be coherent with the *AutoOil Programme* and the European policy on fuel quality, and should take account of the full cycle of environmental costs/benefits. The role of biofuels in the clean fuel specification for 2005 and beyond is being studied under the Auto Oil II project.

Two new directives, currently under negotiation, concerning transport fuel²³ and sulphur reduction in liquid fuels²⁴ already include provisions encouraging the use of

²² Com(97)30 final, 12 March 1997, Proposal for a Council Directive on "Restructuring the Community Framework for the Taxation of Energy Products"

²³ COM(97)248 final, 18 June 1997

²⁴ COM(97)88 final, 12 March 1997 - Proposal for a Council Directive on "Reduction of sulphur content in certain liquid fuels" and modification of Directive EC/93/12.

biofuels for transport, i.e. alcohols and ETBE, vegetable oils and esters for biodiesel.

Given the fact that currently the production cost of liquid biofuel is three times that of conventional fuels, a priority effort needs to be placed on further research and other measures to reduce production costs of biofuels. An increased use of liquid biofuels at present can only be obtained if there is a high rate of tax relief and subsidised raw material production. Detaxation of biofuels is currently made on a limited scale, in the framework of the directive 92/81²⁵ on harmonisation of the structures of excise duties, allowing such detaxation on a pilot scale. The Commission proposes that a market-share of 2% for liquid biofuels could still be considered a pilot phase. This level may well be reached in the short or medium term in some countries (in particular Austria, Germany, France and Italy). The Commission has already made proposals for adjusting the relevant European legislation in order to allow a large scale liquid biofuels detaxation²⁶.

For *biogas* promotion, production of landfill gas or biogas from the food industry or farms will be encouraged, in order to obtain with energy and environmental policy benefits. Fair access to the electricity market will be promoted as indicated in point 2.2.1. above. Measures for biogas will contribute to the achievement of the Commission's strategy on reducing methane emissions²⁷ from manure by using anaerobic digesters or covered lagoons as well as meeting the objectives on protection of waters²⁸ and on landfill²⁹.

It is proposed under this strategy that demonstration programmes at European Union, national, regional and local level should be supported to install recovery and use systems for intensive rearing. In addition, the Commission will examine the possibility of integrating biogas actions in the structural funds.

In order for the markets for *solid biomass* to be further developed, the following must be actively promoted:

- co-firing or fossil fuel substitution in coal power plants and in existing district heating networks;
- new district heating or cooling networks as an outlet for co-generation with biomass;
- greater access to upgraded fuels such as chips and pellets and a more intensive exploitation of appropriate forest, wood and paper industry residues;
- new scaled up IGCC (Integrated Gasification in Combined Cycle) systems in the capacity range of 25-50 Mwe based on a mixture of biomass and waste derived fuels;
- Clean energy generation from municipal waste either by thermal treatment, landfill gas recovery or anaerobic digestion as long as energy generation from waste complements and does not replace waste prevention and recycling.

²⁵ OJ L.316 of 31.10.1992, p. 12

²⁶ a) JO n° C 209 of 29.7.1994, p.9 - Proposal for a Council Directive on excise duties on motor fuels from agricultural sources; b) the above-mentioned in para 2.2.2 proposal for a Directive on the taxation of energy products - see footnote 17

²⁷ COM (96)557 of 15.11.96

²⁸ OJ L.375 of 31.12.91 - Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources and OJ. C184/20 of 17.06.97, Proposal for a framework Directive concerning waters protection

²⁹ COM (97) 105 of 05.03.97 - Proposal for a Council Directive on the landfill of waste

The Commission has recently published a strategy³⁰ to promote combined heat and power. CHP is of paramount importance for the success of biomass implementation. Almost 1/3 of the new additional biomass exploitation by 2010 could fall in this category. District heating and cooling is also vital to maximise the financial and economic benefits of cogeneration. Increased use of bioelectricity is linked, like that for wind and solar electricity, to European Union wide measures for fair access to the electricity market (see Section 2.2.1).

2.2.4 Improving building regulations: its impact on town and country planning

Energy consumption in the domestic and service sectors can be significantly reduced by improving energy intensity overall in addition to more use - in retrofitting as well as for new buildings - of renewables such as solar energy. It is important to adopt a global approach and to integrate measures of rational use of energy (for the building envelope as well as for heating, lighting, ventilation and cooling) with the use of renewable energy technologies. Total energy consumption in this sector could be reduced by 50% in the European Union by 2010, half of which could be accounted for by introducing passive and active solar technologies in buildings for which concrete promotional measures are necessary. This could be facilitated by amendments to the existing Directives on improving energy efficiency in buildings³¹ and to the Directive on building materials³² in order to include new building materials for solar efficiency in the standards specifications.

In order to promote the use of RES in buildings, the following specific measures are proposed:

- incorporation of requirements on the use of solar energy for heating and cooling in building approvals under current legislative, administrative and other provisions on town and country planning should be considered;
- promotion of high efficiency windows and solar facades, natural ventilation and window blinds in new buildings and for retrofitting;
- promotion of active solar energy systems for space heating and cooling and warm water, e.g. solar collectors, geothermal heating and heat pumps;
- promotion of passive solar energy for heating and cooling;
- encouragement of PV systems to be integrated in building construction (roofs, facades) and in public spaces;
- photovoltaic electricity sales to utilities from private customers should be priced so as to allow direct reversible metering;
- measures to encourage the use of construction materials with a low intrinsic energy content, e.g. timber.

2.3 Reinforcing Community Policies

The priority given to renewable energies in existing Community policies, programmes and budgets is mostly very low. There is much scope for reinforcement. It is also important to make the renewable energies potential better known and to increase awareness among all those bearing responsibility for Community programmes.

³⁰ COM(97)514 final, "A Community strategy to promote CHP and to dismantle barriers to its development"

³¹ Council Directive 93/76/EEC of 13 September 1993 "To limit carbon dioxide emissions by improving energy efficiency (SAVE).

³² Council Directive 89/106/EEC of 21 December 1988 "On the approximation of laws, regulations and administrative provisions of the Member States relating to building materials.

2.3.1 Environment

The Fifth Environmental Action Plan gives due consideration to renewable energies and proposes support measures including fiscal incentives³³. The measures in the Fifth Environmental Action Plan referring to renewable energies, will be implemented by the year 2000, within the overall framework of the strategy proposed in this White Paper. The net environmental effects of different renewable energy sources will be taken into account when implementing different measures. It is important to underline that a significant increase in the share of renewable energy sources will play a key role in meeting the Union's CO₂ emission reduction objectives, in parallel to efforts for energy efficiency and other areas. Measures related to climate change will take into account the Community Strategy on RES.

2.3.2 Growth, Competitiveness and Employment

The Commission's White Paper on Growth, Competitiveness and Employment constitutes an important point of reference for further action on renewable energies³⁴. There is indeed a great potential for renewable energies to contribute to the aims set out in that White Paper. Achieving the indicative objective of 12% in 2010 would lead to an increase in the market for European Industry and could create a significant number of new jobs as outlined in Section 1.4. The export market is particularly important as Europe, with its traditional links with Africa, South America, India and lately South-East Asia, is in a very favourable position. The following actions deserve particular attention:

- strengthening the competitive edge of European industry in the global renewable energies market by supporting its ventures into technological leadership and supporting development of a substantive home market in addition to emerging export opportunities;
- investigating opportunities for the creation of new SMEs and jobs;
- introducing RES issues in the actions addressed to SMEs under the social fund;
- action for education and training relating to renewable energies within existing Community programmes.

2.3.3 Competition and State Aid

In considering the various ways in which to promote the development of renewable energy sources, the positive effects of competition should be taken into account. In order to make renewables more competitive, priority should be given to ways which let the market forces function to bring down the costs for producing renewable energy as rapidly and as far as possible.

When authorising State Aids, the Commission has to take into account the derogations laid down in Article 92 of the Treaty. The guiding principle for the Commission in assessing aid for renewable energies, contained in the Community Guidelines on State Aid for Environmental Protection³⁵ is that the beneficial effects of such measures on the environment must outweigh the distorting effects on competition. The Commission will consider appropriate modifications in favour of renewable energies in support of its policy in this area during the revision of the present guidelines taking into consideration the Council's Resolution on the Green

³³ COM (92) 33, ... Fifth Environmental Action Plan - "Towards Sustainability"

³⁴ COM (93) 700.fin - "Growth, Competitiveness and Employment - The Challenges and Ways Forward in the 21st Century"

³⁵ O.J. n° C72, 10 March 1994, p.3

Paper “Energy for the future : renewable sources of energy” which states that investment aid for renewables can, in appropriate cases, be authorised even when they exceed the general levels of aid laid down in those guidelines.

2.3.4 Research, Technological, Development and Demonstration

It is generally recognised that there is still great scope for Research, Technological Development and Demonstration to improve technologies, reduce cost and gain user experience in demonstration projects on condition that technological development is guided by appropriate policy measures for introduction into internal and third country markets and subsequent implementation.

Every kind of action, whether of a fiscal, financial, legal or other nature, is addressed to facilitate the penetration of the technologies into the market. The strategic goals presented under 1.3 above have to be reached at the end by the use of renewable energy technologies, and the role of RTD is to help the development of technologies which are continuously more efficient.

