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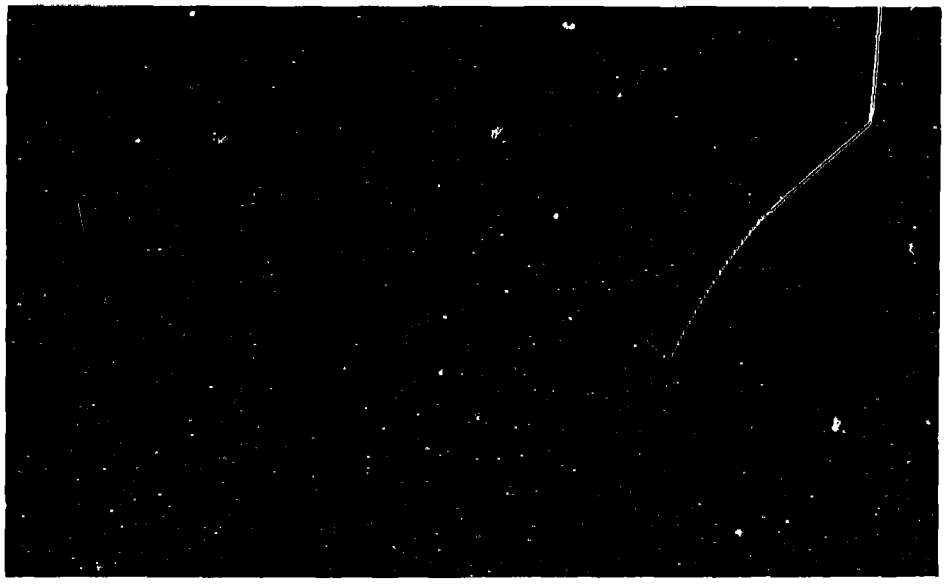
Sommet solaire mondial



High-level Expert Meeting
Réunion d'experts de haut niveau

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Évolution et perspectives du marché solaire : commercialisation et dissemination dans la Communauté européenne

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Evolution and Perspectives of the Solar Market : Commercialisation and Dissemination in the European Community

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INTRODUCTION

One of the aims of the World Solar Summit process, as I understand it, is to create a world-wide think-tank to consider how best to accelerate the commercialisation of solar technologies. The purpose of this paper is to present the situation of the solar market in the European Community, giving an historical perspective and a view to the future. I hope that the paper may be used in two ways during the Round-table discussion.

Firstly I would like my colleagues at the Round-table who are themselves from the EC to discuss, debate and refine the presentation given in this paper of the current situation and to make suggestions for the ways forward.

Secondly, as we are within a global forum, I would like to turn to representatives of other nations and regions to examine the experiences resulting from relationships between their nation and regional experiences in the commercialisation of solar technologies and what is happening in the EC. My intention with both discussions is to foster purposeful collaboration between individuals and organisations both at EC and global level.

By "the solar market" I refer to all renewable energy technologies, so to avoid confusion I use this term "renewable energy technologies (RETs)" throughout the paper. I use the abbreviation "EC" to refer to the European Community countries, and the abbreviation "CEC" to refer to the Commission of the European Communities, the administrative body of the EC based in Brussels. While I draw on published information and on the contributions of my colleagues, all opinions expressed in the paper are my own and do not necessarily reflect the opinion of the CEC, the World Solar Summit Secretariat or the contributors to the paper.

1. A CONTEXT OF TRANSITION

As a background to establishing the current position of the RET market in the EC, I want to point to several simultaneous transition processes which are under way.

The first transition, that of energy technologies and their supply infrastructures, is shared with the rest of the world. Looking to the long term, there is a recognition in the EC that "Achieving long-term sustainable low energy demand levels with corresponding reductions in CO_2 emissions requires ... starting on a growth path for

renewables which ultimately will yield around 40-50% of today's total energy consumption". (1)

However in 1993 in the EC, as in the rest of the world, the RETs have to compete for a share of the energy market with conventional supplies which, using today's costing methods, are in general much more favourably priced. As in the rest of the world, the 1970s oil price rises gave a significant boost to the RET market in the EC. The immediate rush to invest in RETs in the early 1970s was based initially on the idea that they could be cost-competitive in the short term, and the first markets were developed very much in response to that idea. Falling oil prices demolished this hope. However the real lesson of the 1970s was of the significance of energy supply in the economy in general and of the need to invest in security of supply. This gave rise to programmes at national and Community level which were designed to support the RET market as one instrument in building a less vulnerable economy. Later the 1980s brought the environment agenda to the fore, and in particular the threat of climate change. This has had an effect both on the immediate market for RETs and on the public policies of support. However to explore the effects of this in more detail we must look at the other transition process under way, the political one.

The political transition underway in the EC must be acknowledged in any perspective on the market for RETs. Historically the EC has to be viewed simultaneously both as 12 countries and as one regional entity. Each of the twelve countries have had very different approaches to the promotion or RETs, and the national markets for various technologies have often developed quite differently, despite similarities in climate or economic structure. Annex 1 presents the different approaches taken by EC Member States to the development of RETs. These range from the attitude in Denmark where active promotion of the renewables is part of a strategic plan for sustainable development, to the attitude in the UK where the broad policy is to have no policy, that is to say to leave decisions to the "free" market. In this context it is particularly interesting to diverge briefly to examine the market for solar collectors in the various EC member states.

Figure 1 shows the national market share of solar collector sales with respect to the total sales throughout the European Community from 1980 to 1990. Figure 2 presents the same information for 1990 alone. The outstanding fact derived from Figure 1 is that in 1990 Greece, with a population of only 10 million people, accounts for more than 40% of the estimated 3 million m^2 of solar collectors

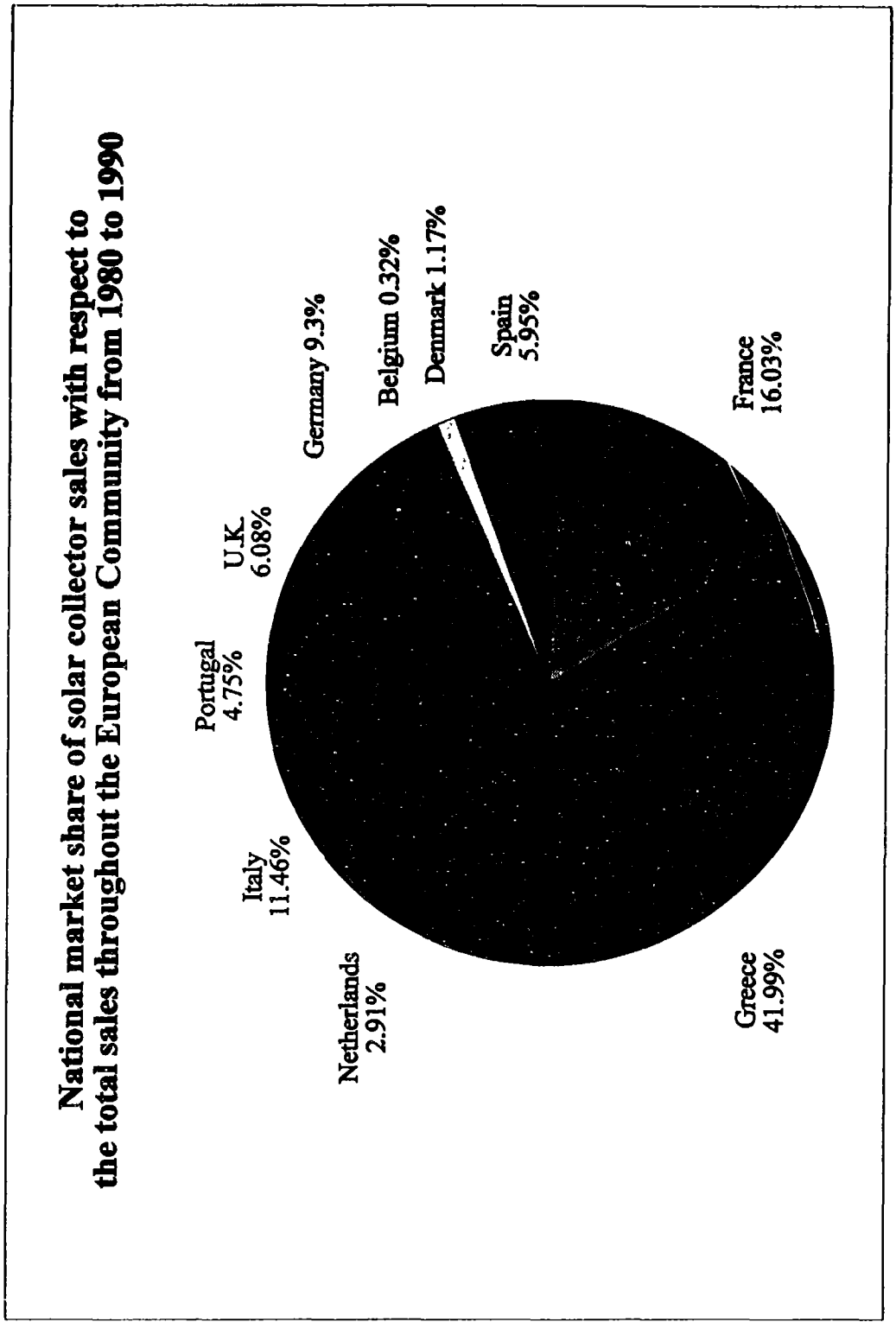

Figure 1 National market share of solar collector sales with respect to the total sales throughout the European Community from 1980 to 1990

