6. Analysis of Member State/technology examples of successful penetration

Photo: Volker Quaschning

The previous section, together with further examples provided in Annex 1, present a series of Member State/technology combinations. They examine the influence that potential success factors have had on the implementation of a technology in a Member State. The potential impact that each factor has on successful penetration is assessed below, by drawing together the results from Section 5 and Annex 1. Based on this analysis, the lessons learnt are shown in Section 7. Each potential success factor (political, legislative, fiscal, financial, administrative, technological development, and information, education and training) is discussed in turn below.

6.1. Political

The examples shown in Section 5 and Annex 1, demonstrate that strong political support at national, regional or local level is a consistent component in successful penetration of renewable energy in each of the Member State/technology combinations studied.

National policies in support of renewable energy

Each of the examples was implemented in a Member State which demonstrated strong support for the development either of renewable energies in general or of a particular renewable energy. By the end of the 1990s, most governments had implemented energy plans

that supported the development of renewable energy and/or had identified national or regional targets for increased renewable energy use and associated policies and measures to support renewable energy uptake.

The main reasons for supporting the development of renewable energy lie in national energy policies which aim to encourage diversity and security of supply, to reduce imports of fuels and to reduce greenhouse gas emissions (in particular carbon dioxide). Renewable energy can make an important contribution towards achieving these objectives. At the point of generation, wind and solar sources provide energy without any associated carbon emissions, while biomass energy is carbon-neutral, provided that the carbon released is recycled in the form of new biomass growth.

Some Member States started to develop renewable energy support programmes earlier than others, usually for country-specific reasons. For example, security of energy supply is given high priority in Member States which have few indigenous fossil fuel resources and must rely heavily on imports. Austria, for instance, has no indigenous fossil resources and has long recognised that renewable energy can help to reduce its fossil imports. Austria's long-established and active political support towards increasing renewable energy use has contributed towards improving the country's security of supply, reducing its energy imports and improving its balance of payments. The Austrian government recognises that this support also improves domestic employment and stimulates indigenous jobs.

Denmark was also quick to identify the potential role that renewable energy could play in employment and job creation. For more than 15 years, Denmark has provided active support to the expansion of its renewable energy industry, through setting targets backed up by practical support measures. The government saw renewable energy, and wind power in particular, as an opportunity to contribute towards a more sustainable fuel mix for energy production (especially by reducing coal use). It recognised that this support would stimulate the development of an emerging industry, enabling Denmark to become a market leader in wind energy. The Danish government therefore implemented a series of energy action plans during the 1980s and 1990s, each becoming progressively more ambitious in terms of renewable energy use, and in line with the government's overall carbon dioxide emission reduction targets.

Another factor acting in favour of increasing support for renewable energy is the political attitude towards nuclear power, especially where there is a national desire to use less or none of it. Sweden has committed itself to phasing out its nuclear capacity, but any replacement with fossil capacity could conflict with the country's international commitments to limit greenhouse gas emissions. Renewable energy, combined with energy efficiency measures, offers an environmentally acceptable alternative.

During the latter part of the 1990s, more and more Member States implemented specific policies towards renewable energy as part of their national energy plans, and developed action plans and targets for increasing their use of renewable energy. Many of these policies and plans are now being expanded.

Denmark implemented a series of energy strategies throughout the 1990s which progressively raised the targets for renewable energy use. Its 1996 strategy, Energy 21, set the target of 1 500 MW of wind turbines by 2005. This target was exceeded in 1999 and a new goal of providing 20 % of electricity consumption from renewable energy resources by 2003 was set. The government's longer term ambition is to generate 50% of the country's electricity requirements from renewable energy sources by the year 2030, a large part of which will come from on and off-shore wind turbine installations.

Finland's 1994 national biomass strategy aimed to increase biomass use by 25 % between 1992 and 2005. The more recent Action Plan provides a further stimulus with a target to increase renewable energy use, including biomass, by 50 % between 1995 and 2010.

Ireland's 1995 targets for electricity generation from renewable energy were increased in a 1999 White Paper to 500 MW by 2005.

