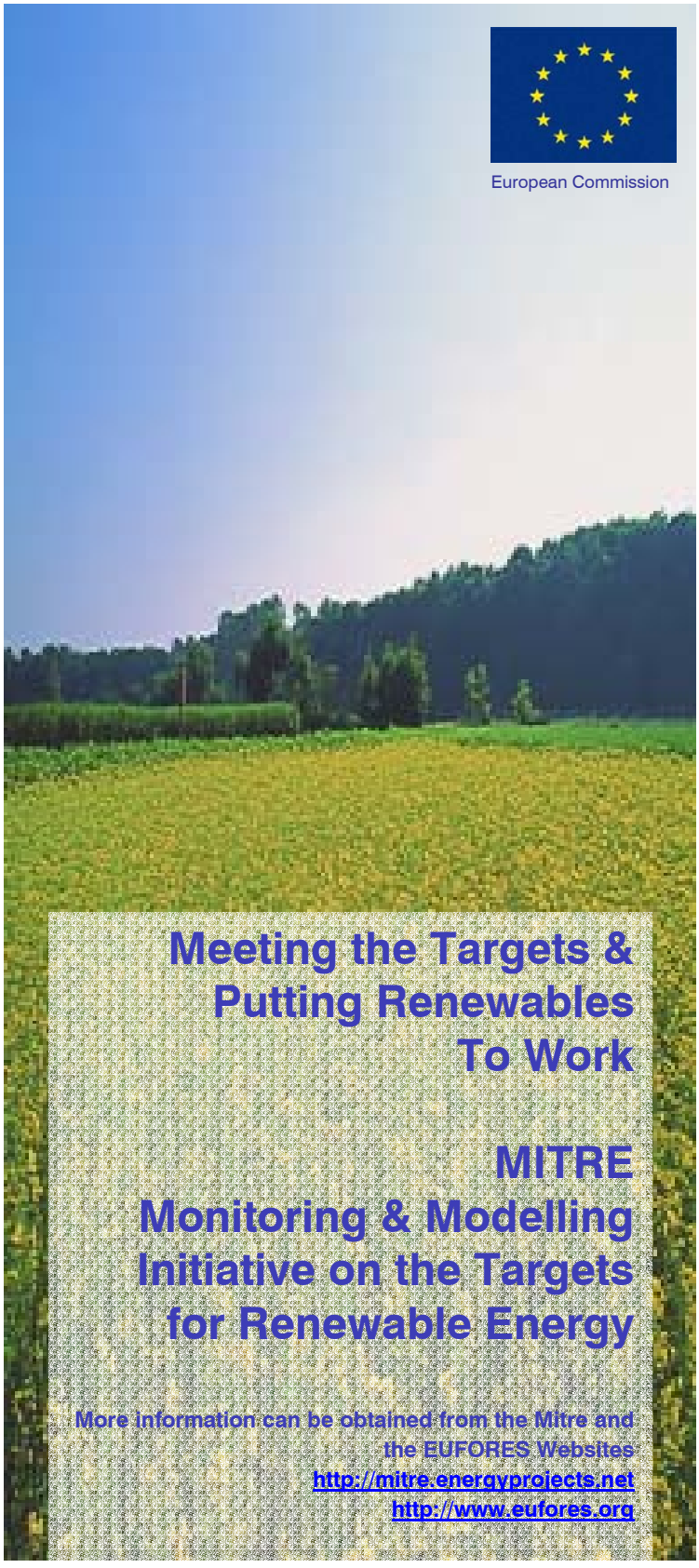
Country Report

FRANCE



INTRODUCTION

This report has been written to focus on the potential for renewable energy in France as a result of the outputs from the SAFIRE model. Many inputs have been used for this analysis, particularly the outputs from other projects financed by DG TREN[1]. Regarding the quantitative analysis, the main sources have been Eurostat, the EurObserv'ER Baromètre, the energy demand outputs from the PRIMES model (2003) and other regional, national and technological data[2]. Regarding the qualitative sources for this analysis, the main source has been the public domain outputs from the ENER-IURE project[3]. For more details and analysis of the legal and policy status of the Member States, please refer to the ENER-IURE web site.

Overview

France has a land area of 545 630 square kilometres. The population of 59.7 million is predominantly urban (76%). Access to energy is mainly through gas and electricity networks. The French electricity market is characterised by a monopolistic structure and a high nuclear capacity responsible for 75% of France's electricity production. The second largest source for electricity production is hydropower (mainly large scale) currently contributing 15% to overall electricity production. Market liberalisation has been slow as compared to other EC countries. Figure 1.1 represents the current energy supply situation. GDP totalled Euro 1 510 billion with per capita GDP at Euro 25 400 (2001 estimates, purchasing power parity).

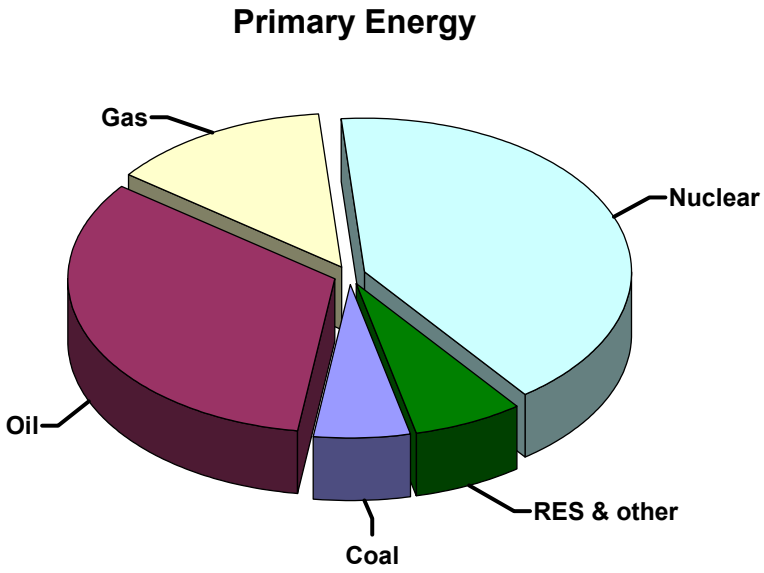


Figure 1 – Share of 2000 primary energy fuelling Source: IEA

France has historically shown little interest in energy efficient technologies and renewable energy sources, but instead concentrated its efforts on the expansion and development in the nuclear sector. France's energy consumption has been growing at a relatively constant rate from 334 TWh in 1996 to 389 TWh in 2000. With 4 TWh of imported electricity and 68 TWh of exported electricity in 1999 France is a net exporter of electricity. The quantity of its exported electricity has been growing significantly, and has more than doubled in the last 15 years.