Source: The European Solar Industry Federation

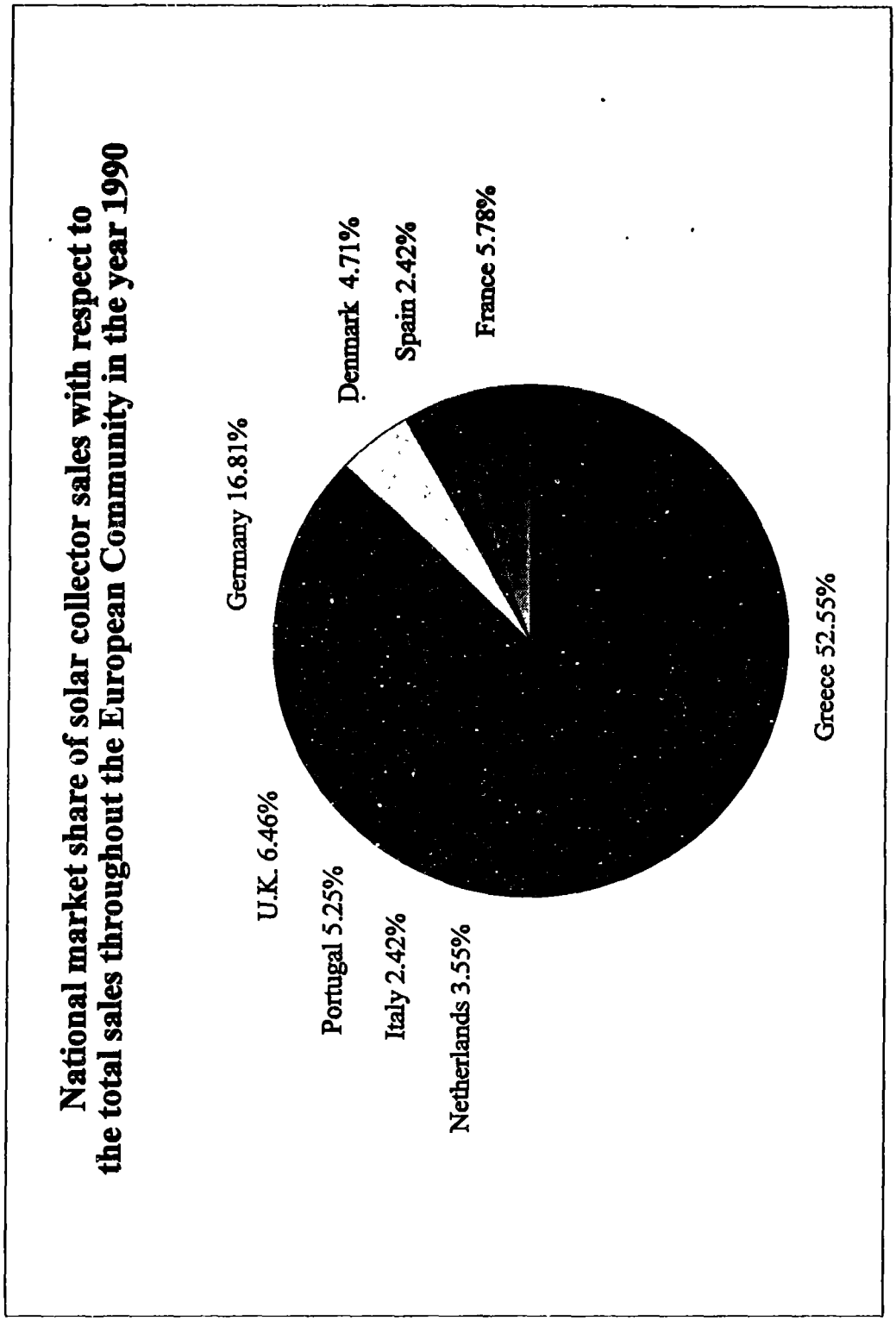

Figure 2 National market share of solar collector sales with respect to the total sales throughout the European Community in the year 1990

Source: The European Solar Industry Federation

installed in the countries of the Community. On the other hand countries such as Spain with a much larger population and equally sunny climate account for a very small percentage. From Figure 2 it appears that this situation is becoming more extreme, with Greece's 1990 market share reaching 53.55%, followed by Germany's share of 16.81%. In the case of Greece, incentives were established by government in 1976, backed up by a large scale awareness campaign in the mid-1980s. In Germany the environmental concern has stimulated the market and there is a strong regional financial support of up to 50% of solar installation costs.

The purpose of examining the case of the solar collector market was to illustrate the national differences between EC countries. However, placing this in the context of political transition in Europe, it is very difficult to predict how these national differences will change. An optimist might suggest that in a framework of increased political integration each country could learn from the best examples of their partners. However this issue is at the very heart of the unification process, and the answers are not clear. In fact countries such as Denmark with advanced environmental programmes are worried that their clear commitments will be compromised by their participation in a political system which includes nations with less obvious commitments to issues of energy and environment (2).

Further transition processes under way in the EC which have a bearing on the development of the renewables concern the direction of agricultural and environmental policy. Global pressure to reduce farm subsidies has already resulted in land being "set aside" from production of food-related crops. The escalation of this pressure brings with it a potential increase in the attractiveness of biomass crops. At the same time a tightening of environmental legislation may well increase the potential for energy from waste.

Another "transitional" element in the EC which impinges on RETs is the very definition of EC borders. Spain, Portugal and Greece, relatively new members, have brought different experiences and priorities to the Community. Further shifts are certain with the proposed membership of the Scandinavian countries. The longer term implications of membership by the Central and Eastern European countries will have a still different effect. Austria, aspiring to become a member of the EC is now emerging as a major consumer for solar collectors in Europe, second only to Germany outside Greece. This development has not been foreseen a decade ago and it illustrates the dynamic nature of the European solar market which is in constant transition, especially in the 1990's.

I have attempted to show how the RETs are currently positioned in a situation of complex change in the EC. It is the task of those involved in the commercialisation of the RETs to analyse the opportunities presented by this flux, and to seize them.

Having presented something of the complexities of the situation for the RETs in the EC, I will now turn to examine the relevant policies and programmes pursued at EC level. Since the 1970s these have represented a significant and cohesive approach to the development of the RET markets in Europe.

2. THE STATUS OF RETs IN THE EC

Details of the current contribution by RETs to both electricity production and heat production in the EC are given in Tables 1 and 2. Annex 2 includes tables which list the technical potential for solar, wind, forestry and agricultural wastes, industrial and municipal wastes, water and geothermal energy in the EC, as well as the land available for energy crops.

An analysis of the precise situation of all RETs is beyond the scope of this paper, but I shall highlight below some details, drawing on a recent overview (3).

2.1 Solar energy for water heating

Table 3 illustrates the 1990 commercial conditions of solar energy for water heating in the Community. By 1990 more than 3,000,000 m^2 of solar collectors were installed, representing a market value of 176.7 MECU and producing 452,100 toe. As discussed earlier (see also Figures 1 and 2) the development of the solar market has developed quite differently in different countries. There are also strong technological differences in the water heating systems installed, with Greece producing mainly thermosyphon systems while the majority of the other countries use either flat plate or evacuated tube collectors in forced circulation systems. Energy saving from solar collectors vary from 300-500 kWh/y,m^2 in Northern Europe up to 600-800 kWh/y,m^2 for Mediterranean countries. Production costs are estimated to vary from 0.07 ECU/kWh for low cost systems in Southern Europe to 0.30 ECU/kWh for Northern Europe. The concept of "guaranteed performance" has been introduced in larger water heating plants in France, Greece and Spain. Telemonitoring techniques mean that the production of hot water to customers can be measured, faults detected early and compensation given for under-supply if necessary. This is important in building customer confidence.

Country	Solar	Wind	Biomass	Hydro	Tidal	Wave	Geo-thermal	Total RETs	% total demand
Belgium	0.00	0.01	0.94	0.31	0.00	0.00	0.00	1.26	1.9
Denmark	0.00	0.51	1.67	0.02	0.00	0.00	0.00	2.20	6.7
France	0.00	0.00	3.02	62.26	0.50	0.00	0.00	65.78	17.7
Germany	0.00	0.02	3.12	18.73	0.00	0.00	0.00	21.87	4.1
Greece	0.00	0.00	0.38	2.52	0.00	0.00	0.01	2.91	8.2
Ireland	0.00	0.00	0.19	0.74	0.00	0.00	0.00	0.93	6.6
Italy	0.00	0.00	1.76	36.20	0.00	0.00	3.20	41.16	16.6
Luxembourg	0.00	0.00	0.06	0.08	0.00	0.00	0.00	0.14	3.0
Netherlands	0.00	0.08	1.59	0.06	0.00	0.00	0.00	1.73	2.6
Portugal	0.00	0.00	0.95	9.01	0.00	0.00	0.00	9.96	15.0
Spain	0.00	0.01	7.04	31.40	0.00	0.00	0.00	38.45	25.6
UK	0.00	0.01	0.99	3.62	0.00	0.00	0.00	4.62	1.4
Total EC-12	**0.00**	**0.66**	**21.68**	**164.94**	**0.50**	**0.00**	**3.21**	**191.00**	**10.1**

Table 1 **RET contribution to electricity in the EC (TWh)**

Source: The European Renewable Energy Study

Country	Forest residue	Agricultural. waste	Industrial waste	Municiple waste	Landfill	Solar	Geo-thermal	Total RETs	% Total demand
Belgium	92	0	135	40	0	0	2	269	1.0
Denmark	257	86	81	120	13	1	1	559	5.5
France	8960	42	420	0	0	30	71	9520	9.6
Germany	3018	57	32	352	21	12	7	3498	1.8
Greece	470	0	64	0	0	69	4	607	5.4
Ireland	32	1	36	1	0	0	0	69	1.2
Italy	2615	51	196	50	1	16	83	3012	3.4
Luxembourg	0	0	0	11	0	0	0	11	0.4
Netherlands	1	0	37	261	0	0	0	299	1.2
Portugal	898	71	96	0	0	21	0	1085	4.2
Spain	296	28	1280	9	0	9	3	1624	3.8
UK	162	39	112	14	3	0	0	331	0.3
Total EC-12	**16796**	**374**	**2489**	**856**	**38**	**158**	**171**	**20883**	**3.3**

Table 2 **RET contribution to heat in the EC (ktoe)**

Source: The European Renewable Energy Study

Country	Population (millions)	Required energy for water heating	Installed collectors (x 10^3 m^2)	Present productivity (x 10^3 tep)	Solar fraction (%)	Market value 1990 (MECU)
Belgium	9.9	2.0	10	1	-	-
Denmark	5.2	1.0	36	3	0.3	11.6
France	56.0	9.6	490	69	0.7	15.5
Germany	77.0	15.5	284	40	0.3	33.0
Greece	10.2	1.4	1280	218	6.6	78.0
Ireland	3.6	0.7	-	-	-	-
Italy	57.0	9.8	350	49	0.5	6
Luxembourg	0.4	0.1	-	-	-	-
Netherlands	15.0	3.0	89.0	7.1	0.2	4.8
Portugal	10.5	1.8	145.0	25.0	1.4	6.5
Spain	39.0	6.7	182.0	25.0	0.4	6.0
UK	57.0	11.5	185.0	15.0	0.1	15.3
Total EC-12	340.8	63.0	3051.0	452.1	0.8	176.7

Table 3 **Total surface of solar collectors installed in the European Community**

Source: European Solar Industry Federation

2.2 Solar photovoltaic energy

The mean annual yield of PV systems in the Community varies from 1 and 2 kWh/day, kWp in less sunny regions to mean annual yields of more than 3 kWh/day, kWp in sunnier regions using hybrid PV/diesel systems or grid connected systems. The cost of PV modules fell during the early 1980s but seems to have stabilised by 1987 at around 7 ECU per Wp for small applications, but there are good prospects for further long term cost reductions. The main current applications for PV are the stand-alone generators for remote sites. They are not normally competitive with grid power, although electricity utilities in Southern Europe are showing an interest in grid-connected systems.