The Netherlands' 1997 White Paper set goals for renewable energy use which were subsequently made more challenging in 1999; they were to meet 5 % of gross inland energy consumption from renewable sources by 2010 and 10 % by 2020.

Spain's 2000 renewables target has now been expanded to a 12 % share of renewables in gross inland energy consumption by 2010.

Regional renewable energy policies
The case studies in this report highlight the important contribution made by regional energy policies in encouraging renewable energy. For Member States with a high degree of regional autonomy, such as Austria, Germany and Spain, many regional authorities have brought forward plans that are more supportive of renewable energy than those implemented at national level. For example:

— Upper Austria initiated an energy plan in 1994 that set clear targets for increasing the use of renewable energy in the region. All Austrian regions now have similar policies.
— In Germany, many regions have established targets for increasing their level of renewable energy use. Regional wind energy targets have been established in northern German *Länder* such as Nordrhein-Westphalia, and these have helped give these regions the highest levels of wind energy use in Europe.
— A similar approach was taken in Spain, where regional governments have taken the initiative in stimulating renewable energy in their regions. Navarre is the one of the most advanced regions in its support for renewable energy and especially for wind power. Other regions are now also showing high levels of renewable energy use.

6.2. Legislative

6.2.1. Power purchase

A guaranteed market for power sales was consistently identified in the case studies as a success factor. During the six year period (1993-1999) covered by this study, two principal legislative options were available for power generators in the various Member State/technology combinations studied - feed-in arrangements and competitive tendering.

Feed-in laws
One of the most effective support measures for encouraging increased renewables generation is the feed-in law, which provides guaranteed power purchase agreements at fixed prices. The most favourable rates and conditions, and consequently some of the greatest rates of increased penetration, especially of wind energy, are to be found in Germany and Spain. In both countries, utilities are obliged to purchase renewable electricity. The prices paid are guaranteed and at a preferential rate.

Wind: The success of the feed-in law is clearly visible in the rapid increase in output from wind in two Member States: output in Germany rose by over 700 % between 1993 and 1999 (from 674 to 5 528 GWh), and in Spain by 2 266 % over the same period (from 116 to 2 744 GWh). The pace of new installations has accelerated quickly in both Member States in recent years, corresponding to the implementation of feed-in legislation. Denmark also achieved a long and sustained growth in wind power installation during the 1990s, again due to developers being able to sell their power at a known and economically favourable rate.

These three Member States dominate the wind power market. The scheme is simple, and provides guaranteed and known power prices, over a number of years. The arrangement removes a large amount of the uncertainty and risk associated with the development of a renewable energy scheme. Other Member States which have offered feed-in arrangements have generally not achieved such high take-up rates. For example, when Italy introduced its pricing system, it was very complex; when the arrangements were simplified more projects were brought forward.

Biomass: The use of biomass in power stations (including biomass combined heat and power stations) has also benefited from feed-in laws, particularly in Denmark, Germany and Spain. The Danish purchase obligation system for biomass has been in operation since the early

1990s. However, despite a 189 % increase in generation output between 1993 and 1999, growth was lower than anticipated, especially in later years. This was mainly because the price available for renewable energy did not change for a number of years and producers no longer considered it commercially viable. Reforms of the electricity industry currently being implemented will alter this situation, through changes to feed-in tariffs and rules for electricity from renewable energies. For instance, green certificates are currently in preparation in Denmark. In Spain, interest in using biomass to generate power has increased with the introduction of attractive feed-in tariffs for generators. In Germany, the feed-in law was revised in 2000 to provide more attractive rates for biomass generators.

Attractive rates are important to obtain sufficient levels of interest and investment in new biomass power plants, which need high levels of capital investment.