[1] European Commission Directorate-General for Energy and Transport
[2] Eurostat (http://www.europa.eu.int/comm/eurostat/); EurObserv'ER Baromètre (http://www.energies-renouvelables.org/ - registration required); ADEME - Agence de l'Environnement et de la Matrise de l'Energie (www.ademe.fr)
[3] Stock-Taking & analysis of the present technical & legal situation of renewable energy sources in Europe (4,1030/C/00-025/2000 - http://www.jrc.es/cfapp/eneriure)

France's economy boasts a sophisticated industrial manufacturing base, which includes not only high-technology goods (information technology and telecommunications, vehicles, aircraft, computer equipment, etc.) but also a number of very large companies producing consumer goods. The industrial structure is unusual for an industrialised country, in that the state still controls a large proportion of the heavy strategic goods industries as well as institutions such as banks and communications companies. Not only in the energy sector the government's privatisation programme has lagged behind that of most other European countries. The agricultural sector continues to be an important part of the French economy. However the agricultural sector is dependent on massive financial support by the government.

CURRENT STATUS AND DEVELOPMENT OF RES

France is rich in renewable energy resources, with the largest forest area in Western Europe, the second largest wind energy stock and high hydraulic and geothermic potential. A decline in the share of nuclear energy is expected by 2010, and efforts are being made to develop France's unused renewable energy potential. The main growth area is expected to be in biomass and the development of this sector is being supported through a number of mechanisms, as well as through research into alternative engines and fuel (electric, gas, bio-fuel vehicles).

France is participating in the European 'Campaign for take off' for renewable energy and is adopting objectives to be met by 2006 for each RES technology. France is also committed to reaching the 21% level of RES by 2010.

Table 1 – Renewable capacity 2000

	MW
Large hydro	21050
Small hydro	2018
Wind	56
Photovoltaics	11
Biomass	55337
MSW/biogas	3901
Geothermal	340
Solar thermal	222
Other	238
Total	**83173**

Source: Eurostat, National data

Hydro

At present, most of France's hydro energy is generated by large hydro plants. A key objective is to increase the contribution of small hydro electricity generation, and a target of generating 4 TWh from small hydro by 2010 has been set.

Wind

The Eole programme aims to give France wind energy capacity of between 250 and 500 MW by 2005. Production of wind-sourced power more than doubled in 2000.

Photovoltaics

Developments have mainly taken place for off-grid applications where PV has proven to be a cost-effective solution. The French Agency for Environment and Energy Management (ADEME) has a photovoltaic promotion programme to stimulate the sustainable and growing market for PV system and associated services, and a competitive industry has now taken shape.

Biomass
Wood is the leading source of renewable energy in France, as it is very widely used in heating. Since 1994, 1 415 wood heating units have been commissioned (515 of which are for collective use and 900 for industrial heating). The use of biomass for electricity generation is a long-term strategy. In 1999, five biomass electricity projects with total power of 13 MW were commissioned by EDF at the request of the government.

Municipal Solid Waste and Biogas
The French National Plan for Improved Energy Efficiency includes an objective of increasing use of biogas for energy, to take advantage of waste management policies.

Geothermal
France has very good geothermal resources. These are mainly used for district heating and a target of connecting an additional 30 000 dwellings to existing systems has been set.

Solar thermal
In 1999, the 'Plan Soleil' scheme was implemented, with the aim of installing 120 000m^2 per year until 2006. Dissemination of solar water technologies has also been taking place, and there is a Solar Thermal Program with plans to bring the market to maturity by 2006 and to make solar thermal competitive with traditional electric water heating.

POLICY FRAMEWORK FOR RES

For the electricity sector, a price mechanism (feed-in tariff for private power generation) has been established and published (mainly for CHP and small hydro power generation). Fiscal policy to support RES has taken the form of tax exemption for investments in rational use of energy and renewable energy production, & the possibility of introducing a CO_2 tax is currently under discussion.

Other support mechanisms for RES, especially biomass, are included in France's National Plan. This includes a national scheme of financial support to wood-energy investments for municipalities and regional or local heat distributors, and fiscal incentives for companies investing in biofuel production. A Wind Energy programme (Eole) was launched in 1996 and will continue until 2005. Wind projects are proposed and the most economically viable are supported by EDF. Mechanisms to support rural electrification both in France and in overseas territories are also in operation. For individuals, financial support is available through ADEME (the national agency for environment and energy resources) for both solar slab heating and solar water heaters.

RES DEVELOPMENT SCENARIOS

Two different modelling scenarios are analysed in MITRE, looking at different views of future energy policies and developments. The two scenarios make a number of policy, technological and non-technological assumptions. They both start with the current reality, but then become more diverse as the calculation period progresses. The two scenarios are:

- **Current Policies (CP)** scenario which involves a mixture of current and expected policies. The current policies are based upon what already exists and also includes future policies that will be implemented (e.g. emissions trading across the European Union).
- **Advanced Renewable Strategy (ARS)** which is based on the Best Practice as defined in TERES II[4] and Impact of Employment[5] projects, however with significant updates in accordance with new proactive renewable policies.