2.3 Wind energy

In the last ten years the European wind industry has gained considerable maturity. The cost of electricity production by means of wind turbines was drastically reduced up to 1988, and since then it has remained stable at around 0.04-0.07 ECU/kWh. Currently the industry offers intermediate sized turbines in the 200-400 kWe range

(25 to 35 m rotor diameter) which are reliable and cost competitive. Wind turbine productivity has improved dramatically, from the earlier 400 kWh / m^2 per year at good sites to 1,200 kWh per m^2 at good sites. The number of wind turbine manufacturers has been strongly reduced from the peak value of around 200 manufacturers in the mid-eighties to about 30 in the early nineties. This is a result of tough competition in Europe and world-wide, linked to the 1986 oil price drop which resulted in a temporary reduction of competitiveness of wind energy, but the total installed capacity has risen considerably as shown in Figure 3.

2.4 Mini-hydro

Electricity production using RETs in the EC is dominated by hydraulic electricity, with production costs ranging from 0.016 ECU/kWh to 0.075 ECU/kWH.

In the EC the total hydro-power plants of installed capacity amount to about 80 GW of which the total capacity for plants less than 10 MW is only 5 GW. Although 95% of potential hydro-power is already in use, only 20% of the potential for small hydro plants (less than 10 MW) are in use, so there is still some scope for further penetration of small plants.

2.5 Energy from biomass

Some trends are highlighted below:

BIOGAS:

- landfill gas has reached commercial maturity in Denmark, Germany, the Netherlands and the UK and there are an estimated 175 landfill gas exploitation works in the EC producing the equivalent of 351,500 toe
- the methanisation of industrial effluents has also reached commercial maturity in the agro-food and paper/pulp industries
- methanisation in large or collective digesters of animal manure has reached technical maturity in Denmark, Italy and the Netherlands

MUNICIPAL SOLID WASTE:

- the percentage of MSW treated by incineration amounts to slightly more than 20% in the Community: the economic recovery potential can be estimated at around 1.5 Mtoe

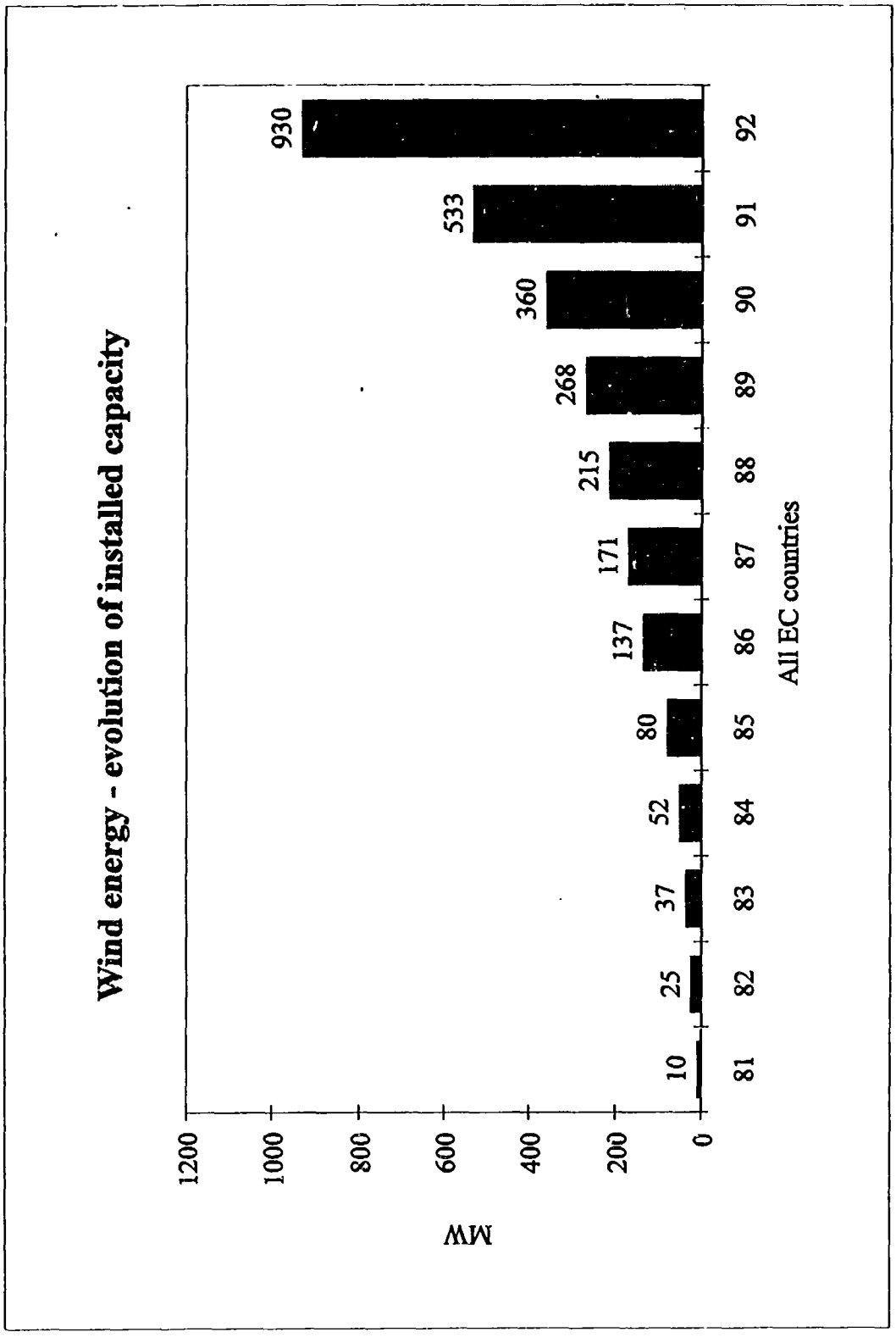

Figure 3 Wind energy evolution of installed capacity

Source: Fabry & Nacfaire (3)

WOOD / WASTE COMBUSTION

- 20 Mtoe, 2% of the Community energy needs, are presently produced in the Community by wood/waste combustion. Only France, producing 9 Mtoe, has produced a detailed statistical evaluation of this energy source

3. CEC ASSISTANCE IN COMMERCIALISING RETs

The main public body responsible for the commercialisation of RETs at European level is the Directorate General for Energy (DG XVII) of the Commission of the European Communities. As part of the Commission they both draft the relevant proposed legislation and administer the associated programmes of activities. (In the EC system the Council of Ministers, comprised of the relevant minister from each Member State, ratifies all regulations, decisions and directives proposed by the Commission after an extensive consultation process which involves the European Parliament as well as the relevant national bodies). Other Directorate-Generals which are also involved in renewable energy technologies include the Directorate General for Research and Development (DG XII), whose responsibility is for R&D.

In my view, the significance of the work of DG XVII is at two levels. Firstly the programmes of financial support for RETs have been, and are, of immense value in providing continuity of funding for the RETs in Europe through difficult times, when individual national governments could not keep up the level of support. Secondly, DG XVII have acted as a catalyst in creating co-operation between businesses in different Member States, in providing a pan-European perspective on the commercialisation of RETs and in stimulating the development of an emerging infrastructure at European level. I will examine both levels of activity and also indicate something of the nature of the political support behind programmes for the renewables.

3.1 CEC programmes of financial support for RETs

A brief summary of EC initiatives relevant to renewable energy technologies is given in Table 4. For more detailed information I recommend that the library services of DGXVII should be used. They are very well stocked with the latest brochures, newsletters and reports. The library being in the same building where this information is generated is in a good position to be well informed and up-to-date. Below I give some information on the THERMIE and the ALTENER Programmes.

Policy / initiative	Description / effect on renewable penetration
THERMIE	Demonstration and funding programme for prototype installations. DG XVII budget for renewables has included biomass, solar and wind. Information dissemination via Organisations for Promotion of Energy Technologies (OPETs).
JOULE	Promotion of innovation with R&D funding from DG XII includes renewables. Actions have included PV, biomass, wind, passive solar and geothermal
SAVE	Aims to improve energy efficiency and reduce the growth in CO_2 emissions by 3%. Majority of work has focused on energy efficiency but some interest in renewables
5th Environmental action programme	Document, entitled "Towards Sustainability", attempts to achieve sustainable development and requires a move towards a less carbon intensive economic structure which will favour an increased use of renewable energy.
ALTENER	An integrated set of policies to increase the penetration of RETs incorporating a full set of measures aimed at breaking down the main economic, technical and institutional barriers to renewables in the EC
Internal Energy Market	Aims to allow free movement of products, improve security of supply and improve competitiveness. Priority to be given to renewables provided they are offered at "reasonable prices"
Carbon / Energy tax	Fiscal mechanism to stabilise CO_2 emissions in 2000 at 1990 levels. The tax of $3/barrel of oil equivalent in 1990 rising to $10 in 2000 is expected to give a significant boost to RETs which are exempt.
PHARE	Cooperation programme between EC and Eastern / Central European Countries. Major support for energy sector and environmental protection
TACIS	Cooperation programme between EC countries in the Commonwealth of Independent States
European Energy Charter	establishment of a pan-Europe energy agreement between EC and Eastern / Central Europe and former Soviet Union
Regional Energy Programmes and VALOREN	EC structural funds available in certain parts of the Community to support energy projects including RETs.