Photovoltaics*:* Successful photovoltaics (PV) implementation has also benefited from feed-in laws. Germany and Spain are the only countries that showed both a high rate and level of penetration over the 1993–99 period. Both countries provide generous feed-in tariffs for PV electricity. Spain revised its tariff upwards in 1998, and this contributed to Spain's increased generation of PV electricity in 1999. In 2000, Germany also revised its PV feed-in tariff upwards. PV technology is at pre-commercial stage for most applications, and cannot yet compete commercially with other energy sources, even with other renewable energies. PV therefore still requires considerable financial support. Germany and, to a lesser extent, Spain have established, in addition to feed-in tariffs for PV electricity, generous funding support schemes to stimulate the level of uptake of PV (see Section 6.4).

In the long term, and as levels of renewable energy increase, the rapid success of feed-in arrangements is leading to concerns over how the costs of the support should be shared among consumers. Germany may be one of the countries where these considerations will be reached most quickly, because it has very high rates of uptake of renewable energy. Some regions in Germany have seen wind capacity grow to represent more than 5 % of the region's total electricity capacity in less than five years. Since 1998, the German electricity market has been opened to competition, and unregulated access was granted to electricity transmission and distribution systems. Under the terms of the 1991 feed-in law, utilities were obliged to pay the cost of the feed-in tariff, passing the extra charge on to the customer. This resulted in high charges for electricity in areas where wind power schemes were common. After 1998, German regulations limited the utilities' purchase obligations for renewable electricity to 5 % of the total electricity consumption within their supply area. When the local utility reached this limit, the obligation no longer applied. The new 2000 German Renewable Law changed this arrangement: it abolished the 5 % limit and introduced a system according to which the costs of the support to renewable energy are distributed among all grid operators so that the costs are borne equally.

Competitive tendering

A competitive tendering mechanism is the main alternative to the feed-in system. It provides a guaranteed market through access to contracts and competitive prices for renewable energy. Competitive tendering has been operated, through largely similar systems, in France, Ireland and the UK. The UK did not meet either of the selection criteria for the successful penetration of renewable electricity technologies. Ireland and France both showed rapid rates of expansion of wind energy between 1993 and 1999, although the fact that both countries started from very low initial penetration levels should be taken into consideration.

Ireland established the Alternative Energy Requirement (AER) as a support mechanism for a range of renewable energy technologies, based on the system in place in the UK since 1990 called the Non-Fossil Fuel Obligation (NFFO ([14]). Both the AER and the NFFO are competitive bidding systems whereby developers respond to calls for tender ('tranches') to provide electricity from a range of renewable energy sources. If they are successful, they

(14) The NFFO is being replaced by a Renewables Obligation, the draft of which obliges suppliers to provide an increasing proportion of their supplies from renewable sources (3 % by April 2003, rising to 10.4 % by April 2011). Suppliers will need to purchase new renewable energy capacity, and it is expected that this will stimulate demand. Increased demand will also encourage premium prices to be paid for renewable electricity.

obtain a guaranteed power price, at the level of their bidding price, and a long-term (e.g. 15-year) contract for power sales from their renewable energy project. Each type of renewable energy project is grouped with other similar technologies, which ensures that there is competition between applications.

France established the Eole system in 1996, which provided support for wind energy through a competitive bidding mechanism, similar to the ones in Ireland and the UK. Its success has been limited. Most of the wind energy developments have been small installations on the island of Corsica or in French overseas departments. Project developers encountered a range of barriers not directly associated with Eole, which have tended to slow down project implementation. Since June 2001 France has replaced competitive tendering with a system similar to the feed-in law to further promote wind energy.

6.2.2. Access to the grid

Straightforward access to the necessary grid infrastructure is also critical to success. Renewable energy electricity generation faces problems of grid access that are different or absent for larger generators. Renewable energy is generally small scale, decentralised, and may be located in rural or remote locations where grid connections are limited or unavailable. In addition, much renewable energy is intermittent ([15]) in nature, especially wind, PV and hydro, and this can attract penalties under some grid access charging tariffs, which favour generators that are able to provide continuous and consistent generation output.

Member States that took the biggest steps to address problems of grid access achieved the greatest levels of renewable electricity penetration during the 1990s, especially for smaller-scale renewable energy projects. Denmark, Germany and Sweden all have policies that oblige utilities to allow straightforward access to the grid for renewable energy producers. They also have transparent and economically fair charging systems for grid access, so that developers know the charges that they are likely to face, in advance.

