France 2001

Third National Communication under the UN Framework Convention on Climate Change

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

INTRODUCTION

In line with obligations under the UN Framework Convention on Climate Change, France, like all the signatories of the convention, is required periodically to provide a National Communication following a plan established by the Conference of Parties to the Convention. This document provides information on national actions related to climate change. It also aims to help our country respect its commitments and encourage the release of information so as to enable an examination and in-depth evaluation of the implementation of the commitments made under the Convention, the Kyoto Protocol and the 1998 European agreement on burden-sharing within the European Union.

This issue includes the amendments of the French version erratum.

CHAPTER 1

Executive Summary

1 National Circumstances

Despite constant economic and demographic growth, the environmental and energy policies implemented by France enabled us to keep greenhouse gas emissions in 2000 at a lower level than in 1990. This result is all the more noteworthy in that constant efforts had previously been made since the energy crisis of 1973.

Taking account of the description in the 2nd National Communication of what had already been achieved communication, the policy of tackling climate change has in recent times been based in particular on the following elements: reinforcement of the Interministerial Task Force on Climate Change (MIES in French), attached to the Prime Minister's office since 1998, which has improved co-ordination of actions both nationally and internationally;

- a significant increase in European co-operation in monitoring greenhouse gas emissions and in co-ordinating measures to limit these emissions;
- drawing up of strict regulations aimed at protecting the environment in general and encouraging energy saving. The most significant measures have been mandatory covering of municipal landfill sites and the recovery of biogases, the regulation of nitrous oxide emissions and the new regulation on household heating;
- a wide-ranging programme to make people aware of the environment, to save energy and to ensure energy efficiency. Since 1974, France has had an Energy Saving Agency to implement these operations, which has more recently been incorporated into the ADEME (Agency for the Environment and Energy Efficiency).

It has become obvious, especially from the coverage of the greenhouse effect in the media, that public awareness of the phenomenon has considerably increased since the 2nd National Communication. The stir created by the work of the IPCC (Intergovernmental Panel on Climate Change) and the involvement of French researchers in these initiatives has also significantly contributed to public awareness. The government and Parliament have shown particular interest in climate change, since France was the first country in the European Union whose Parliament voted a law authorising approval of the Kyoto Protocol on 10 July 2000.

Moreover, given the responsibility of the EU States and of the Community in meeting the Kyoto objectives, France has placed particular emphasis on the development of common, co-ordinated policies at this level.

2 Greenhouse Gas Inventory Information

The information provided here is taken from the inventory for the years 1990 to 1999, sent to the UNFCCC at the beginning of 2001. This inventory was produced on the basis of the common reporting format adopted by the UNFCCC. The table below shows the trend in emissions from the six greenhouse gases covered by the Kyoto Protocol for the period 1990-1999. These emissions reflect the global warming potential of the various gases. They also include emissions and removal levels in the category land use, land use changes and forestry (LULUCF), in particular carbon sinks.

Greenhouse Gas Emissions in France from 1990-1999

Gas (in MteCO_2)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
CO_2, excluding LULUCF	386	409	401	380	376	382	396	390	411	405
CH_4 excluding LULUCF	63	64	65	65	65	66	65	60	60	58
N_20 excluding LULUCF	89	89	86	82	83	85	86	87	79	73
Total fluorinated gases	7.6	6.2	5.4	4.8	4.5	4.9	6.0	7.0	7.9	9.1
Total excluding LULUCF	**546**	**569**	**557**	**531**	**529**	**538**	**553**	**544**	**557**	**545**
Net LULUCF	- 52	- 49	- 54	- 58	- 60	- 57	- 59	- 61	- 60	- 62
Total with LULUCF	**494**	**520**	**503**	**473**	**469**	**481**	**494**	**483**	**497**	**483**

Source : 1990-1999 inventory

As can be seen from the above table, total net emissions of greenhouse gases, including land use, land use changes and forestry (LULUCF), fell significantly between 1998 and 1999 (-2.1%). The partial data available for 2000 confirm this trend. On the basis of these estimates, France has fully fulfilled its Rio Convention commitment to stabilise greenhouse gas emissions, in 2000, at their 1990 level. Total emissions of greenhouse gases, not including LULUCF in France, also slightly diminished between 1998 and 1999 (-0.8%). This excellent result is mainly due to the fall in greenhouse gas emissions other than CO_2 and, in particular, to the determined action taken to reduce emissions of nitrous oxide from the chemical industry. Methane emissions have also significantly diminished, especially in the agricultural sector. The reductions recorded compensate for the slight rise in carbon dioxide emissions (about 5%). However it should be emphasised that the increase in CO_2 emissions has been slower than that of GDP and that of energy consumption, which is reflected in the constant efforts made to improve the carbon intensity in the GDP. Emissions of fluorinated gases have risen significantly for HFCs used for refrigeration, but have fallen in the case of PFCs, in particular thanks to significant progress in aluminium manufacturing techniques.

3 Policies and Measures

In compliance with its international obligations, since 1990, France has developed several national programmes to combat the greenhouse effect. As regards the objective set by the Convention - that is a return, in 2000, to 1990 greenhouse gas levels -, as early as 1993, France provided the European Commission with the "First Elements for a French Programme to Combat the Greenhouse Effect." Then, in February 1995, an "Initial National Programme to Prevent Climate Change" was developed and presented in the "1st National Communication to the Framework Convention on Climate Change". This first series of measures was then reinforced, before the Kyoto Protocol, by the decisions taken at the Council of Ministers of 26 November 1997. As a result, the undertakings entered into at Kyoto by the European Union, on the one hand, and the EU burden-sharing, on the other, meant that a new national programme became necessary. This decision was taken by the Interministerial Commission on Climate Change that met on 27 November 1998, chaired by the Prime Minister.

Sectoral working groups were set up by MIES in the first half of 1999 to identify measures to reinforce and extend those already incorporated into previous programmes. This research was based on consultation with experts, workers and representatives of civil society in each of the sectors concerned. Following these studies, on 19 January 2000, the government approved the new National Programme for Tackling Climate Change (the PNLCC in French), which is now the basis of the present national communication.

Although it is now certain that France will fulfil its commitments under Articles 4.1. and 4.2 of the UNFCCC, it appears that the implementation of additional measures to those already applied in January 2000 will be vital to comply with the Kyoto undertakings, in particular because of the growing consumption of fossil fuels in the transport, housing and service sector.

3.1 The Three Categories of Measures Used in the PNLCC

Firstly, the PNLCC identifies all the measures characterised by their low cost or by the fact that they are "without regrets", that is that they can be justified on the basis of other grounds than that of the greenhouse effect. The nature of these measures, known as first category measures, is very close to those deployed until 1997: regulation, energy management measures in building and in the uses of specific electricity, improvements in the operation of the transport system... First-category measures do not make it possible to allocate an economic value to the emission of a tonne of fossil fuel. The PNLCC has thus created a second category containing a certain number of proposals for economic measures, acting in particular on the price of fossil fuels and encouraging economic actors to take account of greenhouse gases in their production and consumption decisions.

The government has several times suggested that fiscal measures could constitute an effective way of tackling climate changes, in conjunction with traditional political methods. The PNLCC proposals fit into an overall framework of reducing the mandatory tax take, and so provides for ecotaxes to be fully compensated by reductions in other areas of taxation. They converge with the policies put in place in most European countries and recently developed especially in the United Kingdom, Germany and Italy, in compliance with the draft European

directive on energy product taxation. Although the main aim of the directive is to organise a gradual increase in minimum rates, it may constitute the first useful framework for the organisation of a system that will enable the European Union in general to respect its Kyoto commitment, in particular by limiting the risks of unfair competition.

Finally, the PNLCC's proposals provide for "dual" taxation of electricity, with general taxation of the latter being completed by a price-signal based on the carbon content of the fuels used by the producer.

The implementation of an economic approach will be reflected in a tax differential for energy, based on the choice of a base price for the equivalent of a tonne of CO_2 by 2010. This must be chosen so as to encourage the behaviours and decisions expected in this programme, while remaining within a standard that is accepted internationally; otherwise it would generate excessive costs for the French economy. The PNLCC has decided on a basic price of EUR 20 per equivalent tonne of CO_2 to define the taxation level that should be targeted in 2010, on the basis of the "Pôles" and "Gemini" economic models and the "bottom-up" approach developed by the PNLCC's preparatory studies. In the short term, the departure level would be between EUR 6 and EUR 9. These levels are comparable with those chosen by the European countries that have already begun to introduce an environment tax and by the European directive on energy taxation that is being negotiated.

Thirdly and finally, the PNLCC proposes the introduction of long-term structural supply-side actions, in particular for those sectors that are displaying a strong tendency towards increased emissions. These measures will be aimed at the building and service sector, the energy production sector and, in particular, transport.

3.2 The State of Implementation of the Measures

A distinction is made for each sector, between the measures drawn up and introduced (at least partially) prior to the year 2000, which make up the "existing measures", and "additional measures" which include the following:

- measures decided before 2000, but not yet implemented by then;
- new measures included in the PNLCC;
- other measures decided since 2000.

It should be pointed out that many of the most important measures have achieved their most significant effects over the last decade. This applies to:

- decisions on the development of nuclear power, taken prior to 1990, totally implemented before 2000 with the commissioning of the final phase of power stations. These effects are included in the "Without Measures" projection;
- the reduction of nitrous oxide in certain industrial processes which had previously been major emitters.

Energy

As early as 1998, the government decided to revive energy management, which was a condition for the compliance of France with the Kyoto Protocol. It conforms to the need for the country to diversify its energy resources, while preserving its ability to make future energy choices. For this, the government considers it necessary to reinforce the human and financial resources available to ADEME, which is in charge of the implementation of energy control policy and the development of renewable energy sources. Finally, on 6 December 2000, the government presented the National Programme for the Improvement of Energy Efficiency (PNAEE), which, in particular, implements the first phase of the operations planned by the PNLCC and

which has again significantly increased ADEME's operating budget in this field. In all, ADEME now has an operating budget for energy management and renewable energy development operations of more than EUR 137 million, ten times more than in 1998.

The PNLCC considers it vital to give priority to demand management measures, which alone are able both to protect against an increase in the thermal origin of electricity and ensure future choices in electricity production sectors.

In the case of electrical domestic appliances, the measures making it possible to mobilise potential electricity energy saving are mainly based on improvements in the technological range of installations across Europe. France is pushing for European regulations in this domain to be completed. Moreover, effective national distribution of energy-efficient equipment and facilities will be greatly facilitated by specific measures in government buildings, followed by measures at a local level.

In the field of energy production, the scheduled replacement of thermal power stations, operating on fuel and coal, by combined cycle plants using gas and co-generation will lead to substantial savings. To encourage the development of co-generation, tax incentives have also been put in place and conditions for buying back the electricity thus produced have been improved. The development of wind energy has also been much encouraged, with an obligation for electricity distributors to buy back electricity at a minimum rate. These measures apply to carbon dioxide emissions; other measures applying to methane emissions, already implemented before 2000, will be added over the next few years, in particular the replacement of old gas pipes. The PNLCC is proposing to intensify its efforts in favour of renewable energies by accepting a CO_2 avoidance cost of well over EUR 20 per tonne, at least "ex ante"; in fact, although they are still not very well known, scale economies in this field could combine cost reductions and more dynamic industrialisation (for example, for wind energy) and progress in technical efficiency (for solar power) and sector efficiency (wood). As for Corsica and the DOM-TOM, they are covered by a programme of increased development of new renewable energies, given the higher profitability of such projects in these regions.

In the field of wind energy, the government has announced an objective of 5000 MW to be installed by 2010; this will triple the stock initially planned in the PNLCC base scenario. Incentives have also been introduced, with a view to developing the use of wood for heat and electricity production.

Housing, Residential and Services

Several decisive measures concern the housing sector. Firstly, new thermal energy regulations for new buildings were adopted in November 2000; these considerably reinforce previous regulations. They ensure a 15% increase in the energy efficiency requirement for residential buildings, as compared with the 1988 regulations, and a 40% increase for non-residential buildings. Moreover, a progressive reinforcement of this regulation is planned every five years. Inspection will also be stricter.

Various tax measures and financial incentives also apply to existing buildings, where there are considerable possibilities for energy savings. A method of evaluating energy consumption is being developed for housing. For the service sector, audits at the time of sale or rental have been planned. These measures should increase user awareness.

The State has launched measures for improving energy management of its own building stock.

A voluntary agreement has been prepared to encourage the use of wood in construction. Less energy consuming in production, this material also allows for long term carbon storage.

Lastly, several measures have been

taken to encourage the use of renewable energies in building (solar, thermal, geothermal, wood and waste incineration).

Transport

Many measures have been implemented in the transport sector and have often been adopted at the European level.

Some of them fall within the scope of decisions taken, or in the process of being taken, on the eve of the Kyoto Conference and are thus listed among the existing measures, such as:

- an action designed to reduce CO_2 emissions from private cars, as described in the agreement signed between ACEA and the European Commission, an agreement whose negotiation was well underway at the time of the signing of the Kyoto Protocol. Including its effects into the existing measures emphasises, through the difference, the considerable growth of emissions in the transport sector even after vehicle measures have been implemented;
- measures to manage car traffic in cities, within the framework of urban travel plans (UTPs), reinforced by the law on air (loi sur l'air et l'utilisation rationnelle d'énergie).

Measures that extend existing measures, together with a reduction, planned until 2005, in the taxation differential between petrol and diesel and by the completion of the implementation of compliance with the rules for work in road professions, represent reductions of about 3.7 million tonnes of CO_2 equivalent ($MtCO_2e$).

The PNLCC's proposals took into account both the already high level of fuel tax in France and the measures already taken to reduce diesel / petrol difference.

The reference price chosen for a tonne of equivalent CO_2 will serve as the basis for further stages, which, by 2010, should allow for the fair incorporation of the external cost of the greenhouse effect into the prices of different fuels. This completes the objective of convergence, which, by 2005, will already have reduced the difference in taxation between petrol and diesel to the level of the European average.

THE MAIN FIELDS OF ACTION IN FRANCE IN THE TRANSPORT SECTOR

- **Improvement of vehicle technology and reduction in emissions per unit**
- **Policy on goods transport, particularly involving rail freight**
- **Policy on inter-city passenger transport**
- **Policy on urban travel**
- **Pricing and taxation on transport**
- **Relations with transport users**
- **Other actions, in particular in the rail and air sectors**

The authorities have set their goal for 2020 – date of the "transport services schemes" – as a reduction in the upward trend of transport emissions. The aim is to stabilise them at a level of 146 $MtCO_2e$ over the period 2010-2020, for all gases. This means not only managing to control emissions from internal flights, but also that any increase in road traffic must not exceed the improvement in its carbon intensity allowance.

In concrete terms, this implies a target level of 139 $MtCO_2e$ in 2010 and a commitment to implement structural measures, with a slow response rate, immediately. Thus, it is necessary to:

- implement, nationally and at European level, measures on infrastructure, installations and available materials, with a view to making environment friendly transport more attractive (especially rail, sea and river transport) and to developing truly inter-modal services;
- improve and reinforce the management and pricing of urban travel;
- examine, in the context of rural development and of the scheme for development of the EU area, how to organise this area to restrict the need to travel;
- take strong action to incorporate the objectives of improving urban travel in town planning policy.

Many of these actions stem from decisions on which central and regional authorities have collaborated closely. Laws relating to town planning, housing and travel, along with procedures for drawing up contracts between local authorities and the State will all be opportunities for the latter to guide the decision-making process so that it is consistent with its own commitments.

Industry

The PNLCC is planning to renew and increase incentives and funding for energy savings, mainly administered by ADEME, together with targeted measures which will make it possible to obtain additional reductions in nitrous oxide and to limit fluoride gas emissions.

The PNLCC's centerpiece is an ecotax on energy and carbon. This excise tax was initially intended to apply to intermediary consumption by companies, from 2001, and was to be extended, in the course of the programme, that is before 2010, to all energy consumption in all business sectors.

The Constitutional Council rejected the proposed ecotax at the end of 2000. And, because of the rise in oil and natural gas prices observed since the introduction of the programme, the idea of drafting a new proposal was suspended until further notice. The government is working on compensatory measures based on the reinforcement of other sections of the programme: voluntary or negotiated agreements, national markets on tradable permits, regulations and incentives may be implemented to this end.

The aim of the ecotax was to provide backing for all the technical, regulatory, incentive and structural mechanisms planned in other sections of the programme by an economic incentive and a strong signal. In a context where energy prices are high, the need for rapid implementation of the tax system is less imperative, as the incentive to act is now being provided by the market. Thus, in 2000, we saw a fall in greenhouse gas emissions in the transport sector, for the first time since the first oil crisis. This confirms in the longer term the usefulness of implementing an ecotax, which may be the result of the progress of Community work in this area. The various measures relating to the initially-planned energy tax are maintained in the review of this national communication, since these measures have not been set aside over the period of the programme. However, the reservations expressed here should be borne in mind.

Agriculture and Forestry

The 1997 French Programme for the Fight Against Climate Change described the negative impact on greenhouse gases of certain changes in agricultural policy: continuing intensification of milk production, relative extensification of beef production, increase in production beyond French borders, and develop-

ment of the liquid manure policy and use of nitrogen fertilisers.

Moreover, France has launched an industrial-scale experiment in the production and distribution of bio-fuels (ethanol, vegetable oil methyl ester); this operation occupies 400,000 hectares.

The 1997 programme's measures in the forestry sector focused on three areas:

- carbon storage in forests through a revival of the policy for planting trees on agricultural land (doubling of the annual rate for tree-planting, funded up to a level of 30,000 hectares per year);
- carbon storage in forest products, through the development of the use of wood in construction (promotion actions, R&D actions, funding from public funds for "exemplary achievements");
- use of wood for power, especially for shared heating and the "wood energy and local development" budget.

The new actions consist mainly of extending existing measures and fostering their implementation through research and development. For example, in the animal breeding sector there are technical solutions to limit CH_4 and N_2O emissions that result from the treatment of excrement from intensive farming, which will be in the order of 3.3 $MtCO_2e$ per year in 2010. In the plant-growing sector, priority will have to be given to actions on nitrogen protoxyde emissions that aim to control the seepage of nitrogen fertilisers. France is moving toward implementing a duty on excessive mineral and organic nitrogen.