Table 4 EC initiatives relevant to renewable energy technologies

Source: The European Renewable Energy Study

3.1.1 The THERMIE programme

Support for RETs by DG XVII began in 1975 with the first "Energy Demonstration Programme" which included the demonstration of renewable energy technologies. Projects using innovative technologies, selected from competing proposals, were eligible for grant aid of up to 40% of "eligible costs", (that is the additional costs of the innovative technology, the design and monitoring work), and in return the results of the project were to be made publicly available. The THERMIE programme, introduced in 1990, continued the support for hardware demonstration projects. Figure 4 shows the total support for all energy technology

programmes between 1975 and 1992. Figure 5 gives a breakdown of support for different RETs. Figure 6 summarises the support given to energy technology support projects within the THERMIE programme from 1990 - 1992.

The THERMIE programme also included a number of adjustments which were made based on an evaluation of the experience of previous programmes. These adjustments included an allowance for "Associated Measures" designed to accelerate the dissemination of information on energy technologies. Responding to this DG XVII have developed a network of OPETs - "Organisations for the Promotion of Energy Technologies" throughout the European Community, whose brief is to carry out dissemination work through studies, meetings, publications and other media. The distribution of members of the OPET network is illustrated in Figure 7.

The total THERMIE budget is 700 MECU (900 M$US) over 5 years (1990-1994).

3.1.2 The ALTENER programme

ALTENER specifically addresses the RETs alone. Its targets for the year 2005 are to:

- increase the contribution of renewable energy sources to the Community's total energy supply from nearly 4% in 1991 to 8% in 2005
- triple the production of electricity generation from renewable energy sources (excluding large hydro)
- secure biofuel market share of 5% of total fuel consumption by motor vehicles

Specific actions which will assist in achieving these objectives include

- quality and performance standards for small hydro, wind and solar thermal collector systems
- data collection and mapping for small hydro and geothermal
- reduction of the tax on biofuels to a maximum of 10% of excise on fossil fuels
- guarantee of funds for particular risky geothermal projects
- pilot projects for biofuels, energy corps and biogas from livestock effluent
- aid for planning and feasibility studies
- training in passive solar design for architects
- infrastructure, training and information exchange

Detailed actions and budgets are not available at time of writing as the programme has not yet been passed by the Council of Ministers, but the budget is expected to be 40 MECU over a 5 year period, 1993-1997.

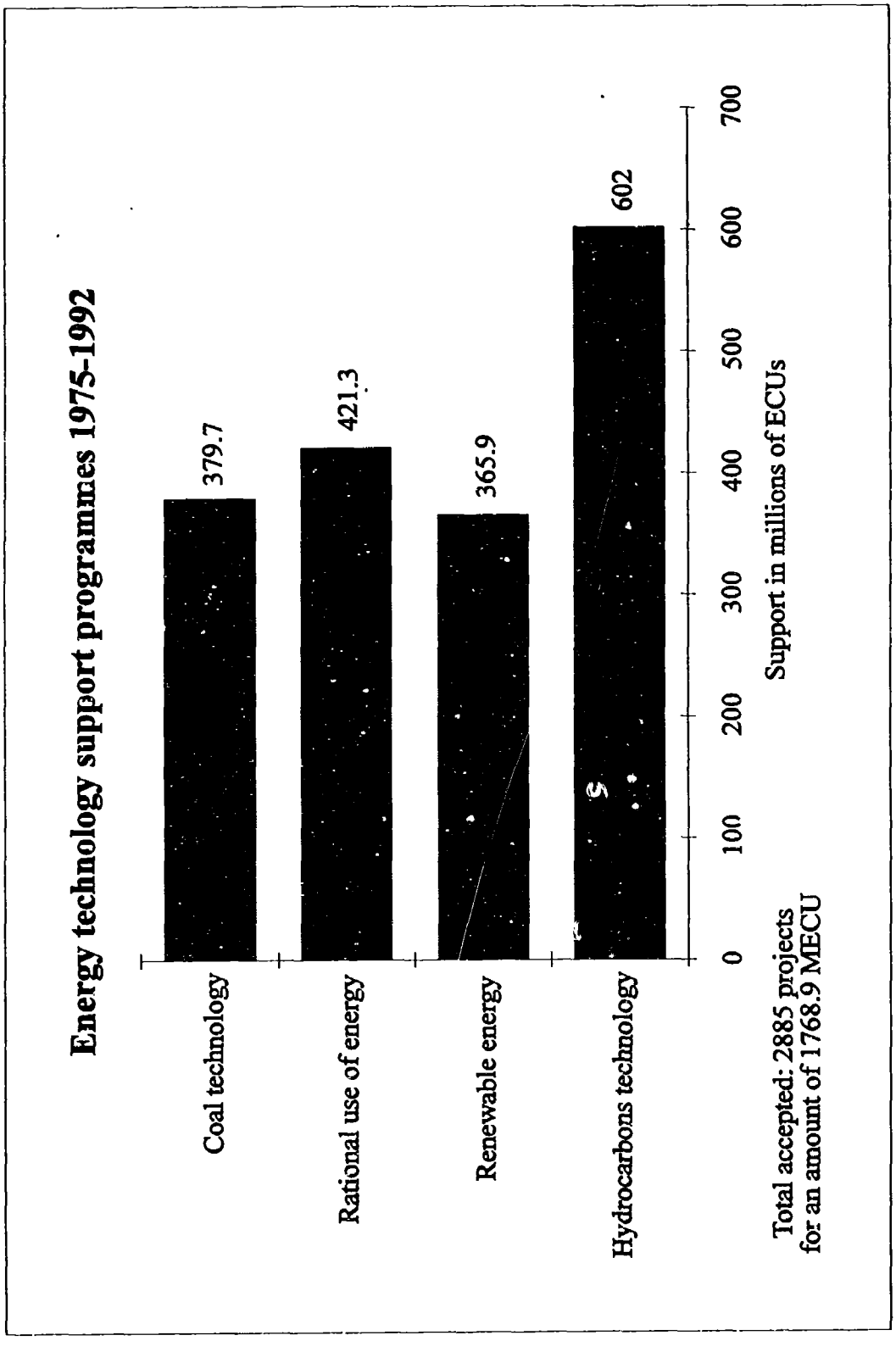

Figure 4 Energy technology support programmes 1975 - 1992

Source: Fabry & Nacfaire (3)

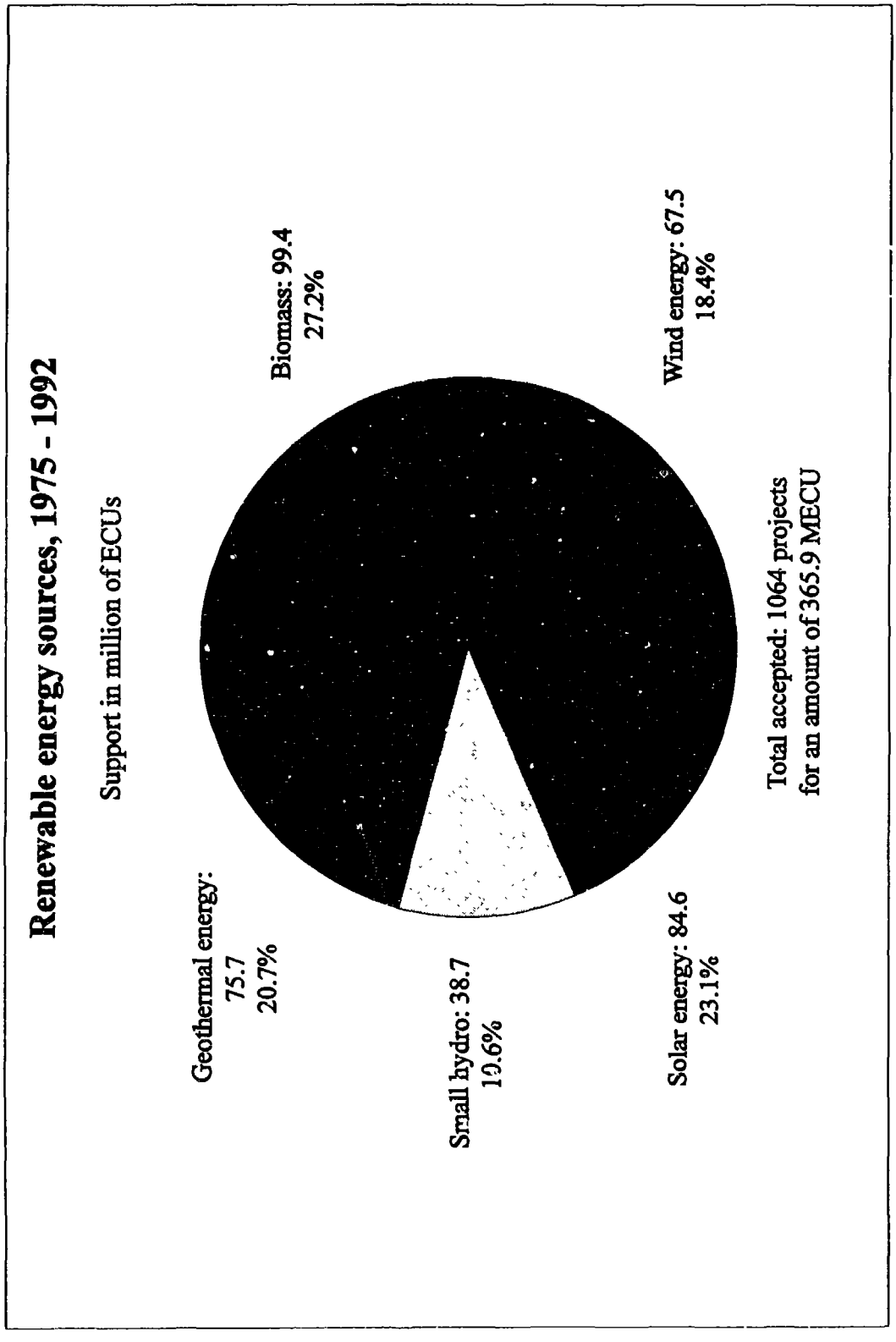

Figure 5 Renewable energy source 1975 - 1992 support in million ECUs

Source: Fabry & Nacfaire (3)