Two barriers have been identified, in the cases examined in this study, which can limit the ease with which a developer can get a new renewable energy project connected to the grid, and the cost of achieving this.

Firstly, the grid itself may have limitations that make it difficult for a renewable energy project to be connected. This is often the case where the grid does not have the capacity to accept new power load, or where the proposed site for the renewable energy project is remote from a convenient grid access point. This limitation to wind expansion was encountered in the Portuguese wind energy case study, as well as in southern Italy, where large regions have inadequate grids. Rectifying this requires grid extension/strengthening, which may be very costly and could make the proposed project uneconomic if the developer has to bear these costs.

The second barrier occurs when the independent developer is not given ready access to the grid, at a reasonable price. This is the case in France where it has been a contributing factor to wind energy levels being considerably lower than those in Germany and Spain. (This problem has also been encountered in the UK, where grid access charges are not fixed or transparent, and may vary considerably between different regions of the country or between different utility companies.)

Access to electricity grids for renewable energy sources has not been treated equally among Member States. This is one issue that the EU directive on renewable energy in the internal electricity market (see Section 7), addresses. The directive requires Member States to take the necessary measures to guarantee the transmission and distribution of electricity produced from renewable resources and encourages such electricity to be given priority access to the grid. Measures to achieve this include developing transparent and non-discriminatory systems and costs for grid connection. The implementation of these requirements in all Member

(15) There is no power generated when the wind does not blow/when it is dark/when there is little or no water.

States should help renewable generation to penetrate much more successfully into the EU's electricity networks.

6.3. Fiscal

Fiscal measures may be implemented in the form of environmental taxes, which penalise the use of fossil fuel (and hence benefit renewable energy use) or as a positive form of tax incentive for environmentally beneficial investment, such as a tax exemption or reduction. Both forms of fiscal support measure are increasingly being used by Member States to encourage renewable energy and other environmentally beneficial activities, or for penalising fossil generation or other environmentally damaging activities.

6.3.1. Environmental taxes

Denmark was one of the first countries to implement an environmental tax. Energy consumers were charged a CO_2 tax from 1992, with some of the revenue given to generators of electricity from renewable sources.

Member States, including Austria, Denmark, Finland, Italy, the Netherlands and Sweden, have now implemented various forms of environmental tax. They have introduced energy or environmental taxes as part of their overall energy policy to more accurately reflect the total costs (including costs to the environment) of generating heat or power from fossil or non-fossil sources. The types of environmental taxes implemented vary widely; they may be levied on energy use (both heat and electricity), power or heat generation, CO_2, or SO_2.

In all cases, renewable energy generation for power and heat benefits through either exemptions or refunds. In Sweden, the introduction of carbon dioxide and energy taxes from which biomass is exempted helped the expansion of biomass district heating and biomass combined heat and power plants, as the taxes made other options, in particular coal-fired district heating and coal-fired combined heat and power plants, more expensive.

In some cases (including Austria and Italy), some or all of the revenues received from energy taxes are recycled to benefit renewable energy, energy efficiency, or other environmental projects.

6.3.2. Tax incentives for investment

Fiscal arrangements can also be used to encourage investment in renewable energy or energy-saving projects.

Tax exemptions or reductions can encourage private individuals and companies to consider investing in renewable energy projects as an attractive financial option. For example, in Germany and Sweden, investment in wind schemes can be offset against tax for individuals, while in Ireland, the Netherlands and Spain companies receive tax relief if they invest in renewable energy projects. In Greece, the installation of solar thermal water-heating systems has been stimulated by tax exemptions for households buying renewable energy appliances such as solar water heaters. In the Netherlands, companies and firms which invest in energy-saving projects (including renewable energy projects) can benefit from claiming accelerated depreciation of investment in equipment for such projects.