As regards forestry operations, the increase in funding for afforestation of agricultural land, to achieve a rate of 30,000 hectares per year by 2006, has been confirmed. This measure, decided previously, had not initially been backed by funding.

However, the National Plan for French Forests, which was issued following the damage caused by the two storms in December 1999, and unveiled on 12 January 2000, calls for the redeployment of financial and human resources, which will initially lead to a fall in the level of afforestation of agricultural lands, of probably less than 10,000 hectares per year, in favour of forest re-planting. Subsequently, the annual afforestation level is expected to increase to 20,000 hectares per year in 2006. After that time, increases in initiatives to timber agricultural land will depend on situation of the forests, and in particular the extent of natural regeneration that may occur and that cannot be assessed as of today. The human, technical and financial resources required to advance to an annual agricultural land afforestation rate of 30,000 hectares, after 2006, will be re-assessed in 2005.

Waste

Greenhouse gas emissions from waste are basically of two sorts: methane emissions from anaerobic fermentation processes in landfill sites and CO_2 emissions due to the incineration of waste of fossil origin (mainly plastics). The previous French Programme for the Fight Against Climate Change, adopted in 1997, was based on the introduction of the "Waste" Law in 1992, interpreted as a prohibition on the dumping of waste prone to rotting from 2002 onwards. This development was possible because of the significant increase in incineration. Moreover, it stipulated a high level of investment in biogas harnessing, which was to apply to 80% of sites by 2010. Under these conditions, and as a significant increase in waste production and its content in "plastic matter" was expected at the same time, the fall in CH_4 emissions from landfill sites was more than compensated for by the increase in fossil CO_2 emissions from incineration.

The PNLCC was built on a shift in French waste policy, as defined in 1998. The measures apply to the following points:

- control of waste production;
- development of the re-use of matter and organic products;
- recovery of the heat produced by inci-

nerators; the overall balance in terms of greenhouse gas emissions from incineration is critically dependent on the way the energy is re-used;

- equipping of all landfill sites with harnessing systems; there will be an in-depth assessment of the efficiency of harnessing systems;
- assessment of the value of biological pre-treatment.

4 Projections and the Total Effect of Policies and Measures

Projections on French emissions of carbon gas used to provide power have been issued using a technical-economic demand simulation model MEDEE-ME [Energy Demand Change Model].

Other methods have been used for non-energy emissions.

In 1990, looking at the six gases covered by the Kyoto Protocol, France emitted 545 $MtCO_2e$, not taking into account biomass combustion or LUCF effects. If none of the measures aimed at reducing them are introduced, the "without measures" projection shows that emissions will attain a level of 688 $MtCO_2e$ in 2010, making for an increase of 26%. If all of the existing measures were implemented, the level would be brought down to 577 $MtCO_2e$, still 32 $MtCO_2e$ above the reference year, 1990. Additional measures will make it possible to bring down the level of emissions to 519 $MtCO_2e$ in 2010, that is – 4.6% in comparison with 1990.

This should enable France to keep to its commitments despite the uncertainties inherent to forecasts and the economic climate.

Projection of $MtCO_2e$ Emissions Without Measures (excluding LUCF and biomass)

	1990	1999	2010	2020
			without Dom-Tom émissions	
CO_2 produced by power	360.1	384	444.9	526.5
CO_2 not produced by power	25.3	21.1	22.1	22.7
CH_4 - power	10.2	7.8	7	6.9
- agriculture	34.3	32.2	32	32.2
- waste	18.7	17.5	36.3	36.9
- other	0.1	0.1	0.1	0.1
N_2O - power	3.8	6.1	9	11
- industrial processes	27.8	11.0	48.5	48.6
- agriculture	56.1	54.3	53	53.8
- other	1	1.0	1.1	1.1
HFC, PFC and SF_6	7.6	9.1	34.0	43.3
Total	**545**	**544**	**688**	**783**

Projection of $MtCO_2e$ Emissions with existing measures (excluding LUCF and biomass)

		1990	1999	2010	2020
				without Dom-Tom émissions	
CO_2 produced by power		360.1	384	406	468.4
CO_2 not produced by power		25.3	21.1	21.6	22.3
CH_4	- power	10.2	7.8	7.2	7.2
	- agriculture	34.3	32.2	32.0	32.2
	- waste	18.7	17.5	7.4	5.2
	- other	0.1	0.1	0.1	0.1
N_2O	- power	3.8	6.1	9.0	10.0
	- industrial processes	27.8	11.0	13.9	14.0
	- agriculture	56.1	54.3	54.3	53.8
	- other	1	1.0	1.1	1.2
HFC, PFC and SF_6		7.6	9.1	26	32.2
Total		**545**	**544**	**577**	**647**

Projection of $MtCO_2e$ Emissions with additional measures (excluding LUCF and biomass)

		1990	1999	2010	2020
				without Dom-Tom émissions	
CO_2 produced by power		360.1	384	376.8	388.5
CO_2 not produced by power		25.3	21.1	21.6	22.3
CH_4	- power	10.2	7.8	8.0	8.2
	- agriculture	34.3	32.2	31.1	31.3
	- waste	18.7	17.5	7.4	5.2
	- other	0.1	0.1	0.1	0.1
N_2O	- power	3.8	6.1	8.0	9.0
	- industrial processes	27.8	11.0	2.6	2.6
	- agriculture	56.1	54.3	51.2	52.1
	- other	1	1.0	1.1	1.2
HFC, PFC and SF_6		7.6	9.1	11.1	10.
Total		**545**	**544**	**519**	**531**

5 Vulnerability Assessment, Climate Change Impacts and Adaptation Measures

Since 1993, France has been developing study and research programmes whose objective is to assess the possible impacts of climate changes on France (including the DOM-TOM) and the adaptation measurements that are likely to be implemented in the more vulnerable geographic areas and sectors of activity.
An update on present knowledge of the "Potential Impact of Climate Change in France in the 20th Century" was published in 1998 by the Interministerial Task Force on Climate Change and the Ministry of Land Planning and the Environment (MATE), then republished in 2000. Seminars organised by MIES and open to a broad public (see Chapter 9, "Education, Training and Public Awareness") have enabled us to define knowledge and challenges in mountainous milieus and in coastal regions. Other useful lessons on vulnerability and adaptability have been learnt from the experience of the storms that hit France in December 1999, especially in forest environments, electricity production/distribution as well as the construction and insurance sectors.

5.1 Observed and Simulated Climate Change

The results with the greatest impact are the advances made in models simulating climate change, which can now focus in on the zone of interest, in this case Western Europe and the Mediterranean Basin. The results of the two models used in France are consistent with those obtained by other international teams, which predict a standard scenario for doubling CO_2 between the beginning of the 20th century and 2060. They indicate global warming of around 2 degrees in Western Europe, slightly more marked in the Mediterranean regions and in summer, with an increase in winter precipitation and a reduction in summer precipitation, especially in Mediterranean regions. The North-South pluviometric contrast would be accentuated, with an increase in precipitation north of the 45th parallel and a decline in the south.
As a reference for all the studies, Météo-France has built up a climatology of grid points in France for temperature and precipitation, showing in particular average warming for the 20th century of 1 degree for minimum temperatures (equal throughout France) and 0.6 degrees for maximum temperatures (especially marked in the South). These average warming trends are accompanied by an increase in winter and autumn precipitation and a fall in summer precipitation.

5.2 Forecast Effects of the Climate Changes and Possible Adaptation Measures

Global warming would lead to a withdrawal of snow cover in the Alps and Pyrenees, which would have significant socio-economic consequences (reduction in tourism for snow sports). Accelerated snow (and glacier) melting in the springtime would increase the risk of avalanches and mudslides in the mountains and of intense flooding in the valleys of the Rhone and Garonne. Generally speaking, intensification of the hydrological cycle would increase the risk of floods

in winter and spring, as well as the duration of low water levels (from June-July to October-November). Therefore it would be necessary to incorporate the "new climate situation" into schemes for the development and management of river basins, to conserve the multiple functions and uses of the resource.

The reduction in ground water reserves during the summer plant season would lead to significant decline and losses in agricultural, and especially forest, production (losses that would not be entirely balanced out by the "fertilising" effect of the increase in CO_2, especially in the south). There should be more intensive monitoring of the state of health of forests.

In the case of pastures and beef farming for the production of meat in the Massif Central, simulations indicate an increase of 20% in annual grass production (without taking account of the risk of dry spells) and changes in the quality of fodder, which may encourage farmers to reconvert their temporary pastures into permanent ones. This land use change would then tend to increase the amount of carbon stored in soils. A rise (of 30 to 50 centimetres) in sea level along the coast of mainland France and the DOM-TOM would have several serious consequences. These phenomena could well be aggravated if, as modelling exercises seem to indicate, cases of "over-rise" (brutal and temporary rise in sea level) were more frequent than today, because of a possible increase in storms and tropical cyclones. Faced with these risks for coastal areas, there are two adaptation strategies open to us over the next decades - protecting coasts or moving away from them.

As regards the effects on health, forecasts are mixed. Birds and mosquitoes from Africa, carrying the West Nile virus seem to have already arrived on the Mediterranean Coast at certain periods. The spread of dengue and, to a lesser extent, malaria is also to be feared, especially in the DOM-TOM. We will therefore have to increase epidemiological surveillance of the diseases, combined with surveillance of their vector (birds, mosquitoes, ticks, mites, etc.) and that of environmental factors (including climate variations) that encourage their spread.

France has not (yet) defined a specific programme for responding to climate change. On the other hand, there are already laws on land development and the protection of the environment and plans (resulting from these laws) to prevent natural risks and to encourage integrated management of natural territories, environments and resources. Research is being carried out in three main fields of action: prevention of natural risks, land development and management of water resources.

6 Financial Resources and Transfer of Technology

France has built its policy in this area around two objectives:

- maintaining an active development aid policy;
- supporting specific and additional mechanisms intended to fight against the greenhouse effect.

France is one of the most generous countries as regards Public Development Aid (PDA). In 2000, it was in fifth position in terms of the volume of aid provided, with EUR 4.5 billion. The Ministries concerned and public financial establishments - the French Development Agency (AFD), research agencies, such as CIRAD and IRD, ADEME and some regional councils – are responsible for bilateral co-operation.

France's net contribution to bilateral aid was EUR 3.1 billion in 2000, that is the equivalent of 69% of its total public development funding. Public funding mainly focuses on vital sectors – local, urban and rural development and access to basic education, health and drinking water services. This action has the following objectives:

- supporting sustainable development in partner countries for infrastructures or business sectors where the long–term stakes are particularly high, especially in situations where human intervention can lead to irreversible deterioration, or when incorrectly managed industrial development can lead to industrial and environmental catastrophes;
- supporting the incorporation of environmental criteria and sustainable management of natural resources in bi- and multi-lateral development funding, following strategies that are consistent with the expectations of the receiving countries;
- contributing to the protection of the environment. In addition to its direct contribution to the Global Environment Facility (GEF), France set up a similar fund in 1994. This bilateral fund is called the French Fund for the Global Environment Facility (FFEM) and it incorporates world environmental concerns into its bilateral funding.

The sum of financial resources allocated to multi-lateral aid by France in 2000 was EUR 1.39 billion. The main bodies through which this aid was channelled were the UN, the European Commission and international financial institutions. France fully participates in this initiative, being on average the fourth largest financial backer of multilateral development institutions. Contributions to multilateral institutions represented 11% of total French development aid in 2000.

France was one of the initial creators of the GEF, which finances the extra cost of protecting the planet with development projects. With USD 144 million, our country is the fourth largest contributor to the GEF. Untill now, 35% of GEF funding has financed projects on the greenhouse effect. The FFEM received EUR 67 million for the period 1995-98 and another EUR 67 million for the period 1999-2002. The FFEM portfolio includes one hundred projects; it has a commitment capacity of EUR 114 million, of which 58 million are devoted to projects related to climate change prevention.

International scientific co-operation helps to improve general knowledge, to identify vulnerability to climate change and action that can be taken to ensure that developments emit fewer greenhouse gases. Amongst the various research themes, particular emphasis is placed on those concerning more efficient use of land: combating deforestation, storage of carbon in the biomass, use of the

7 Research and Systematic Observation

7.1 Research

Physical Sciences Research

French research on climate is centred on the National Research Programme on Climate Dynamics (PNEDC), in which the following organisations participate: CEA, CEMAGREF, IFREMER, IFRTP, INSU, the Ministry of Research, Météo-France, the Ministry for the Environment and IRD. The PNEDC responds to the need to look at the interaction between the various components of the climate system – atmosphere, ocean, geosphere, biosphere – interactively. It reports to the CNRS National Institute of Sciences of the Universe (INSU).

To a large extent the PNEDC's interests correspond to those defined internationally by the World Climate Research Programme (WCRP).

However, some of its components also correspond to the concerns of other international programmes, such as SPARC (Stratospheric Processes and their Role in Climate), GEWEX (Global Energy and Water Cycle Experiment) and the International Geosphere Biosphere Programme (IGBP), as regards, in particular, paleoclimatology (Pages programme), atmospheric chemistry (IGAC) and atmospheric modelling (GAM). Finally, two non-specific projects – the use of WOCE data and the Clipper modelling project – work in parallel with the PNEDC. Moreover, this programme also provides specialist elements for defining and putting in place future space missions and climate observation and monitoring networks (GCOS and the climate component of GOOS) and for communicating with the socio-economic sector in the field of long-term forecasting and man-made climate changes.

The ECLIPSE programme (Climate Environment of the Past: History and Evolution) was created more recently as a complement to the PNEDC. It deals with analysis of glacier and sediment archives (lake or marine) and with paleoclimatology from a multi-disciplinary point of view (universe sciences, Human and Social Sciences, life sciences). It documents natural climate variability, making it possible to understand its mechanisms and the way it operates during key periods in the history of the Earth. Each community in ECLIPSE contributes to the development of consistent and quantifiable scenarios linking major changes in the terrestrial environment to the various possible causes (external or internal forcing).

Other programmes deal with the water cycle (GEWEX-radiation balance), the world ocean dynamic (WOCE) and the tropical ocean-atmosphere coupling (TOGA-Coare). Moreover, some complementary aspects or aspects bordering climatology are dealt with by the four other INSU programmes - PNCA, PATOM, PROOF and PNTS – presented below.

- **The PNCA** (National Atmospheric Chemistry Programme) deals with various issues related to the problem of atmospheric chemistry and climate interactions, following complementary approaches – experiments in the field, laboratory tests and modelling.
- **The PATOM** (Multi-Scale Atmosphere Ocean Programme) concerns the understanding and parameterisation of physical processes, which transform energy in the atmosphere and in the ocean, using experimental, theoretical and numerical methods. The priority themes are atmospheric and ocean variations in time scales lower than the season. The emphasis is placed on coupling dynamics and chemistry or hydrology for the atmosphere, dynamics and biogeo-

chemistry for oceanography with the various areas (offshore, coasts, shore).

- **The PROOF** (Bio-chemical Processes in the Ocean and Fluxes) replaced the JGOFS-France programme in 1998. It is based on the study of the processes governing the fluxes of chemical and bio-chemical elements exchanged between the atmosphere, the ocean and the marine biosphere, with special attention being paid to the improvement of coupled physical and bio-geochemical models. These models will also make it possible to describe the functioning of the climate system, past and present, more accurately and will be useful in assessing future systems.
- **The PNTS** is the National Programme for Space Remote Sensing. This involves satellite observation for improved observation, and therefore understanding, of how the climate system works.

Research Pertaining to Adaptation, Mitigation and Related Technologies

This research is mainly carried out as part of the GICC programme (Ministry of the Environment). The general issues address the world of international negotiations, greenhouse gas (and aerosol) emission reductions, potential effects and strategies for adapting to climate risk. This programme is original in that it links up pure science and human science teams and works on three principal dates (2010, 2030, 2100). Various economic models are used: macro-economic or growth models, general balance models and sector models (optimisation of energy, agriculture etc.). In the long term, it is planned to develop economy-climate coupled models to analyse costs-profits that are proper expert-systems to optimise the level of greenhouse gas reduction to be determined and negotiated internationally.

Technological Research Programme

ADEME is carrying out a technological research programme on the greenhouse effect, including five key actions:

- reducing energy carbon content;
- improving energy efficiency and management of demand in transport, housing, the services sector and industry;
- reducing emissions of specific greenhouse gases (CO_2, N_2O, HCFC, SF_6) in industrial processes;
- CO_2 storage;
- control of the effects of specific greenhouse gases (CH_4, CO_2, N_2O) in agriculture and in the channels for recycling organic waste.

There is also a socio-economic aspect relating to behaviours and lifestyles, and the legal and financial framework of the CO_2 market.

European Research Prospects

European research is carried out under the 5th RTDFP (Research and Technical Development Framework Programme), which has a budget of EUR 14.96 billion.

It consists of six key projects, one of which is called "Planetary Change, Climate and Biodiversity". Its budget is EUR 301 million. The 6th RTDFP, which is currently being negotiated, should include a priority issue on sustainable development and planetary change.

7.2 Systematic Observation

France is participating fully in the Global Climate Observing System (GCOS). It incorporates the following four components: meteorological and atmospheric, oceanic, terrestrial, spatial.

Meteorological observation refers to Météo-France's general observation mission; its policy is governed by the framework programme on meteorological observation (1999) and the framework programme dedicated to climatology (2001). However, the composite aspect of GCOS makes it a system in which some operators come from other institutions – laboratories dependent on the Ministry of Research, the Ministry for the Environment, Oceanography and Overseas

institutions. The general policy for distributing data is contained in Resolution 40 of the WMO, regarding the distribution of meteorological data. They are looking into the issue of long series of data and continuation of the observation networks within the framework of the GCOS. The concept of Environment Observatories (operational or research) tries to address this question.

Since 1999, the Global Surface Network (GSN) has had six stations in mainland France. In France's dominions, the GSN network has the following fourteen stations. Cayenne-Rochambeau (Guyana), Le Raizet (Guadeloupe), Dzaoudzi-Pamanzi (Mayotte), Martin de Vivies (Amsterdam Island), Port-aux-Français (Kuergelen Islands), Dumont d'Urville (Adelia Land), Koumac and Nouméa (New Caledonia), Hififo (Wallis Island) and for French Polynesia, Atuona, Tahiti-Faa, Rikitea, Tubuai and Rapa.