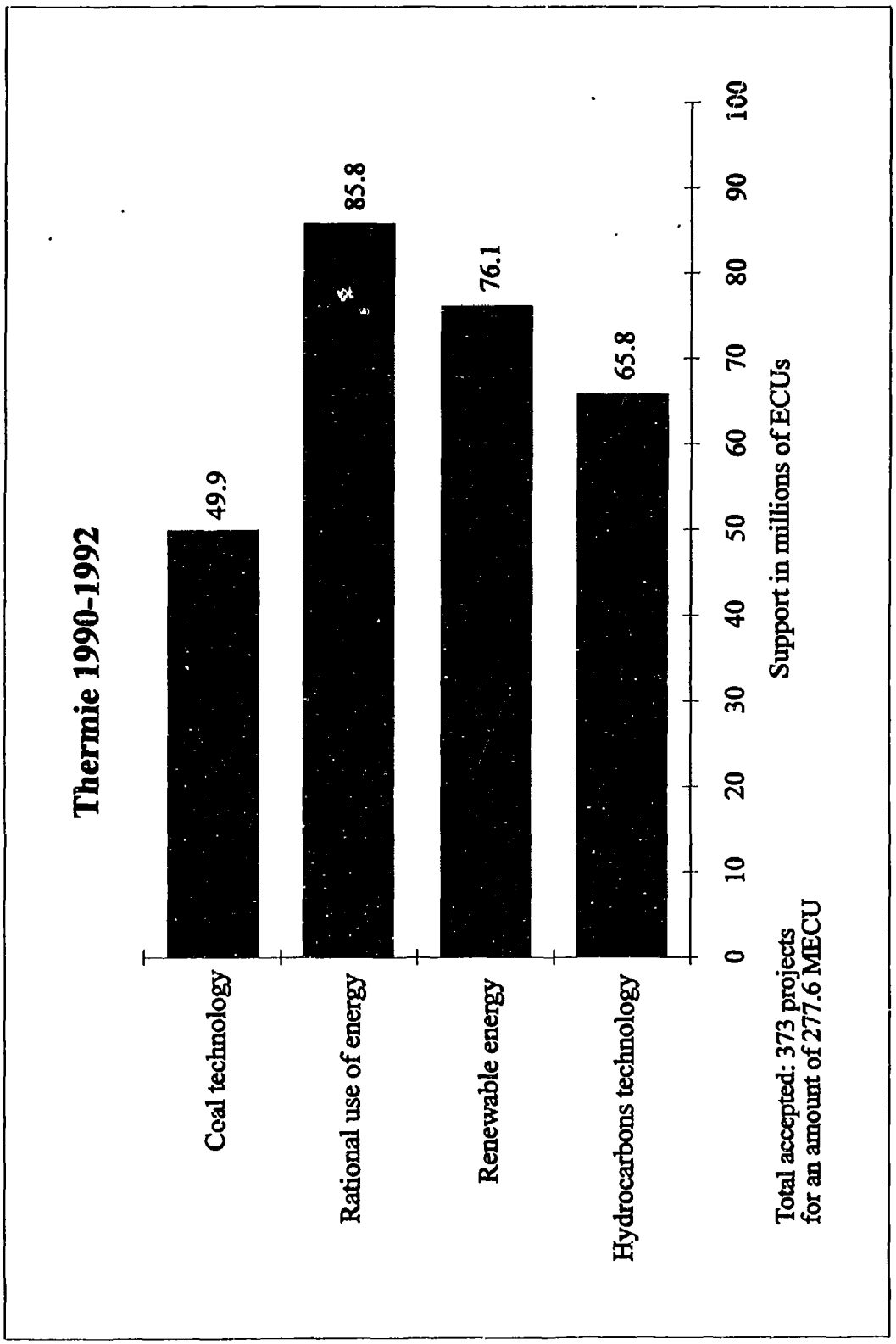

Figure 6 Thermie 1990 - 1992 project support in millions of ECUs

Source: Fabry & Nacfaire (3)

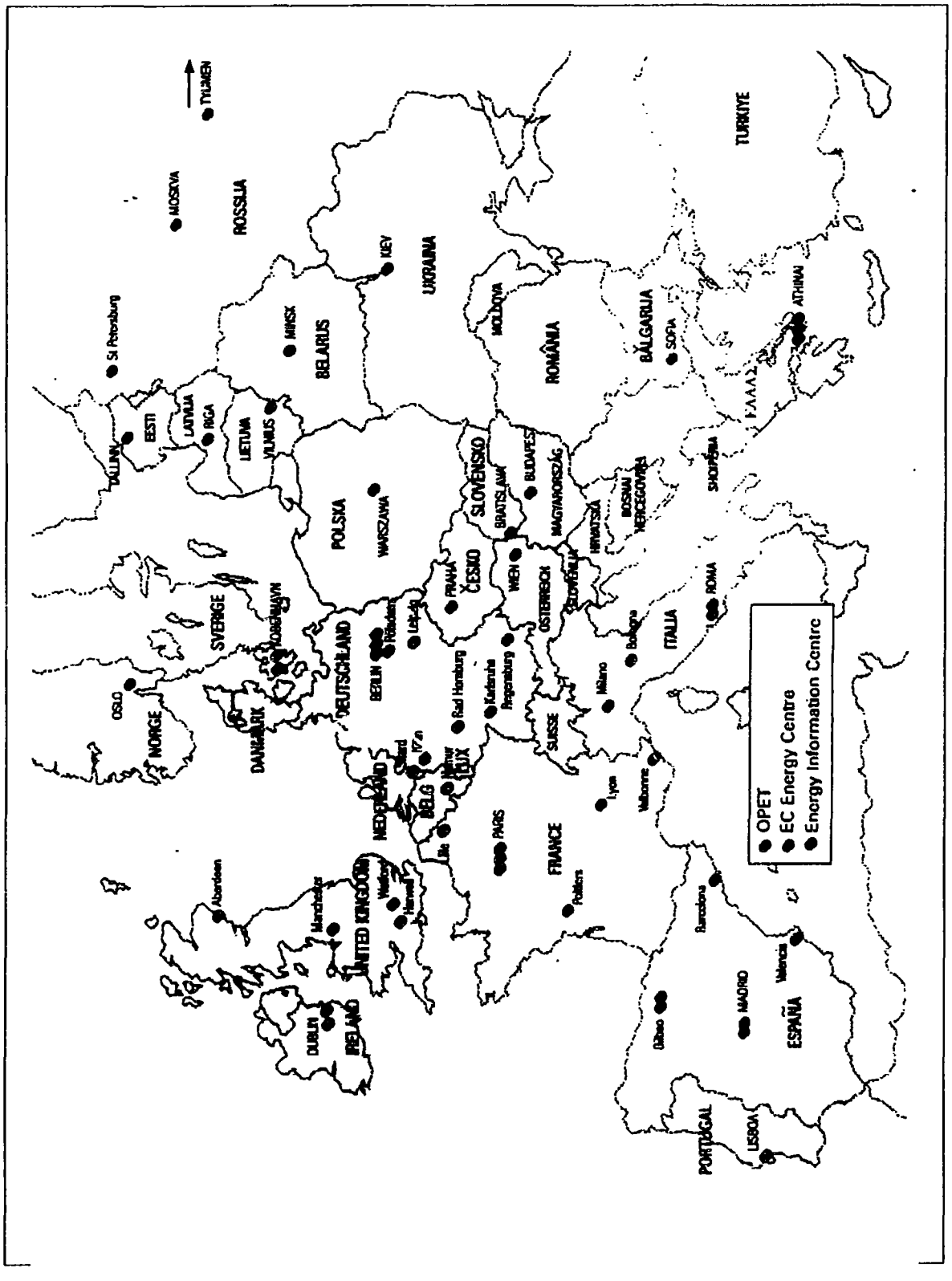

Figure 7 The European OPET network

Source: Fabry & Nacfaire (3)

3.2 General support by the CEC for the commercialisation of RETs

The CEC is well known for the programmes of financial support described above. What is often not acknowledged is the other ways in which the existence of a public body working at EC level can help to stimulate the commercialisation of RETs. Some aspects of this work are highlighted below.

3.2.1 Fostering co-operation between Member States

Most programmes of financial support give preference to project proposals which are from applicants in more than one member country, a measure which acts to speed up the dissemination of information and allow other Member States to benefit rapidly from their neighbour's work. An excellent example of this is one of the fields where I am personally involved: transparent insulation. It was the German government, not the EC who invested heavily in the R&D to start up transparent insulation. Once the technology had developed to near-market viability by the end of the 1980s, DG XVII became involved in its commercialisation through supporting demonstration projects outside as well as in Germany and in supporting conferences and publications all of which were accessible to everyone in the EC (4).

3.2.2 Providing an EC-wide perspective

The development of demonstration projects throughout the EC underlined the need for a broad understanding of the direction of development of RETs. One significant initiative recently under way is the move to include statistics for the renewables in the published EUROSTAT data available for all energy sources. This in turn makes possible comprehensive studies and projections such as the The European Renewable Energy Study (5) which I will present later in some detail.

3.2.3 Promoting infrastructural development

One of the most obvious achievements of DG XVII in the early 1990s is the creation of the OPET network mentioned earlier. This network provides a "distribution system" throughout the EC for information on energy technologies, including RETs. While the OPET network is still in its infancy it is hoped that further development will allow it to become a very efficient instrument in dissemination.

DG XVII have also encouraged the formation of Europe-wide associations to act as

partners in the promotion of RETs. The European Wind Energy Association (EWEA), the European Photovoltaic Industries Association (EPIA), the European Solar Industries Federation (ESIF), the European Secretariat of the International Solar Energy Society (ISES Europe) and EUROSOLAR are all creations of the last ten years. While the Commission played no direct part in their formation, the very existence of a significant funding body at European level was undoubtedly a major impetus for the industries and interest groups to organise themselves at this level, and subsequent co-operation between some of these bodies and DG XVII has often been very fruitful. As a good example of this joint action I mention an EWEA report published in 1991. "Wind Energy in Europe: Time for Action" (6) This slim, attractive publication, partly financed by DG XVII, presents the case for wind energy and outlines a strategy for its development in Europe.

3.3 Perspectives on CEC programmes of support for RETs

However in presenting the EC-wide actions to promote the commercialisation of the renewables undertaken by the CEC it should also be mentioned that there is considerable controversy between the various EC opinion-forming and decision-making bodies as to the level of support for RETs. A resolution published by the European parliament in January 1993 makes a radical call for increased support for RETs (7) and "deplores the inability of the Commission and Council to implement rapidly decisions concerning renewable forms of energy". At the moment the Parliament have no powers to initiate legislation, but this may change in the evolution of the political process.