6.3.3. Biofuels — benefiting from lowering of excise duty

Biofuels in France benefit from a special fiscal arrangement. In the 1992 mineral oils directive (92/81 article 8.2(d), the European Community allowed Member States to lower excise duty rates for technological purposes (for pilot plants) to develop fuels from renewable energy resources. France, in particular, took advantage of this regulation to lower excise tax on biofuels, making biofuels competitive with higher-taxed fossil fuels. For example, French aid to biodiesel (a type of biofuel) was approximately EUR 120 million in 2000, with similar levels of support in previous years.

The future of this type of support is nevertheless unclear following a recent European Community legal ruling (September 2000) that these reduced rates were applied, in the case of France, for economic and industrial rather than technological purposes, and should

therefore not be granted according to article 8.2(d) of the mineral oils directive. However, article 8.4 of the same directive allows Member States to grant derogations (to lower excise duty rates) for other policy purposes too upon Council approval. France has now applied for such a derogation. This tax exemption is being investigated by the European Commission in order to examine the compatibility of France's application for derogation under article 8.4 with Community state aid rules for environmental protection (OJC 37, 3.2.2001).

6.4. Financial

Financial support for the development of renewable energy schemes at the commercial or near-commercial stage is found in almost all the Member State/technology combinations studied. This kind of support is generally through grants or loans towards capital or operational costs. It is clearly an important factor in influencing the successful implementation of renewable energy technologies, both for power and for heat technologies.

Public sector funding
Wind: With the implementation of feed-in arrangements to provide guaranteed premium prices for power purchase, there is progressively less requirement for developers to also receive grants towards their installations. The guaranteed prices available through feed-in support give investors sufficient confidence to invest in the market. In some regions in Germany, however, support through the feed-in law has been enhanced by grants or low-interest loans for wind energy (and other renewable energy) developments. The successful and rapid expansion of Germany's wind energy industry is mainly due to the availability of feed-in support rather than as a result of subsidies. In Spain, because of the success of wind energy, support available through the Energy Savings and Efficiency Plan (PAEE) has been reduced.

The situation in the Member States which have had competitive tendering support mechanisms is different. France has not provided additional funding to new wind energy projects over and above the support provided through the Eole mechanism. The NFFO system in the UK was also the primary source of support. In contrast, Ireland has provided a range of fiscal and financial measures to support wind energy developments (and other renewable energy technologies, including biomass). This additional support may have been a contributory factor towards the more rapid penetration of wind energy in Ireland over the period studied.

For Member States such as Sweden without either a feed-in or a tendering system, subsidies are still the main mechanism for supporting wind energy schemes.

Biomass: Almost all the examples of biomass installations — either for power (including combined heat and power) or for district heating — received a significant level of subsidy from public funds. Austria, Denmark, Finland, France, Germany, Sweden (for biomass power only) and Spain all provided a variety of grants towards the costs of biomass installations.

The high costs of developing new district heating grids, or of updating or extending existing ones, can be a limitation to the use of biomass in district heating. For this reason, it is common in Member States such as Austria for biomass district heating schemes to receive considerable levels of financial support towards the heating grid. However, Sweden did not use large subsidies to develop its district heating system. The introduction of carbon and energy taxes, from which biomass is exempted, and considerable research and development support, along with a number of other reasons, helped biomass district heating to expand in Sweden.

Photovoltaics*:* PV is not yet an economically competitive technology, and requires considerable levels of subsidy to be implemented. Only Germany and Spain showed both high rates and levels of penetration over the six years 1993–99. This was due to the high levels of grants available for PV installations, combined with the guaranteed and favourable purchase price provided through feed-in arrangements. For 1999–2003, Germany has committed EUR 560 million towards its 100 000 roofs programme, thus providing an important stimulus to the PV industry. This new programme, supported by the more favourable feed-in tariffs that have

become available for PV, have recently increased even further the already rapid rates of installation of PV in Germany. Other Member States are also starting up similar programmes (such as Italy's 10 000 roofs programme). The costs of PV have dropped considerably over the past 10 years, and it is anticipated that further cost reductions will occur as the market expands.