The primary source for the development of these two scenarios, particularly the starting point for them (the year 2000), is the outputs from the ENER-IURE project[6] (a project partially funded by the European

[4] The (Second) European Renewable Energy Study, 1997
[5] The Impact of Renewables on Employment and Economic Growth, 1999

Commission). One of the core objectives of ENER-IURE has been to synthesise existing regulations that affect renewable energy sources in Europe and to report on the key aspects of national policy and legislative framework in each Member State. By structuring these regulations according to the various administrative levels on which the European Union currently operates, it has been possible to develop consistent scenarios that reflect the real position of renewable policy in the region, while also enabling the MITRE team to develop realistic views of future policy options through to 2020.

Table 2 includes an overview summary of the two scenarios, focusing on the main policy and technology developments implemented in the future, for the whole modelling period of 2000 to 2020.

Table 2 – Overview of Policy Scenarios for SAFIRE Modelling (2000-2020)

Policy area	Current Policies	Advanced Renewable Strategy
RTD & technology development	- Current RTD expenditure maintained, leading to expected technology cost reductions	- Increased RTD effort leading to faster technology cost reductions - Increased learning by doing effects - Major improvement in capability to deal with interruptible supplies
Energy markets & finance	- Renewable electricity premium phased in between 2005-2015 through emissions trading scheme - Internalisation of energy costs through carbon tax implemented by 2010-2020 - Current subsidies implemented as per current policy, or phased out between 2005-2010 - Phased removal of excise duties on biofuels for transport by 2005	- 20% renewable electricity premium phased in from 2005-2010 through emissions trading scheme - Biomass cogeneration supported through improved electricity buybacks (2005-2010) - Internalisation of energy costs implemented through carbon tax by 2010 - Current subsidies continued to 2010, or longer if specified in current policy - Reduced interest rates & tax breaks on renewable investment - Removal of biofuel transport excise duties by 2005 - Shift towards decentralised markets
Government policy	- Existing government programmes, phasing out as planned - Acceptance that renewable industry is a key economic area is slow - Full gas and electricity liberalisation achieved by 2010	- Reduction of uncertainty through longer term standardised planning - Policy harmonisation across the region - Renewable energy becomes a key policy driver for employment and international competitiveness - Full gas & electricity liberalisation achieved by 2006
Environmental & other regulations	- -0% greenhouse gas emissions target is maintained and extended to 2020	- Greenhouse gas emissions reduction targets tightened & extended to 2020 - Energy-to-waste schemes supported through higher landfill costs
Agriculture	- Financial support for energy crop schemes for heat, electricity & transport markets, phased out by 2010 - Energy crop yields increase by 10% for both wood and biofuels by 2020	- Higher financial support for energy crop schemes (heat, electricity & transport), phased out in 2010 - Land guarantees for energy crops - High set-up costs alleviated - Yields increase by 20% for wood and 25% for transport biofuels by 2020.
Non technical & policy aspects	- Risk to developers gradually decreases, improving willingness to invest - Gradual improvement in consumer attitudes towards renewable energy	- Government initiatives to reduce risk as information flows are improved, enhancing willingness to invest - Public opinion supports renewables, ownership & knowledge are widespread - Improved consumer attitude towards renewable energy, leading to easier planning & higher sales

[6] Information on ENER-IURE can be found at the following web site: http://www.jrc.es/cfapp/eneriure

Current Policies

The CP scenario involves a mixture of current and expected policies. The current policies are based upon what already exists and also includes future policies that will be implemented. Where policies have a specified end-point, it is either assumed that the policy finishes at this point or that it is phased out for a number of years after this closing point. For all current policies, it is assumed that they are all phased out by 2010, unless already stated in the relevant legislation, targets or elsewhere. In addition to the current and definite future policies, as outlined in the previous sections, CP also assumes that further policies and technological developments will occur in the future. This includes the following main strategic and policy options:

- implementation of EU wide renewable rights trading between 2005 and 2015 (most likely through a tradable green certificate scheme)
- gradual internalisation of the environmental costs of energy (through the introduction of a carbon tax), which is currently under discussion in France via a CO_2 tax
- phased removal of excise duties on transport biofuels, with full phase out by 2005, a policy that France has already approved
- gradual decrease in renewable technology costs over the period, which is currently supported by France's Nation Plan, Wind Energy programme and ADEME
- gradual improvements in technology efficiencies and performance, and agricultural yields
- greenhouse gas emissions trading at €5-10/tonne CO_2e (equivalent)

Owing to current and expected policy and legislation, the CP scenario includes a lot of the future expected changes that are highlighted in the ARS scenario. The main difference is that these strategies and effects are implemented at lower levels and introduced over a longer period of time.

Advanced Renewable Strategy

This scenario uses two main sources. Firstly, it is based upon the Best Practice scenario from the TERES II[7] and Impact of Employment[8] projects. Secondly, it has been significantly updated to include current policies (based upon CP) and to reflect changes in renewable policy, thinking and culture since the original Best Practice scenario was created in 1996.

The second principle of the Advanced Renewable Strategy scenario is that it assumes that the policies included in CP are either not phased out over time or that their lifetime is extended by a further 5-10 years. Recognising the environmental impact of fuels is recognised in this scenario and an EU wide carbon tax is introduced between 2005 and 2010. Owing to increased penetrations, technological costs are assumed to reduce at a faster rate than in CP. Government policy is assumed to be proactive and consistent, consumer opinion is positively encouraged through ownership and information campaigns, and electricity markets/policy are aimed at developing and promoting small-scale decentralised production. Renewable proactive policies are harmonised across the region. The key components of this scenario include the following:

- implementation of EU wide renewable rights trading between 2005 & 2010 (most likely through a tradable green certificate scheme)
- internalisation of the environmental costs of energy between 2005 & 2010 (through the introduction of a carbon tax)
- full removal of excise duties on transport biofuels by 2005
- decrease in renewable technology costs over the period, greatly helped through learning by doing

[7] The (Second) European Renewable Energy Study, 1997
[8] The Impact of Renewables on Employment and Economic Growth, 1999

- significant improvements towards 2010 in technology efficiencies and performance, and agricultural yields
- greenhouse gas emissions trading at €15-20/tonne CO_2e (equivalent)

Where current national policy is similar to the principles of the ARS scenario, there will be no difference between the scenarios on such policy, technology or market items.