4. THE EUROPEAN RENEWABLE ENERGY STUDY (TERES)

Having outlined the context for the development of RETs in the EC, I would now like to turn to examine in detail the precise position of the RETs in the EC energy market and to examine the possible scenarios for development. To do this I am greatly assisted by a recent study commissioned by DG XVII and currently being published. The object of the European Renewable Energy Study (TERES), which I also referred to above and from which many of my figures and tables are derived, was to assess the long term prospects for renewable energy sources in the Member States of the EC and for the countries of Central and Eastern Europe. Starting from an overview of the current situation, the study uses a computer-based tool ALTREM for assessment of the commercial penetration of RETs according to their costs relative to conventional fuel prices, over the period 1990 to 2010. TERES also

RET	Main Barriers to Penetration	Possible Policy Interventions
PV	Low efficiency - large land areas needed. High costs due to small market. Consumer uncertainty in new technology. Barriers on grid connection	R&D Support (JOULE). Subsidies to encourage market development. Demonstration programmes (THERMIE). Legislate to permit grid connection.
Active Solar	Consumer resistance due to poor reputation. High capital cost. Small scale production, therefore high costs No retail outlets.	Information campaign to stimulate industry. Tax incentives to depreciate investment. Subsidies.
Passive Solar	Reluctance to use new design techniques by architects and planners.	Tighten buildings regulations and publicise results of demonstration programmes.
Solar Thermal Electric	High risk associated with new technology. More efficient technologies not proven.	Premium buy back rates to encourage users. R&D Support.
Wind	Environmental (noise,visual interference, etc.) Delays to projects at planning stage. Uncertainty over project assessment procedures. Poor economics at lower wind speeds.	Clear planning guidelines to describe acceptance / rejection criteria. Improve speed of planning permission. Standard assessment of proposals. R&D Support to reduce costs.
Biomass General	Concentration on large systems limits opportunities for small scale (15 kW - 2 MW). Advanced technologies needed to reduce costs	Clearer energy policy and strategy for encouraging use of renewables; R&D on small systems. R&D.
Energy Crops	Low yields and high planting costs. Poor information and no incentives for farmers. High costs due to new technology. Barrier to allow small system to connect to grid.	R&D to improve yields and reduce costs. Agricultural demonstrations and information packages for farmers. Support for standard analysis procedures for energy farming systems. Demonstration and dissemination. Grants or low interest loans. Legislate to allow connections.
Solid Wastes	Environmental (emissions).	R&D
Liquid Wastes	No suitable small scale systems.	R&D
Landfill gas	Resource limitation. Need for engines to deal with corrosive gases.	Strict control of existing non-productive sites. R&D on small scale systems.
Agric. Wastes	Improved comminution and drying techniques needed to overcome transport and processing constraints.	R&D.
Hydro	Barriers on grid connection for small hydro. Barriers by water authorities in use of water. Environmental impact of large hydro.	Legislate to permit grid connection. Clear guidelines for use of water. Standard assessment procedure to cover wider benefits and external costs.
Tidal	Environmental (upstream pollution, destroys wildlife habitat etc.). High investment cost, and relatively low rates of return over very long periods.	Standard procedure for assessment including job creation, leisure benefits and external costs. Government investment.
Wave	Not yet proven technically	R&D support and demonstration
Geothermal	High costs of exploration. Resource limitation / high O&M costs. environmental	Government support R&D R&D

Table 5 Constraints and policy interventions for the dissemination of RETs

Source: The European Renewable Energy Study

classifies the main barriers to penetration by the various RETs and makes suggestions for possible policy interventions. These are summarised in Table 5.

The overall contribution of all renewable energy technologies (RETs) to primary energy needs in the European Community in 1990 is currently estimated to be 4.3%. Figure 8 illustrates the estimates of RET contributions to final energy consumption in 2010, comparing a range of scenarios with technical potential and 1990 contribution. Figure 9 shows RET penetration as a percentage of primary energy according to the same range of scenarios. The scenarios used are:

1.	*Base Case*	*National strategy of individual Member States*
2.	*Existing programmes*	*Additional effects of existing EC programmes related to the environment and energy technologies, including THERMIE, SAVE, JOULE, 5th Environmental Action Programme*
3.	*Proposed policies*	*Successful implementation of proposed EC energy policy framework including ALTENER, Internal Energy market, Carbon / Energy Tax. Also some supporting measures to remove constraints*
4.	*Full social cost*	*Internalisation of all external costs associated with energy production and supply. Full supporting measures to remove constraints on RET penetration.*

Referring back to the ALTENER programme described earlier in this paper, the stated objective by the Commission was to increase the contribution of RETs to 8% of primary energy. However according to the results presented in Figure 8, significant growth in the penetration of renewables will not occur unless further policy measures are taken to assist the commercialisation of RETs.

Growth in the EC under the *Existing Programmes* scenario is slow, from 4.3% of primary energy production in 1990 to 6.5% in 2010.

In the *Proposed Policies* scenario more rapid growth is achieved, to 9.3% in 2010. Under this scenario the ALTENER target of 8% total RET contribution and tripling of RET electricity production by 2005 can be met.

In the *Full Social Cost Scenario*, accompanied by all the policy measures listed above, the RET penetration increases to 13.4% of primary energy needs in 2010.

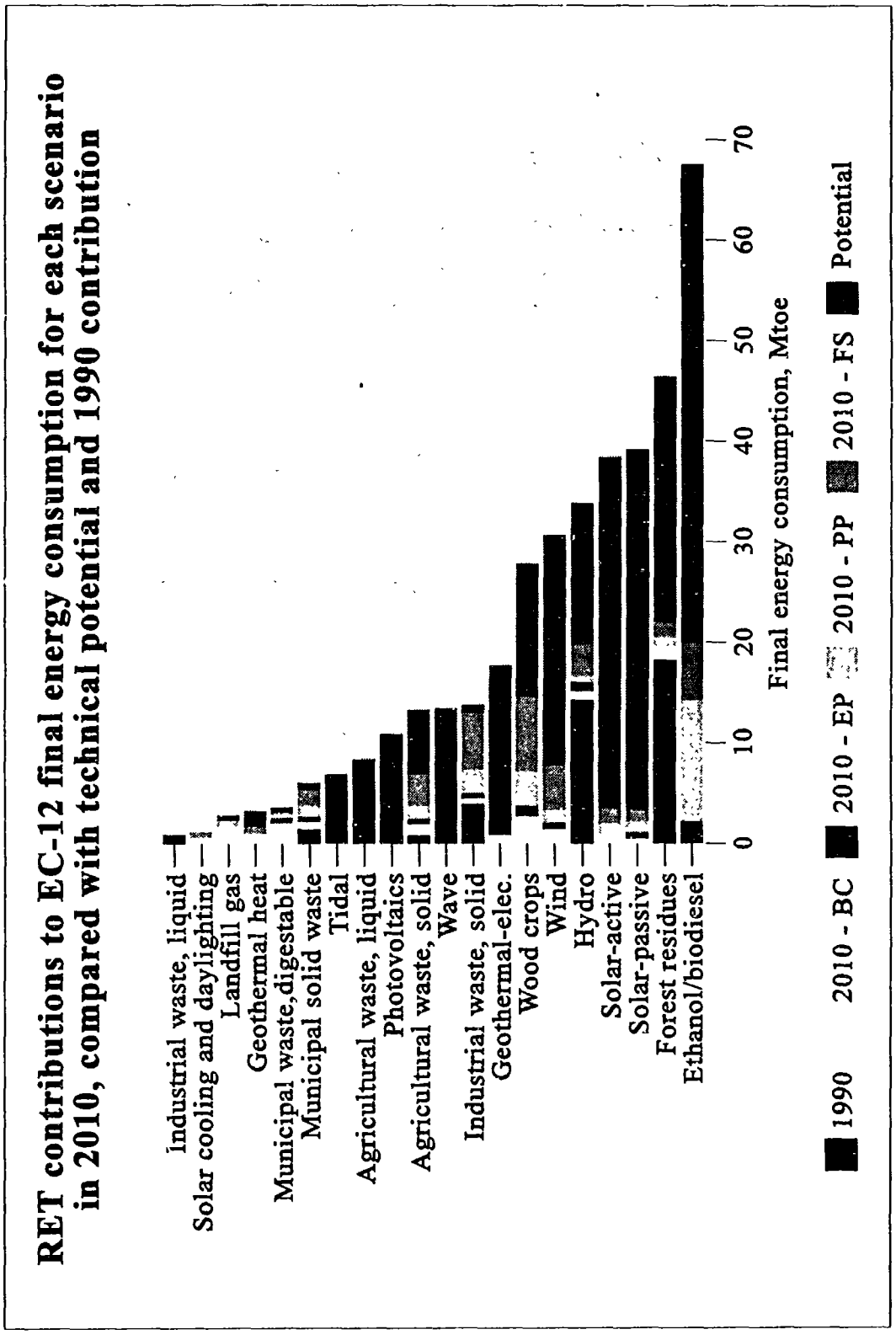

Figure 8 RET contribution to EC-12 final energy consumption for each scenario in 2010

Source: The European renewable energy study (5)

This scenario also achieves the ALTENER target of liquid biofuels accounting for 5% of transport fuels. However TERES underlines the importance of a wide range of policies and measures at national and local level as essential in complementing measures taken at Community level.

Having established that action at the levels of "Proposed policies" and "Full Social Cost" scenarios are essential to achieve any significant growth in market share by RETs, it is appropriate to look at some of the scenarios developed in TERES in more detail.

4.1 The Proposed Policies Scenario

Some of the main features of the proposed policies currently "on the table" at EC level are given below.

ALTENER is expected to aid RET cost reductions through technical programmes, demonstration projects, product standardisation and the provision of reliable information.

The proposed carbon / energy tax (8) is much more controversial and the time scale for its introduction is unpredictable. The proposal is for a progressive $3-$10 / barrel oil equivalent to be introduced between 1993-2000, with 50% of the tax being levied on the fuels associated carbon emissions and 50% being levied on its energy value. All renewables are exempt. Disagreements between Member States and powerful lobbies will delay action on this, while the EC will also look for "complementary" moves by the rest of the industrialised world so that its international competitiveness is not prejudiced.

Other developments which could have beneficial effects include an increase in buy back rates for RET generated electricity and the increase in waste disposal costs throughout by 2010 as environmental harmonisation is implemented.