The French contribution to oceanographic observation for climate comes under the GOOS system (Global Ocean Observation System) and contains the following: voluntary and occasional observation ships, ocean gauges, floating and anchored weather buoys and, finally, sub-surface floaters (Coriolis Project). We would like to emphasise the pre-operational direction of ocean observation, with Mercator modelling projects, the Coriolis observation project and the future data assimilation experiment, GODAE (2002-2004). The seven French agencies involved in oceanography (CNES, CNRS, IFREMER, IFRTP, IRD, Météo-France and SHOM) are joining forces to develop a complete and coherent system of operational oceanography based on three focal points: satellite altimetry (JASON), global numerical modelling with assimilation (MERCATOR) and in situ measures (Coriolis). The Coriolis project aims to construct a pre-operational structure for acquiring, collecting, validating and distributing world ocean data (temperature, salininity and current profiles) responding to the needs of modellers (MERCATOR) and of the scientific community (under CLIVAR).

The Global Terrestrial Network (GTN) deals with observation of mountain glaciers, long-term monitoring of greenhouse gases (RAMCES) and, finally, measurements of carbon fluxes linked to terrestrial ecosystems (FLUXNET). Mountain glaciers are thus studied in numerous parts of France and abroad, in particular by LGGE, IRD and CEMAGREF. The RAMCES network aims to understand greenhouse gas cycles and to provide a regional balance. France is also actively participating in measuring carbon flows in terrestrial ecosystems carried out under the international programme Fluxnet, and the various programmes connected with the Carboeurope project group. Forest ecosystems have also been systematically observed by the National Forestry Inventory (IFN) every ten years for almost forty years. A mechanism for monitoring environmental influences was also put in place after the damage caused by acid rain.

In the area of space observation, the CNES was one of the pioneer organisations in observing the earth from space. The programme takes up almost a third of its budget. It works with international cooperation, in a bilateral framework, and it also participates to a large extent in European Space Agency projects. This programme is organised in "sectors" – a series of projects in response to common objectives or requiring specific techniques, with a concern for innovation, satisfaction of scientific needs and development of applications. The three sectors – terrestrial observation, meteorological observation and research – have increasingly contributed to our understanding of climate. France has also contributed significantly to EUMETSAT (European Agency for Meteorological Satellites), which manages Météosat and the future polar orbiting platform, METOP.

8 Education, Training and Public Awareness

Courses in Life and Earth Sciences, during which the phenomenon of the greenhouse effect is introduced, are mandatory for all students at secondary school and sixth form college. Great emphasis is placed on the importance of long-term management of resources, respect for their natural equilibrium and biological heritage; the concept of sustainable development is addressed. The scientific phenomenon of the greenhouse effect is generally taught in the lower VIth . In addition, a module organised around a case study encourages more in-depth study.

The French population as a whole is increasingly familiar with the notion of the greenhouse effect. Recent natural catastrophes have led to more in-depth study of the phenomenon and sparked the media to focus on it. A study carried out by IFEN has shown that the fight against air and atmospheric pollution is seen as a priority for government action. However, although there is awareness of air and atmospheric pollution, understanding of the greenhouse effect is still very vague today. This emerged from an ADEME public opinion study carried out in 2000.

To support and encourage the commitments made at the local level, the Interministerial Task Force on Climate Change (MIES) has set up a working group called "Declinaison Territoriale" [National Applications], as part of the National Programme for Tackling Climate Change. Its objectives are to exchange experiences; to set up a formal methodological framework that can be implemented by all the players in the field; to strengthen experimental collaboration with pilot towns; to define the boundaries of decentralisation and the needs associated with the fight against climate change. It was with this goal in mind that MIES published a work entitled "Handbook for Decision-Makers", an operational tool enabling communities engaged in combating the greenhouse effect to direct their actions and quantify the effects of their decisions in terms of emissions of greenhouse gases. A series of conferences were also held locally.

To address the general public, MIES has set up a Web site, which deals mainly with information on the mechanisms and impacts of the greenhouse effect, statistics on emissions of greenhouse gas emissions in France and international negotiations. Several sites maintained by scientific organisations (Météo-France, INSU, etc.) also deal with questions relating to the climate.

As regards environmental associations, the work carried out by Réseau Action Climat [Climate Action Network], which encompasses around twenty organisations deserves to be mentioned here. Founded before the Kyoto Summit to enable the voices of French associations to be heard in international negotiations on climate change, it is the French link to CAN (Climate Action Network), the global NGO network on the topic. Moreover, the French Association of Companies for the Environment numbers around forty-five major companies that actively work in favour of better protection for the environment, by looking for effective approaches and by promoting their skills. It is also in charge of expressing the corporate viewpoint on these subjects and participating in the development of environmental policies.

Because of its role and its interministerial status, MIES has regular contact with the industries affected by energy and greenhouse gas issues and is also extending its field of activity where the banking sector is concerned. Thus, in October 1998, a conference was organised in Paris on the challenges of global warming for industrial players. The following year, the seminar was aimed at financial players. ■

CHAPTER 2

National Circumstances Relevant to Greenhouse Gas Emissions and Removals

INTRODUCTION

This chapter presents a summary of social and economic data on France that may be linked to the production of greenhouse gases or global warming in general. We will address, in the following order, institutions, demography, geography, climate, economy, energy, the residential-service sector, transport, industry, waste, agriculture, forests and other national circumstances.

1 Institutions

France is a Republic and a parliamentary democracy with a unitary State and a traditionally centralised civil service. However, over the past twenty years, a strong move toward decentralisation has reinforced the powers and jurisdiction of local authorities. It was accompanied by a reduction in the power of the State at the regional and departmental levels. Decisions on the greenhouse effect are made at national level by Parliament and the government. The Interministerial Task Force on Climate Change (MIES) was created in 1992 to organise and co-ordinate the actions of the various ministries vested with the authority to deal with the issue: the Ministry for the Economy, Finance and Industry; the Ministry for Public Works, Housing and Transport; the Ministry of Agriculture; the Ministry of Land Planning and the Environment; the Ministry for Agriculture and Fishing; the Ministry of Research.

Government decisions are relayed to the decentralised level by the decentralised services placed under the authority of the Department Prefects. National agencies, such as the Agency for the Environment and Energy Management (ADEME) and the National Agency for the Improvement of Housing (ANAH) implement action programmes and allocate specific funding. However, the regions (26 in all) and the other local authorities (100 departments, 36,000 communes) can also launch local action plans or programmes, in particular relating to urban and rural development, urban transport, operations to support renewable energies, implementation of the local Agenda 21, etc.

The Overseas Territories and Departments (DOM-TOM) (New Caledonia, Wallis et Futuna, French Polynesia, Mayotte, Saint-Pierre et Miquelon, French Oceanian and Antarctic territories) have a different administrative status. The three Oceanian territories have a territorial assembly.

In recent times, taking into account previous achievements, described in the 2nd National Communication, the policy for combating climate change has been based, in particular, on the following elements:

- reinforcement of the Interministerial Task Force on Climate Change, attached to the office of the Prime Minister in 1998, which has made it easier to co-ordinate projects nationally and internationally;
- significant strengthening of European co-operation as regards monitoring greenhouse gas emissions and co-ordinating measures to reduce emissions;
- establishing strict regulations to protect the environment in general and to

encourage energy saving. The most noteworthy examples of this are the covering over of landfill sites, the regulation of nitrous oxide emissions and the new thermal regulations for housing;

- a vast programme to raise public awareness of the environment, energy saving and energy efficiency. Since 1974, France has been able to carry out actions of this sort through its Agency for Energy Saving (now part of the Agency for the Environment and Energy Management).

Public awareness of the greenhouse effect has grown significantly since the 2nd National Communication, as can be seen, in particular, in the attention the media has devoted to the topic. The impact of the work of the Group of Intergovernmental Panel on Climate Change (IPCC) and the involvement of French researchers in these projects has certainly contributed considerably to this awareness. The government and Parliament have also shown particular interest in climate change, since France was the first country in the European Union whose parliament voted in the Law approving the Kyoto Protocol on 10 July 2000. Moreover, Law No 2001-153 of 19 February 2001 formally declared the fight against climate change a national priority.

Taking into account the scope of the efforts already made and the results achieved, the cost of the new measures likely to be taken in France will often be very high. That is why France considers it vital that the cost per tonne of carbon avoided, of measures taken to reduce emissions in national programmes be similar in the various countries in Annex I to the UNFCCC, thus guaranteeing economic efficiency and compliance with the "polluter country" principle.

Moreover, given the responsibility of the EU States and of the Community in achieving the Kyoto objectives, France has placed great emphasis on common and co-ordinated policies at this level.

2 Demography

On the basis of the 1999 census, the French mainland population amounts to 58.7 million people (2000 estimate). The population is growing at a rate of 4.3 inhabitants per thousand, of whom 3.5 result from the birth rate's being higher than the mortality rate. 21% of the population is over the age of 60; in mainland France, just under one French person in 6 is over the age of 64, as opposed to 1 in 8 thirty years ago. At the same time, the proportion of those under the age of 20 has fallen from one-third to one-fourth. In 2020, the population should be 63.5 million and the percentage of those over 60 is likely to continue to rise, reaching 27%.

See Illustration in Annex 1, "Population Changes between 1990 and 1999", page 188.

The average population density in France is 105 inhabitants per square kilometre. It varies significantly from one department to another, from 14 inhabitants per square kilometre in Lozère to 20,126 inhabitants per square kilometre in the Paris region. 70% of the population live in 10% of the territory. Conversely, 60% of the land is occupied by only 10% of the population.

Between 1990 and 1999, the main urban areas significantly contributed to the country's demographic growth. Eleven of these alone totalled half of this growth. The urban region around Paris remains the most densely populated, but its contribution to demographic growth is falling.

Sixteen cities in the provinces are seeing remarkable population growth – double that of mainland France – including, in

descending order, Montpellier, Toulouse, Rennes, the French part of the conurbation of Geneva, Annecy, La Rochelle, Nantes and Poitiers.
The urban areas of the Greater Southeast and the Val-de-Loire are among the most dynamic. The population is thus continuing to concentrate around a smaller and smaller number of cities. At the same time, these cities are spreading out further and further, sometimes benefiting from the lack of dynamism in neighbouring areas.

See Annex II, "Town Planning changes between 1982 and 1999", page 189.

"WORK-HOME TRANSPORT"

The population working outside their place of residence is constantly rising: in 1999, they accounted for 60.9% of the working population with a job, as compared to 52.3% in 1990 and 46.1% in 1982. "Home-work" commuting is becoming longer: in 1999, most workers worked on average 15.1 kilometres from their home, as compared to 14.1 kilometres in 1990 and 13.1 kilometres in 1982. Workers living in the area around Paris have longer commutes than the national average (23.8 kilometres). The proportion of people travelling to work is highest in the North and Northeast.

3 Geography

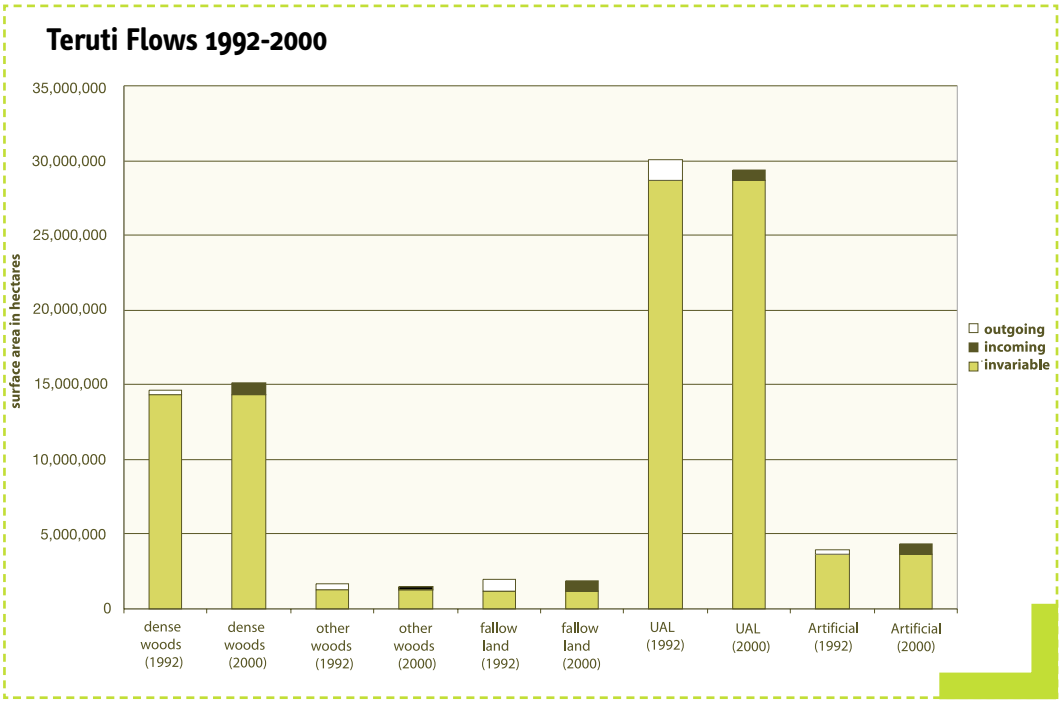
Mainland France (550,000 square kilometres) is the largest of the countries in the European Union. Located between the Atlantic and the Mediterranean, France has around 3,200 kilometres of coastline. A country of average altitude, where plains and hills occupy two-thirds of the territory, it has two mountain barriers to the east and the south – the Alps and the Pyrenees. Mont-Blanc (4,810.4 metres high), the highest point in France, is in the Alps, on the frontier with Italy. The Massif Central, in the centre of the country, is instrumental in separating the waters into four main basins: the Seine in the North, the Loire in the Northwest, the Rhone in the East and the Garonne in the Southwest. According to the Corine Land Cover inventory, "artificialised" land covers 20,877 square kilometres, or 3.8% of mainland France, agricultural land 342,368 square kilometres (62.3%), forests and semi-natural environments, 181,129 square kilometres (33%), wetlands 1,737 square kilometres (0.3%) and waterways within administrative borders, 3,479 square kilometres (0.6%).

See Annex III, "Corine Land Cover", page 190.

The annual Teruti survey shows trends in land occupation.
Between 1992 and 2000, the agricultural land used diminished by 2.3%. Natural areas increased by 1.3%, thanks to a 3.5% extension in forests. Artificial areas, although a relatively small proportion of the total area, had the highest growth (+ 11% between 1992 and 2000). Between 1992 and 2000, 852,000 hectares of agricultural land was returned to nature (forest, fallow land and heath). Conversely, 499,000 hectares of natural areas were turned into agricultural land and 225,000 hectares into artificial areas. In total, "natural" areas have increased by 346,000 hectares, especially thanks to forest expansion.

2

National Circumstances Relevant to Greenhouse Gas Emissions and Removals



4 Climate

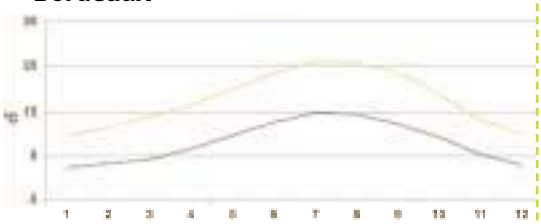
France is exposed to three main climatic influences: ocean, continental and Mediterranean. The ocean climate is found on the West : there is very little difference in temperature between winter and summer. The continental climate prevails in eastern France: winters are cold and summers hot with frequent storms. The Southeast is characterised by a Mediterranean climate: summers are dry and hot and winters mild, while precipitation is abundant in Spring and Autumn.

Regional Profiles of Five Cities

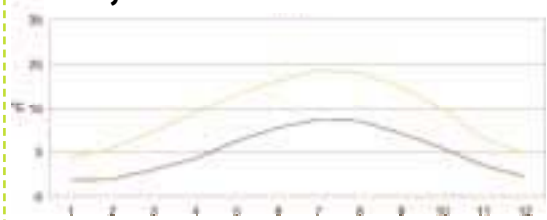
Source : Météo France

Average Minimum and Maximum Temperatures (°C)

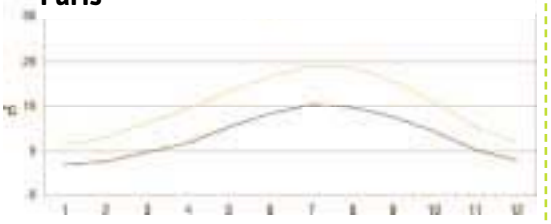
Bordeaux



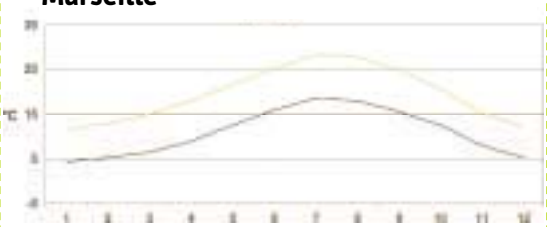
Nancy



Paris



Marseille

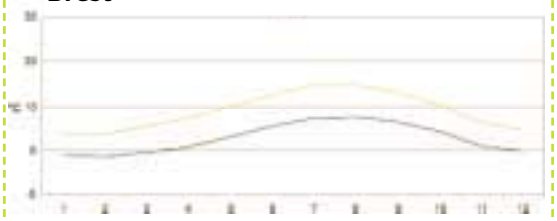


Brest (alt. 98 ml)

	Jan.	Feb.	Mar.	April	May	June	July.	Aug.	Sept.	Oct.	Nov.	Dec.
mini.	3.9	3.8	4.5	5.7	8.1	10.5	12.4	12.6	11.5	9.4	6.2	4.9
maxi.	8.7	8.9	10.5	12.4	15.1	18.0	20.1	20.0	18.5	15.5	11.6	9.7

- **Temperature (in °C)**
  - Max. recorded 34.8
  - Average 10.9
  - Min. recorded - 10.9
- **Amount of rain and snow (in mm)** 1109
- **Number of days of rain > 2,5 mm per year** 112

Brest



Global warming has been estimated at 0.6°C on average since the beginning of the century. In mainland France, the techniques for harmonising climatological data, used by Météo-France to extract the climatic signal by removing disruptive effects as far as possible, show warming of 0.5°C to 1.4°C. Warming is higher in daily minimum temperatures, and in the West than in the East.

See Annexes IV and V, "Warming Observed in France in the 20th century".