As research, development and demonstration on renewable energies is moving strongly into industrial development and higher cost intensity, the financial means to be earmarked for renewable energy sources should be increased significantly. The 4th Framework Programme for Research, Technological Development and Demonstration and more particularly the Non Nuclear Energy RTD programme is giving a priority to Renewable Energies sources as they represent about 45% of its total budget. The 5th Framework Programme should offer the possibility to finance the necessary RTD efforts in this area. The specific programme “Competitiveness and Sustainable Growth” which will be part of the 5th Framework Programme, contains a key action on energy which indicates clearly the important role of renewable energies and decentralised production energy systems”.

All RTD activities related to RES should take into account the present Strategy and Action Plan, including the socio-economic aspects. The complementarity between RTD on RES and RTD on other technologies should also be encouraged. The role of RTD is important upstream of the actions in the “Campaign for Take Off” described later in that it should provide the cost efficient technologies to be used in this Campaign.

2.3.5 Regional Policy

Renewable energies already feature to some extent in the European Union’s regional policy. In 1999 new guidelines for 2000-2007 will be decided. The next multi-annual funds negotiation package will be the occasion to extend, consolidate, and clarify the aid opportunities available for renewable energies and above all to increase the weight given to RES within the energy programmes. Decision-making criteria must reflect the importance of renewables’ potential for less favoured regions (which are in general dependent on energy imports), peripheral and remote areas, islands, rural areas, in particular those lacking traditional energies. In those areas RES have a high potential for new job creation, for the development of indigenous resources and industrial and service activities (particularly in objective 1 areas). The latter also applies to industrial areas under reconversion and cities (future objective 2). New incentives should also be undertaken in the tourism sector as the great potential of renewable energies in this area is still largely unexplored.

The Community will give support to regional and local projects and planning in the framework of its promotional programmes such as ALTENER (see 2.5.1). However,

it is essential to encourage the Member States to include RES implementation plans in the programmes that they will submit to the structural funds for co-financing (ERDF and accompanying Community Support Frameworks), so that the share of RES in energy programmes under the Objective 1 CSF could reach at least 12 %. This would reflect fully the objective set out in this White Paper for renewable energy consumption by 2010. However, in order to stimulate a shift towards renewable energy use so that this objective can be reached at MS level, a considerably higher engagement of the structural funds seems appropriate. Since the demand for funding for RES projects has to be Member State driven, effort has to be put in explaining the possibilities for RES funding and raising awareness on their potential and benefits for the regions. Other programmes for Objective 2 regions should also contribute to the promotion of RES.

It is important for the Commission to highlight that regional funds invested in renewable energy sources development could contribute to increased standards of living and income in less favoured, peripheral, island, remote or declining regions in different ways :

- favouring the use of local resources and therefore indigenous development;
- being usually labour intensive, they could contribute to the creation of local permanent jobs;
- contributing to reduce the dependency on energy imports;
- reinforcing energy supply for local communities, green tourism, preserved areas, etc.;
- contributing to develop the local R&TD and Innovation potential, through the promotion of specific research-innovation projects adapted to local needs.

The CSF sub-programmes for R&TD and innovation should also give particular attention to projects aiming at the development of new technologies and processes adapted to local and regional needs in the areas of RES.

2.3.6 Common Agricultural policy and rural development policy

Agriculture is a key sector for the European strategy of doubling the share of renewable energies in gross energy demand in the European Union by 2010. New activities and new sources of income are emerging on-farm and off-farm. Among those, the production of renewable raw materials, for non-food purposes in niche markets or the energy sector, can represent a new opportunity for agriculture and forestry and contribute to job creation in rural areas³⁶

The reference in Agenda 2000 refers to the encouragement of renewable energies. In particular biomass should be fully implemented using all available policy instruments be they agricultural, fiscal or industrial. In the future CAP alternative use for agricultural products will be a major element. Member States should be encouraged, in the context of the national aid regimes, to support renewable energies.

Within **the future rural development policy**, the Commission will encourage Member States and regions to give renewable energy projects a high priority within their programmes for rural areas. However, the regions will continue to have to assume their responsibility for the selection of the projects.

³⁶ COM(97)2000 Vol.I, p 26 (EN)

The Common Agricultural Policy could contribute by supporting the biomass energy sector to increase standards of living and income in different ways :

- developing energy crops and utilising agricultural and forestry residues as a reliable source of raw material, under the reformed common agricultural policy, negotiated in accordance with Agenda 2000, making full use of the results of the research and development policy;
- giving support for bio-based renewable energies under the rural development policy and other ongoing programmes;
- supporting the regions by co-financing innovative, demonstrative and transferable renewable energy projects, such as the installation of combined solar, wind and biomass heat and electricity production under a new Community initiative for rural areas, as it is already possible within the existing LEADER programme;
- applying the regulation 951/97 on processing and marketing of agricultural products in relation to renewable energy products wherever feasible;

the Commission will table a proposal enabling Member States to make the granting of direct payments for arable crops and set-aside conditional on the respect of environmental provisions, allowing them to be increasingly used to pursue environmental objectives³⁷.

The existing possibilities under Regulation 2078/92 will be reviewed in the context of Agenda 2000. In this context, programmes which reduce environmental pressures from biomass-production and other uses under the agri-environmental objectives should be developed. In particular, schemes where energy crops are produced using reduced water supply, low inputs, by organic methods or harvested in a way to promote biodiversity etc could attract a premium. The Commission could envisage more agri-environmental schemes being developed by national authorities to support energy crops respecting the fact that priorities for programmes would continue to be set by regional needs and potentials.

On a European **forestry** strategy the European Parliament, in its “Thomas Report” has called on the Commission to put forward a legislative proposal. This report, inter alia, considers the need for adding value to biomass through energy production including a wide range of instruments. The report is currently under examination by the Commission, and particular attention will be paid to this point.

Non food policy should also provide for support for energy uses of agricultural products, by-products and short rotation forestry. The Commission intends to examine the adequacy of existing instruments particularly in the sense of the need to promote RES and to improve further harmonisation. Some support is in fact already provided for in the European legislation, such as 1586/97 (non food set aside) Regulation 2080/92 (forest measures), 2078/92 (agro-environmental measures) and 950/97 (improvement of efficiency in the agricultural sector). Full use should be made of those existing Regulations.

³⁷ COM(97)2000 Vol. I, p 29 (EN)

2.3.7 External Relations

Information on and promotion of RES is important for third countries, especially as they will also have to contribute to global CO₂ emission reductions. In that respect, it is important to promote RES in the European assistance programmes, such as PHARE, TACIS, MEDA, the European Development Fund and other Lomé Convention facilities, as well as in all relevant co-operation and other agreements with developing or industrialised third countries, taking into account the possibilities and constraints of each programme. For PHARE and TACIS, the promotion of renewable sources has to be considered in the context of the economic and energy sector reform priorities of these programmes.

A proactive co-operation and export policy to support renewable energies will be stimulated, by enlarging the scope and basis of the relevant European Union energy programmes such as SYNERGY, as well as the Scientific and Technological Cooperation components of the 5th RTD Framework Programme. The action list should include the following:

- support for co-operation on energy planning and integrated resource planning with emerging economies, in order to optimise exploitation of the available renewable energy potential;
- support for exporters, in the form of credit guarantees and “currency turmoil” insurance and in the organisation of trade missions, fairs, joint workshops etc.;
- collaboration in the implementation of the “World Solar Programme 1996-2005” which intends to realize worldwide, and especially in the developing countries, high priority regional and national projects;
- cooperation with the international financing organisations such as the World Bank and the Global Environment Facility GEF.

Special action concerning ACP Countries :

- a special initiative to promote solar electricity (photovoltaics for deprived rural areas in third countries currently without electricity)³⁸;
- encourage increased use of alternative renewable energy sources to resolve the problems caused by overconsumption of fuelwood in both rural and urban areas of developing countries;
- encourage the development of suitable fuelwood species plantation;
- stepping up the ACP States’ research and development activities as regards the development of new and renewable energy sources;

Special action concerning associated countries:

- a special initiative to promote the process of approximation of Community legislation on renewables in associated countries;
- implementation of Protocols concerning the participation of associated countries in promotional EU programmes such as ALTENER;
- involving associated and third countries in demonstration programmes under the 5th RTD Framework Programme, in addition to specific energy policy programmes such as SYNERGY and ALTENER;

³⁸ Today, an estimated 2 billion people worldwide lack access to modern energy sources. Photovoltaics technology is now cost-effective in stand-alone power applications remote from utility grids.

2.4 Strengthening co-operation between Member States

For successful implementation of the European Union Strategy and Action Plan for renewable energies, effective co-operation between Member States is of paramount importance. At present serious discrepancies persist in levels of advancement both as regards renewable energy implementation in the different Member States, and between the technologies themselves. Co-operation within a Europe-wide implementation strategy offers considerable added value to Member States, as successful policies and experiences at national level can be shared, and national renewables goals better co-ordinated, with the result that the efficiency of overall policies as well as particular projects will increase.