4.2 Full Social Cost Scenario

Within this scenario, taxes on conventional fuels would be introduced representing the full external environmental costs, by country, of each fuel and of electricity generation. They include monetary values of the costs of CO_2, NO_x, SO_2 and particulate emissions and also represent monetary values of the risks associated with nuclear power. Large hydro is given a small (5%) environmental tax and tidal

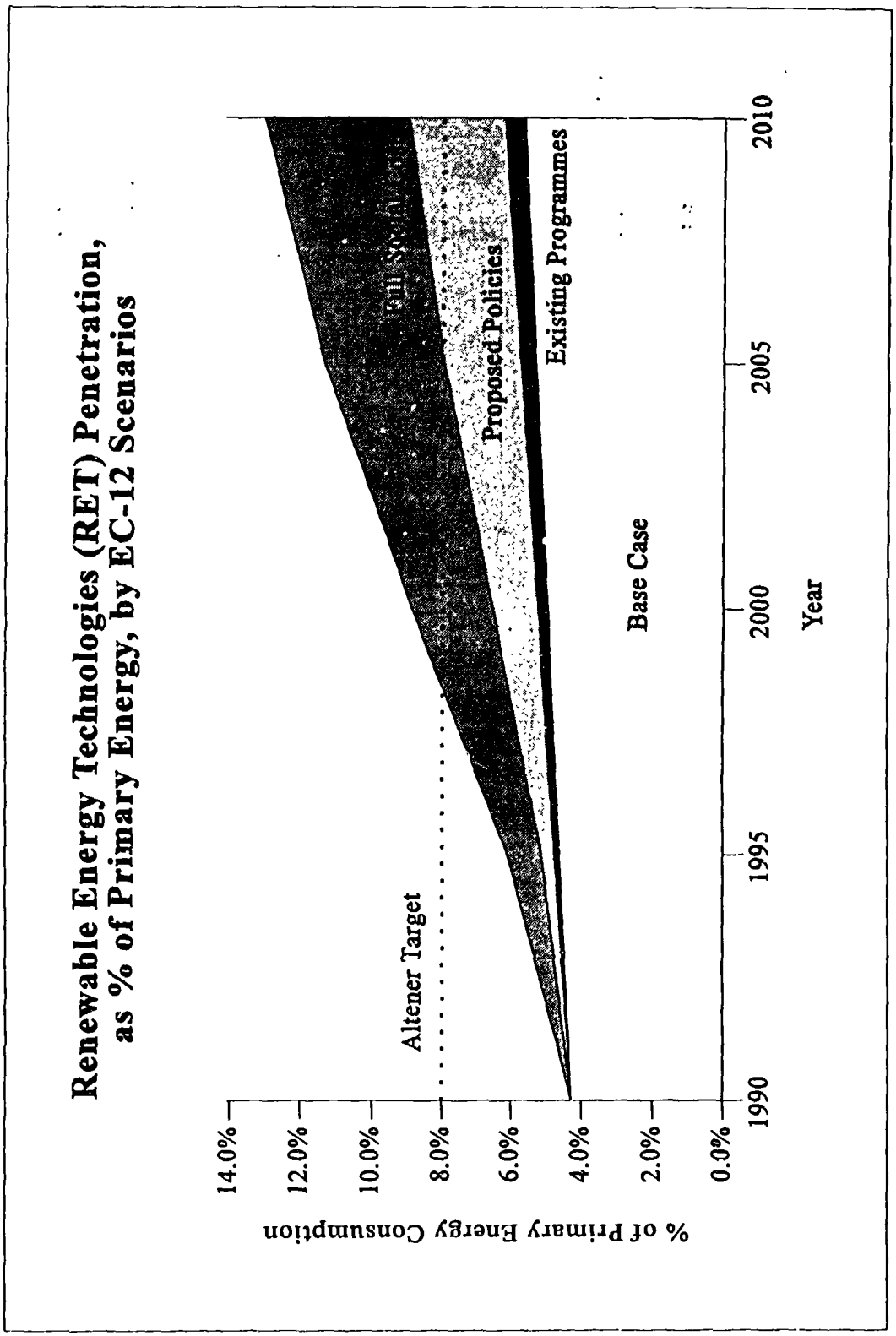

Figure 9 RET penetration as percent of primary energy

Source: The European renewable energy study (5)

schemes are given a subsidy to reflect wide social benefits. Other RETs are assumed to have zero net external costs, with their positive (employment and regional development) effects balancing any negative effects (noise, visual intrusion, research costs). In this scenario the costs of energy from RETs decrease with technical development and larger markets.

4.3 TERES conclusions and recommendations

The most important obstacles to RET penetration, and the means of overcoming them, are summarised as follows, with quotations taken directly from TERES:

Government commitment

"Uncertainty about the future of renewable energy and the commitment of governments to renewables is a major obstacle to investment .... Clear, challenging, but achievable long-term targets for RET penetration set by the CEC and national governments would do much to eliminate this uncertainty ..."

RD&D

"If longer term penetration of energy markets beyond 2010 is to continue, Community policy will need to continue to support several other RETs which, although not commercial by 2010, have high potential at least for some countries ... One of the most important R,D&D issues to emerge from TERES is the need to emphasise the small scale and de-centralised RETs if the potential of renewables is to be achieved in the relatively short term. Greater support for R&D and initial market entry would assist this segment of the market."

Information, training and pilot schemes

"Many RETs are unfamiliar to potential users and investors, whether at the domestic, farm, industrial or financial level ... although the CEC has already commenced with many of these initiatives, support must be accelerated if RETs are to penetrate sufficiently to meet targets."

Utilities

"Reductions of utility restrictions ...on autonomous generators and power sales to third parties will remove some of the major obstacles to RETs ...

"The use of modern control systems will allow the entry onto the grid of large numbers of small, variable, output generators. Utility management and operational systems should be adjusted to suit this change in scale of operation ...

"Acceptance on the part of energy policy makers and utilities that reductions in planned growth of conventional generating capacity will be needed to make room for renewables generation.

Policy issues and recommendations

"The clearest policy issue to emerge from TERES is that Community support to include valuation of external costs of energy production, together with a high level of national government support of renewables, is essential if RETs are to make a significant impact on energy supplies in Europe by the year 2010. This support must include all the measures presented for the Full Social Cost scenario, together with a wide range of technical, institutional, educational, financial and legislative measures which will operate at national level"

5. SUMMARY AND CONCLUSIONS

I want to underline several points which I think are of significance.

1. **The context for the RET market in the EC is a situation of enormous change** with many simultaneous transitional processes in action. These transitions: in attitude to the environment, in agricultural policy, in the political unification process and in the very membership of the Community all offer opportunities to the development of the RET market.

2. **There is an existing strong foundation of support for commercialisation of the RETs** at the level of the Commission. It is evident that the European Parliament are eager to extend this support. The ultimate decision-makers are the Council of Ministers representing Member States, so the attitudes of individual governments to the support for the renewables remains of fundamental importance.

3. **Recent years have seen the development of a significant infrastructure for the promotion of RETs at EC level.** As well as the CEC's OPET network the European Photovoltaic Industry Association, the European Wind Energy Association, the European Solar Industry Federation, the European Secretariat of the International Solar Energy Society and EUROSOLAR are all active, as well as the EUREC agency (European Renewable Energy Centres), CERE (Communities of Europe for Renewable Energy and EURE (European Utilities

for Renewable Energy). *None of these associations existed 10 years ago.* We must devise ways to utilise this developing infrastructure with optimal efficiency and promote close cooperation between them.

4. **The expertise and skills involved in developing RETs cover a wide range of disciplines and backgrounds,** and likewise the barriers to be overcome vary enormously between technologies. For example those seeking to promote passive solar architecture must learn to grapple with the psychological importance of aesthetics, while the wind turbine manufacturers must address, at industry level, the reduction of utility restrictions to autonomous generators. The only thing which these two bodies - and all promoters of RETs - have in common is the environmental benefits of their energy solutions.

5. **The most important single issue of relevance to the commercialisation of all RETs is the inclusion in all energy costings of external costs of production.** The first step towards this lies in the carbon / energy tax currently under debate at EC level. If representatives from disparate groupings representing the RETs in the EC are to come together on any single point, it must surely be on this issue.

I now refer back to my introduction where I indicated that I would like to provoke two levels of discussion.

Firstly I ask my colleagues at the Round-table who are themselves from the EC to discuss, debate and refine the presentation given in this paper of the current situation of the RETs in the EC. I would like to ask them if they agree with my thesis that the most significant issue we all have in common, and therefore should address jointly, is the issue of internalisation of energy costings. If there is agreement on this I should like to discuss ways in which we can work together on this issue. I would like also to throw open the floor to other directions which our Round-table discussion might take in connection with the RETs at EC level.

Having used the Round-table as an attempt to consolidate an EC position on the commercialisation of RETs I would then like to look to the broader international participation in the Summit and examine the relationships between their national and regional experiences in the commercialisation of solar technologies and what is happening in the EC.

The question of energy tax is being debated in several industrialised nations. In the USA there are many differing opinions about it, but people concerned with the environment can offer constructive answers about taxing carbon dioxide output in order to meet the obligations to reduce the growth of greenhouse gases. This has been promised and solemnly signed up to in 1992 during the Earth Summit in Rio de Janeiro.

Members of the European Community indicated that they will levy a carbon tax only if their principal competitors do likewise. In Japan the Trade and Industry Ministry opposes carbon tax. If the American example of introducing an energy tax helps others to follow suit the environment will benefit from this all over the world.

Looking at the industrialised countries, I would expect that the issue of carbon / energy tax is a very appropriate topic for discussion given the significance of the complementarity principle. (See also the proposed policies scenario in 4.1.)

Looking at the developing countries I would like to discuss how developments achieved in the RETs in the EC can be effectively and appropriately transferred to South America, Africa and Asia.

The EC is particularly concerned with the development not only of its eastern neighbours but also its neighbours to the south, in the countries bounding the Mediterranean, as well as with the countries covered by the Lome convention which have had long-standing ties with Europe.

Financial support for technology transfer from the EC to these regions does exist, and it is in our joint interest to ensure that transfer of renewable energy technologies receive their fair share of funding.

In both discussions, at EC and international level, my intention is to focus on the importance of collaboration. Competition is of course an important motive force behind technology development, but at the moment I believe we must also work together to find ways to increase the volume of the market within which we can compete. This is an evaluation which is not unique to myself, it is derived from numerous recent discussions with respected colleagues. I trust that the World Solar Summit will provide a valuable platform on which to build such collaboration.