RENEWABLE ENERGY PROSPECTS

This section summarises the outputs from the renewable energy modelling. It focuses on four main aspects of renewable energy in France:

- Electricity
- Electricity targets
- Heat
- Biofuels

In the targets analysis, the achievement of the targets is calculated from the share of gross (energy) consumption in 2010[9]. This means that if *actual* energy consumption growth is different than forecast, the absolute targets will also be different. Therefore, if lower *actual* energy consumption than forecast is achieved and the renewable forecasts (specified below) remain the same, the net renewable share of gross consumption will be higher and the targets easier to achieve.

Electricity

Table 3 shoes the electricity modelling outputs for the Current policies (CP) scenario, while figure 2 shows the gross renewable electricity consumption in the same scenario.

Table 3 – Renewable electricity installed capacity (MW_e) and gross annual consumption (GWh_e), Current Policies scenario

	MW_e			GWh_e		
	2000	**2010**	**2020**	**2000**	**2010**	**2020**
Large hydro	21050	21050	21050	62695	64539	64539
Small hydro	2018	2147	2147	7425	7899	7899
Wind	56	4736	11914	77	12247	31657
Photovoltaics	11	41	271	14	48	291
Biomass	340	2255	2531	1656	12529	14151
Wastes/Biogas	314	735	789	1315	3571	3835
Geothermal	5	5	5	21	22	22
Solar thermal	0	18	18	0	40	40
Other	238	238	238	542	542	542
Total	**24032**	**31226**	**38963**	**73744**	**101437**	**122977**

Under the CP Scenario, there is little change in renewable electricity production up to 2005, then rapid growth in wind and, to a lesser extent, biomass thereafter. Renewable electricity production increases by 36% between 2000 and 2010 and by 67% across the modelling period.

Production from large and small hydro, which accounted for 95% of France's renewable electricity output in 2000, remains static, although its relative share declines falling to 71% of the renewable generation mix in 2010, and to 59% in 2020.

[9] Baseline scenario, PRIMES model, 2003

The production of electricity from wind is predicted to increase from just under 0.1 TWh/year in 2000, to 12.2 TWh/year in 2010 and to 31.7 TWh/year in 2020, which would account for over a quarter of the total renewable generation. The market for biomass grows most strongly in the period 2005 to 2010 when biomass's share of the renewable generation mix increases from 2% to 12%. There is also a small growth in production waste/biogas, accounting for 4% of the renewable generation mix by 2010. In all cases, the bulk of the growth in renewable energy sources is between 2005 and 2015.

There is also a small increase in energy production from photovoltaics and solar thermal. There is no increase in production from geothermal.

Figure 2 – Gross electricity consumption CP scenario (GWh)

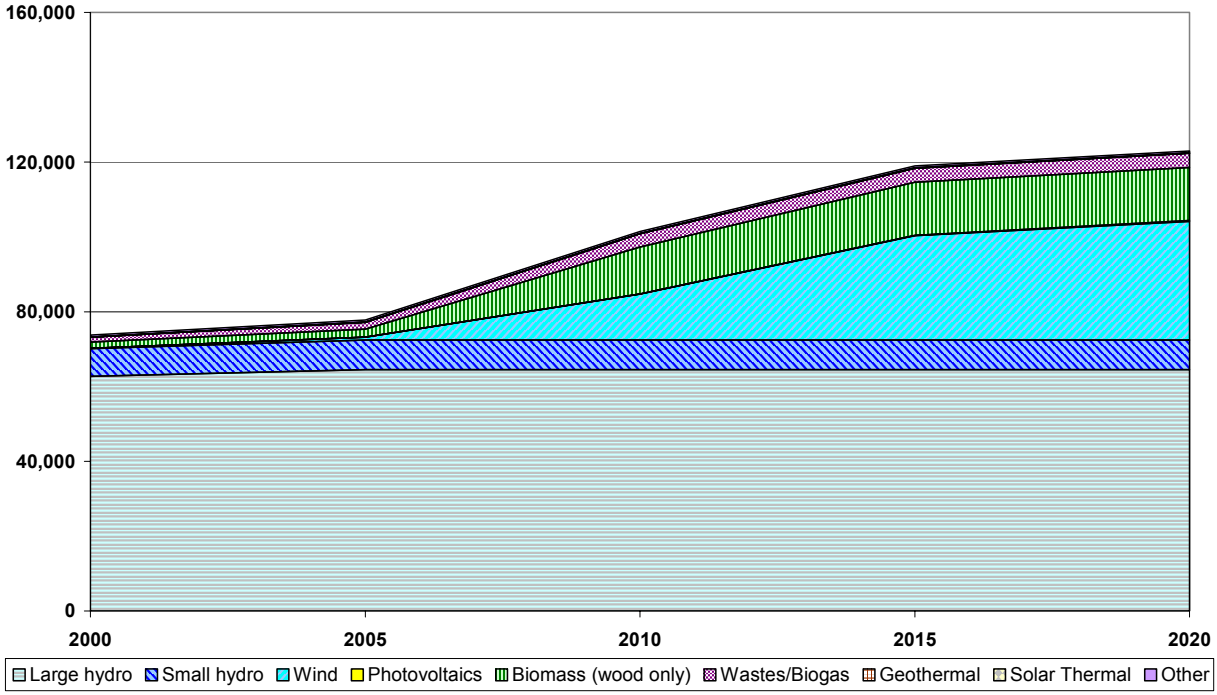
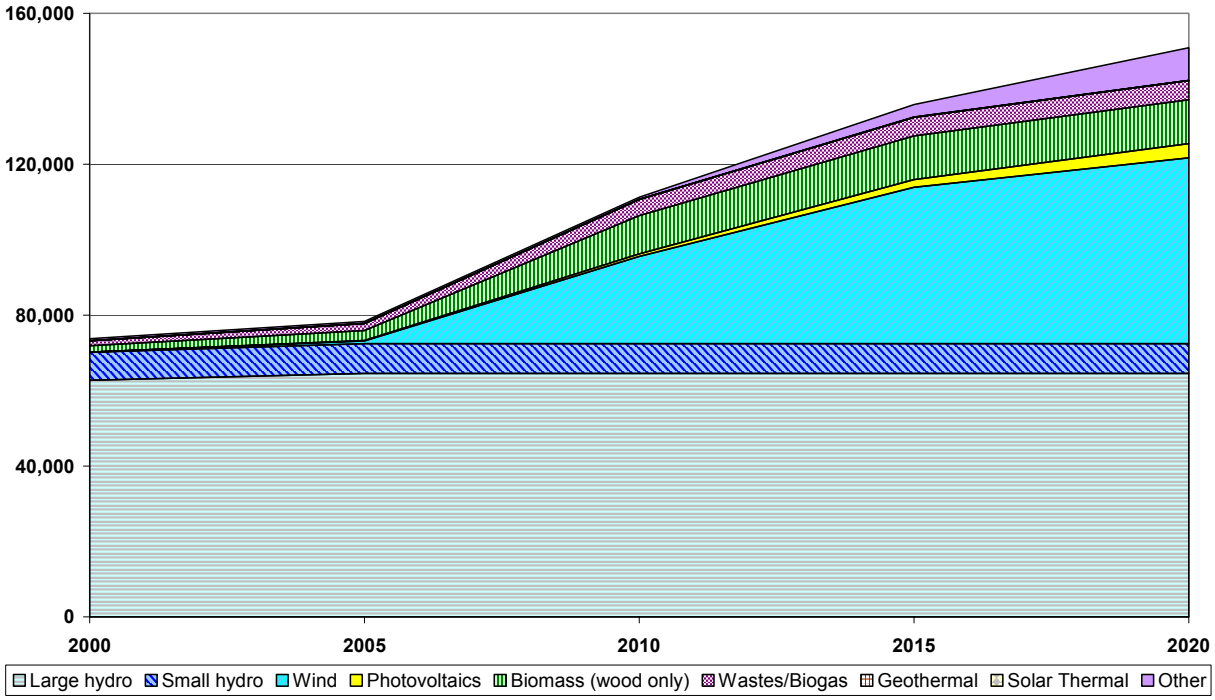