The Commission adopted on 4 October 1996 a proposal for a Council Decision concerning the Organisation of Co-operation around Agreed Community Energy Objectives³⁹. The draft decision identifies the promotion of renewable energy resources as one of the agreed common energy objectives and calls for supportive measures at both Community and national levels with the aim of achieving a significant share of renewables in primary energy production in the Community by 2010. Concrete measures will be proposed as part of the implementation of the Council Decision, once adopted.

2.5 Support Measures

2.5.1 Targeted Promotion

The ALTENER II⁴⁰ programme, and the subsequent programme included in the proposed Energy Framework Programme⁴¹ will have a crucial role to play as the basic instrument for the Action plan.

ALTENER II will continue to support the development of sectoral market strategies, standards and harmonisation. Support will be given to RES planning at national, regional and local levels and to information and education infrastructures. Support will also be given to the development of new market and financial instruments. Dissemination of information is also a major action in ALTENER II. In addition, promotion of innovative and efficient renewable energy technologies and dissemination of related information are also supported by JOULE-THERMIE.

In order to enhance the impact of ALTENER II in RES market penetration, new measures to help overcome obstacles and increase operational capacity for the production of energy from RES have been proposed. These actions will be targeted on assisting biomass, solar thermal and PV, buildings, wind, small hydro and geothermal to penetrate the market. Actions under ALTENER II will also be crucial for the preparation of the Renewables Campaign for Take-off (see chapter 3).

³⁹ COM (97)436 final, 26.08.97. Proposal for a Council Decision concerning the organisation of co-operation around Community energy objectives

⁴⁰ COM(97)87 final of 12.3.1997, Proposal for a Council Decision concerning a multiannual programme for the promotion of RES (ALTENER II)

⁴¹ COM (97)550, 18.11.97, Proposal for a Council Decision establishing a multiannual framework programme for actions in the energy sector, and associated measures.

Monitoring the progress in the implementation of the RES Strategy in Member States and in the Community will be critical and measures in ALTENER II to support monitoring and evaluation are essential (see chapter 4).

In order to achieve the objectives for renewables, a major effort will be required to harness the potential, influence and experience of all manner of associations and bodies such as citizens' groups (grass-roots organisations), relevant non-governmental organisations, and pressure-groups including the international environmental protection organisations.

At local and regional level, the creation of energy agencies under the SAVE II programme allows local authorities to play an important role in the promotion of renewable energies, mobilising local partnerships, focusing on practical actions and of becoming a key initiator of policies at local level.

The setting up of effective networks is important in order to convey information on renewables at all levels - from the technological to the financial to the local public environmental concerns. A major feature of the Commission effort in this area will be the use of Internet websites.

Other public relations tools such as industry awards, renewable energy prizes, conferences and other open events can and already do have a strong promotional effect in the renewables field, but careful selection in the allocation of support is essential to avoid dispersion of effort.

2.5.2 Market Acceptability and Consumer Protection

The following actions are planned:

- consumer information on quality goods and services for renewable energies. This information is to be disseminated in such a way that customers can choose anywhere in the internal market the most appropriate European product and source at the least price;
- standards should be established at European level but also at a wider international level in order to support exports. Since standardisation work in the renewables field started only in 1995, an increased effort has to be made to extend standards to all commercial equipment; provisional certification has also to be promoted. The EU Joint Research Centre has an important role to play in this respect, giving technical support to the CEN and CENELEC in the framework of ALTENER;
- in order to respond to and mobilise the existing strong public support for renewable energies, products should be clearly labelled as such;
- best practice experience in particular for services, system operation (a typical field for this is passive solar applications) should be collected and widely disseminated;
- regional focal points for information and consumer advice should be set up. The existing regional and city energy centres - and those which continue to be set up under the SAVE II programme are in most cases ideally situated and equipped to take on this role.

2.5.3 Better positioning for RES on the institutional banks and commercial finance market

International financial institutions such as the EIB (incl. EIF etc.) and the EBRD and their national counterparts have already become involved in the financing of

renewable energies, in particular hydro and wind plants. Their role can be strengthened considerably by :

- providing soft loans and credit guarantees;
- creating special facilities for renewable energies;
- developing schemes facilitating loans for small renewable energy projects.

Specific action focused on commercial banks will be promoted:

- guidelines and risk evaluation schemes to help banks to audit RES businesses applying for loans;
- EU support to packaged projects in order to facilitate soft loans access.

2.5.4 Renewable Energy Networking

Transnational co-operation in Europe is important in order to exchange experience and to increase effectiveness. As the scale of renewable energies implementation becomes more significant, the following initiatives should be taken:

- networks of regions, islands, and cities aiming at a 100% energy supply from renewable energies by 2010;
- networks of universities and schools pioneering renewable energies;
- renewable energies technology research and technological development networks;
- renewable energies twinning of cities, schools, farms etc.;
- temporary networks for specific tasks;
- the virtual centre "AGORES" for the collection and dissemination of information on: regulation, calls for proposals, Community and Member States programmes, technical state-of-art, training, financing, assistance, etc.

Chapter 3 Campaign for take-off

3.1 Introduction

Even though renewable energy technologies have reached a certain maturity, there are many obstacles to their market penetration. In order to assist a real take off of renewables for large scale penetration, make progress towards the objective of doubling the EU renewable energy sources share by 2010, and ensure a co-ordinated approach throughout the Community, the Commission proposes a campaign for take off of renewables. This will need to be undertaken over a number of years and will require close cooperation between the Member States and the Commission. The proposed campaign aims to promote the implementation of large-scale projects in different renewable energy sectors and will send clear signals for greater use of renewable energy sources. In preparation for the Campaign, the Commission will catalogue and analyse all existing European Union and Member States' activities and programmes which could provide support for such a campaign. The conclusion of this preparatory survey will be reported to Council and to the European Parliament. Detailed guidelines for the campaign will then be drawn up, together with the Member States.

It is clear that the role of Member States is critical in this concerted action for promoting large scale implementation of renewables. The Commission's role will be to establish the framework, to provide technical and financial assistance, where appropriate, and to coordinate actions. For such a major effort to succeed, it is also important to implicate all the interested parties and bodies in promoting renewables through the means available to them. The involvement of these actors can include the negotiation of commitments and voluntary agreements where appropriate.

Many parties can be potentially active in a campaign to promote renewables, including the following:

- the regions;
- municipalities and their distribution utilities;
- the oil and car industries;
- town and country planning bodies and architects;
- authorities in charge of public procurement;
- industry associations and utilities;
- farmers associations;
- forest-based industries and cooperatives.

In the preparatory phase for the campaign, proposals will be made for their involvement and contribution.

3.2 Key Actions

The following key actions are proposed to be promoted during the campaign:

3.2.1 1,000,000 Photovoltaic Systems

Photovoltaics (PV) is a high technology with strong export potential in a very competitive global market and fierce competition with Japan and the USA. There is a very motivated PV industry in Europe which should be supported in its effort to bring domestic and export markets off the ground. Besides the leading European

oil and other big companies, many SMEs are active in the field. There is much scope for their number to increase and for large numbers of jobs to be created.

An ambitious and very visible promotion campaign is needed in order to provide a sufficiently large market base to enable the prices to fall substantially, and so the Campaign will comprise an EU wide 500,000 PV roof and façade initiative for the domestic market and an export initiative for 500,000 PV village systems to kick start decentralised electrification in developing countries. The basic capacity for each of the systems (the integrated building systems in Europe as well as the solar village schemes overseas), is 1kW_e i.e. the total capacity to be installed in this Campaign by 2010 is 1GW_p .

A large part of the future PV market will be associated with building applications, especially in Europe where the electricity grid is omnipresent. A 500,000 PV roof and facade campaign on the European Union will represent, on the basis of 1kW generators, a total capacity of 500MW_p and will make up one-sixth of the 3GW_p estimated implementation potential outlined in Annex II. This is a very significant campaign for the future of PV, even though it will affect less than 2% of the 30 million houses and non-residential units which will probably be built between now and 2010. This is without taking into consideration the equally large potential for PV retrofitting in existing buildings.

The rationale of such a goal in a global solar market is its consistency with the corresponding goals fixed in Japan and the United States. The first 1000 PV roof programme implemented in Germany at the beginning of the 1990's proved highly successful for market introduction of PV, quality assurance and cost improvements. Japan is implementing in 1997 a 10,000 roof programme which is funded for one-third from public sources. The total investment cost of a 500,000 roof programme would be 1.5 billion ECU (assuming 1kW generators at an average price over the 13 year period of 3 ECU/W). On average, it would mean approximately the installation of 40,000 systems per year. Total yearly investment costs would then be 120 million ECU of which one third i.e. 40 million ECU might be provided from public funds. The equivalent amounts will be used for the export initiative. Although there are virtually no regulations in place to promote PV in the European Union, there is a wide spectrum of funding and fiscal incentives for PV employed today. The most important ones are the 50 % investment subsidy in some German Länder, Greece and other Member States, a full cost electricity tariff for PV energy supplied to the grid in some German cities and accelerated depreciation in the Netherlands. A less generous support of one-third of the investment cost from public funds which is currently applied in Japan may actually be sufficient to open up the commercial markets.