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ANNEX 1:

Characteristics of the background for renewable energy technologies in the EC member states

BELGIUM

- Limited fossil and renewable resources
- Dependence of electricity sector on nuclear energy (60% of supply).
- No significant government promotion of renewables at federal level.
- Regionalisation of energy planning means some promotion of RETs at local level.
- Some areas have administrative procedures to encourage RETs.
- Good electricity infrastructure ensures no constraint on penetration of RETs.
- Public awareness of, but little enthusiasm for RETs and RET lobby groups rather weak.

DENMARK

National plan:	Energy 2000	
Technology target	2000	Wind: 800-1350 MW_e
	2005	Wind: 1500 MW_e
	2005	Biomass: 1 MTOE

- Significant North Sea gas reserves
- Significant wind and agricultural-based biomass resources
- Significant proportion of electricity imported (25% of supply)
- High taxes on coal, oil and electricity; gas and RETs not taxed.
- Extensive cogeneration capacity.
- Comprehensive national energy planning.
- Significant national commitment to the environment and therefore to RETs. Renewables well integrated into energy supply strategy.
- Widespread awareness and public support for renewables.

FRANCE

- Limited fossil fuel resources
- Dependence of electricity sector on nuclear energy
- Strong central planning process
- Large agricultural-based biomass potential
- continuing nuclear programme limits RET penetration into electricity sector

GERMANY

Technology target 1995 Wind 250 MW_e
1995 PV: 2250 x 1-5 kW_p units

- Limited national fossil fuel resources (except coal).
- Stringent environmental legislation.
- Priority for investment being given to integration of Eastern Germany
- Exploitable renewable resources small compared to national demand
- Strong RET, R,D&D expenditure and technology base
- Favourable programmes for initial market support for RETs.

GREECE

Estimate of future use 2000Wind: 150 MW_e

- Limited fossil fuel resources (except lignite)
- Heavy dependence on coal and imported oil for electricity generation
- High energy costs associated with island supply
- Significant solar, wind, biomass and unexploited hydro resources
- Series of incentives, tax breaks, grants, loans but few private funds for RETs
- Unsatisfactory buy-back situation
- Future policies plan to put emphasis on RET planning, financing and R&D
- Strong institutional inertia limits penetration of new technologies
- general lack of awareness of RETs, except active solar

IRELAND

- Limited fossil fuel resources (except peat)
- Low energy intensity economy
- Energy planning favours conventional supplies
- Extensive wind resources
- Poor electricity grid infrastructure to areas with renewable resources
- No incentives for RETs and little support from government
- Poor awareness of renewables in industry, commercial and domestic sectors
- Over capacity in the electric supply industry

ITALY

National plan	PEN:	17.5 Mtoe by 2000
Technology target	2000	PV 25 MW_p
	2000	Active solar 0.2 Mtoe
	2000	Wind: 300-600 MW_e
	2000	Hydro: 25 We
	2000	Geothermal electric: 9TWh
	2000	Geothermal heat: 0.33 Mtoe

- No major fossil fuel reserves
- Rapid switch to gas in the electricity sector
- Historically comprehensive central energy planning process
- Significant biomass, solar and geothermal resources
- Favourable RET policies but delays in implementation

LUXEMBOURG

- Heavy dependence on imported energy of all types
- High energy intensity economy
- Energy policy reflects that of surrounding Member States
- Limited RET resources, no significant government promotion

NETHERLANDS

National plan	Electricity plan 1991-2000 & KWW study: 5% by 2010 & 25% by 2050	
Technology target	2000	Wind: 1000 MW_e
	2010	Wind: 2000 MW_e
	2010	Active solar: 0.1 Mtoe
	2010	PV: 0.1 Mtoe
	2010	Geo: 0.1 Mtoe
	2010	Bio: 2.0 Mtoe

PORTUGAL

National plan 10% in medium term

- Limited fossil fuel resources
- Extensive forest cover
- Significant solar resources
- Unexploited hydro resources
- Decentralised production and use of natural resources are stated policy
- Tax reductions on RET investments

SPAIN

National plan PAEE 91: 3.749 MTOE by 2000 (not Including. large hydro)
Targets below given as % of this

Technology targets Biomass: 74.9%
Municipal solid waste: 10.3%
Small hydro: 8.8%
Wind: 2.9%
Active solar: 2.7%
Geothermal: 0.3%
PV: 0.1%

- Clear national declarations and support for RETs and R,D & D
- Significant solar, biomass, unexploited hydro resources, good wind regime
- Autonomous regions make policy difficult to implement
- Government support for inward technology transfer
- Vocal RET lobby groups but largely ineffective to date
- Good awareness of RETs in industrial, commercial and domestic sectors

UK

Technology target: All sources: 1500 MW_e

- Large coal and significant North Sea oil and gas reserves
- Wholesale privatisation of energy sector
- Extensive wind resources
- Pressure on traditional waste disposal options
- Support for RETs through Non-Fossil Fuel Obligation (NFFO)

ANNEX 2:

Technical potential for Renewable Energy Technologies in the European Community

Country	PV de-centralised TWh	Passive daylighting TWh	Total PV + passive TWh	Active heating ktoe	Passive heating ktoe	Total heating active-passive ktoe
Belgium	5	0.3	5.3	991	2943	3934
Denmark	2	0.2	2.2	458	1378	1836
France	24	2.3	26.3	10203	3771	13974
Germany	33	2.3	35.3	6367	13280	19647
Greece	3	0.1	3.1	1320	25	1345
Ireland	1	0.1	1.1	305	753	1058
Italy	17	1.9	18.9	5434	362	5796
Luxembourg	0	0.0	0.0	26	98	124
Netherlands	5	0.5	5.5	1448	3996	5444
Portugal	2	0.4	2.4	1423	20	1443
Spain	12	1.4	13.4	5023	87	5110
UK	19	1.9	20.9	4758	11992	16750
Total EC-12	124	12	136.0	*37758*	38706	76464

Table A2.1 EC Solar technical potential

Source: The European Renewable Energy Study

Country	Land area for each band (1000 km2)					On shore technical potential (TWh)
	<4 m/s	4-5 m/s	5-6 m/s	6-7m/s	>7 m/s	
Belgium	0	19	9	2	0	2
Denmark	0	2	13	19	9	25
France	328	88	60	44	27	66
Germany	143	135	57	14	7	19
Greece	18	53	40	12	9	20
Ireland	1	13	20	24	13	34
Italy	6	178	93	24	0	18
Luxembourg	1	1	0	0	0	0
Netherlands	0	15	14	10	2	10
Portugal	0	87	5	0	0	0
Spain	106	212	151	20	15	33
UK	0	47	66	81	54	126
Total EC-12	603	850	528	250	136	353

Table A2.2 EC Wind Technical potential

Source: The European Renewable Energy Study

Country	Forestry residues	Agricultural solid wastes	Agricultural liquid wastes
Belgium	150	353	1450
Denmark	1400	4289	3680
France	6500	10200	70000
Germany	4500	27000	85000
Greece	5020	4800	6000
Ireland	700	1600	22000
Italy	8000	3900	30000
Luxembourg	18	90	5
Netherlands	1500	800	65000
Portugal	3945	1410	11000
Spain	3250	4320	50000
UK	3260	5000	75000
Total EC-12	**38243**	**63762**	**419135**

Table A2.3 Forestry and agricultural wastes

Source: The European Renewable Energy Study

Country	Industrial solid waste (kT/yr)	Industrial liquid waste (kT/yr)	Municipal solid waste (kT/yr)	Municipal liquid waste (kT/yr)	Landfill gas (TWh)
Belgium	1161	48	1128	1420	2850
Denmark	647	558	700	618	400
France	31688	7217	21400	13889	7000
Germany	42250	9622	35750	18519	2100
Greece	397	1475	3000	2010	15
Ireland	600	650	1384	524	10
Italy	2300	6950	5400	7845	18100
Luxembourg	181	8	113	90	0
Netherlands	1500	2000	2100	3121	0
Portugal	425	1580	241	726	263
Spain	20500	4806	2419	7509	2870
UK	25000	5861	20000	15693	28600
Total EC-12	**126649**	**40775**	**61455**	**69155**	**62208**

Table A2.4 Industrial and municipal wastes

Source: The European Renewable Energy Study

Country	Technical potential TWh	Small hydro proportion %	Proportion utilised %	Tidal TWh	Wave TWh
Belgium	0.6	58%	52%	0	0
Denmark	0.1*	100%	18%	0	21
France	72.0	11%	86%	37	40
Germany	27.0	10%	69%	0	0
Greece	25.0	8%	10%	0	0
Ireland	1.6*	16%	46%	1	44
Italy	150.0	15%	24%	0	0
Luxembourg	0.5	76%	15%	0	0
Netherlands	0.6	26%	10%	0	NA
Portugal	24.5	26%	37%	NA	NA
Spain	70.0	55%	45%	NA	NA
UK	7.5	8%	48%	40	50
Total EC-12	**380**	**21%**	**39%**	**100**	**155**

Table A2.5 EC-12 water technical potential

Source: The European Renewable Energy Study

Country	Estimated electric potential	Potential already utilised	Estimated heat potential	Potential already utilised
Belgium	0	-	2	1%
Denmark	0	-	3	<1%
France	0	-	69	1%
Germany	0	-	46	<1%
Greece	1	1%	2	2%
Ireland	0	-	2	<1%
Italy	34	10%	60	2%
Luxembourg	0	-	0	-
Netherlands	0	-	12	0%
Portugal	0	-	2	0%
Spain	1	0%	5	1%
UK	0	-	<1	36%
Total EC-12	36*	10%*	200	1%

Table A2.6 Geothermal technical potential

Source: The European Renewable Energy Study

Country	Land area available in country 1000 km^2	Total population of country millions	Population per land available km^2
Belgium	12	9.9	825
Denmark	6	5.2	867
France	1394	56.0	50
Germany	5594	77.0	14
Greece	1200	10.2	8
Ireland	70	3.6	51
Italy	8975	57.0	6
Luxembourg	1	0.4	400
Netherlands	500	15.0	30
Portugal	800	10.5	13
Spain	1165	39.0	33
UK	2562	57.0	22
Total EC-12	**22279**	**340.8**	**15**

Table A2.7 Land available for Energy Crops

Source: The European Renewable Energy Study