Table 4 shows the electricity modelling outputs for the Advanced Renewable Strategy (ARS) scenario, while figure 3 shows the gross renewable electricity consumption in the same scenario.

Table 4 – Renewable electricity installed capacity (MW_e) and gross annual consumption (GWh_e), Advanced Renewable Strategy Scenario.

	MW_e			GWh_e		
	2000	**2010**	**2020**	**2000**	**2010**	**2020**
Large hydro	21050	21050	21050	62695	64539	64539
Small hydro	2018	2147	2147	7425	7899	7899
Wind	56	8416	19542	77	23100	49264
Photovoltaics	11	550	3239	14	662	3751
Biomass	340	1836	2079	1656	10168	11644
Wastes/Biogas	314	858	992	1315	4279	5056
Geothermal	5	5	5	21	22	22
Solar Thermal	0	18	18	0	40	40
Other	238	238	3801	542	542	8658
Total	**24032**	**35118**	**52874**	**73744**	**111251**	**150874**

Figure 3 – Gross electricity consumption ARS scenario (GWh)



The ARS scenario predicts that renewable electricity generation capacity will increase by 50% between 2000 and 2010, and more than double by 2020.

The ARS scenario shows a similar trend to the CP scenario. There is little change in renewable electricity production until 2005, and then a dramatic growth in wind power thereafter, with more modest additional capacity in a range of other technologies. Large and small hydro remains static, thus the share of hydro declines markedly from 95% 2000 to 65% in 2010 and less than half (48%) in 2020. Nonetheless hydro remains the largest renewable energy source.

Wind power increases its share of the renewable generation mix from <1% in 2000 to 21% (23.1 TWh/year) in 2010, and to 33% by 2020. The growth pattern of biomass is similar to that in the CP Scenario; however the growth is less in absolute terms. This is because, in the CP scenario, the expansion of wind is restricted by planning rather than resource constraints; in the ARS scenario the planning restrictions are less severe allowing the development of more low cost wind options, to the detriment of biomass. Nonetheless, electricity production from biomass grows strongly in the period 2005 to 2010, increasing to 10.2 TWh/year in 2010 giving a 9% of the generation mix. This share drops to 8% by 2020.

The ARS scenario predicts a more substantial increase in photovoltaics than the CP scenario, particularly after 2015. Wave and tidal (marked as 'other') also start gaining market share from 2010 onwards, achieving a 6% share by 2020.

Electricity Targets

Under the RES-E directive, France has an indicative target of 21% of gross electricity consumption from renewables by 2010. This compares with 15% in 1997. Table 5 displays the status of the two scenarios in comparison with the RES-E Directive indicative target. The target is missed in both cases. A contributing factor to the difficulty of France meeting its targets is that the electricity demand is growing rapidly and is expected to increase by more than 11% in the period of 2000 to 2010.

Table 5 – Gross renewable consumption as proportion of total electricity compared with indicative target (21%)

Scenario	Proportion of total consumption[10]	Shortfall from target	Estimated year for achieving target
1997 (ref: RES-E Directive)	15%		
Current Policies (2010)	17.9%	3.1%	2016
Advanced Renewable Strategy (2010)	19.6%	1.4%	2012

Notes: Estimated date for achieving target is based upon a straight line extrapolation from growth between 2010 & 2020
Estimated year calculation uses the gross electricity consumption for 2010

Heat

In addition to electricity output, renewable heat has an equally important part to play in Europe towards the substitution of fossil fuels. As in all the Member States, renewable fuels already play a part in heating supply, providing 10.7 Mtoe of heat consumption in 2000. Unlike for RES-E, there are no indicative targets for renewable heat supply in the European Union. Therefore, this section only reviews the potential for renewable heating in France and the potential to 2010.

Table 6 shows the gross renewable inland consumption for heating purposes in France for both scenarios. The information is displayed graphically in figures 4 and 5.