This campaign should incorporate specific actions such as:

- promotion of photovoltaics in schools and other public buildings. This action has not only an educational effect to increase knowledge and awareness at an early and receptive age, but it is technically sound as it minimises the need for storage capacity and in many cases can benefit from advantageous financing;
- incentives for photovoltaics applications in tourism, and sports and recreational facilities, which offers considerable potential due to strongly peaking seasonal demand in mass tourism and the fact that a large proportion of tourist sites are isolated and/or mountainous or otherwise expensive to supply from grids;

- incentives for financing from public funds and city utilities, for instance by spreading the extra cost for photovoltaics over the entire customer base as opposed to the sole purchasers for solar electricity.

3.2.2 10,000 MW of Large Wind Farms

Wind energy today is competitive and has already been widely installed at specific sites with favourable conditions. Areas potentially suitable for wind energy applications are dispersed throughout the European Union. At present, some have to bear additional costs due to their particular location which increases installation and/or operational costs (areas far from existing grids, in very cold, hot or dusty climates, offshore, islands, remote rural areas etc.). In particular, there is enormous potential for offshore wind farms. They have the advantage of higher wind speeds, although access is clearly more difficult. In order to achieve large-scale penetration of wind energy in the European Union these areas have also to be used. A specific campaign is thus required to support large wind farms in such locations and the development of such new or adapted technology as may be appropriate. This programme will clearly imply a major role for the utilities most concerned.

The 10,000 MW of wind farms proposed here represent 25% of the feasible overall wind energy penetration for 2010 outlined in Annex II. No public financing will be needed for the 30,000 MW remaining installed capacity provided that a fair access to the European grids for the wind turbines is guaranteed, as described in section 2.2.1. An additional help is needed only for the less favourable or unconventional applications described above.

The average ex-works cost of wind turbines for wind farms is today less than 800 ECU/kW of installed capacity. Project preparation cost depends heavily on local circumstances, such as condition of the soil, road conditions, proximity to electrical grid sub-stations, etc. For flat onshore sites the overall cost of an installed wind farm is about 1,000 ECU/kW. This cost could increase substantially for offshore and unconventional site applications. On the other hand, costs are expected to fall by at least 30% by 2010. It is then logical to assume the total investment cost of the proposed 10,000 MW will be in the order of 10 billion ECU. A public expenditure of 15% would amount to 1.5 billion ECU throughout the Union or a little more than 100 million ECU per year.

3.2.3 10,000 MW_{th} of biomass installations

Bioenergy is among the most promising areas within the biomass sector, and combined heat and power using biomass has the greatest potential in volume among all renewable energies. Consequently, a campaign to promote and support decentralised biopower installations throughout the European Union is essential. Such installations could range in scale from a few hundred kW to multi-MW and combine different technologies, as appropriate to local circumstances, including fuel switching. Wherever possible use should be made of opportunities for rationalisation through regional and local level implementation.

The estimated contribution of biomass in combined heat and power plants, as outlined in Annex II.1, could be 26 Mtoe. This corresponds typically to an overall installed capacity of approximately 20 GW_e or 60 GW_{th}. The promotion of 10 GW_{th} through this campaign represents 1/6 of the total estimated contribution biomass could make by 2010. It will in particular be important to take measures in the early years of this action plan in order to launch a bioenergy market.

The total installation cost of such an initiative would be in the order of 5 billion ECU, assuming an average cost of 500 ECU/kW_{th} of installed capacity. A public expenditure of 20% would amount to 1 billion ECU for the whole period for the whole Union or around 80 million ECU per year. The biomass feedstock cost would amount to 270 million ECU per year, if we assume a 100 ECU/toe.

3.2.4 Integration of Renewable Energies in 100 Communities

To optimise the available potential of renewable energy technologies requires them to be used together wherever this is productive either in integrated systems for local power supply or, on the other hand, in dispersed schemes for regional power supply. These obviously have to be adapted to the conditions of each specific location, so as to ensure reliable power supply to the required quality and continuity standards.

As part of this campaign action, a number of pilot communities, regions, cities and islands will be selected from those which can reasonably aim at 100% power supply from renewables. These pioneer collectivities, in order to feature as credible pacemakers, should be of varying size and characteristics. On a small scale, the units could be blocks of buildings, new neighbourhoods in residential areas, recreational areas, small rural areas, or isolated ones such as islands or mountain communities. On a larger scale, "solar cities" should be identified, as well as large rural areas, and administrative regions which can benefit from an existing sense of community. Large islands (e.g. Sicily, Sardinia, Crete, Rhodes, Mallorca, Canary Islands or Madeira) could also be used as pilot regions.

In order to specify the actions required and to monitor progress, a strategy including schedules, priorities and players must be defined. Local and regional authorities as well as regional energy centres have a central role to play in implementing this project.

Preference should be given to activities involving combinations of technology and application in such a way that such projects have the potential to cover the entire range from pre-feasibility study, through feasibility study and demonstration phase (mainly programme financed), to large-scale implementation with (mainly) commercial international financing.

The costs of this initiative are difficult to define with any precision at this stage due to the different size and nature of each possible action. Projects implemented in other sectors of the present campaign can also be a part of the actions promoted here. As a first estimate one may assume a yearly cost of 200 million ECU, with a public funding in the order of 20% or 40 million ECU per year throughout the Union

3.3 Estimates of some of the costs and benefits

Cost estimates and an investment plan to be financed by all partners, Community and Member States' programmes and funds and also by institutional and commercial banks, utilities and others, will have to be drawn up. The effects of this Campaign on CO₂ emissions and employment will also be analysed in detail. As a first estimate, the Campaign could involve 20.5 billion ECU of investments for the period 1998-2010. Public funding from all possible sources (European, national, regional, local), to stimulate the Campaign could be in the order of 4 billion ECU or

300 million ECU per year. At the same time, it must be underlined that 3.3 billion ECU will be saved in avoided fuel cost to 2010 and external benefits in the order of 2 billion ECU per year are estimated.

The following table summarises the figures related to the Campaign and estimates the direct benefits in avoided fuel costs and reduction of CO₂ emissions.

Campaign Action	Proposed New Installed Capacity	Estimated Total Investment Cost billion ECU	Suggested Public Funding billion ECU	Total Avoided Fuel Costs billion ECU	CO2 Reduction million tn/year
1.1,000,000 PV systems	1,000 MWp	3	1	0.07	1
2.10,000 MW Wind Farms	10,000 MW	10	1.5	2.8	20
3.10,000 MWth Biomass	10,000 MWth	5	1	-	16
4.Integration in 100 Communities	1,500 MW	2.5	0.5	0.43	3
Total		20.5	4	3.3	40

Chapter 4 Follow up and Implementation

4.1 Implementation and Monitoring of Progress

During the period of implementation of the Strategy and Action Plan outlined in this White Paper, there is the need for a constant monitoring of activities in order to follow closely the progress achieved in terms of penetration of RES, and to ensure and improve co-ordination of programmes and policies under the responsibilities of the Community and the Member States.

There is, in this context a case for improving the co-ordination and data collection as regards the action on renewables undertaken within the various programmes of the Community and the activities of Member States, and for developing a unified acceptable system of statistics based on the substitution principle. The Commission, in the framework of the ALTENER II programme and in co-operation with the Statistical Office and the JRC will create a monitoring scheme which can register all Community support given to renewables as well as the action undertaken at national level and progress made in terms of renewables penetration in different sectors. In this way policies and programmes affecting renewables and progress towards increasing the share of renewables can be monitored reliably and effectively.

4.2 Internal Co-ordination of EU Policies and Programmes

A major added value of a Community Strategy is the proposed integration of the promotion of RES in several policy areas. In order to ensure the effective follow-up and implementation of this aspect within the Commission, the internal co-ordination will be strengthened to deal with all policy aspects of renewable energy integration in the Community's policies and areas of responsibility.

4.3 Implementation by Member States and Co-operation at EU level.

The active participation of the Member States in the further development and implementation of the Strategy, as well as in the assessment and monitoring of progress is essential. Co-operation within an EU-framework provides added-value for the effectiveness of the actions and also offers considerable benefit to Member States, as successful policies and experiences on national and local levels can be disseminated and objectives and actions can be coordinated. Joint policies and transnational Projects will increase efficiency.

A working group involving Commission and Member States representatives will be established in order to monitor the measures undertaken and evaluate the impact of energy policy decisions at all levels with regard to the use of renewable energy sources. Member States need to adopt national goals and strategies, and these will be compared alongside European wide action discussed and to be put into effect. The Member States, as part of their contribution to this process, will be asked to report to the working group the feasible contribution they can realistically make to the 2010 target, including how they intend to promote renewables sector by sector. The working group should also co-ordinate responses and form a view on the likelihood of the RES Community objective being achieved, and if necessary stimulate new measures.

4.4 Implementation of Action Plan - Next Steps

The Community Strategy presented above is the basic framework for action for achieving the indicative objective of 12% penetration of renewables by 2010. In order to implement the Strategy, concrete measures are proposed in an Action Plan (Annex I), which the Strategy sets out the individual actions by categories, and indicates the form of each action. Actions are attributed to the EU, Member States or both, depending on the nature of the action and in accordance with the principle of subsidiarity. Whole-hearted commitment will be necessary from all the players involved, EU institutions, Member States, regional and local authorities, industry and consumers, to implement this Action Plan and, in so doing, achieve the objective adopted for a significant increase in the share of renewable energies in the total inland energy consumption by 2010. If the objective of doubling the share is achieved it will have an important impact on reducing the EU's CO₂ emission as well as contribute to job creation and regional economic development.