Solar thermal*:* Three Member States (Austria, Germany and Greece) achieved significant increases in exploitation of solar energy for heat. In all three, substantial subsidies are being or have been provided to households or industry to install solar thermal. This support is still required because the payback period for solar thermal installations is long. In Austria and Germany, many of the subsidies for solar thermal installations are provided from regional government funds, and are implemented at the local level. Solar thermal is often not included in national energy policy targets because it is a heat technology and can most successfully be implemented at the local level.

Structural Funds

Support for renewable energy has also been accessed from non-energy European Community programmes, especially the Structural Funds. These funds provide support for project development, training and other key measures designed to reduce unemployment and stimulate economic activity, and are targeted towards the most disadvantaged regions of the EU. In the cases examined Austria, Ireland, Portugal and Spain all made some use of Structural Funds to support renewable energy developments. The current round of Structural Funds (2000–06) is likely to give support to a much larger number of projects with a renewable energy component.

Accessing the Structural Funds and other similar programmes can only be achieved if there is support for renewable energy at national and regional levels, and a recognition of the important role that renewable energy can play not only as an energy resource but also as a contributor to economic and social cohesion. The case study of the Austrian district heating scheme showed that it received generous grants from national and regional governments, as well as from Structural Funds, in recognition of the potential benefits for local farmers of having an additional market for their biomass.

Favourable loans

Low-interest loans for the development of renewable energy projects may be provided by banks or other private sector financial institutions operating with ethical investment principles. Some German and Dutch financing institutions in particular are able to offer low-interest loans for environmental projects.

More often, however, favourable loans are provided through public sector funding sources. These may be administered either at the national level or regionally. In Germany, a national loan scheme to support PV installations is administered by regional state banks. In Austria, low-interest loans and long-term credits are available from public banks to support biomass installations, in particular district heating schemes. State financial institutions are often more proactive in the development of renewable energy in their regions. In Germany, preferential loans are provided through funds from regional or local sources. In the Navarre (Spain) wind energy case study, the regional bank is a shareholder in the public–private company established to develop the region's wind energy resources.

Table 7 **Summary of the principal support mechanisms identified in the case studies for renewable energy power developments (1993–99)**

Member State	Legislative support	Fiscal initiatives	Financial support
Austria	Guaranteed prices	Energy taxes on gas and electricity; revenue partly recycled to support renewable energy	Public grants, subsidies and loans
Denmark	Purchase obligation + premium guaranteed prices	Energy/carbon dioxide taxes on fossil fuel; revenue partly 'recycled' to support renewable energy	Subsidies provided historically for research, development and demonstration (R,D&D), especially in wind Subsidies (capital grants — biomass)
Finland	Transmission costs are fixed; grid access is open to all producers	Energy/carbon dioxide taxes on fossil fuel; revenue partly 'recycled' to support renewable energy	Subsidies on investments and equipment (capital grants)
France	Competitive tendering (Eole 2005)	–	Subsidies (capital grants — biomass)
Germany	Purchase obligation + premium guaranteed prices	Tax benefits for investing in renewable energy	Subsidies and low-interest loans for all renewable energy projects provided by local banks Direct financial support: PV roofs programme; subsidies for biomass installations
Greece	Purchase obligation + premium guaranteed prices	Tax benefits for investing in renewable energy	Subsidies (capital grants — solar thermal)
Ireland	Competitive tendering (Alternative Energy Requirement, AER)	Tax benefits for investing in renewable energy	Subsidies (capital grants)
Italy	Purchase obligation + premium guaranteed prices	Energy/carbon dioxide taxes on fossil fuel; revenue recycled to support renewable energy	–
Netherlands	Purchase obligation	Energy/carbon dioxide taxation favourable towards renewable energy Tax benefits for investing in renewable energy	Government subsidies Obligation for utilities to invest in renewable energy projects
Portugal	Purchase obligation + premium guaranteed prices	–	Interest-free loans Support for grid connection
Spain	Purchase obligation + premium guaranteed prices	Tax benefits for investing in renewable energy	Capital grants (biomass)
Sweden	Purchase obligation	Renewable energy pays lower or no energy tax or nitrous oxide levy Tax benefits for investing in renewable energy	Investment grants

6.5. Administrative

The role of the municipality/regional government

It is increasingly recognised that the successful replication of renewable energy projects can only be achieved on a wide scale if there is active support at the level at which individual projects are brought forward for approval. In most cases this is at local level.