"CLIMATIC EVENTS"

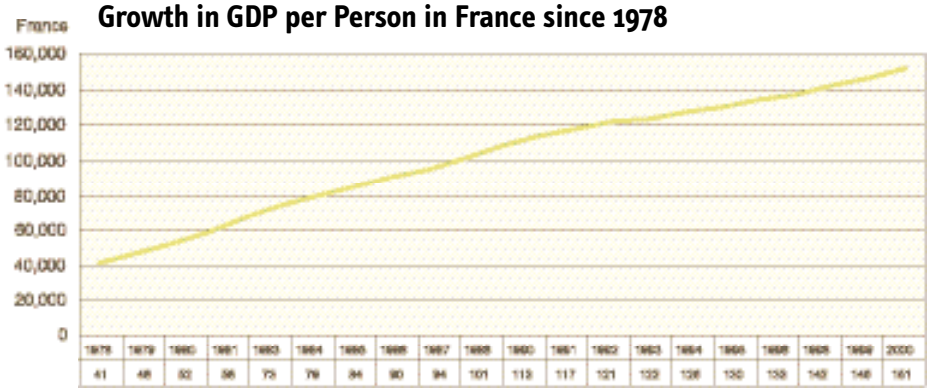
Warning: The list below is a record of the natural disasters and climatic events that occurred on French soil (mainland and overseas) during the time span between 1998 and 2001. However, this register does not offer proof that there is a direct relationship between the events listed and the climatic disturbances that may possibly be attributable to the greenhouse effect.

- **September 1998: Hurricane Georges, Caribbean**
- **19-25 February 1999: Heavy rain leading to flooding in the Franche-Comté and Burgundy regions**
- **30 May 1999: Severe storms in the Ile-de-France region. Three casualties and several people injured. 110,000 homes left without electricity.**
- **12-13 November 1999: Torrential rains in the Midi-Pyrénées and Languedoc-Roussillon regions.**
- **17-20 November 1999: Hurricane followed by Tropical Storm Lenny in Guadeloupe and Martinique.**
- **26-28 December 1999: Two successive storms of exceptional intensity (winds of up to 180 km/h) devastated France within a few hours of each another, in the North (Lothar), then in the South (Martin): 79 of France's 95 departments affected, 88 casualties, 3.45 million households left without electricity; damage is estimated at EUR 11.4 billion (FRF 75 billion).**
- **6-11 May 2000: Severe thunderstorms in the North and West of France.**
- **19 September 2000: Severe thunderstorm with winds gusting up to 180 km/h in Montpellier.**
- **20 September 2000: Heavy rain in Marseilles.**
- **29-30 October 2000: Severe storms in the North and West of France (Manche, Bretagne and Haute-Normandie regions).**
- **11-13 December 2000: Flooding in several towns in the Finistère department (Brittany) cause by heavy rainfall over the four preceding weeks.**
- **January 2001: Reoccurrence of flooding in Brittany (Redon, Quimperlé, Morlaix) due to a series of heavy rains.**
- **March-May 2001: Flooding of the Somme River caused by lengthy heavy rains**

5 Economy

In 2000, Gross Domestic Product (GDP) increased by 3.1% in volume, after growth of 2.9% in 1999 and 3.4% in 1998. Households, because of their consumption, and companies, because of their investments, are the pillars of this growth. In 2000, GDP per inhabitant amounted to EUR 23,170 (FRF 152,000) per person.

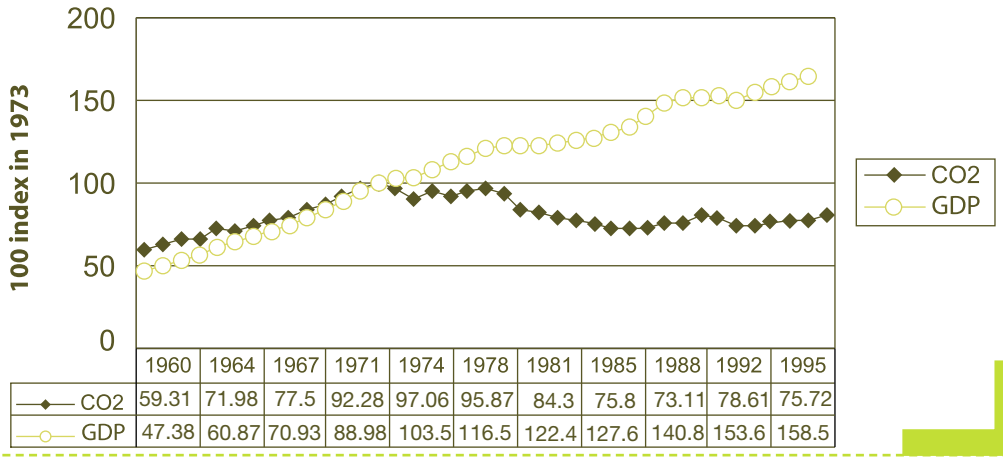
Growth in GDP per Person in France since 1978



Source : INSEE, 2001

Between 1960 and 1973, gross CO_2 emissions (365 million tonnes in 1960) increased at the same rate as GDP and reached 615 Mt. After this period, they split off from GDP until 1988, when they bottomed out at 123 MtC. Since then, they have increased and have fluctuated around the 1990 level (468 Mt), with a range of between – 2% and + 6%.

ComparativeTrends in CO_2 Emissions and GDP between 1960 and 1998



	1960	1964	1967	1971	1974	1978	1981	1985	1988	1992	1995
CO2	59.31	71.98	77.5	92.28	97.06	95.87	84.3	75.8	73.11	78.61	75.72
GDP	47.38	60.87	70.93	88.98	103.5	116.5	122.4	127.6	140.8	153.6	158.5

Source: INSEE, Citepa-Secten, 1999

Comparatively speaking, 30% of total added value in 2000 came from agriculture, industry, energy and building (35% in 1980, 31% in 1990), while 70% came from services. The car industry grew by 6.6% in volume over 1999, services for companies by 4.8% and public works industries by 4.7%. Added value for intermediate goods increased by 4.1%, that of trade by 3.3% and that of financial activities by 3.1%.

Added Value per Branch in Volume
(prices for previous year chained, 1995 basis)

In billions of euros	1980	1990	2000
Agriculture, forestry, fishing	190.8	222.6	260.4
Industry (including energy)	1 216.3	1 414.6	1 733.9
- agricultural and food industries	189.2	191.3	190.1
- consumer goods industry	225.0	254.4	270.6
- car industry	89.7	89.1	140.8
- capital goods	176.2	230.0	310.5
- intermediary goods industries	337.5	471.4	599.7
- energy	212.7	179.0	226.5
Building	368.7	406.7	339.8
Services that are mainly sold and administered	3 481.8	4 818.6	5 710.7
- proportion from transport services	191.2	264.7	357.0
Imaginary unit branch	- 194.2	- 313.5	- 207.9
Total	**5 107.9**	**6 554.6**	**7 838.6**

Source : INSEE, National Accounts

Foreign Trade

In 1999, France's balance of trade reached almost EUR 10 billion (FRF 165 billion); this was the third surplus of the decade. Benefiting from the favourable international climate, exported goods increased by 8% in value between 1998 and 1999. The continuing depreciation of the euro against the dollar and the pound improved the competitiveness of French products. Imports increased by 4.9% in value, sustained by dynamic domestic demand, both from households through consumer goods and from industry through investment. However, the increasing cost of oil added nearly EUR 1 billion to the heavy fuel bill.

France's Balance of Trade (FOB/CIF) per Product Group

In billions of euros	1996	1997	1998	1999
Agriculture, forestry, fishing				
Exports	9.3	9.7	9.8	10.1
Imports	7.4	7.8	8.0	7.8
Agricultural and food industries				
Exports	24.2	27.1	27.2	27.0
Imports	18.0	18.9	20.0	19.9
Consumer goods				
Exports	30.0	34.1	36.9	39.3
Imports	32.6	36.2	40.8	42.8
Car industry				
Exports	27.3	31.5	35.7	38.2
Imports	23.8	21.6	26.6	30.0
Capital goods				
Exports	53.7	63.9	70.6	72.4
Imports	46.6	52.8	60.4	64.1
Intermediary goods				
Exports	74.6	84.3	88.7	89.3
Imports	73.6	82.0	88.8	90.0
Energy	0.0	0.0	0.0	0.0
Exports	7.0	7.6	7.2	7.7
Imports	18.9	21.1	16.7	19.6
Total				
Goods exports (FOB)	226.0	258.2	276.1	283.9
Goods imports (CIF)	220.9	240.5	261.2	274.0
Balance	**5.1**	**17.8**	**14.9**	**9.9**

Source : INSEE, 2000

2

National Circumstances Relevant to Greenhouse Gas Emissions and Removals

The agricultural product surplus increased slowly and, most notably, there was a recovery in grain sales to Russia, the Middle East and the European Union. The balance of trade for the food industry remained stable. The consumer goods sector reduced its deficit by EUR 0.15 billion (FRF 2 billion) with, in particular, a surplus in pharmaceuticals and perfumery products: + EUR 6.56 billion (FRF 43 billion). In the car industry, exports increased by 6.5% thanks in particular to sales to Spain and Italy, while imports increased more (+ 11%). The balance of trade for manufactured goods fell by almost 19%, yet still remained high, at EUR 8.38 billion (FRF 55 billion). The balance of trade for intermediary goods remained negative, although coverage was close to 100%.

In 2000, the European Union remained France's principal partner, with a surplus of EUR 7.15 billion (FRF 46.9 billion). Nevertheless the balance of trade with the euro zone showed a deficit of EUR 1.42 billion (FRF 9.3 billion), after a surplus of EUR 3.31 billion (21.7 billion) in 1999. The main countries responsible for this deterioration were Germany, the Belgium-Luxembourg Economic Union and the Netherlands.

Foreign Trade in 2000

In billions of euros	1999 balance	2000 balance	Export of FOB goods	Import of CIF goods
European Union	**12.4**	**7.1**	**205.6**	**198.5**
- including UK	6.1	5.3	31.6	26.3
including euro zone	**3.3**	**- 1.4**	**162.3**	**163.7**
-of which Spain	7.5	8.6	31.0	22.4
- of which UBL - of which Italy	1.5	0.5	23.9	23.4
- of which the Netherlands	- 0.8	- 0.1	28.6	28.7
- of which Germany	- 0.7	- 1.8	14.0	15.8
	- 2.9	- 5.2	48.3	53.4

Source : INSEE, 2001

"EUROPEAN MONETARY UNION"

The euro has been the official currency of 11 countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, The Netherlands, Portugal and Spain) since 1 January 1999.
National monetary units will continue to prevail until 1 January 2002 in EU Member States. On 1 January 2002, at the latest, euro coins and bills will be put in use. In France, franc coins and bills will no longer be valid starting on 17 February 2002.
The parity between the franc and the euro is as follows: EUR 1 = FRF 6.55957

5.1 Energy

In 2000, end consumption of energy in France – calculated at end user level, meaning companies, households and civil service buildings – reached 216 MTOE, that is 3.7 TOE (tonne of oil equivalent) per inhabitant. It was three times as high as in 1960 and increased by 35% over 1973 levels. This trend can be explained by a doubling in energy consumption, over 30 years, in the housing and service sector and in transport, while energy consumption in industry virtually stabilised.

French production of primary energy is consists of:

- nuclear energy (installed capacity 63 200 MW; 415 TWh, or 92.3 MTOE);
- hydraulic power (72.8 TWh, that is 16.2 MTOE);
- renewable thermal energy sources (wood, waste, bio-fuels, biogas) which represent 11.8 MTOE;
- fossil fuels, around 6 MTOE.

Because it has very low amounts of fossil fuels, France is highly dependent on imported energy. This situation has led to the development of national energy sources and the implementation of a vigorous policy of energy consumption management; as a result, the rate of energy independence in France has increased to 50%, as against 23% in 1973.

Energy management is one of the essential pillars of energy policy in France. It contributes to our country's independence in energy sources, to its economic competitiveness and to the protection of the environment, in particular to the reduction of CO_2 emissions. The revival of energy management decided by the government in 1998, following the assessment body's report published in the same year, fulfils the need to diversify resources in France, all the while maintaining its ability to make future energy choices. It is also a condition for France's compliance with the commitments made under the Kyoto Protocol to fight greenhouse gas emissions. To implement this policy, the government felt it was necessary to increase the financial and human resources available to ADEME, in charge of the implementation of the energy management policy, whose operational funds allocated to energy management and to the development of renewable energies increased massively between 1998 and 2001.

The Nuclear Programme

Initially designed to allay concerns over safety in the supply process, the nuclear programme makes France one of the industrialised countries that emit the least carbon dioxide, whether per inhabitant or per unit of GDP. However, in the 1990s, the development of nuclear energy reached a production capacity enabling it to satisfy basic demand until the end of the first period of commitment to the Kyoto Protocol. That is why we have not envisaged increasing this potential in the years to come, so as to avoid compromising our competitive advantages.

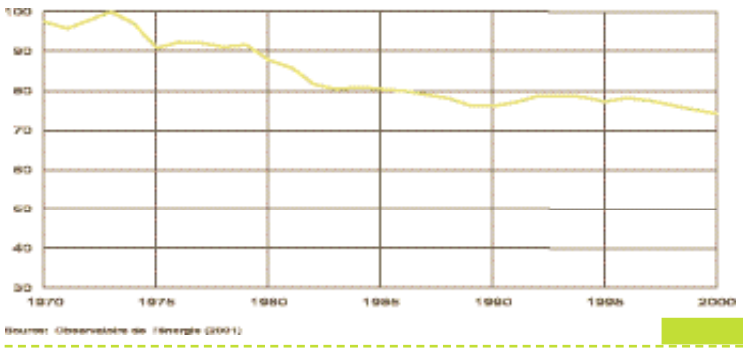
Renewable Energy Sources

Thanks to the hydraulic sector and to wood fuel, France is the leading producer of renewable energy sources, with 27.5 million TOE in 2000, making for 23% of our production and 11% of our consumption in primary energy (source: Energy Observatory). The development of renewable energy resources is one of the vital aspects of France's energy policy for several reasons: renewable energies contribute to the safety of our energy supply; they help to protect the environment; lastly, they contribute to the creation of local business and sustainable land development.

The authorities are pushing multi-year programmes for the development of renewable energies, together with clearly defined objectives and durable resources, which are implemented by ADEME. This strategy should enable true

structuring of existing energy sectors, in particular wood, whose potential in terms of jobs and local development is significant.
New sectors, such as wind energy, will be able to rapidly attain a high level of technological and industrial development.

France's Primary Energy Intensity (base rate 100 in 1973))

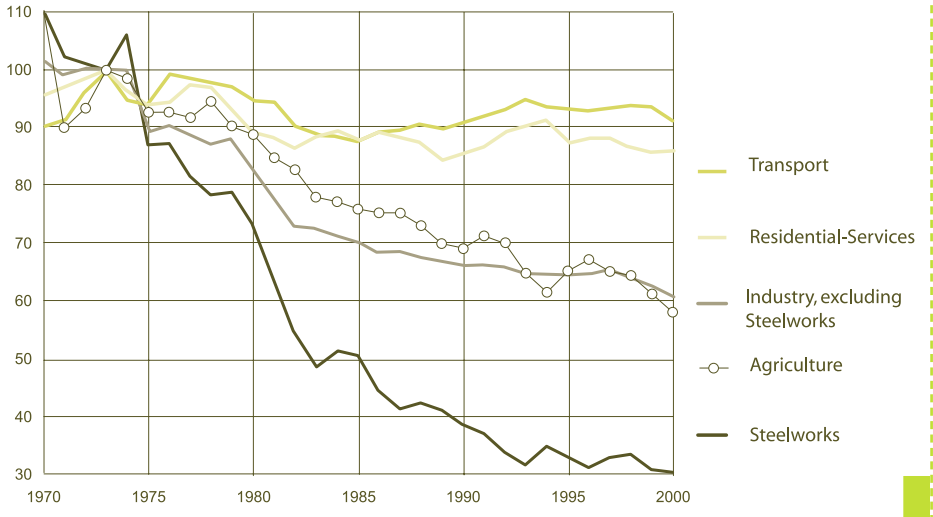


Source: Observatoire de l'énergie (2001)

Change in Energy Intensity

Energy intensity is the ratio between primary energy corrected for the climate and the volume of commercial GDP. It is the indicator most widely used to measure a country's or a sector's capacity to use energy rationally.
The graph above shows the development of energy intensity in France between 1973 and 2000. In this period, the country saw a significant improvement in its energy intensity, that is, its capacity to produce greater wealth with the same quantity of energy. The rate of improvement in the last few years (1.5% per year) had only been achieved in the past because of the constraints imposed by oil crises. The diagram below shows the development of energy intensity in each of the main sectors.

Energy Intensity by Sector of Consumption (base rate 100 in 1973)



Source: Observatoire de l'énergie (2001)

5.2 Buildings, Housing, Service Sector

End consumption of energy in the housing-services sector is constantly increasing. Evaluated at around 64 MTOE in 1973, it amounted to 84 MTOE in 1990 and more than 100 MTOE in 2000. While energy consumption due to heating rose very little between 1973 and 2000, thanks to the construction of a great deal of new housing with better insulation, the percentage of this use, which accounted for 70% of total consumption in the housing-services sector, is currently at about 45%. On the other hand, specific electricity consumption in the housing-services sector (lighting, electrical goods, office automation, etc.) increased threefold between 1973 and 1998 and now represents 30% of total energy consumption in the sector.

The percentage of energy consumed in the housing-services sector is as follows:

- solid fuels: 0.7%
- oil products: 16.5%
- gas: 19%
- electricity: 54%
- renewable energy sources: 8.8%

There exists considerable potential for energy saving, especially where consumption of specific electricity is concerned. The effects of the new thermal regulations, which came into effect on 1 June, will only be measurable in the medium and long term. However, the improvement in energy efficiency in the housing-services sector in the last five years (the energy intensity of the sector fell by an average of 0.88% per year between 1994 and 2000) leads us to imagine that households are more aware of consumption management. Technical advances have been made, which have enabled the market to offer appliances and material that are more energy-efficient. The significant upgrading of public resources allocated to energy management and energy efficiency implemented by the government will amplify this trend.