A Communication to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions will be produced every two years in order to evaluate the success of the strategy and recommend a revised direction and/or new actions if sufficient progress in the penetration of renewables does not appear to be made.

The European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions are invited to endorse the EU Strategy and Action Plan set out in this White Paper, and to support its implementation over the period to 2010.

Annex I

PRELIMINARY INDICATIVE ACTION PLAN FOR RES 1998-2010 (Includes some actions already initiated)

ACTION PLAN	European Union	Member States	Chapter
1. Objectives and Strategies			
Community Strategy and overall objective of 12% for the EU up to 2010	Communication of the Commission - White Paper - (1997)	-	1.3.1
Member States setting individual objectives to 2005 and 2010 and establishing strategies	-	action	1.3.1
2. Internal Market Measures			
Fair Access for RES to the Electricity Market	Proposal for a Directive (1998)	transposition	2.2.1
Restructuring the Community Framework for the Taxation of Energy Products	Proposal for a revised Directive (COM/97/30)	transposition or harmonisation	2.2.2
Start-up subsidies for new production plants. SME's and new job creation	-	action	2.2.2.
Development or/and harmonisation concerning "golden" or "green" funds	1998 : Promotion 2000 : Communication of the Commission	action	2.2.2.
Progressive increase of the market share of liquid biofuels		action	2.2.3
Promotion of Biofuels in transport fuel	Proposal for a Directive COM(97)248	transposition	2.2.3
Promotion of biofuels in low-sulphur liquid fuels	Proposal for a Directive COM(97)88	transposition	2.2.3
Extend the scope of the SAVE Directive to passive and active solar systems in buildings to take into account the energy gains for heating and cooling	Proposal for Amendment of Directive 93/76/EC (1998)	transposition	2.2.4.
Extend the scope of the Directive to building materials with a low intrinsic energy content	Proposal for Amendment of Directive 89/106/EC (1998)	transposition	2.2.4.

3. Reinforcing Community Policies			
Inclusion of Actions on Renewables in the overall strategy for combatting climate change	Communication of the Commission COM(97)481	-	2.3.1.
Adoption and implementation of the 5th Framework Programme for RTD (1998-2002)	Decision of the EP and the Council (.../.../...)	-	2.3.4.
RES to be included in the main priorities jointly with employment and environment in the regional fund new phase (2000-2006)	To be decided in 1999.	implementation	2.3.5. and 2.3.6.
Promotion of biomass in CAP and rural development proposals for 2000-2006	CAP proposals/Agenda 2000 Decision awaited 1998		2.3.6.
Review of Reg. 2078/92 in context of Agenda 2000 Examination of adequacy of existing instruments and possibility of further harmonisation	Review of Reg. 2078/92 and other existing instruments		2.3.6
Definition of an energy strategy for the co-operation with ACP countries, in the Lomé Convention Framework, emphasizing the role of RES	Communication		2.3.7
Sufficient funding from TACIS and PHARE for RES in order to implement Protocols opening EU support programmes ALTENER and SYNERGY to associated countries. Appropriate agreements with Mediterranean area countries as well as other areas. Collaboration in the implementation of the World Solar Programme 1996-2005.	Specific Protocols Communication		2.3.7.
4. Strengthening Co-operation between Member States			
Strengthening co-operation between MS under Council Decision on the Organisation of Co-operation around Agreed Community Energy Objectives	Proposal for a Council Decision (COM/.../...)	implementation	2.4
5. Support measures			
EU programme to promote RES, open to CEECs and Cyprus, aimed at creating the necessary conditions for the implementation of the Action Plan particularly the legal, socio-economic and administrative conditions and encourage private	Proposal for a Council Decision "ALTENER II" (COM/97/87) Proposal for Framework	submission of projets	

and public investments in the production and use of energy from RES to include specific actions for the identification and promotion of business opportunities	Programme for Energy Actions 1998-2002		
Consumer information campaigns. Targeted information action on the protection of environment with simultaneous energy recovery	EU actions		2.5.2
Development of European standards and certifications	CEN and CENELEC under ALTENER	certification by agreed bodies	2.5.2
Better positioning for RES on the institutional banks and commercial finance market by developing schemes facilitating investments in RES projects	agreements and projects	agreements	2.5.3
Creation of a virtual centre "AGORES" for collection and dissemination of information	action under ALTENER	data	2.5.4
6. Campaign for take-off			
1,000,000 PV systems half in EU, half in third countries.	EU promotion and financial contribution	co-funding	3.1
10,000 MW of large wind farm	EU promotion and financial contribution	co-funding	3.2
10,000 MWth of biomass installations	EU promotion and financial contribution	co-funding	3.3
Integration of Renewable Energies in 100 Communities	EU promotion and financial contribution	co-funding	3.4
7. Follow-up			
Scheme to monitor progress	EU action under ALTENER	data	4.1
Improvement of data collection and Statistics	Commission action		4.1
Inter-services co-ordination group	Commission action		4.2
Creation of a Working Group involving Commission and Member States	Commission action		4.3
Regular reporting to the Union's Institutions	Commission action		4.4

Annex II

Estimated Contributions by Sector - A scenario for 2010

In this Annex, the realistic potential for exploitation of the different renewable energy sources is presented within the framework of the Strategy and Action Plan. The contribution that the various renewable energy sectors could make by 2010 towards achieving the indicative objective of 12% share of renewables is estimated. These estimates present one particular scenario of RES development - it is clear that the market could evolve differently. Nonetheless, it is considered important to present an overall view of projected developments, in order to help orientate policy instruments and campaigns.

II.1 Biomass

Currently biomass accounts for about 3% of total inland energy consumption (EU15). However in the new Member States - Austria, Finland and Sweden - this renewable source already accounts for 12%, 23% and 18% respectively of primary energy supply. It is difficult to make estimates in this area on future development as regards the extent to which the biomass and its distribution sector will expand. Under the particular scenario followed in this Annex, use of three times the present amount of 44.8 Mtoe is considered to be a possible development for 2010, on condition that effective measures are in fact adopted. This would mean additional biomass amounting to 90 Mtoe, equivalent to 8.5% of the projected total energy consumption in that year.

Biomass is a widespread resource as it includes in addition to woody biomass and the residues of the wood working industry, energy crops, agricultural residues and agro-food effluents, manures as well as the organic fraction of municipal solid waste or source, separated household waste and sewage sludge. Energy from biomass is versatile in that it can produce electricity, heat, or transport fuel as appropriate, and unlike electricity it can be stored - simply and usually economically. In addition, production units can range from small scale up to multi-megawatt size.

The additional estimated bioenergy use of 90 Mtoe by 2010 would be derived from agricultural, forest, and forest industry residues, waste streams as well as from new energy crops. Biomass exploitation has the double benefit of exploiting an important renewable energy resource and also of improving the environment and climate. Clearly in the development of biomass particular care will need to be taken to safeguard bio-diversity in the EU. Strategies and approaches should be adopted that minimise the impacts on bio-diversity.

The advantages of exploiting biomass, based on new technologies, can be clearly seen in the case of biogas exploitation. This consists largely of methane, a gas with a large greenhouse impact. It is estimated that the total energy content of land fill gas and digestible agricultural wastes in the EU exceeds 80 Mtoe. The contribution that could be made by biogas exploitation from livestock production, agro-industrial effluents, sewage treatment and landfill by 2010 is estimated at 15 Mtoe. A stronger exploitation of the biogas resource is indeed in line with the Commission's strategy for

reducing methane emissions on environmental grounds. This point has received particular attention in the preparation of a global agreement on greenhouse gas emissions. On the other hand, a new directive on landfill which is currently being discussed by the European Union institutions is rather going to limit the production of biogas from land fill : The directive plans a 75% reduction of biodegradable rubbish that can be dumped in landfill sites by 2010. However, the volume of the organic matter that could be used as feed stock for the production of biogas by anaerobic digestion would increase and the organic matter landfilled before 2010 will continue to produce methane by fermentation for several years after 2010.

As far as solid residues are concerned, there is first at all a huge potential so far unexploited in the form of wood and agricultural residues, straw etc. which exceeds 150 Mtoe per year. It is estimated that 30 Mtoe can be mobilised annually by 2010 for the power and the heating and industrial process heat market. Energy crops also need to be considered if the objective of doubling the renewable energies' share by 2010 is to be achieved. In total, the contribution for bioenergy production from crops by 2010 is estimated at 45 Mtoe i.e. an amount equal to that anticipated for bioenergy from residues and wastes. Of this 18Mtoe could be in the form of liquid biofuels (including however liquid biofuels from non-energy crops such as wood residues, used vegetal oils, or biogas used as motor fuel) and 27 Mtoe as biomass for heat and/or power, under one particular scenario.

Liquid biofuels are currently the least competitive product from biomass in the market place, given the low oil prices. It is, however, important to ensure their continuing and growing, presence in the fuel market since the short/medium term oil-prices are unpredictable, and in the longer term alternatives to the finite oil reserves are needed. The energy demand in the transport sector is expected to grow strongly in the future and so will the emission problems associated with it, and the external dependence on oil, if no alternatives are available. Biofuels have an overall positive energy balance, although this varies from crop to crop, and also depends on the crop replaced. Whether there is such an increase will depend crucially on closing the gap between production costs of bio-fuels and competing products.