Table 6 – Renewable heat gross consumption (Mtoe)

	Current policies			Advanced Renewable Strategy		
	2000	**2010**	**2020**	**2000**	**2010**	**2020**
Biomass	9.27	11.87	13.03	9.27	12.42	13.31
Wastes/Biogas	1.24	1.41	1.63	1.24	1.79	2.27
Geothermal	0.12	0.33	0.43	0.12	0.42	1.12
Solar Thermal	0.03	0.05	0.12	0.03	0.27	0.75
Total	**10.66**	**13.67**	**15.20**	**10.66**	**14.90**	**17.46**

In both scenarios, there is moderate growth in renewable heating consumption from 2003 with the total consumption increasing by 28% in 2010 in the CP scenario and 40% the ARS scenario. Heat is predicted to come from a range of sources. The majority (around 80% in both scenarios) is from biomass, with a small contribution from geothermal and waste/biogas in the CP scenario, and additionally solar thermal in the ARS scenario.

[10] Total electricity consumption taken from EU15 Baseline scenario, PRIMES model, 2003.

Figure 4 – Heat consumption CP scenario (Mtoe)

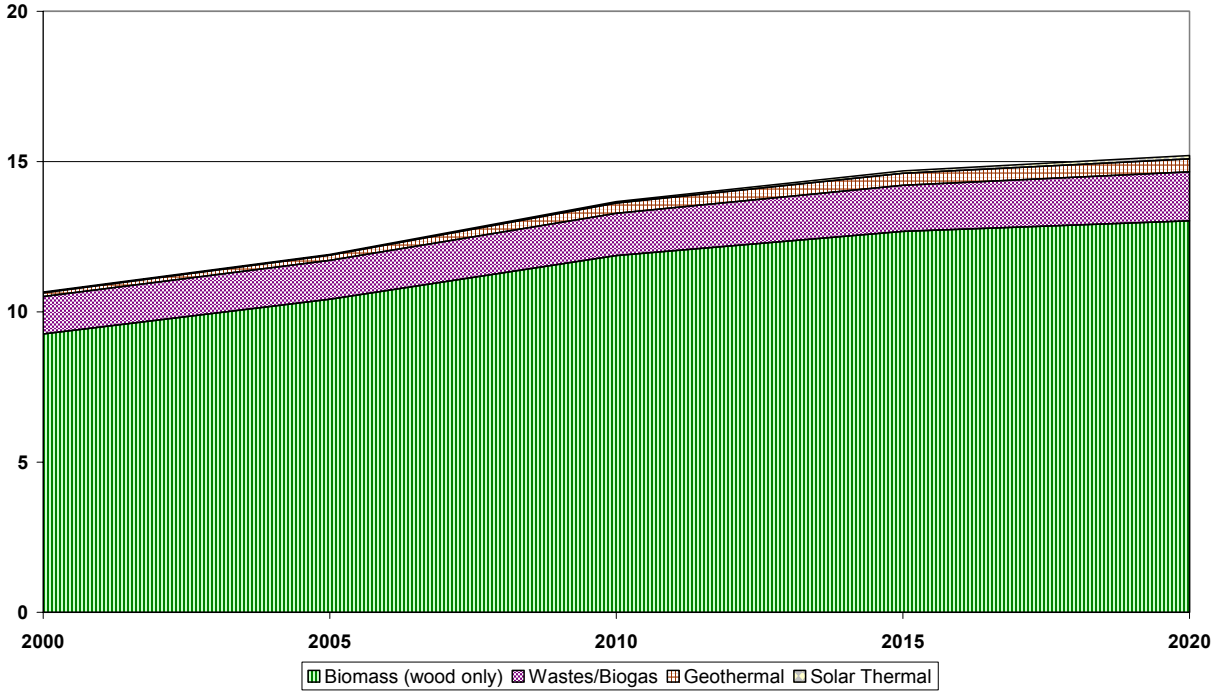
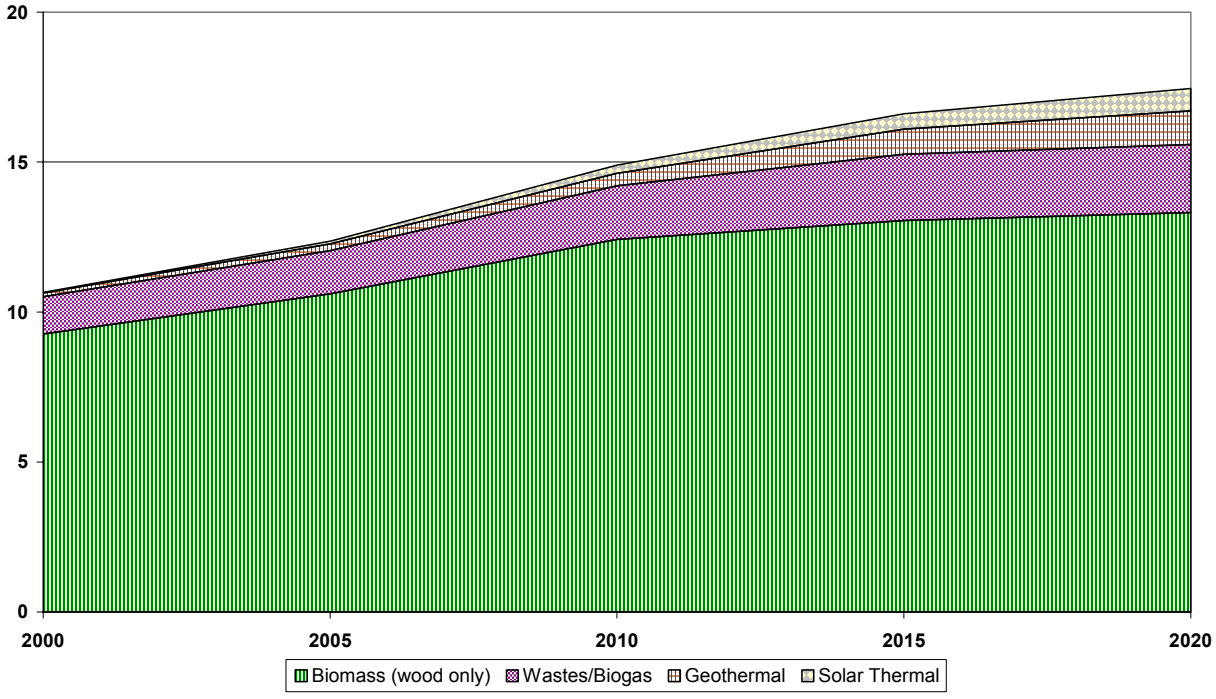