5.3 Transport

Passenger transport has increased by 18% in ten years. The share accounted for by cars is still dominant, as public transport accounted for only 16% in 2000. Rail transport represents 9.6% of internal passenger transport, bus and coach transport 5% and air transport 2%. In 2000, the number of private cars on the roads was 27.8 million. The number of vehicles using diesel is rising at a steadier rate than that of the whole car population. In 2000, they accounted for 35% of the total population of private cars and 74% of light commercial vehicles. In ten years, unit consumption of petrol-running cars in France fell by 7% and that of heavy vehicles increased by 8%.

In 2000, the number of passengers served increased more regularly on international airlines than on domestic airlines. About one-third of air transport users use domestic airlines.

Growth in Passenger Traffic

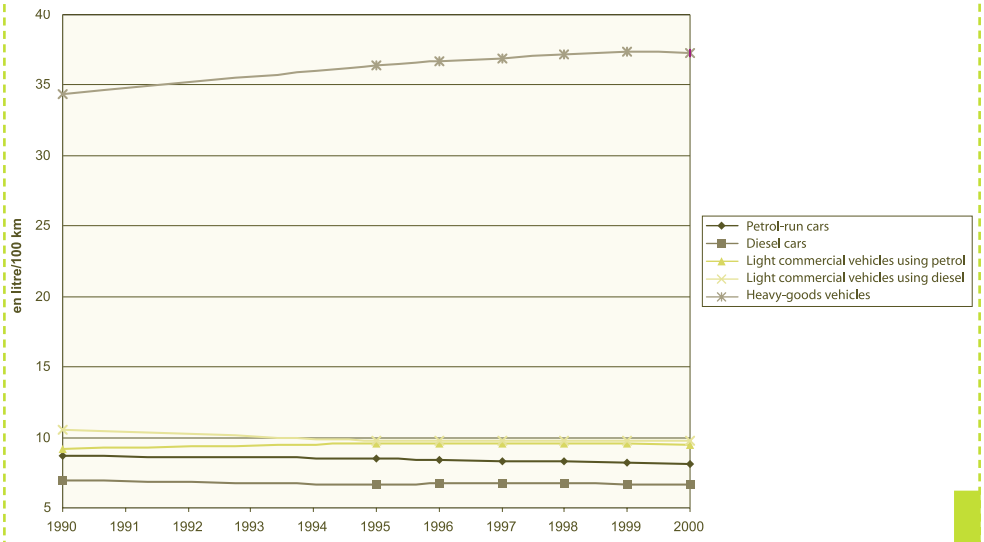
In billions of journeys per kilometre	1985	1990	1995	1996	1997	1998	1999	2000
Buses, coaches	37.0	41.3	41.6	42.4	42.0	42.7	40.7	41.5
Public rail transport	70.9	73.9	64.5	69.3	71.5	74.3	76.9	80.6
Internal airlines	7.4	11.4	12.7	13.8	13.8	14.5	15.7	15.7
Private cars	489.6	585.6	640.1	649.1	659.5	678.6	699.6	705.2
Total public transport	115.3	126.6	118.8	125.5	127.3	131.5	133.3	137.8
Total	**604.9**	**712.2**	**758.9**	**774.6**	**786.8**	**810.1**	**832.9**	**843.0**

Growth in the Number of Vehicles Registered in France

In thousands of cars	1990	1995	1996	1997	1998	1999	2000
Private cars	23,280	25,000	25,300	27,795	26,450	27,145	27,770
- of which petrol	19,760	18,378	18,098	18,045	18,131	18,210	18,150
- of which diesel	3,520	6,622	7,204	7,750	8,319	8,935	9,621
Light commercial vehicles	4,223	4,555	4,606	4,697	4,822	4,934	5,055
- of which petrol	2,279	1,560	1,494	1,443	1,404	1,356	1,299
- of which diesel	1,944	2,995	3,112	3,254	3,418	3,578	3,756
Lorries	535	611	617	625	617	622	627
Total	**28,109**	**30,166**	**30,523**	**33,117**	**31,889**	**32,701**	**33,452**
Total diesel	5,999	10,228	10,933	11,629	12,354	13,135	14,004

Source: Ministry for Public Works, Transport and Housing, according to CCFA, 2002

Growth in the Number of Vehicles Registered in France (thousands of vehicles)



Growth in Air Transport Demand

% growth ... in thousands	Number of passengers			Journeys		
	Trend 1999/1998	Trend 2000/1999	Level in 2000	Trend 1999/1998	Trend 2000/1999	Level in 2000
Internal / external	10.2	10.8	66,971.5	10.3	7.5	905.2
Paris / provinces	6.5	0.1	21,164.9	2.2	- 0.8	246.2
Provinces / provinces	8.9	5.0	5,828.5	3.0	0.7	214.2
Total apart from dominions	**9.2**	**7.8**	**93,964.8**	**7.5**	**4.8**	**1,365.6**
Mainland / DOM	4.3	6.4	3,754.0	4.5	5.4	10.5
Internal / DOM	7.5	3.9	2,062.7	- 0.7	- 5.8	103.4
International / DOM-TOM	4.6	6.8	1,911.8	0.6	- 0.2	64.1
Total DOM-TOM	**5.2**	**5.8**	**7,728.5**	**0.0**	**- 3.3**	**178.0**
Total	**8.9**	**7.6**	**101,693.0**	**6.5**	**3.8**	**1,543.6**

Source : Ministry for Public Works, Transport and Housing, DGAC, 2001

Goods transport has increased by 25% in ten years. Road transport is dominant (169% of kilometre-tonnes) with an increase of 35% in ten years, as a result of the increase in tonnage (+13%) and transport distance (+19%). About 2.1 billion tonnes are transported by road.
In all, no less than 2,828,000 lorries crossed France in 1999, 39% more than in 1992-1993, rail transit only reaching 10.3 million tonnes, one-quarter of road transit. "Exchange" traffic, which includes either loading or unloading in France and abroad, has increased by 66% over the same period (the border stations used in this survey involved Switzerland, Italy and Spain) with 4,530,000 lorries transporting 57.8 million tonnes.
Despite a trend towards improvement seen in the transport sector in 2000, significant efforts must still be made.

Growth in Goods Transport

Traffic in billions of kilometre-tonnes	1985	1990	1995	1996	1997	1998	1999	2000
Rail	54,2	49,7	46,6	48,3	52,5	52,7	52,1	55,4
Road	102,0	138,1	157,1	158,2	159,8	167,8	182,5	184,7
Waterways	8,4	7,2	5,9	5,7	5,7	6,2	6,8	7,3
Pipelines	24,1	20,5	22,3	21,9	21,8	21,6	21,4	21,5
Total	188,7	215,5	231,9	234,1	239,8	248,3	262,8	268,9

5.4 Industry

Industry is the sector that has generated the greatest energy savings since 1973. Between 1973 and 2000, energy intensity in the steel sector recorded a decrease of 70% and industry (excluding steel), 39%. In the intermediary goods and car industry, added value increased respectively by 20% and 41%; greenhouse gas emissions fell by 15% and 17%. In the food and agricultural industry, added value has increased little, but emissions have increased significantly (+37%). Throughout Industry, the de-coupling is clear: +16% in added value and -10% for emissions.

Coupling / De-coupling between Added Value in Industry and Greenhouse Gas Emissions

% growth 1990 / 1998	Greenhouse effect	Added value
Total industry (excluding energy)	- 10 %	16 %
- food and agricultural industries	37 %	1 %
- consumer goods industries	5 %	0 %
- car industry	- 17 %	41 %
- capital goods industry	7 %	29 %
- intermediary goods industry	- 15 %	20 %
Energy	3 %	19 %

Source: IFEN-NAMEA, based on CIECA data, 2000 – INSEE, National Accounts

5.5 Waste

Total waste production amounts to around 622 million tonnes. Most of it consists of agricultural waste (375 million tonnes) and public works waste (100 million tonnes). In 1998, production of household waste, excluding non-household waste removed by local organisations, was a little more than 1 kilo per inhabitant and per day. The average amount increased by 7% between 1993 and 1998.

Household waste mainly consists of fermentable items and recyclable packaging.

Production of Waste in France (in millions of tonnes)

Public waste[1]	47
- of which household waste	22
- of which recyclable bulky waste	6
- of which community waste	14
Industrial waste	
- ordinary industrial waste	94
- special industrial waste	11
Waste from high-risk hospital treatments	0.15
Public works waste	100
- of which inert waste from the buildings sector	20.8
Agricultural waste	375
Total	**622**

Breakdown of household waste

- Textiles: 3 %
- Metals: 4 %
- Plastics: 11 %
- Glass: 13 %
- Various: 15 %
- Cardboard: 25 %
- Fermentables: 29 %

Source: MATE / ADEME / IFEN, 2000

(1) Of which ordinary industrial waste collected with household waste.

Most household and assimilated waste (almost 49%) is sent to landfill sites. The Law of 13 July 1992 on the elimination of waste stipulates that, from the year 2002, only final waste will be allowed in landfill sites. It will therefore be necessary to arrange for waste to be transported and prepared for re-use or recycling. To this end, the Law stipulates that each department implement a plan for eliminating household and assimilated waste.

Method of Treatment on Household and Assimilated Waste in France

In tonnes	Compost	Storage in dumps	Incineration[1]	Incineration[2]	Holding Stations	Sorting Stations	Total
Household waste	3,071,067	24,616,945	1,582,332	9,711,011	7,999,146	3,707,735	50,688,236
Household rubbish	1,543,639	10,857,995	1,440,837	8,554,052	4,998,951	1,067,882	28,463,356

(1) Incineration with energy recovery
(2) Incineration without energy recovery

5.6 Agriculture

The usable agricultural land (SAU) covers 33 million hectares or 55% of the surface area of mainland France. Agricultural land has been diminishing regularly for half a century. The freeing-up of land benefits wooded areas and non-agricultural land. Usable agricultural land is not spread evenly throughout the country. Based on the ratio between agricultural land and total land per department, a general contrast can be made between the country's two halves, as split by a line running between Bordeaux and Nancy: the northern half is more agricultural, while the southern half contains mountainous areas and most of the poorest agricultural areas. Forage crops have been diminishing constantly to the advantage of the major crops, with an increase in land dedicated to the growth of grains and industrial farming. Fallow land has continued to diminish. The land devoted to permanent farming (vines, orchards) has continued to diminish since the 1980s.

Trend in Usable Agricultural Land

In thousands of hectares	1980	1990	2000[1]
Surface area used, of which:	31,744	30,615	29,883
- arable land	17,472	18,040	18,359
- areas always under grass	12,850	11,363	10,368
- vines, orchards and other	1,422	1,212	1,156
Agricultural land not under cultivation	2,757	2,931	2,845
Poplar groves, woods and forests	14,615	14,828	15,220
Non-agricultural land	5,804	6,545	6,972
Mainland land	**54,919**	**54,919**	**54,919**

(Estimate figures provided end August-beginning September 2001). Source : AGRESTE, 2001.

In 1999, the number of cattle increased by 0.7% after falling between 1996 and 1998. The number of pigs continues to increase. In twenty years, the increase in the number of pigs was nearly 40%. The reduction in the sheep population continued the decline begun in the 1980s.

Development of Livestock

In thousands of animals	1980	1990	1999
Cattle	23,554	21,647	20,097
- of which cows	10,247	9,057	8,896
Pigs	11,610	12,520	15,993
Sheep	13,127	11,071	9,509
Goats	1,263	1,161	1,191
Equidae	361	339	364
Poultry	228,713	260,525	313,325

Source : AGRESTE.

Sales of nitrogen fertilisers, which had levelled off at the beginning of the 1990s, have since recovered rapidly. However, livestock effluent containing nitrogen has tended to stabilise, or even diminish. The nitrates that result from synthetic fertilisers and nitrogen contained in livestock effluent emit N_2O. In 1997, more than 20,000 square kilometres were irrigated, or 7% of the Usable Agricultural Surface Area. Only 5 400 kilometres were irrigated in 1970 and the increase between 1995 and 1997 was more rapid than previously. This increase went hand-in-hand with an increased use of water for agriculture. The amount of agricultural surface area equipped for irrigation was over 20% in sixteen departments (mainly in the southern half of France and in the Beauce region). For the whole of mainland France, 10% of the UAS (27 000 square kilometres) is equipped for this purpose.

5.7 Forests

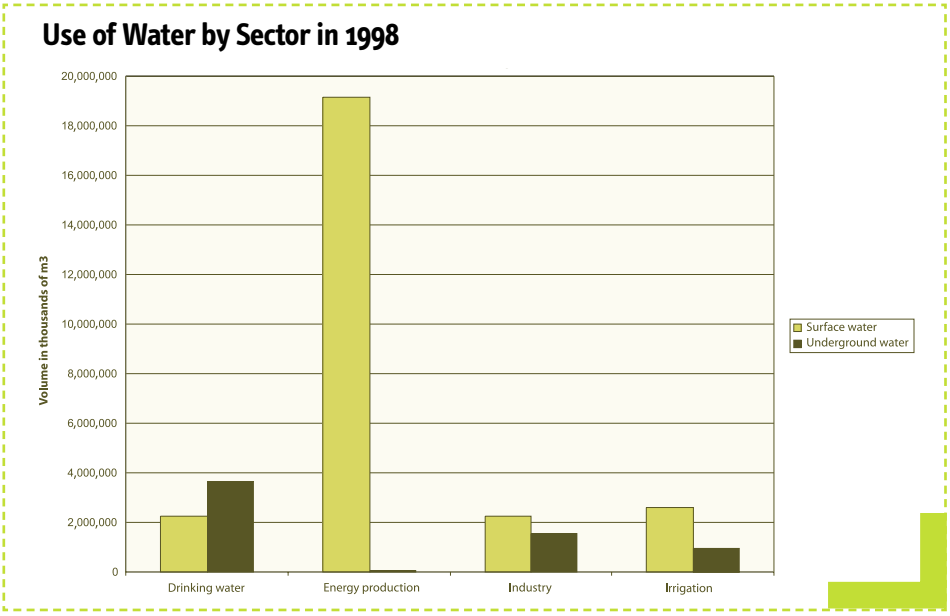
Forests in mainland France are constantly growing. Their surface area increased by more than 507,000 hectares between 1992 and 2000. Forests occupy 27.3% of the country and 2.2% is occupied by wooded areas (poplar groves, copses and scattered trees). French forests are very diverse, reflecting the diversity of the biogeographic conditions in the country. Thus, at least fifteen species have to be included to cover 90% of the forest area. Broad-leaved trees are dominant, occupying more than 63% of the wooded area. Resinous trees and mixed forest respectively occupy 27% and 9% of wooded land.

See Annex IV, "309 Forest Regions on a Natural Scale ", page 193

6 Other National Circumstances

6.1 Use of Water by Sector

Most water is used by power stations. Water from power stations is, however, rapidly returned to its original environment.

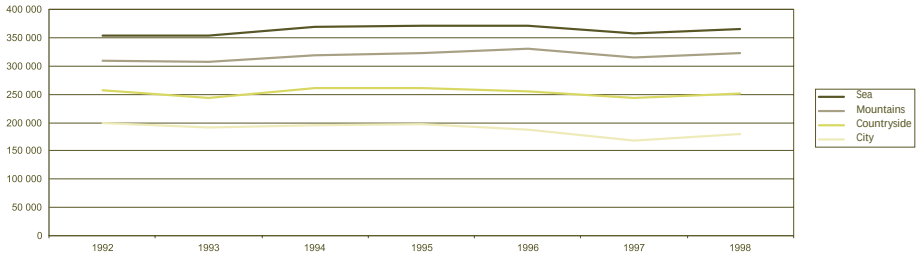


Inventory 2001.

6.2 Tourism

France is the leading tourist destination in the world with 73,042,000 foreign tourists in 2000. The Tourism sector, which represents two million direct and indirect jobs, is the leading beneficiary in the balance of payments. The "Travel" entry in the balance of payments exceeded EUR 15.15 billion (FRF 99.4 billion). Domestic tourism and assimilated tourism consumption amounted to EUR 1.202 million (FRF 1788.6 billion) in 1999. In 1998, a total of 365 million tourist nights were spent by the sea, nearly one-third of holiday nights were spent in the main tourist areas; and a total of 180 million nights (16%) were spent in mountain destinations. Thus any climate change would have a considerable impact on this sector of the economy by changing the coastline and the snow level in the mountains.

Trend in Nights Spent in Personal Stays

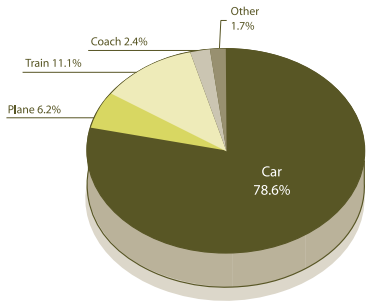


	1/01/92	1/01/93	1/01/94	1/01/95	1/01/96	1/01/97	1/01/98
Sea	353 260	352 879	368 462	371 751	370 583	357 958	365 660
Mountains	199 626	191 262	195 714	196 809	187 749	168 769	179 988
Countryside	309 225	306 976	319 534	322 052	330 281	315 412	322 084
City	257 361	243 859	261 618	260 425	254 592	243 680	251 036

Source: IFEN, according to Department of Tourism / SOFRES, 2000

Cars are the main means of transport, with 79% of the 145 million personal stays in 1997. The train is the main means of public transport used (11% of stays). Planes and coaches are less often used, accounting for, respectively 6% and 2% of personal stays.

Means of Transport Used by the French to Reach their Holiday Destination (1997)



Contribution of Tourist Trips to Greenhouse Gas Emissions

	Greenhouse gas			PRG 100[1]
	CO_2	CH_4	N_2O	
Road transport	14.2 %	9.6 %	26.5 %	14.4 %
All transport	13.4 %	9.5 %	26.1 %	13.5 %
Emissions in whole of France	5.5 %	0.1 %	0.5 %	3.8 %

Sources : CITEPA (Coralie Inventory, SECTEN format; 1994 data plus estimate updated on 5 August 1999).
(1) Global warming potential in 100 years.

CHAPTER 3

Greenhouse Gas Inventory Information

INTRODUCTION

The French inventory on greenhouse gas emissions was produced in accordance with the recommendations issued by CCNUCC, and is presented in Common Reporting Format. It has been made consistent with the model used as the basis for calculating emissions levels, thanks to an interface that assigns each of the basic emissions sources, as defined in the harmonised European inventory, to the corresponding slot in the CRF system. The full inventory, along with a notice on methodology, is included in the annexes. The salient points of the last inventory, which covers the period from 1990 to 1999, presented to CCNUCC in 2001, are analysed hereafter.