Future development of biofuels will have to be based mostly on production in Europe. In 1993 the "utilised agricultural area" of EU15 was approx. 141 million hectares of which 76 million hectares were "arable land". It is doubtful that more than a maximum of 10 Million hectares, i.e. 7.1% of the agricultural area would be sustainable for biomass crop production, the choice of crop species for liquid biofuels would need to be limited to the most productive ones with the maximum benefit and minimum environmental impact.

As far as the potential contribution of 27 Mtoe from solid cellulosic bioenergy crops is concerned, the options for production are manifold. This material can be derived from short rotation forestry, (ex: willow), or non wood, energy crops (ex: miscanthus) also good for combustion and gasification. There are various plant species suitable for specific types of agricultural land. There is a choice of crops for short rotation forestry on rather marginal land of lower value. At yields of 10 tonnes per hectare and year, a production of for example, 27 Mtoe of solid biomass by 2010 would imply a cultivated area of 6.3 Million hectares of land. There exist also various options for high yield C4 plants, annual or perennial ones. They deliver about twice as much material as the short rotation forestry.

There are also plants which produce simultaneously cellulosic materials and feedstocks for liquid biofuels. An example is sweet sorghum which typically yields 5 m³ bioethanol and 20 t of dry cellulosic material per hectare and year. It is important here to note that the fast-growing plants have several other attractions : many are annual and fit into conventional agricultural practice; they do not require the best arable land; they require less than half the water and fertilisers required by fast growing crops, such as maize. There is also a promising prospect for production of liquid biofuels from cellulosic matter. All options of species should be carefully examined with preference given to the high-yielding/low input crops, which respect biodiversity. In any case, it seems appropriate in any biomass development strategy to set an upper maximum a limit for land use. It is estimated, in this scenario approach, that if the maximum reasonable development of biomass is made by 2010, as much as 10 Million hectares of land would be needed, much of it marginal land. Clearly, the environmental impacts of this development would need to be assessed, and the growth of the biomass sector would have to be compatible with sustainable development.

The overall volume of the solid vegetal biomass market is estimated at 57 Mtoe in 2010, the projected feedstocks being energy crops (27 Mtoe) and residues (30 Mtoe). If the market indeed develops in this direction, it is predicted that 25 Mtoe would be taken up by the market for direct heating and industrial process heat and 32 Mtoe would go to power generation. A portion of these 32 Mtoe, i.e. 6 Mtoe could be used in cofiring plants in combination with coal and the remaining 26 Mtoe in combined heat and power installations

Projected additional bioenergy use by 2010

under the scenario presented	90 Mtoe
* Biogas exploitation (livestock production, sewage treatment, landfills)	15 Mtoe
* Agricultural and Forest Residues	30 Mtoe
* Energy Crops	45 Mtoe

II.2 Hydro Power

Hydro power is a proven mature technology and its operation has been competitive with other commercial energy sources for many years. However, the existing technical and economic potential for large hydro power plants has either been used, or is unavailable due to environmental constraints. In contrast to this situation, only about 20% of the economic potential for small hydro power plants has been so far exploited. In addition many existing small hydro plants are out of operation, often as a result of a lack of specific incentives as to maintenance and other costs, as well as the overall grid pricing situation, but can be refurbished with relatively modest outlay, especially in the case of small typically rural and relatively isolated installations. European Union countries dominate the world market for small hydro equipment.

In 1995 approximately 307 TWh of hydro energy was produced in the Union from an overall capacity of 92 GW. Small hydro plants, i.e. plants smaller than 10 MW accounted for 10% of installed capacity (9.3 GW) and produced 37 TWh.

An increase of 10 % in installed capacity of large hydro (8,500 MW) is likely by 2010 if one takes into account projects already planned, and some environmentally acceptable development. . An additional installed capacity of 4,500 MW of small hydro plants by 2010 is a realistic contribution which could be achieved given a more favourable regulatory environment, since these small projects, if correctly planned, can have much lower environmental impact.

II.3 Wind Energy

Wind energy technology is developing fast. The average weight of wind turbines has halved in five years, the annual energy output per turbine has increased fourfold, and costs have decreased by a factor of ten in ten years. At present, the average size of new machines being installed is 600 kW, although there are a few machines as powerful as 1.5 MW on the market. About 90% of the world's manufacturers of medium and large-sized wind turbines are European. The largest machines are at present produced only by European manufacturers. Wind turbines give rise to some noise pollution, and research effort is being successfully undertaken to reduce noise emissions.

Wind energy is in some Member States currently the fastest growing energy source for electricity production. Europe is the world leader in wind energy, with more installed capacity than any other region of the world: 3.5 GW in EU15 at the end of 1996. There has been an average annual installation growth rate of 36% in the past five years, reaching, at present, an annual rate of 1 GW/year. If production continues to increase by the same rate, yearly production of turbines in 2010 will amount to more than 20 GW and the accumulated capacity will be more than 100 GW. A constant installation rate at this current value (~ 1 GW per year) would mean 18 GW of installed generation capacity in 2010. Therefore an estimated contribution of 40 GW wind power in the RES development by 2010 for the EU15, while ambitious, is realistic given the strength of these trends. The campaign for take-off for 10GW should provide a basis for wider implementation of wind powered electricity generation under more difficult conditions.

A significant contribution from wind energy for 2010 can only be achieved if conditions of access to the European grids are fair for the wind generators. A major factor in the recent market success of wind energy in Member States such as Denmark, Spain, and in particular in Germany, which now has the world's largest electricity generating capacity from wind, has been the price to be paid by utilities to wind generators for sale onto the grid. Any major changes that might be made in this regulatory structure should encourage and not jeopardise the appropriate development of wind energy.

II.4 Solar Thermal

Solar thermal heating technology is almost fully mature. There is nevertheless scope for further cost reductions from larger scale production and improvements in both production processes and marketing. At present in EU-15 about 300 small and medium enterprises are active in this sector, directly employing about 10,000 people. Solar thermal heating is cost-competitive today as compared with electric water heating, in particular in the southern parts of the European Union. Design is constantly being improved to minimise visual impact.

In 1995 there were 6.5 Million m² of solar collectors installed in the European Union with a 15% growth rate over the preceding few years. The annual current installation rate is 1,000,000 m², concentrated in three EU member countries - Austria, Germany, and Greece. A growth rate of 25% could be achieved if the other 12 European Union member countries even partially followed this example. At a 20% annual growth rate, total installed capacity would be 100 Million m² in 2010 which taking all relevant factors into consideration is an achievable contribution to RES development. Use of large collector fields in large-scale applications such as district heating systems - the most economically rational way of using solar thermal energy - would in itself stimulate a dramatic increase in collector production. Public awareness campaigns can effectively also boost the market as has been borne out by experience in Greece.

II.5 Photovoltaics

Solar photovoltaic electricity generation is very much a recent and close-to-state-of-the-art renewable energy technology. Costs have fallen dramatically with a 25% cost decrease over the past 5 years, but are still significantly higher than for electricity generated from conventional fuels. The European Union, currently accounts for about one third of annual, more than 100 MW_p, world-wide photovoltaic module production and use. The European industry has built up a leading position in the field of photovoltaic incorporation in buildings. Europe also has the lead in applications of photovoltaics in developing countries.

Eurostat estimates that 32 MW_p of photovoltaic generation capacity was installed (EU12) at the end of 1995. The most recent estimate from the European Photovoltaic Industry Association (EPIA) suggests as much as 70 MW_p (EU 15). Photovoltaics is very much a global market. World annual module production is forecast at 2.4 GW_p by 2010. To attain an annual output of 2.4 GW_p world-wide, would require annual growth of 25%. Such an estimate is in fact compatible with the assumptions used in an EPIA study commissioned by the Commission.

Under the above assumptions a contribution of 3 GW_p installed capacity in EU15 from photovoltaics by 2010 seems ambitious but realistic. It is forecast that this would be accounted for mainly by grid-connected installations incorporated into the structure of buildings (roofs and façades) as well as a certain number of large-scale power plants (0.5-5.0 MW_p). Anyhow, PV technology should be considered in a more general way not just as a measure of GW_p installed. As it is the case for solar thermal applications, PV systems are always associated with Rational Use of Energy measures in buildings and can be evaluated as a part of the significant effort of reducing energy consumption, which always should accompany their utilisation. Grid-connected photovoltaic generation is not competitive at currently prevailing classical fuel-based generation costs and also compared with wind turbines, but it could be based on an average cost level of 3 ECU/W_p of installed capacity, which on the basis of current trends could happen around 2005. A sizeable initiative at European level for incorporating photovoltaic modules in roofs and facades can thus play a major part in definitively launching this technology. Secondary advantages of building integration such as lighting, heat supply, façade substitution should be valorised. The concept of energy system should take into account the "added value of PV". Integration of 2 PV in buildings can also convert any visual impact into an architectural design advantage.

The campaign for take-off promoting the installation of 1,000,000 photovoltaic roofs and facades would mean new capacity of 0.5GWp in the Union and 0.5GWp in third countries.