Figure 5– Heat consumption ARS scenario (Mtoe)



Biofuels for transport

Until recently, the main focus on renewable energy has been on heat and electricity, with the transport sector having less significance. However, this position is currently being addressed, primarily with the proposed Biofuels Directive[11], which has raised the importance of transport fuels on a level with heat

[11] Proposal for a Directive on the promotion of the use of biofuels for transport, COM(2001) 547

and electricity. This section reviews the potential for biofuels in France, including the potential to meet the proposed target for biofuels in the proposed Directive.

Table 7 shows the predicted biofuel consumption from the modelling process. France currently uses a small quantity of biofuels. Both scenarios predict a similar growth pattern, with a large increase in consumption up to 2010 and reduced growth to 2020. The ARS scenario runs at about twice that of the CP scenario. By 2020 the CP scenario has a 366% increase on 2000, whilst the ARS scenario has a 826% increase.

Table 7 – Biofuel consumption (Mtoe)

	2000	2010	2020
Current policies	0.38	1.60	1.77
Advanced Renewable Strategy	0.38	2.68	3.14

Table 8 shows the status of biofuel consumption as a proportion of sold gasoline and diesel in comparison with the target in the proposed Biofuels Directive. This target specifies a standard penetration, across all Member States, of 5.75% by 2010. As shown in the table, France achieves the target by 2010 in the ARS scenario, but not until 2024 in the CP scenario. This means that the target is within reach for France, but that significant changes need to be adopted from its current policies in order to achieve the proposed target.

Table 8 – Biofuel consumption as share of gasoline & diesel demand (proposed 2010 target 5.75%)

Scenario	Proportion of gross consumption[12]	Shortfall from target	Estimated year for achieving target
Current Policies (2010)	3.52%	2.23%	2024
Advanced Renewable Strategy (2010)	5.89%	Achieved	Achieved

Notes: Estimated date for achieving target is based upon a straight line extrapolation from growth between 2010 & 2020
Estimated year calculation uses the gasoline & diesel demand for 2010

From the modelling analysis, there is one key factor that directly affects the growth of biofuels for transport and has a direct impact on the potential to achieve the target. This constraint is the physical resource available for producing transport biofuels. This resource can take the form of land available for planting the relevant crops, or from the use of secondary biomass residues or organic wastes. This latter source is estimated to have a potential of 3 million tonnes of resource per year in the European Union, and is assumed by MITRE, in each Member State, to comprise 25% of the total resource. If neither the land nor the secondary crops are allocated for this purpose, the prospect of achieving the target is zero. Table 9 shows the land requirements in France to produce the calculated quantities of biomass and biofuels in the analysis.

[12] Total electricity consumption taken from EU15 Baseline scenario, PRIMES model, 2003.

Table 9 – Land requirements for biofuels (thousand hectares unless specified)

Land used for:	Base year	Current Policies 2010	Current Policies 2020	Advanced Renewable Strategy 2010	Advanced Renewable Strategy 2020
Wood crops (heat & electricity)	2000	397	563	451	577
Transport fuels	2000	925	988	1530	1738
Proportion of total agricultural land area required (%)[13]	1%	4%	5%	6%	7%

Note: It is assumed that 25% of the transport biofuel resource comes from secondary crops. This land is not included in the numbers in the table

It should also be noted that this analysis assumes that the energy crops that are used for biofuels have the yields of today. There is the potential to use new crops with higher yields (by 2010), which can also significantly reduce the land requirements for biofuels.

EMPLOYMENT GROWTH

Given the increase in renewable penetration in France, there are significant employment opportunities arising from this growth. Therefore, in addition to heading towards meeting its renewable energy targets, the French economy can directly benefit, in the future, from the implementation of a proactive renewable energy strategy. The outputs from the employment modelling are summarised in this section. It focuses on three main aspects, calculating the growth in direct and indirect employment for the renewables industry from the year 2000. The areas of analysis cover net employment growth by:

- Sector
- Technology
- Skill level

It should be noted that the employment analysis does not include the large hydro industry.

Net Employment Growth by Sector

One of the major benefits arising from renewable energy is from employment, particularly in the agricultural sector. This growth is divided into five categories:

- National market
- EU market
- Agriculture
- Conventional displacement
- Support effects

The **national market** is defined as the gross employment growth that occurs from the development of renewable energy technologies in the national market. This includes the construction, installation and operating of renewable plant. This employment figure takes into account the fact that some Member States import renewable technology, which limits the amount of jobs created within the national economy.

The **EU market** is the gross employment growth arising from exports of renewable technologies to other EU countries. This benefits some Member States more than others, particularly those with significant renewable manufacturing capacity. However, this number does not include the employment generated from renewables technologies into the world market, as it is not possible to model this factor

[13] Total agricultural land is based upon actual use plus set-aside in 2000. Source: Eurostat

in the RIOT and SAFIRE models. Additionally, the employment modelling assumes that growth in demand for equipment needed to supply renewable energy will be met by growth in output of plant by the same countries that presently produce the equipment. The modelling makes no assumptions about the pattern or relative share of renewable manufacturing changing across the EU countries. No analysis has been made of the employment effects of exports outside the European Union.

Employment in the **agricultural** sector occurs from the supply of three different fuels into the energy sector, be it for heat, electricity or transport. These fuels are energy crops, forest residues (where relevant), and agricultural wastes. Agricultural wastes can also be subdivided into liquid and solid wastes, for example, slurry and straw/olive husks respectively. The growth in agricultural employment for the renewable energy sector does not necessarily mean that new people are brought into agriculture, as some of the growth will be from increased utilisation of part-time and seasonal agricultural workers. The main difference will be that the agricultural employment security will be greatly improved, as the energy sector will enable the development of long term contracts and steady incomes within a high risk and low income sector.