Public acceptance of renewable energy, and an understanding of the benefits that can come from it, is therefore vital if there is to be a sustained flow of projects accepted for development. A strong commitment from regional or local government is one of the ways that this can be achieved.

Most of the examples of projects or technologies studied in this report received a strong level of support at the regional or local level, from the government or local councils. For example:

— Austrian district heating plants are supported by municipalities, including providing assistance for planning issues and by acting as a consumer for the heat supplied.
— In Germany, some municipalities work with the utility to establish solar thermal installations.
— Municipalities support the use of biodiesel in urban areas in France.
— In Sweden, a number of municipalities have recognised the socio-economic and environmental benefits of biomass district heating and are proactively promoting biomass-fuelled district heating plants.

This local or regional support is vital to successful implementation of many of the technologies, especially the smaller ones such as small-scale wind, solar thermal or biomass heating schemes. The municipality or the regional government has responsibility for overcoming many barriers at local level in order to bring forward renewable energy successfully. These actions include:

— implementing regional legislation in support of renewable energy (see Section 6.1);
— providing funding support for local renewable energy projects (see Section 6.4);
— identifying areas in the region where renewable energy developments are acceptable: wind energy planning in particular benefits from clear guidance from local authorities on where wind turbines are or are not permitted — in Germany, for example, some regional authorities identify appropriate sites;
— ensuring that planners receive adequate information to reach balanced decisions about new renewable energy proposals: local resource assessments help to identify the most favourable sites for new developments — in Ireland, for example, a wind energy atlas was developed to support regional planning for wind;
— ensuring that planning and development legislation and regulations do not discriminate against renewable energy: this can be important in areas such as buildings regulations as new PV panels need to be sited in a position to maximise solar energy collection.

Local support for and promotion of the project or the whole technology is important to overcome these barriers. A number of the project examples used in the case studies had encountered some level of local opposition prior to project implementation: opposition to new wind energy developments in Germany and to a new biomass district heating system in Austria. In the UK, planning and implementation of renewable energy during the 1990s was led by the national government, with little opportunity for regional or local initiatives, and as a result there was a strong level of local opposition to renewable energy developments. Local and regional involvement in planning for renewable energy is now being encouraged to try to overcome this opposition.

Recognising the socio-economic benefits from renewables
The socio-economic benefits of new renewable energy projects are increasingly becoming an important component in decisions to implement new renewable energy strategies. Renewable energy technologies provide local jobs, and keep investment in the local economy, especially for biomass projects which provide an additional benefit in stimulating the local biomass fuel industry.

Austria in particular has recognised the significant benefits that renewable energy technologies can provide to a region's economy. Many Austrian district heating schemes are supported through Structural Funds, because they help to create employment. Farmers and others in biomass-related employment, benefit considerably from biomass-fired heat or power schemes, to which they can provide readily available fuel.

In Spain, the Navarre regional government supported the development of renewable energy (especially wind) because of its benefits to the local economy. The region has gained not only from inward investment and employment in the installation of wind turbines, but the regional government has supported the establishment of Spanish wind turbine manufacturing capacity, in collaboration with Danish turbine manufacturers. The result has been a very rapid increase in Spanish manufacturing capability for wind turbines, both to service the domestic market and increasingly for overseas markets.

6.6. Technological development

Until the 1990s, renewable energy technologies were less technically advanced than conventional energy technologies. Research and technological development has been carried out to address this. Public sector funding programmes for research, development and demonstration stimulate the development of new renewable energy technologies to make them more competitive in the wider energy sector. These programmes support activities to reduce capital and operating costs, improve efficiency and demonstrate long-term reliability.