II.6 Passive Solar

Thermal energy demand (mostly for space heating) in the domestic and tertiary sector in EU15 represents 23% of total energy demand. It is estimated that 40% of energy actually consumed in this sector is in fact gained from solar energy through windows, but this passive energy supply is not taken into account in statistics. Consequently, the potential for further reducing the thermal energy demand in buildings with available passive solar techniques is very substantial. "Solar" and "low-energy" buildings cost almost no more to build than conventional ones. Experience in Austria has shown that passive solar construction increases overall dwelling costs by less than 4% while achieving 75% reductions in heating energy. Large gains can also be achieved in the existing building stock by retrofitting windows and facades to make more use of natural sunlight and simultaneously insulate. New materials for windows, daylighting and insulation are commercially available. Passive cooling techniques have also been developed during the last few years and could help reduce the fast-growing cooling demand in southern European countries.

Even conservative estimates show that a 10% reduction by 2010 in thermal energy demand for buildings is easily attainable by increased recourse to passive solar techniques. If it is assumed that thermal energy demand in the domestic and tertiary sector remains stable (at 23% of the total), then this represents fuel savings of 35 Mtoe. Switzerland has already committed itself to a 30% energy reduction for heating in buildings by the same year. These additional gains should be counted in the balance of the European Union's gross energy consumption.

II.7 Geothermal and Heat Pumps

Geothermal energy accounts for only a very small part of total renewable energy production in the European Union. Although power production is already viable from high-temperature dry steam, the risks associated with exploitation still present a disincentive to investment. The use of geothermal heat is thus growing slowly. However, the use of heat pumps to upgrade lower temperature ground heat is becoming much more common.

Currently installed geothermal power capacity in the European Union amounts to 500 MW. More electrical units are gradually coming on stream in France (above all overseas departments), Italy, and Portugal (the Azores). It is estimated that a doubling of the current installed capacity is an achievable contribution to RES growth by 2010.

Most low-temperature geothermal heat is employed in buildings applications. The current capacity of 750 MW_{th} is concentrated in France and Italy. This capacity could be more than tripled in 2010, to give 2.5 GW_{th}.

Turning to heat pumps, those installed to date mostly use electricity or fuel as the necessary driving energy input. A new generation make use of heat exchangers installed some 100m underground which thus exploit naturally stored solar energy and some intrinsic heat from the earth itself already at such a depth. A total of 60,000 geothermal heat pumps were installed in 1995 in the European Union, most of them in

Sweden representing 8% of the capacity for all types. Assuming that this total installed heat pump capacity will be tripled by 2010 in EU15 and that the market share of geothermal heat pumps will double to reach 15%, gives an estimated achievable total capacity of 2.5 GW_{th} by 2010.

II.8 Other Renewable Technologies

There are a number of other renewable energy technologies, such as solar thermal power, tidal power, ocean currents, wave power, hot dry rock, ocean thermal energy conversion, for which the current market in the European Union is non-existent. Projections are difficult to make, but some of these technologies will undoubtedly offer significant potential in the future. It is reasonable to expect that at least one of these renewable sources will have started to be exploited commercially over the coming decade or so, which justifies assuming a marginal contribution of 1 GW by 2010.

II.9 Achieving the Overall Community objective for RES

Table 1A summarises the estimated contributions by sector described in the present annex in the particular scenario chosen for projecting ways of achieving a 12% share of renewables in the Union by 2010. Table 2 compares gross energy consumption by type of renewable energy in Mtoe for the year 1995 with that projected for the year 2010, assuming that these contributions by the different RES are indeed made. On this basis the overall objective of doubling the current share of renewables to 12% by 2010 can be realistically achieved. The projected total gross inland consumption for 2010 is taken from the Pre-Kyoto scenario (Conventional Wisdom, "European Energy to 2020", see footnote 8). If post-Kyoto energy use turns out to be lower than that foreseen prior to Kyoto, this will have the effect of slightly increasing the current indicative objective to above 12%. On the other hand, enlargement to States with very little or no penetration of renewables may have the effect in practice of lowering the objective to below 12%. This will be taken into account in the monitoring and review mechanisms foreseen.

II.10 Estimated RES Contributions in Electricity and Heat Generation

In Table 3 the current and projected contribution of renewables to the electricity market is presented by type of energy. If appropriate measures are taken, electricity production from renewables could grow significantly by 2010, from the present 14.3% to 23.5%. The projected total electricity production for 2010, once again, is taken from the Pre-Kyoto scenario. Finally, the doubling of the heat produced by renewables is the projected development for 2010 for the heat sector as shown in table 4 if the promotion strategy for RES is successful.

II.11 Assessment of some of the costs and benefits

In table 6 the estimated investment costs and the benefits related to, avoided fuel costs, and CO₂ emissions reduction, are presented by type of renewable energy while Table 5 provides estimates for the overall strategy to 2010. The first column of Table 6 shows the additional capacities needed to be installed in order to achieve the estimated

contributions by different RES. In columns 2 and 3 the current unit costs by type of technology and the corresponding projected unit costs in 2010 are presented respectively. The fourth column shows an average reference unit cost, where the projected time frame for the deployment of each technology is taken into account. For those types of energy where installations are projected to grow steadily, such as wind energy, the average unit cost is nearer to the 2010 value. For those technologies, such as hydro, where the installations will be more or less evenly distributed in time, the mean value between 1997 and 2010 is taken as the average reference unit cost. In the 5th column the total investment needed for the installations is presented. Column 6 shows the expected annual business in 2010. Installation rate, operation and maintenance as well as fuel costs (for biomass) are included in the figures presented in this column.

Estimations on avoided fuel costs are presented in columns 7 and 8. Additional fuel savings from wind, hydro, photovoltaics and solar thermal collectors have been estimated to be 3 billion ECU in the year 2010. Assuming a constant rate of increase of installations during the period 1997-2010, a total amount of 21 billion ECU of additional fuel savings is calculated. Fuel substitution of coal and oil at 1997 prices has been assumed in all calculations. Biomass and geothermal are considered to have the same fuel costs as fossil fuel technologies and they are not included in the estimation. On the other hand, all renewables contribute to the reduction of fuel import supplies achieving a 17.4% reduction in 2010 with respect to the 1994 figures.

The last column shows the CO₂ emission reduction figures. For electricity production from wind, hydro, photovoltaics and geothermal, the displacement mainly, but not exclusively, of conventional coal fired power plants is assumed. The CO₂ emissions, in this case, are calculated on the basis that one TWh produced by renewable saves one million tonnes of CO₂. As far as biomass is concerned, although it has a neutral effect on CO₂, the emissions generated during the feedstock production have been taken into account.

In addition, a significant number of additional jobs are expected to arise as a result of the doubling of the share of renewable energies foreseen in this Community strategy (see section 1.4).

The sum of these estimated figures shows that a total investment of 165.1 billion ECU could be needed in order to achieve the overall significant increase in renewable penetration aimed for in this strategy. . As a result of this investment, an annual business of 36.6 billion ECU is estimated to be generated in 2010, creating a significant number of new jobs, avoiding fuel costs of 21 billion ECU, reducing imports by 17.4% and reducing the CO₂ emissions by 402 million tones per year with respect to 1997.

Annexe III Member States' plans and actions for the development of renewables

Austria has a share of 24.3 % for RES. The Austrian government introduced in 1996 an energy tax on electricity and gas excluding RES. In 1994 a promotional tariff for power generation from solar, wind and biomass was introduced. Further development of hydro power, biomass in existing thermal plants and energy crops and solar energy are the main objectives.

In **Belgium**, energy policy has been decentralized. While there is no specific target for the energy sector, promoting RES is expected to see a reduction in CO₂ emissions of about 20 MT by 2000 in industry. In Wallonie the PEDD (Environment plan for sustainable development), adopted in 1995 is expected to be followed by a development programme for RES.

In 1996 **Denmark** elaborated an Energy Action Plan "Energy 21" including medium and long-term scenarios to 2005, 2020 and 2030. The assumptions to 2005 for RES include 200 MW offshore wind turbines, about 1 PJ landfill gas and about 1 PJ geothermal heat. After 2005 the assumptions include developing 5500 MW wind turbines (of which 4000 MW offshore), 145 PJ annually from biomass and biogas including energy crops and 25 PJ annually from geothermal and heat pumps in district-heating.

The **Finnish** government adopted in 1995 a decision on energy policy which includes increased use of bioenergy of 25% by 2005. A promotion programme for wind energy in 1993 set a target of 100 MW installed capacity by 2005.

France started in 1996 a five year programme including 225 MW from wood combustion, 20.000 solar thermal panels for the DOM areas and 250 to 500 MW of wind turbines "Eole 2005".

In **Germany** the Act "Stromeinspeisungsgesetz" of 1991 has had a significant effect on new capacity from RES. A programme to support RES was adopted by the Federal Government with 100 million DM for the period 1995-98. Many of the Länder also have programmes. RTD is very important, with a 250 MW wind demonstration programme. 30% of the government's RTD programme is for RES. Solar thermal and PV campaigns (1000 Roofs) have had an important impact. In wind energy, Germany holds second place in the world.