Conventional displacement refers to the employment losses occurring from the substitution of demand in the conventional fuel sector within each Member State. This is typically jobs substituted in the fossil fuel and nuclear sectors, where relevant for each country.

Support effects relates to employment losses occurring from the macroeconomic effects of support mechanisms for renewables. The size of this effect is dependent upon the level and type of support in each country. For example, if a Member State applies a feed-in tariff for renewable electricity that is payable by the consumer, then the consumer's spending power on other goods will be reduced owing to higher electricity bills. This decrease in spending will have a direct knock-on effect on employment in other sectors of the national economy.

Table 10 – Net employment growth from 2000 (thousand FTE/year)

	Current Policies		**Advanced Renewable Strategy**	
	2010	**2020**	**2010**	**2020**
Gross national employment	107	159	182	275
Gross EU employment	5	5	8	11
Agriculture	76	86	96	109
Conventional displacement	-6	-7	-8	-10
Support effects	-13	-4	-35	-9
Net national employment growth[14]	**88**	**148**	**139**	**256**
Net employment growth	**168**	**238**	**243**	**373**

Table 10 shows the net growth in employment in France arising from the increase in renewable penetration. This shows that the potential net employment growth in France is 373 000 full time equivalent (FTE) jobs per year in 2020 under the ARS scenario, two thirds of this with CP. The 2010 employment growth figures show a similar proportion, with ARS standing at 243 000 FTE.

The potential for employment in the renewable energy industry in France is above the EU-15 average in both scenarios. A net increase of total employment of 168 000 FTE in 2010 under the CP scenario and 243 000 FTE under the ARS scenario will have a significant impact on employment in the country, forming approximately 1.02% and 1.08% of the total national labour force respectively.

The single largest employment area is from 'gross national employment', which accounts for 57-70% of the jobs created depending on the scenario and year. This is because both scenarios predict substantial growth in renewables in France, which will create local jobs.

[14] Defined as gross national employment less conventional displacement & support effects (also used in table 12)

The second largest area is agriculture, providing 27%-41% of the employment growth depending on the scenario and year. A large proportion of this employment will come from the development of energy crops for the biomass energy and biofuels markets.

The results indicate that France will not be a major exporter in renewable energy good or services to other EU countries. 'Gross EU employment' is 3% or less in all scenarios.

The 'conventional displacement' and 'support effects', when added to together, amount to between 5% and 15% of the number of jobs created depending on the scenario. The support effect is strongest in the ARS scenario up unto 2010, as more economic resources are deployed for supporting renewables than in the CP scenario.

Net Employment Growth by Technology

This section shows the net growth in national employment by technology (excluding export market effects). The results (Table 11) show that the main sectors of growth are the biomass/wood and agricultural sectors, followed by the wind, photovoltaic and solar thermal markets. The effect of the increased biomass/biofuel capacity in the ARS scenario has a dual benefit of increasing employment by 30% in the technology by 2020 in comparison with the CP scenario and increasing the employment in the supply of agricultural fuels, particularly energy crops for the transport market, by 50%. The difference between the scenarios of wind sector penetrations is not reflected in the employment results, as the majority of employment is focused in operating and maintaining the plant. Without any national wind turbine manufacturing capacity, the opportunities for large scale employment are not large.

The employment growth from exports to the rest of the EU is small and is located in the agricultural fuels sector, as France does not have a major renewable energy manufacturing industry.

Table 11 – Employment growth from 2000 by technology (excl. export markets - 1000 FTE/year)

	Current Policies		Advanced Renewable Strategy	
	2010	**2020**	**2010**	**2020**
Small hydro	1.9	1.9	1.9	1.9
Wind	9.0	16.6	24.4	32.9
Photovoltaics	0.1	1.0	2.2	11.5
Biomass/biofuels	66.8	75.1	82.5	97.8
Wastes/biogas	7.4	8.1	8.7	10.0
Geothermal	0.6	0.8	1.0	2.9
Solar thermal	0.5	1.3	4.1	10.2
Other	0.1	0.1	0.1	3.1
Agricultural fuels	77.3	128.8	109.7	191.6
Total	**163.8**	**233.7**	**234.6**	**361.9**

Net Employment Growth by Skill Level

Further analysis of the net national employment growth has also been performed, investigating the skills mix of the national employment in each Member State. This analysis had divided the net employment growth into skilled and unskilled employment. These can be defined as:

- **Skilled employment** describes people working either as professionals, managers, officials and technicians or associate professionals. These correspond to classes 1, 2 and 3 in the standard ISCO[15] international occupational classification system.
- **Unskilled employment** consists of people occupied as clerks, service workers and manual workers. These occupations are covered by ISCO classes 4 through to 9, excluding class 6.

ISCO class 6 is defined as "Skilled agricultural and fishery workers". Unfortunately, the Eurostat data used for the MITRE employment analysis does not include any data on class 6, since few countries include agricultural workers in their standard employment surveys (the data is often collected separately), so it has not been possible to include agricultural employment in the skill mix employment analysis.

The results of this analysis are shown in able 12. This shows that 28-31% of non-agricultural net national employment growth in the CP scenario is skilled, with 26-32% in ARS. These ratios compare with an average 27-29% share of skilled employment growth across the EU15. In both scenarios the results reflect the nature of France's renewable penetration, where more of the employment comes from operation and maintenance, which has a higher level of skills requirements than from manufacturing and construction.

able 12 – Net national employment growth from 2000 by skill level (thousand FTE/year)

	Current Policies		**Advanced Renewable Strategy**	
	2010	**2020**	**2010**	**2020**
Skilled employment	24.4	46.2	1.0	3.5
Unskilled employment	63.6	101.6	5.1	14.9
Net national employment growth	**88.0**	**147.8**	**6.1**	**18.4**

Note: This table excludes employment in the agricultural sector

[15] Source: International Labour Organisation