Over the period examined, the European Community provided support towards the development of renewable energy through a range of energy programmes such as Joule (research and development), Thermie (demonstration) and Altener (a programme specifically targeted at overcoming non-technical barriers and implementation of renewable energy). The Thermie programme in particular provided support for a large number of renewable energy demonstration projects during the 1990s. Examples included wind farms in Ireland, biomass power plant in the UK, PV installations in Italy and the Netherlands, and biomass combined heat and power in Italy.

Current European Community programmes provide support for renewable energy development, particularly through the fifth framework programme for research and development, and the Altener renewable energy programme. In addition, these and other programmes support newer emerging renewable energy technologies such as wave power and offshore wind power.

National energy research, development and demonstration programmes have also played a vital role in the development of renewable energy technologies. Many of the examples studied highlighted how important early and targeted support for research, development and demonstration at the Member State level has been.

The extent to which each Member State is prepared to support technological developments is often reflected in its subsequent indigenous industrial capabilities and expertise as the following examples illustrate:

— The Finnish and Swedish biomass industries are among the most successful in the EU; much of this can be attributed to the comprehensive research and development support provided by the respective national governments, in collaboration with industry.
— Danish wind turbine manufacturing capability was developed with early support from the government during the 1980s, and Denmark now leads the world in its technological capabilities in this field. During the early stages of development, subsidies were high enough to enable the industry to establish itself. Then subsidies were replaced by financial support for generation output.
— Support for biomass technological development in German regions has helped to establish a strong indigenous capability to service the emerging domestic market.
— Germany and the Netherlands have an indigenous PV cell manufacturing capability thanks to government and industry research in this area.

6.7. Education, information and training

Education and information to the general public is a vital component of a successful renewable energy deployment programme.

Some Member States already derive a high proportion of their energy from renewable sources, especially from biomass resources. Austria, Finland, Portugal and Sweden have some of the highest levels of use of biomass for energy in Europe. In such situations, new biomass projects seldom encounter opposition. They are supported because the population is fully aware of the local benefits — particularly through generating jobs for farmers and creating alternative outlets for biomass wastes from sawmill operations.

Cooperative participation in a project is one way to engage the local population in a new renewable energy development. A number of Member States, particularly Denmark, Germany

and Sweden, have a long history of cooperative ventures, particularly for farming. Smaller-scale renewable energy projects can be developed and financed cooperatively, and in these Member States this type of arrangement has been successful in bringing forward a large number of new renewable energy projects, especially wind turbines.

However, in many situations there may be less awareness of renewable energy locally. In addition, larger-scale projects are generally not suitable for cooperative involvement. In these cases, developers need to work with the local community to provide information about the nature of the new developments and their potential benefits. A number of the case studies presented, such as wind energy in Spain, show a strong element of informing the local community before the project was fully accepted.

Both national government and local communities play important roles in raising awareness of renewable energy, through information dissemination activities, education and training at school, in the workplace and to the general public. The overall objective is to raise awareness and to ensure that the potential benefits of renewables are effectively communicated.

The role of energy agencies

A number of the technology/Member State combinations studied were projects that had been brought forward with the support of the local or regional energy agency — for example, in Upper Austria and in Berlin, Germany. Energy agencies play an important part in promoting and raising awareness of renewable energy, and in transferring national objectives to the regions. More and more of these agencies are being established throughout Europe, most often with initial financial support from the European Commission, with the aim of stimulating the expansion of renewable energy locally. They are seen as a means by which national and in particular regional energy plans can be implemented at the local level. They can work with the municipality to raise awareness and work alongside developers and utilities to achieve real and visible results. Smaller-scale renewable energy technologies, especially heat technologies such as solar thermal and biomass district heating but also PV, have benefited greatly from the proactive involvement of energy agencies.

Environmental awareness

Citizens of most EU Member States are well informed about the benefits of environmental protection, and the important role that renewable energy can play in a country's energy policy. Concern about nuclear power in particular is one of the main reasons why, for example, Austrians, Danes, Germans and Swedes generally welcome renewable energy as an environmentally acceptable alternative. In most countries the general public can perceive and appreciate the positive environmental benefits from renewable energy, and can therefore translate this enthusiasm into strong commitment and support.