The **Greek** government has a comprehensive approach to encourage RES. The law 2244/1994 was strengthened by the Decision 8295/1995 in order to remove restrictions on electricity production from independent producers up to 50 MW. The electric utility (PPC) has a ten year programme to develop RES with the following targets : biomass (733 Mtoe by 2000 and 1400 Mtoe

by 2005) wind (68 and 136 Mtoe) small hydro (15 Mtoe and 41) solar (156 Mtoe and 204) and geothermal (20 Mtoe and 40). In 1994 a second Support Framework of the Community earmarked 100 MECU for RES, 75% of funding will come from structural funds.

In **Ireland**, as a result of the AER 1 and 2 initiatives (Alternative Energy Requirement programme of 1994) and the RES Strategy, the additional RES generation will be 6% of installed capacity by 1999 bringing the total to 11%.

In **Italy**, if progress continues the PEW (National Energy Plan) expectations could be surpassed and RES could give a contribution of 2700 MW by 2000. Specific targets are 600 MW for wind and 75 MW for PV by 2000.

Luxembourg has no specific policy objectives for RES, nevertheless instruments include subsidies for solar, biomass, wind, small hydro and heat pumps.

The Netherlands has an Action Programme 1997-2000 for RES and has elaborated scenario for 2007 and 2020 which includes: development of wind energy (750 MW in 2000, 2000 MW in 2007) solar PV(119 MW 2007) biomass (residual flows 30-80PJ/year and energy crops (12-70 PJ/year) solar Thermal (5 PJ in 2007 or 250.000 water heaters) and heat pumps (50 PJ in 2007).

In **Portugal**, the Energy Programme of 1994 had a target of about 170 MW for RES electricity. Traditional biomass is about 26% of energy needs in the residential sector. The biomass centre has a specific programme to develop biomass.

In **Spain** the PEW (National Energy Plan) for 1991-2000 had the following objectives : SMP 213 Mtoe, biomass 427 Mtoe, wind 35 Mtoe, PV 0.389 Mtoe, solar 34 Mtoe and geo thermal 10 Mtoe. At the end of 1996 the objectives were surpassed in SMP 1045%, wind 381.5% and PV 149%.

The **Swedish** Government Bill 1996/97 : 84 on a Sustainable Energy Supply includes measures aimed at increasing the supply of electricity and heating from RES. The five year scenario for RES includes an expansion of bio-fuel-based CHP of approximately the equivalent of 0.75 Twh of electricity per year, an annual increase of around 0.5 Twh from land-based wind facilities and an annual increase of 0.25 Twh from small-scale hydropower.

The **United Kingdom** is currently reviewing its policy on renewable energy, consideration being given to achieving 10% of the country's electricity need from RES by 2010.

Table 1**Share of Renewable Energy Sources in Gross Inland Energy Consumption**

	1990	1995
Austria	22.1	24.3
Belgium	1.0	1.0
Denmark	6.3	7.3
Finland	18.9	21.3
France	6.4	7.1
Germany	1.7	1.8
Greece	7.1	7.3
Ireland	1.6	2.0
Italy	5.3	5.5
Luxembourg	1.3	1.4
Netherlands	1.3	1.4
Portugal	17.6	15.7
Spain	6.7	5.7
Sweden	24.7	25.4
United Kingdom	0.5	0.7
European Union	5.0	5.3

Source: EUROSTAT

Table 1 A**ESTIMATED CONTRIBUTIONS BY SECTOR
IN THE 2010 SCENARIO**

TYPE OF ENERGY	SHARE IN THE EU IN 1995	PROJECTED SHARE BY 2010
1. Wind	2.5 GW	40 GW
2. Hydro	92 GW	105 GW
2.1 Large	(82.5 GW)	(91 GW)
2.2. Small	(9.5 GW)	(14 GW)
3. Photovoltaics	0.03 GWp	3 GWp
4. Biomass	44.8 Mtoe	135 Mtoe
5. Geothermal		
5.a Electric	0.5 GW	1 GW
5.b Heat (incl. heat pumps)	1.3 GWth	5 GWth
6. Solar Thermal Collectors	6,5 Million m ²	100 Million m ²
7. Passive Solar		35 Mtoe
8. Others		1 GW

Table 2

CURRENT AND PROJECTED FUTURE GROSS RENEWABLE ENERGY CONSUMPTION (Mtoe) FOR 2010

TYPE OF ENERGY	CONSUMPTION IN 1995				PROJECTED CONSUMPTION BY 2010			
	Eurostat Convention	% of total	Substitution Principle	% of total	Eurostat Convention	% of total	Substitution Principle	% of total
Total Gross Inland Consumption	1,366		1,409		1,583 (Pre-Kyoto)		1,633	
1. Wind	0.35	0.02	0,9	0.06	6.9	0.44	17.6	1.07
2. Total Hydro	26.4	1.9	67.5	4.8	30.55	1.93	78.1	4.78
2.a. Large (incl. pump storage)	(23.2)		(59.4)		(25.8)		(66)	
2.b. Small	(3.2)		(8.1)		(4.75)		(12.1)	
3. Photovoltaics	0.002	-	0.006	-	0.26	0.02	0.7	0.05
4. Biomass	44.8	3.3	44.8	3.12	135	8.53	135	8.27
5. Geothermal	2.5	0.2	1.2	0.1	5.2	0.33	2.5	0.15
5.a Electric	(2.1)		(0.8)		(4.2)		(1.5)	
5.b Heat (incl. heat pumps)	(0.4)		(0.4)		(1.0)		(1.0)	
6. Solar Thermal Collectors	0.26	0.02	0.26	0.02	4	0.25	4	0.24
Total Renewable Energies	74.3	5.44	114.7	8.1	182	11.5	238.1	14.6
7. Passive Solar					35	2.2	35	2.1

Table 3**CURRENT AND PROJECTED
ELECTRICITY PRODUCTION BY RES (tWh) FOR 2010**

TYPE OF ENERGY	ACTUAL IN 1995		PROJECTED FOR 2010	
	TWh	% of total	TWh	% of total
Total	2,366		2,870 (Pre-Kyoto)	
1. Wind	4	0.2	80	2.8
2. Total Hydro	307	13	355	12.4
2.a. Large (incl. pumped storage)	(270)		(300)	
2.b. Small	(37)		(55)	
3. Photovoltaics	0.03	-	3	0.1
4. Biomass	22.5	0.95	230	8.0
5. Geothermal	3.5	0.15	7	0.2
Total Renewable Energies	337	14.3	675	23.5

Table 4**CURRENT AND PROJECTED
HEAT PRODUCTION (Mtoe) for 2010**

TYPE OF ENERGY	ACTUAL IN 1995	PROJECTED BY 2010
1. Biomass	38.04	75
2. Geothermal	0.4	1
3. Solar Thermal Collectors	0.26	4
Total Renewable Energies	38.7	80
4. Passive Solar	—	35

TABLE 5

**ESTIMATED INVESTMENT COSTS AND BENEFITS
OF THE OVERALL STRATEGY IN THE 2010 SCENARIO**

Total investment energy sector of which RES ⁴²	249 billion ECU 39 billion ECU
Total investment RES in Action Plan	165 billion ECU
Net investment RES in Action Plan	95 billion ECU
Annual net investment RES in Action Plan	6,8 billion ECU
Additional net investment due to RES	74 billion ECU
Increase of total energy sector investment	29.7%
Employment creation	see Section 1.4
Avoided annual fuel cost in 2010	3 billion ECU
Total avoided fuel cost 1997-2010	21 billion ECU
Import reduction (ref. 1994)	17.4%
CO₂ reduction (with respect to 1997)	up to 402 million tn/ year
(with respect to the 2010 pre-Kyoto scenario)	250 million tn/year
Annual benefits from CO₂ reduction ⁴³	5 to 45 billion ECU

⁴² European Energy 2020. A scenario approach, European Commission, 1996

⁴³ COM(97) 481 final - see footnote 2

TABLE 6**ESTIMATED INVESTMENT COSTS/ BENEFITS BY SECTOR**

TYPE OF ENERGY	ADDITIONAL CAPACITY 1997-2010	UNIT COST 1997 ECU	UNIT COST 2010 ECU	AVERAGE UNIT COST ECU	TOTAL INVESTMENT 1997-2010 billion ECU	ADDITIONAL ANNUAL BUSINESS 2010 billion ECU	BENEFIT OF ANNUAL AVOIDED FUEL COSTS 2010 billion ECU	TOTAL BENEFIT OF AVOIDED FUEL COSTS 1997-2010 billion ECU	CO ₂ REDUCTION milliom tn/year IN 2010
1. Wind	36 GW	1,000/KW	700/KW	800/KW	28.8	4	1.43	10	72
2. Hydro	13 GW	1,200/KW	1,000/KW	1,100/KW	14.3	2	0.91	6.4	48
3. Photovoltaics	3 GWp	5,000/KWp	2,500/KWp	3,000/KWp	9	1.5	0.06	0.4	3
4. Biomass	90Mtoe				84	24.1	-	-	255
5. Geothermal (+ heat pumps)	2.5 GW	2,500/KW	1,500/KW	2,000/KW	5	0.5	-	-	5
6. Solar Collectors	94 Mio m ²	400/m ²	200/m ²	250/m ²	24	4.5	0.6	4.2	19
Total for EU market					165.1	36.6	3	21	402