1 Overall Trends in Greenhouse Gas Emissions as Compared with 1990

The table below shows the development in emissions from the six greenhouse gases covered by the Kyoto Protocol for the period 1990-1999. These figures include the global warming powers of the different gases. They also include removal by carbon dioxide sinks: this is calculated based on the sink estimation method used by France in the annual inventories of its greenhouse gas emissions.

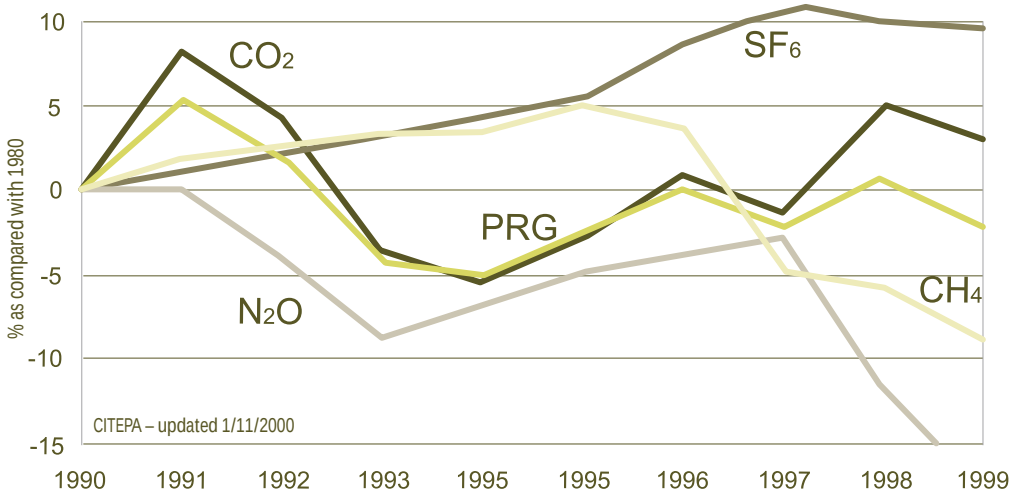
Total greenhouse gas emissions (not taking into account land use, land use changes and forests, LULUCF) in France fell slightly between 1998 and 1999 (- 0.8%). Forecasts for 2000 confirm this trend. On the basis of these figures, France is fulfilling its commitments under the Rio Convention to stabilise emissions from greenhouse gases at the 1990 level. This positive result was mainly due to the reduction in emissions from greenhouse gases other than CO_2 and, in particular, to the willful action taken to reduce emissions from nitrous oxide in the chemical industry. The falls recorded compensate for the slight rise in carbon gas emissions (about 5%). However, it should be pointed out that the increase in greenhouse gas emissions was lower than that of GDP and than that of energy consumption, which means that there has been an overall improvement in GDP carbon intensity. CFC emissions have significantly increased in the case of HFCs used in refrigeration, but PFCs have diminished, thanks especially to the considerable progress made in aluminium manufacturing techniques.

Gaz	1990	1998	1999	Evolution 1990-1999 (%)
CO_2, excluding LUCF	386.0	411.0	405.0	5.0
CH_4 excluding LUCF	63.0	60.0	58.0	- 9.0
N_2O excluding LUCF	89.0	79.0	73.0	- 17.0
HFCs	2.3	3.8	4.8	114.0
PFCs	3.2	1.7	1.9	- 40.0
SF_4	2.2	2.4	2.4	9.8
Total fluorinated gases	7.6	7.9	9.1	19.7
Total excluding LUCF	546.0	558.0	545.0	- 0.2
Total including LUCF	**494.0**	**497.0**	**483.0**	**- 2.1**

Source: Inventory 1998/1999

2 Distribution of Gas Emissions

In 1999, CO_2 emissions accounted for almost 69.5% of total greenhouse gas emissions, CH_4 12.3%, N_2O 16.3%, and CFCs 1.9%. Changes in emissions from the various gases are shown in the diagram below.



2.1 Carbon Emissions

CO_2 emissions over the period 1990-1999 show an overall decline between 1991 and 1994, then a gradual increase to + 5% in gross emissions as compared to 1990.

Some of the explanatory factors include economic activity, climate variations, fluctuations in energy prices and the effects of public policies on the environment and energy management, or sectoral measures.

Transport produces the largest proportion of CO_2 emissions, with 34.3% in 1999, and is also one of the sectors most responsible for the rise in those emissions. Emissions in this sector have been increasing regularly since 1990 (+16%). This constant trend is mainly due to the increase in road (+19.5%) and goods (+37.4%) traffic.

On the other hand, the forecasts for 2000 showed a break in the upward trend of emissions from transport. This development has still to be confirmed: for this, we would have to be able to distinguish between the general economic impact of the increase in fuel prices (+30% at the end of 2000) and the more lasting effects, such as technological improvements in vehicles.

Emissions from buildings have only slightly increased, despite the significant increase in heated surfaces. This positive result can be explained by the stricter regulations on heating in new buildings and energy savings in existing buildings.

Trends in CO_2 emissions in the energy production sector (power stations, refineries etc.) are dependent on the fossil fuel requirements of power stations. These remained stable over the last decade, despite a significant rise in electricity production, thanks to the commissioning of new nuclear power stations. The economic fluctuations can be explained by cold winters, variations in hydraulic production and the availability of other means of production, especially nuclear.

The industrial sector (energy consumption and industrial processes, 1A2 and 2A in the CCNUCC headings) represents 21.7% of CO_2 emissions. After a decline that lasted until 1993, CO_2 emissions

resulting from energy have since tended to stabilise. The absence of an increase in CO_2 emissions – despite sectoral growth as from 1994 – can be explained by structural effects and some improvements in energy efficiency.

2.2 Methane Emissions

Methane emissions in 1999 came mainly from enteric fermentation in ruminants and the management of animal faeces (respectively 46.8% and 6.1% of total methane emissions), as well as from the dumping of waste matter (27.6%). Combustion was responsible for 4.7% of emissions, the extraction and distribution of carbon and natural gas for 7.7%.

Emissions fell by 9% between 1990 and 1999. This trend may partly be attributed to the agricultural sector (enteric fermentation in ruminants, affected by the fall in the bovine population) and partly to fugitive emissions from fuels (modernisation of natural gas distribution networks). Where landfills are concerned, after an increase in the period 1990-1996, there was a turn-around in the trend as a result of the policy for developing retrieval of biogas from landfill sites and of the global waste management policy intended to limit the production of household waste and to avoid putting it in landfills.

2.3 Emissions from Nitrous Oxide

In 1999, nitrous oxide was emitted mainly from agricultural land (65%), by the chemical industry (14%) and by transport (4%). The overall trend was towards a decline in emissions (-17%) between 1990 and 1999. This decline was particularly significant in the chemical industry sector (-60%) and was the result of regulatory action affecting emissions resulting from the production of adipic and nitric acids. The agricultural sector saw a slight fall (-3.3%). However, there was an increase in the transport sector, resulting from the development of catalytic converters. However, the emission coefficients used in inventory methods could lead to significant over-estimates.

2.4 Fluorinated Gas Emissions

After a fall in 1993, due to regulations on the manufacture of HCFC 23, HFC emissions significantly increased afterwards (they are now ten times their 1990 level in mass volume, slightly over twice as much in global warming potential), because of the growing use of HFCs to replace CFCs and HCFCs. Most of the emissions are produced by the refrigeration and air conditioning sector, especially car air conditioning, which is growing rapidly, and aerosols and insulation foams.

PFC emissions come from the first fusion aluminium industry and from the manufacturing of semi-conductors. There was a significant fall in emissions in 1994, thanks to the implementation of a technology that strongly reduced emissions resulting from first fusion aluminium production. Therefore, despite an increase since that time in semi-conductor production and a recovery in the aluminium sector as a result of the expansion of the industry, the level of PFC emissions in 1999 remained below that of 1990.

SF_6 emissions came from transport equipment and electric power distribution, where they increased after 1990 because of increased production of electrical equipment, and in magnesium foundries. The situation observed in 1999 shows a growth of 10% over 1990.

See Annexes I, II, III and IV, pages 194 to 199.

CHAPTER 4

Policies and Measures

France's commitment in the field of policies and measures intended to attenuate climate change began at the beginning of the 1990s at the Rio Conference and the signing of the Framework Convention on Climate Change. Evolving and becoming stronger as international negotiations and expertise on the subject developed, it led to the adoption, in 2000, of the National Programme for Tackling Climate Change (PNLCC) by the Interministerial Commission on the Climate Change (CIES), a body that includes all the Ministers involved in the issue, and is chaired by the Prime Minister.

Elaborated after the Kyoto Conference to enable France to respect its 1997 commitments under the protocol, the PNLCC was designed to enable this objective to be achieved as a priority through domestic political action, that is without having recourse to flexibility mechanisms between States. This does not reflect any form of opposition to these mechanisms, upon which France reserves the right to call "in fine"; however, its decision is intended to show its preference for a real reduction in emissions on its own territory, in compliance with the principle of supplementarity .

The programme consists of around one hundred new measures and takes on previously adopted measures, often adding to them. It makes up the framework for State action against climate change over the 2000-2010 decade. When the programme was adopted, it was decided that the Interministerial Task Force on Climate Change (MIES) would organise a seminar every year to review the implementation of the programme and to announce the concrete implementation decisions on measures or additional measures to be put in place. Following the Kyoto Conference, the government also decided that, as from 1998, it would revive its energy management policy, which was one of the conditions of France's compliance with the commitments made under the Agreement. This fulfilled the need for energy resource diversification in the country, while preserving France's ability to make future energy choices. For this, the government increased the financial and human resources available to the

NOTE ON THE NUMBERING AND PRESENTATION OF MEASURES

In order to make this document easier to read and use in conjunction with the PNLCC, the reference numbers associated with the measures in the PNLCC have been listed throughout the text. The numbering system is based on that of the PNLCC, with a few additions and variations:

◗ the existing measures mentioned in the PNLCC had not been numbered. For greater ease, we have adopted a secondary numbering system that begins with 0, and generally follows the order in which the PNLCC's existing measures appear. The prefix used is that of the sector concerned (I for Industry, T for Transport, etc.);

◗ in the PNLCC, not all of the measures involving the Buildings sector were numbered. We decided to instate a systematic numbering scheme so as to maintain integrity and consistency in the way the measures are presented. These measures are listed under the prefix RT (Residential-Tertiary), along with the corresponding number, where new measures are concerned, in the paragraph where they are mentioned. For example, RT-4.4 deals with the measure covered in paragraph 3.4.4 of the Buildings chapter of the PNLCC (pp. 104-119 of the PNLCC).

Lastly, the existing measures—which are in fact nothing more than background factors or measures that have been revived in a more determined form as new measures—are listed in a special format: letters in non-bold italics, as shown in the following example:

E-0.2 Development of Cogeneration and Wind Energy

As opposed to:

E-2.2 Information and Training for the Promotion of More Efficient Appliances

This format will also be used when referring to various sections within a chapter.

Measures specifically introduced by the PNAEE are listed along with the references of the paragraph in which they are covered:

PNAEE 1) a Energy Information Stands

The charts that list all of the measures make it possible to recognise the measures that had already been presented in France's 2nd National Communication. These are also listed with a number that corresponds to the order in which they appear in this document's summary charts.

In the following sector-based reports, the measures are presented either in the order in which they are listed in the PNLCC or by subject, depending on which is more practical. The listing of the numbers in the margin is intended to make reading sufficiently easy in either case.

As a general rule, quotations of sections from the PNLCC are listed in italics.

All of the quantities of greenhouse gases have been converted into tonnes of CO_2 equivalent (tCO_2e) in order to comply with the technical recommendations issued by UNFCCC. The PNLCC listed them in tonnes of carbon equivalent (tCe). As a reminder, 1 tCe = 3.67 tCO_2e. Lastly $MtCO_2e$ means millions of tCO_2e.

ADEME (Agency for the Environment and Energy Management), in charge of the implementation of energy management and renewable energy development policy. Thanks to the consistent funding of EUR 76 million per year granted by the government and allocated to energy management and development of renewable energies in 1999, ADEME was able to launch an ambitious programme to refocus and intensify its measures in this area, in particular by giving priority to programmes to aid in decision-making. Lastly, on 6 December 2000, the government presented Parliament with the National Programme for Improving Energy Efficiency (PNAEE) which, in particular, implemented a first set of measures scheduled by the PNLCC and which again significantly increased funding for ADEME intervention in this area. In all, ADEME now has a budget for action in energy management and renewable energy development projects of more than EUR 137 million, more than ten times that of 1998.

The PNAEE also aims to secure energy independence and, in particular, to reduce the consequences for our country of the oil crises that periodically shake the world economy.

Lastly, it includes a major communications effort targeting households and small companies, which applies, specifies and completes the PNLCC's principles. In fact, since there has been no national information campaign on energy saving since the middle of the 1980s, the younger age groups in the population have never been made aware of the need to save energy.

1 Energy Production

The emissions covered in this chapter are those resulting from electricity and heat production, as well as escaping methane emissions from coal mines and leaks in natural gas grids. Refined oil and coke products are not included.

The contribution of the energy sector to greenhouse gas emissions in France is fairly low (8%). This is obviously due to the important share of energy produced through hydraulic and nuclear technology.

The general trend in emissions in the sector is rising because of the increase in electricity demand and the foreseeable decline in the share of nuclear energy in total production in 2010.

The choice as to whether nuclear power stations should be re-commissioned or decommissioned will come up massively starting in 2010. It will determine the specific levels of emissions from electricity production in later decades. The PNLCC considers it vital to give priority to actions that control demand, which are the only ones that can both be guaranteed against the effects of increased thermal energy in electricity production and preserve future choices on channels for electricity production.

The measures taken to manage electricity demand (EMD) are dealt with in this section because they will affect the electricity production sector. Of course, EMD actions relating to buildings should be studied in conjunction with the corresponding section. The relations between the various sections are explained to the greatest extent possible.

The topic of district heating systems is dealt with in the "Buildings" section (RT-0.8 and RT-4.4).

1.1 Main Existing Measures and Background

E-0.1 Nuclear Power Stations Connected Between 1990 and 2000

Listed under Number E-0.1, this is more a background item than a measure to fight against climate change, as the decisions regarding the facilities were made before these concerns arose.

E-0.2 Development of Co-Generation and Wind Energy

A target of 4 GW of co-generation was posted for the period 1995-2010. The aim of the development of wind energy, under the "Eole 2001" plan, was to install a production capacity of 250 to 500 MW between now and 2005. These objectives have been significantly increased. They have even been achieved where co-generation is concerned.

E-03 Reducing the Peaks in the Load Curve, Tempo Rate, Demand Management Measures, ADEME / EDF Agreement

E-0.4 Doubling of Incineration Capacity for Household Waste and Ordinary Industrial Waste

The change of direction in waste policy that took place in 1988 led this objective to be called into question. Today, our aim is more to limit waste production and increase the recycling of materials and organic waste, than increase incineration capacity as previously described.

E-0.5 Correction of Negative Effects of the Rate Standardisation Policy in the DOM-TOM (Overseas Departments and Territories), Corsica and Mainland Rural Areas with Sparse Population

E0.6 European Regulation on Energy Efficiency of Electrical Appliances

In line with the control of energy demand, dealt with in this chapter, two European directives, in particular, concerning energy efficiency in electrical appliances, can be cited.

Since 1992, a label indicating, for a given type of appliance, its classification on a scale of energy efficiency between A and G, must appear on appliances at their point of sale. This requirement is governed by Directive 92/75/EEC. Since 1996, Directive 96/57/EEC has restricted the sale of refrigerators and freezers with insufficient energy efficiency. These two directives were respectively integrated into French law by the Decrees of 7 July 1994 and 31 March 1998.

N.B. A more detailed presentation of the problem and the action programme for the years to come are elaborated upon in Paragraph 1.2 – "Action on Energy Demand" hereafter..

E-1.1 Agreements Negotiated with Relevant Industries on Fugitive CH_4 Emissions from Gas Networks

The replacement of pipes in grey cast iron and other pipes with PET/steel piping was furthered so as to continue improving the air tightness of the French gas distribution network. This action is also motivated by safety considerations and normal renewal of the networks, and mainly takes place as part of the normal renovation of sector structures.

By 2010, the policy of systematic replacement of porous pipes in the gas distribution networks will, for the most part, have been carried out and will make it possible to avoid 0.64 $MtCO_2$ emissions per year as compared with 1990.

N.B. This measure had already been mentioned in the 2nd National Communication; which is why it is considered an existing measure herein. However, in the PNLCC it has a new measure number, because it was to be raised in the new planning contract between the State and Gaz de France for the period 2001-2003.

1.2 Agreements Negotiated with Energy Industries

E-1.2 Agreements Negotiated (Nuclear Fuel Cycle and Losses from Electrical Power Cables)

In 1997, the nuclear fuel cycle consumed about 17 TWh of electricity (3.5% of national production). Technical solutions exist to reduce the consumption level significantly; their implementation conditions will be examined.

The Pierrelatte plant houses France's uranium enrichment capacity. In service since the beginning of the 1980s, it uses the uranium enrichment process involving gas diffusion, which consumes a great amount of electricity.

After 20 years of use, the process has become mature and the studies carried out show that only marginal improvements in electricity consumption could be achieved at this time. The plant should not become physically obsolete before it is forty, according to the best estimates. However, the emergence of competing technologies, which incidentally consume far less power, will make it necessary for its economic lifespan to be reduced.

Significant resources are currently being devoted to the study of replacement processes, which, in the long run, could reduce electricity consumption by up to a factor of 50.

Losses in the electricity grids amounted to 30.3 TWh in 2000, or 5.86% of national production. The State authorities concerned are examining measures to reduce their level in the future, in collaboration with the grid manager.

A variety of solutions contributing to a reduction in the volume of losses have already been implemented. The grid managers have opted for technical choices such as the use of higher voltage power lines, an increase in the operating voltage of an existing power line and recourse to underground cables. An agreement signed between the State and EDF gives the preference to these options.

In addition, the Law of 10 February 2000 on electricity-related utilities will give managers and users of the networks greater visibility on the economic impact of the losses. In fact the aforementioned Law stipulates that managers of public transport and distribution networks keep separate accounts that clearly show the cost of energy acquired to compensate the losses. This was not the case when network management operations were combined with those of production. The cost will have to be covered by network-use tariffs to be set by the Electricity Regulatory Commission.

1.3 Action on Electricity Demand

The specific uses of electricity concern the use of domestic or electrical office appliances, ventilation and lighting systems, and pumps and motors. The base scenario is built on the assumption that electricity consumption linked to these specific uses will grow significantly in the housing and service sectors.

The greenhouse gas emissions resulting from these uses are carbon gases (CO_2) from electricity production in thermal power plants (for emissions of fluorinated gases present in refrigeration equipment, see heading "Refrigerant Gases").

The market for the appliances concerned is mainly European. The measures designed to take advantage of potential energy savings are therefore largely reliant on improvements in the equipment-related technology available at the European level. In addition, effective national distribution of materials and equipment with good energy efficiency will be facilitated by specific actions in State buildings, carried on by actions across the country.

E-2.1 European Regulation to Improve the Efficiency of Electrical Appliances Offered for Sale

Numerous and varied appliances are manufactured for specific electricity uses and the configuration of the appliance population is constantly changing because of the emergence of new uses and technologies. Moreover, the energy cost in proportion to the overall cost can vary considerably from one appliance to another. High in the case of motors, it is low for computers.

Considerable savings can be made in electricity consumption, provided that the appropriate investments, which involve low additional costs, be made. These will rapidly be balanced out by the energy savings obtained. However, the investments are not being made spontaneously since contractors and customers do not know the cost of using these appliances.

As regards manufacturers, they do not pay for their appliances' electricity consumption and, therefore, are only concerned about the energy efficiency of their appliances to the extent that demand moves in this direction.

In the area of rational energy use, regulatory work on the energy efficiency of household electrical appliances, which started in 1992 at European level, is continuing. These regulations appear as directives, which are then integrated into French law. They have two objectives:

- raising consumer awareness of energy consumption through mandatory labelling on energy efficiency at the point of sale. Refrigerators, freezers, washing machines, dryers and lamps are currently subject to mandatory labelling. Two new directives imposing mandatory labelling on ovens and certain air conditioning appliances are being reviewed by the competent Community bodies.
- removing the least efficient appliances from the market by setting energy efficiency thresholds.

An energy efficiency threshold has been set for refrigerators and freezers (Directive No. 96.57/EC of 3 September 1996, transposed into French law by Decree No. 98-257 of 31 March 1991). A directive setting an energy efficiency threshold for fluorescent lighting ballast has also been adopted. It will be transposed into French law before the end of 2001.

France is striving to ensure that additions be made to existing European regulations on energy efficiency in household appliances. New draft directives are currently being examined.

In December 2000, during its presidency of the European Union, France succeeded in making the "development of a framework directive on energy efficiency standards, including stricter measures for reducing losses from appliances on stand-by mode" one of the priority actions of the action plan to reinforce energy efficiency in the European Community. At its request, a directive on energy efficiency in buildings was also included and is currently under review. These two projects have been introduced as priority objectives in the European Programme for the Fight Against Climate Change.

At the same time, a series of European standards will gradually have to be developed under Commission mandate. The compliance of an electrical appliance with the standard governing it would be one way to prove compliance of the appliance with regulations.

Moreover, the European Union is also pursuing the path of voluntary agreements with industrialists to improve the energy efficiency of office automation appliances. The agreement between the European Union and the USA aiming at promoting the distribution of the "Energy Star" logo is currently being finalised.

E-2.2 Information and Training for the Promotion of Efficient Appliances

Training the Professionals

Awareness and training actions will be introduced for players in the electrical appliance distribution and installation chain.

Sellers of household appliances, office automation equipment, computer equipment and lighting appliances will be informed of the institutional measures underway to improve the technological characteristics of appliances, so that they can explain to their customers the meaning of the data on the energy label and the energy efficiency labels, as well as provide information on the impact on the greenhouse effect.

The technicians in the sectors involved, and particularly installers and repairers of heating and ventilation equipment, refrigerator specialists and electricians will need to be kept informed of the risks to the global environment of greenhouse gas emissions and of the importance of the technical improvements planned for the equipment in this respect.

User Information

In order to raise public awareness of the importance of managing electricity use in the fight against the greenhouse effect, information campaigns will be carried out to explain, in particular, the role of energy labelling for electrical appliances, labels for electronic and computer equipment, as well as the need to reduce consumption of appliances on stand-by mode

In this area, it should be noted that the first phase of the "Energy Information Stands" programme was implemented in 2001, with co-financing from ADEME. Its purpose is to provide advice and expertise to individuals, small companies and local authorities.

E-2.3 Introducing Requirements Into the Thermal Regulations Relating to Equipment Connected to Specific Uses of Electricity

The energy efficiency of electrical equipment in new buildings for housing and service use is the purpose of this initiative. The areas covered include mainly the use of motors and pumps in all types of building, the lighting of all service sector premises and the common parts of collective housing.

A new heating regulation came into force on 1 June 2001 (see "Buildings" section). It already introduced the use of heating accessories (pumps, extractors) and lighting for the service sector. The reduction in electricity consumption resulting from these specific uses will be continued when the regulation is further reinforced.

E-2.4 Measures Regarding the Property of Certain Owners

For information only. This measure concerns public buildings. See "Buildings" section.

E-2.5 Electrical Work in Existing Buildings

For information only. In the present report, this measure is dealt with in the "Buildings" section.

E-2.6 Tax Measures

For information only. The issue of the energy-carbon ecotax is dealt with in paragraph 7.1 and the issue of VAT in paragraph 7.2.

1.4 Measures on Energy Production

E-3 Substituting Traditional Power Stations with Gas Combined Cycles (GCC) and Co-generation

In the base scenario, part of the electricity demand towards 2010 will be satisfied by traditional coal or heavy fuel production power stations, most of which were built before the 1980s. These units are likely to emit about 27.5 $MtCO_2e$ per year in 2010. Their total replacement by efficient units supplied by natural gas (combined cycle using GCC and co-generation would make it possible to reduce CO_2 emissions by 14.7 $MtCO_2e$ per year (estimate).

Preliminary economic assessments show that the changeover from coal and heavy fuel to natural gas could cost, in the case of fossil coal, between FRF 500 and 1500 per teC (EUR 76 to 229 per teC), that is between FRF 136 and 409 per tonne of CO_2 equivalent (EUR 21 to 62 per $teCO_2$). A tax level of 136 francs per tonne of CO_2 equivalent (EUR 21 per tonne of CO_2 equivalent) would mean that energy replacements would save 5.5 $MtCO_2e$ per year (out of technical potential of 14.7 $MtCO_2e$ per year).

For information on the plan to introduce an energy and carbon tax, see the separate section at the beginning of the chapter.

Moreover, it should be noted that current traditional power stations using coal or fuel were almost all built between 1960 and 1975. Their lifespan is about 40 years, so that most of them should be decommissioned between now and 2010; this is even more likely given the economic factors referred to above. Moreover, the imminent adoption of two EU directives, which aim respectively to restrict emissions into the atmosphere from major combustion facilities and instate national emissions thresholds, will accelerate the decommissioning process of some of the stations.

Lastly, since the end of 1997, the public authorities have adopted a specific policy in favour of the development of co-generation.

Co-generation plants can benefit from fiscal aids:

- exceptional depreciation over 12 months;
- reduction of 50% on corporation tax; this reduction could be increased to 100% by local authorities;
- exoneration from the Inland Duty on Natural Gas (TICGN) and the Inland Duty on Oil Products (TIPP) on heavy fuel with low sulphur levels.

Moreover, the conditions of payment on electricity produced by co-generation were considerably improved in March 1997; an incentive towards energy efficiency has also been implemented.

While waiting for the regulation that is to result from the implementation of the Modernisation and Development Law on Electricity-related utilities, a temporary mechanism for the period 1999-2000 has been introduced. Through it, the additional incentive towards energy efficiency was raised for the most energy-efficient plants. These measures have made it possible to speed up the development of the technology: 3.5 to 4 GW have been commissioned since 1997.

The Electricity Law of 10 February 2000 introduced a new mechanism requiring EDF or non-nationalised distributors to purchase electricity produced by plants using renewable energies or co-generation techniques. The Decree of 6 December 2000 stipulated that the mandatory purchase mechanism could benefit co-generation plants producing less than 12 MW. The Decree of 10 May 2001 established the framework for the specification of purchase conditions and the Order of 31 July specified the tariffs applicable.

These new provisions will enable the development of co-generation to continue.

It has also been suggested that the system for the exchange of emissions credits, which may be stopped for energy-intensive industries, be extended to the electricity sector.

E-4 Development of Renewable Energies

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. It has been intent on making use of this potential ever since the

first oil crisis in 1973. Today it is the leading European producer of Renewable Energies (REN); mainly thanks to wood-fuel and hydro-electricity, France draws 23% of its production of primary energy and 13% of its energy consumption from its renewable sources. The provisional balance for 2000 estimates French production of renewable energies (mainland + DOM-TOM) at 27.5 MTOE.

	Electricity (GWh)	Thermal (Ktep)
Hydraulic	73,587	
Wind	94	
Sun	10	20
Geothermic	21	117
Solid urban waste	1,522	661
Wood and wood waste	1,437	8,948
Harvest residue	378	201
Biogas	346	63
Bio-fuels		335
Total	**77,394**	**10,345**
	In all	**27,527 KTOE**

However, there is still considerable potential to be exploited and determined efforts have been made, mainly since 1998, to emerge from a period of relative stagnation and to develop energies that had been little used until then.

There are three major arguments in favour of developing renewable energies: energy independence and supply safety, economic and social development and the protection of the environment. The policy of distributing renewable energies in France focuses on three goals:

- achieving sustainable results, through a supply-structuring system. The programmes set up are multi-annual with clearly defined objectives and constant resources;
- working in close conjunction with local authorities;
- using public funding as effectively as possible.

France's strategy must enable true structuring of existing production sectors, especially wood, which has particularly high potential in terms of jobs and local development. New sectors, such as wind energy, must rapidly be able to reach a high level of technological and industrial development.

The government's determination has been expressed in a number of measures and actions to encourage renewable energies (tax, regulation). Moreover, the authorities are pushing forward multi-yearly development programmes for these energies, combined with clearly defined objectives and constant resource levels, implemented by ADEME.

Tax Measures Promoting the Use of Renewable Energy Sources

Where individuals are concerned, the combination of a tax credit mechanism and a reduced VAT rate have reduced the cost of purchase of renewable energy production appliances by 15%. For companies, investment in renewable energies will benefit from exceptional depreciation over one year.

New Government Measures to Accelerate the Development of Renewable Electricity Sources

The European Draft Directive for the Development of Electricity Produced from Renewable Resources: adopted under the impetus of the French Presidency in December 2000, the European draft directive aims to increase the proportion of renewable energy sources in European electricity consumption to 22% by 2010. For France, the objective will exceed 20%, as compared to 15% at the present time.

France has also worked to ensure that the text adopted guarantee the existence of national support systems for renewable energy sources, a vital condition for their development, at least initially. The government has taken the following measures to achieve this ambitious objective:

- mobilisation of all the players involved, especially the Regions, through the Collective Energy Scheme;
- financial commitments on the repurchase price of electricity produced from renewable energies;
- reinforcement of the action mechanisms open to ADEME and the Regions.

The objective on the consumption of renewable energies will be part of the multi-annual production programme provided for in the Electricity Law, which is the reference framework for the development of medium-term electricity production plants.

Law N° 2000-108 of 10 February 2000, concerning the modernisation and development of the electricity-related utilities and the new purchase tariffs: the mandatory purchase by EDF and non-nationalised distributors of electricity produced from REN will be a leading instrument for supporting renewable energies. The power threshold below which plants can benefit from this purchase obligation was set at 12 MW by the Decree of 6 December 2000, which corresponds to the maximum threshold provided for by the legislator.

RT-4.2 Solar power for heating

RT-4.3 Geothermics

For information. The issues of geothermal and solar power are dealt with in the "Buildings" section.

E-4.1 Support for the Production of Wind Energy Electricity

The wind energy industry is expanding rapidly world-wide (it is thought that between now and the end of the next century, wind-sourced power could play a part comparable to that of hydraulic power) and its production cost, which is forecast to plunge by 2020, could make it economically profitable by that time. Increased support for this sector is fully justified as a precautionary measure focusing on post-2010; in case nuclear power production should be abandoned or reach its upper limits, wind energy would offer significant prospects for CO_2 savings in 2020, by moving away from fossil-fuel power.

Launched in 1996, the Eole 2005 programme aims to give France wind energy capacity of between 250 and 500 MW by 2005. The 55 projects selected make up total power of 361 MW. Production of wind-sourced power more than doubled in 2000. As part of the additional measures, the government has announced its objective of 5000 MW of power commissioned by 2010, more than three times that provided for initially in the base scenario. The effect of this action in reducing emissions is estimated at 1.8 $MtCO_2e$ per year in 2010, in addition to the 2.6 $MtCO_2e$ per year obtained by previous measures. Tariffs that are conducive to the purchase of electricity from wind energy were published in the Order of 8 June 2001.

E 4.2 Developing Wood Energy

So as to deal with this subject only once, this section looks at the related measures described by the PNLCC in the chapters "Agriculture", "Buildings" and "Energy production".

RT-4.1 Wood Energy

Firstly, it should be emphasised that, currently, wood is very widely used in heating in France, and is, in fact, the leading source of renewable energy today (apart from traditional hydraulic power). It was estimated to at 8.1 MTOE in 1997 (source: Energy Observatory, 1999).

The Development of Wood Energy for Collective Use and District Heating Systems

The development of the use of wood for these uses requires that:

- *investment funding programmes be continued or reinforced;*
- *commercial supply channels be implemented and developed;*
- *the reduced rate of VAT be extended to the supply of heating power using wood (including, where necessary, the connection to a heating grid) (See RT-7.2).*

Maintenance and Development of the Use of Wood Energy in Housing

The actions focusing either on heating appliances or on fuels should be noted:

- *the development of R&D with a view toward improving heating appliances;*
- *the development of information on the efficiency of appliances through the use of labels and promotion of the most efficient appliances;*
- *the development of standards and labels on wood fuel providing information on product quality;*
- *the requirement to equip all new individual housing heated by electricity with a chimney pipe, in line with the Law on Air and the Rational Use of Energy;*
- *a subsidy for the most efficient heating appliances, in the order of FRF 50 million per year (EUR 7.6 million);*
- *the availability of suitable bank products.*

Launched in 1994, the Wood Energy Local Development Plan (PBEDL) aimed to create a sustainable dynamic for wood heating in multi-tenant housing.

In order to achieve sufficient participation levels, the programme concentrated on a limited number of favourable geographical areas, regions and departments, chosen following a call for tenders. In addition to its aim to structure the offering in this area, the programme had established quantitative objectives: 225 MW in wood heating factories, saving 70,000 TOE and creating between 250 and 500 jobs.

At the end of 1999, 155 subsidies were granted for decision-making, thirty projects for structuring wood-fuel supply were carried out and 320 collective wood-powered heating units (190 in the housing-services sector and 130 in industry) were commissioned, 130 of which opened in the year 1999 alone.

Almost EUR 30.5 million of public funding, paid equally by ADEME and the local authorities concerned, were devoted to this programme.

The latter allowed for the installation of wood-burning boilers with overall power of 263 MW, consuming 70,000 TOE of wood per year, and creating 210 local jobs outside the manufacturing industry.

With the extension of the PNEDL, the 2000-2006 wood-power programme fits into the overall framework of the State-Region plan contracts. It focuses on the whole country, including the DOM-TOM, and concerns collective, as well as individual use of firewood.

ADEME and the associated regions are expected to allocate EUR 15.2 million (FRF 100 million) to the measures supporting this plan:

- an investment funding system for the purchase of wood heating units, open to industrial companies and to the housing-service sector. Experimental wood co-generation plants are encouraged for this;
- a system for promoting individual wood heating, based on the certification of heating appliances and the organisation of networks for the distribution of quality wood fuel.

The wood energy programme run by ADEME has the following objectives:

- maintaining domestic consumption of wood at 8 MTOE per year (mainly in the form of logs) and improving the energy yield and environmental efficiency of individual fuel burners by 10%;
- installing 1,000 new collective or industrial wood boilers between 2000 and 2006, thanks to structuring actions on the technology and supply market, in partnership with local authorities and professionals from the wood sector. At the end of 2000, ninety-four new collective and service sector heating units and 48 new heating units in the wood industry had been installed as part of the programme. Total investment in these 142 new heating units in 2000 amounted to EUR 62.5 million (FRF 410 million), EUR 7.3 million (FRF 47.9 million francs) of which came in the form of ADEME grants.

Overall, the total number of wood heating units commissioned since 1994 covers 1 415 plants (515 of which are for collective use and 900 for industrial heating); this represents total power of 2,403 MW (1,970 of which are used by industry).

E-4.2.1 Wood / Electricity Dual Energy

Alongside measures to manage demand and to smooth load curves, in particular using the "Tempo" tariff offer (see E-0.3), for several years, EDF has been promoting, in partnership with ADEME, the use of back-up wood heating solutions (inserts, stoves). This action, originally aimed at new housing, has been extended to housing for sale that requires renovations. It is accompanied by output requirements on the wood heating appliances, which contribute to the positive development of the market.

A booklet entitled "Electricity and Wood Heating Guide" has been published by EDF. It provides details on efficient technical solutions for wood heating and indicates the technical options available to combine electric and wood heating to optimum advantage.

In the year 2000, about 23,000 households were equipped with a wood insert. Twelve thousand new inserts should be installed in 2001.

A-2.4.1 Use of Forest Products to Provide Power

To preserve, and even encourage, wood consumption in individual housing, it is not only necessary to encourage more efficient equipment, but also better understand the cause-effect relationships behind firewood supply in rural areas and consumer demand. It is also necessary that supply be better structured.

In 2000, the wood energy plan led to an increase of 50,000 TOE of wood. ADEME is carrying out studies on the supply of that power.

PNLCC p.136 Storm Annex

The storms of December 1999 brought down large areas of French forest. The PNLCC, adopted one month later, incorporated this new factor and, to some extent, redirected the initially planned policy, especially to make maximal use of the fallen wood.

Apart from the particular emphasis placed on the carrying out of the measures already planned measures and mentioned above, it may be noted that the target regarding new wood-burning heating units was increased.

Raised from 100 to 200, the objective has been attained, as 142 new wood facilities have been fitted.

E-4.2.2. Production of Electricity from Biomass

The use of biomass for electricity production is a long-term strategy, which will significantly reduce CO_2 emissions in the future.

Biomass is generally used for heating. It can currently be put to the following electrical uses:

- biogas-operated engines (landfill sites, purifying stations, food production industries); their installed power capacity is about 50 MW and produces 0.7 TWh;
- co-generation using steam turbines:

190 MW in the DOM using cane-trash and coal and 100 MW in the paper sector;

- incineration of household waste: 90 MW.

At the request of the government, EDF launched a bid for tenders in 1999, following which five projects with total power of 13 MW will be carried out. Other projects are currently being studied.

In addition, ADEME and EDF will finance R&D projects in this area, in particular:

- *on biomass/coal co-combustion, in new LFC-type units or pulverised coal units in conjunction with herbaceous biomass (which has another positive effect – reduction in SO2 emissions);*
- *the combined cycle with prior biomass gasification .*

E5 – District Heating Systems

For information: in the PNLCC this point simply refers readers back to measure RT-4.4.

E-6 The DOM-TOM and Corsica Programme

Because most of the electricity in the DOM-TOM and in Corsica is produced by diesel generators, the development of renewable energies in these regions is of particular interest.

Consequently, the objectives set by ADEME for 2010 include the installation of 80,000 square metres of new solar panels for the production of hot water for washing, the electrification of 500 isolated sites, additional production of 600 GWh per year of electricity from renewable sources (wind: 100 MW; geothermics: 50 MW; small hydraulics: 20 MW) and the development of 10,000 TOE of wood energy per year.

Since then, the objectives set have been reinforced and expanded. The aforementioned measures will be implemented over the period 2000-2006 and 5 to 10 MW of electricity and 10 to 20 MW of thermal energy will be installed through co-generation/ biomass gasification.

2 Buildings, Housing, Services

In the buildings sector, France is continuing its vigorous policy of energy management, which has been greatly reinforced in the last few years. Its main impact is on regulations governing new buildings, but it also concerns existing buildings. It is also based on standardisation work and on information to users through the display of consumption levels. Finally, it has been decided that the use of wood in construction will be increased.

This chapter is organised by topic: the PNLCC measures therefore do not appear in their numbered order. However, particular care has been taken to ensure that all the measures are mentioned here, even when they have already been dealt with in another section.

N.B. Issues relating to fiscal measures, the ecotax on carbon-energy, and wood energy are dealt with in other sections ("Energy production" for the latter).

2.1 New Buildings

RT-0.1 Thermal Regulations (New Buildings)

RT-1.1 Reinforcement of Thermal Regulations

RT-1.4 Reinforcement of Control Means and Procedures

Since 1974, and in close collaboration with building professionals, France has initiated regulations that subject new buildings to heat insulation requirements. These regulations have been regularly reinforced and, in housing, their content has been extended towards a global approach to building that takes into account both thermal efficiency in buildings and that of heating equipment and hot water for washing.

The adoption of these regulations has reduced average consumption in new housing to half the level recorded in 1975. Today, heat savings as a result of the implementation of the thermal regulations in housing is calculated to be 15% of total heat consumption in the housing sector. Because it is not easy to reverse choices made in new buildings, due to the long life span of buildings, and because of the gradual and long-term impact of those decisions on the rate of construction of new buildings, France has decided to progressively reinforce regulatory requirements to prevent the greenhouse effect.

A new heating regulation was published in the French "Journal Officiel" on 30 November 2000 and came into force on 1 June 2001. It reflects an increase of 15% in the energy efficiency requirement on residential housing as compared to the previous 1988 regulation and of 40% for non-residential buildings. In comparison with current good practice which exceed the level of the former regulation, the actual efficiency of service sector buildings increased by 15 to 25%, while that of the housing sector improved by 5% on average.

The scope of regulation has also been extended. In addition to heating and hot water for washing, the regulations also apply to summer comfort in housing without air conditioning (requirement for compliance with a maximum agreed temperature to prevent the subsequent addition of air conditioning). For air-conditioned buildings, the regulations impose mechanisms to reduce consumption. Air conditioning consumption will be taken into account in the calculation, within two years for all buildings. The new regulation also includes lighting consumption for non-housing buildings and use of heating and ventilation accessories for all buildings.

For the first time, the regulations introduce a maximum, incompensable regulatory level for thermal energy bridges. Initially, the threshold has been placed at a level that is not too restrictive, but will be progressively lowered over the course of the opcoming regulatory stages. Thus thermal energy bridges will have to be gradually removed or treated.

Moreover, it should be emphasised that this new regulation is accompanied by a series of methods and calculation software that

integrate the latest European standards. It will thus be easily implemented by building professionals and will make it possible to easily optimise the buildings' thermal energy design. In addition, technical solutions eliminating the need for calculations will be offered to craftsmen and individuals to enable them to build everyday constructions.

As soon as the regulation was implemented, work was undertaken with the professionals concerned to follow the practical conditions of the regulation's enforcement and enable companies to learn the new rules gradually.

Lastly, it is intended that the thermal regulations will be regularly revised, every five years, based on the experience acquired and technological progress. It has been suggested that a 10% increase at each stage be the target.

The new regulations aim to remove certain equipment that is inadequate in terms of efficiency from the new construction market, such as medium- or low-range electric radiators, metal windows without heating insulation and gas boilers with pilot lights.

As they are easier to implement, the regulations should benefit from better compliance. However, inspections will have to be more rigorous, especially for individual housing and the service sector. ADEME has also agreed to finance voluntary inspection of the energy efficiency of buildings, so as to support the use of the new building regulations by the professions. Urban heating and wood heating are to be incorporated into the thermal regulations in October (decree currently being signed). Work has started to include and use solar power in the thermal regulations; it should be completed within the next six months.

2.2 Existing Buildings

The housing and service sector is made up of 27 million flats and houses, 22 million of which are principal places of residence that are constantly occupied and 720 million square metres of heated service sector premises. Most of these – 75% for accommodation and 65% in the service sector – were built before the first regulations on thermal energy in buildings came into force in 1975.

After the first oil crisis of 1973, France developed a vigorous policy for energy management in existing housing and substantial improvements were thus made. Three types of actions were launched:

- decision-making grants intended to encourage contractors to carry out energy-saving renovations;
- a policy to regulate and standardise all components;
- investment funding encompassing several types of action, including direct subsidies and tax incentives.

It has been estimated that energy-management investment in buildings built before 1975, carried out because of the measures taken, resulted in heat savings of about 10 to 20% of total heating consumption.

However, these measures must be continued and made more stringent. Work to improve existing buildings will initially benefit from the indirect effects of the heating regulation, as the regulation will encourage and develop the commercialisation of the most efficient building products and processes.

RT-0.3 Reduced rate of VAT for Work on Old Buildings

In September 1999, the government lowered the VAT rate for improvement, transformation, conversion and maintenance work on housing finished more than two years beforehand by 15 points (from 20.6% to 5.5%). The materials and work within the scope of this measure include renovations intended to control energy consumption and develop renewable energies. This measure partially replaced the system that prevailed during the previous period: income tax reductions only concerned taxed households and were impacted by a maximum reduction ceiling.

RT-0.2 Reductions in Income Tax

At the same time, to complete the system, a new tax credit was instated to benefit certain types of large equipment, which are still subject to the normal VAT rate, and are

supplied as part of renovations on existing housing. The tax credit applies to households, regardless of whether they are subject to income tax, since the credit is paid to those who cannot use it as a tax reduction.
The Finance Law for 2001 has extended this tax benefit to the cost of energy production equipment using a source of renewable energy that is to be fitted in a house which is the taxpayer's main place of residence, whatever the construction date was completed. This measure can be cumulated with the reduced VAT rate mentioned above. In autumn 2001, the benefits from this measure were extended to insulation work in buildings and heating regulation material.
An assessment of the new fiscal system (last two measures) was launched by the government in 2000, in order to measure its impact on energy-saving renovations.

RT-0.4 Exceptional Depreciation for Companies

The exceptional depreciation scheme allows companies to depreciate immediately, over a twelve-month period from the putting into service of the energy-saving equipment purchased or manufactured between 1 January 1991 and 31 December 2002 (Article 39 AB of the General Tax Code). This advantage is restricted by law to equipment mentioned in a list that takes into account technological development, especially in the field of co-generation and reversible air conditioning techniques. The list was modified by decree on 10 February 1999. The Finance Law for 2001 extended the exceptional depreciation advantage to renewable energy production equipment. This list was consequently updated through the Order of 14 June 2001.

RT-0.5 Grant for Housing Improvement

RT-0.6 ANAH Grant

A single body – the National Agency for Housing Improvement (ANAH) – handles all grants designed for private owners (grant for home improvements for owner-occupiers, and subsidies for leasing owners). Total grants for improving private housing will reach FRF 3 billion in 2001. Equipment (boilers, windows, etc.) that contributes to energy efficiency in the building are funded on the basis of their energy efficiency.

RT-0.7 PALULOS

The grant for improving rented accommodation and public housing (PALULOS) helps council lessors to improve all their housing. One hundred and twenty thousand actions are planned in the 2001 budget. Some of them will improve the energy efficiency of buildings.
The recently created legal status of private council housing lessor should also encourage energy-saving renovations in old housing.

RT-6.2 Conditions for Making Grants to the Property Business

The government has continued and reinforced its policy on encouraging energy management renovations. In line with the broader policy for improving existing housing, described in the previous points, work on energy-related aspects is now included, depending on the improvement in energy efficiency achieved, or will be subject to a minimum requirement level to receive the grant applied for.

RT-0.11 Overhaul of Public Housing

Moreover, the budget available for the demolition-reconstruction of public housing has been increased from FRF 140 million to FRF 170 million. This will make it possible to demolish more than ten thousand units per year; they will be replaced by more energy-efficient new or renovated housing.

RT-2 Voluntary Agreements

The "Construction-Environment-Timber" charter is one example (see below, "Wood used in construction"). Possibility of obtaining commitments for the withdrawal of inefficient products from the market.

RT-3.2 Action on Pilot Sector Buildings

As regards service sector buildings, the government seeks to develop voluntary

agreements for improving existing premises with organisations that ask to do so, thereby co-ordinating their action with that of the authorities, with a view to achieving quantified and scheduled objectives for saving energy. In this area, attention should be drawn on the signing in November 2000 of the "Charter on the renovation of existing premises" by the construction professions (CAPEB and FFB), financial bodies and the representatives of the major real estate owners, with ADEME and GGUHC (Department of Urban Development, Habitat and Construction, Ministry for Public Works, Transport and Housing). An agreement has been made with the National Council for Shopping Centres for joint action to improve energy efficiency in shopping centres, as part of the fight against greenhouse gas emissions.

RT-5.1 Pertaining to the Rental Sector

Certain renovations that could lead to substantial energy savings and, as a result, a reduction in heating bills, are not carried out by the owners of rented housing.

The conditions for relieving this situation are under review.

RT-5.2 Distribution of Heating Charges (Co-Ownership Properties and Collective Service Sector)

Where shared heating installations exist, occupants and lessor-owners – even if the problem brought up in the previous point is settled – have no interest in achieving savings if heating costs are shared in accordance with the rule of thousandths (that is, in proportion to the surface area of each apartment), as is most often the case. Likewise, this does not encourage the adoption of energy-saving practices. That is why, in buildings of this type, there is significant over-consumption in comparison with buildings that have individual heating systems. The current rules on the installation of meters that display actual consumption levels in each apartment will be evaluated and adapted if necessary.

RT-6.1 Programmed Operations for Thermal Improvements in Buildings (OPATB)

These operations, initiated by local authorities, will be funded up to a maximum of FRF 420 million over five years by ADEME. The objective is to co-ordinate, in a given area – neighbourhood, town, canton, department – over a period of up to several years, an operation that combines organisation and consulting, traditional action on the part of competent organisations (ANAH and ADEME) and additional grants awarded local authorities. The aim is to achieve general involvement in the renovation of the assets concerned.

ADEME funds energy analyses for service sector buildings and also plans to offer investment grants for work contributing to the energy efficiency of public or private service sector buildings, as part of the action planned to improve thermal heating in buildings.

RT-6.3 Grant System for Service Sector Buildings (FRF 100 million per year)

PNAEE IV) Studying the Implementation of a Fund based on FIDEME's Concept for Financing Renovation

A system is under review; it could take on the form of quasi-equity funding, enabling companies to receive bank loans to which they would not have had access in traditional finance conditions (see below, 1-1.4).

2.3 Standardisation of Building Materials and Equipment

RT-1.2 Technical Standardisation and Regulation of Components
RT-6.5 Support for Labelling Policy (FRF 145 million per year)
RT-8.1 Labelling and Information for the Public
RT 8.2 Environmental Quality of Products Built
RT-9 HQE Approach

Save up at the same time as the new thermal regulations, standardisation work was undertaken at AFNOR, as were life cycle analyses at the CSTB, so as to improve the technical quality of available building products. The authorities are continuing to promote the HQE (High Environmental Quality) concept. Regarding the contractual calculation methods used to determine thermal energy consumption, France emphasises that, at the efficiency levels now required, uncertainty as to the energy efficiency of products and equipment are now a decisive factor that must be taken into account. It is vital to introduce a safety coefficient into the calculations made, as is done in other areas, such as structure calculation. As there is no direct method of calculating the energy efficiency of buildings, certified products and equipment are used to calculate regulated contractual consumption. Moreover, the rules used to calculate the efficiency of insulating materials have been toughened (from a 50 / 50 fractile to a 90 / 90 fractile).

2.4 Information for Users

RT-0.10 Standardised Estimate of Energy Costs

The Law on Air and Rational Use of Energy of 30 December 1996 calls for the implementation of a requirement to supply a standardised estimate of the annual amount of energy consumption charges in housing or premises used by the service sector offered for sale or rental.

The development of a simple method of evaluation for housing, that can be used by an individual or a property agency, is proving to be delicate. Additional work must be carried out to make the calculated contractual consumption level reflect the intrinsic thermal energy quality of the housing with enough precision.

In the non-housing sector, it is impossible to define general rules: consumption analysis will be requested on a case-by-case basis for premises over a certain size. A method for small service sector premises can be based on the method used in the housing sector.

RT-1.3 Audits of Service Sector Buildings in Existence at the Time of Buying or Letting

The aim is to make an energy audit mandatory as soon as a service sector building over a certain size is put up for sale or rental.

This objective reflects the obligation, introduced by the Law on Air and Rational Use of Energy, to supply a standard estimate of annual expenditure on power.

E-2.5 Electricity Work in Existing Buildings

This measure acts as a complement that can support the system by making technical documents describing the equipment available, and making the work carried out on energy savings transparent.

When work is carried out on lighting, pumps and motors (ventilation, lifts, heating accelerators, etc.), the contractor must provide a detailed description of the facilitie carried out. Upon completion of the work, the document must remain available, with a view to future improvements, and as information for future occupants.

For the service sector, energy analysis must be supplied for any sale or rental transaction. It must contain the specific electricity consumption listed above.

2.5 State Buildings

E-2.4 Action on the Assets of Certain Building Owners

In reality, although it is not clear from the title, this measure concerns government buildings, apart from a preliminary reminder of other measures for other owners.

In government buildings, organisational measures in the departments and measures to raise the awareness of managers will encourage the promotion of energy-saving equipment, the optimisation of facilities management and of work scheduling in public purchases. The equipment concerned will be pumps and motors, lighting (fluocompact bulbs, ballast with high energy yield) and equipment for office automation. These measures will be complemented by awareness initiatives targeting all government workers. There is high potential for reducing consumption provided that energy-saving practices are adopted.

It should be noted that the Action Plan for Energy Efficiency and the European Programme for the Fight Against Climate Change include a draft directive on public purchases, which aims to enable the definition of criteria for the choice of efficient products and the issuing of technological calls for tender, intended to encourage the development of new products.

RT-0.9 Projects Involving Government Buildings
RT-3.1 Project on Government Buildings

The various measures taken up to now have shown a certain number of limitations that must now be overcome to reduce emissions from government buildings and to motivate other owners, who also manage significant amounts of property, to adopt similar methods.

Therefore:

- *measures will be taken to organise departments in such a way that concerns over energy efficiency are taken into account; these organisational measures will be complemented by awareness-raising projects aimed at all workers;*
- *technical measures with mandatory periodic audits of energy supply contracts and energy and fluid consumption. (…) Economical equipment and energy will also promoted for public purchase.*
- *measures relating to funding will be implemented (…).*

These three types of measures require the development of a common work method and co-ordination of the efforts and potential of the various ministries. Three of them have a special role to play: the State Secretariat for Industry (MEFI), which is the natural counterpart on energy policy and heads a group of top civil servants responsible for energy; the Ministry of Land Planning and the Environment, responsible for "green development"; and the Ministry of Public Works, which has responsibility for construction and public building and a high-profile presence across the country, which makes it an effective go-between with the local authorities.

MIES will give the Prime Minister a proposal for organising the various departments involved and an operating programme for government departments.

Incentives will be granted to reward highly effective undertakings, in the form of funding for decision-making studies and for the carrying out of a number of exemplary operations.

To provide an example, the Minister for Public Works, Transport and Housing has decided, in conjunction with the Ministry for Economy, Finance and Industry, to improve its property management. Energy savings were selected as the priority topic. The property is managed in a highly decentralised way. An Action Plan will be implemented at the end of 2001 to reinforce understanding of energy consumption in these buildings. As part of this, a list of the various levers that need to be put in place to achieve effective results (methodological and technical support, funding) will be drawn up. In addition to having a direct impact on the property for which it is responsible, the programme is expected to serve as motivation for other managers of public buildings.

2.6 The Development and Use of Wood in Construction

RT-2 Voluntary Agreement on Wood in Building
A-0.1 Timber in Construction
A-2.4.2 Timber in Construction

The Air and Rational Use of Energy Law of 30 December 1996 calls for a decree stipulating the conditions under which certain new structures will have to be built with a minimum amount of timber.

Of the 14.7 million cubic metres consumed annually in France in the form of sawn wood and panels, it is thought that about 12 million cubic metres are used for long-lasting uses (furniture and buildings); this represents a tangible long-term asset of 7.3 $MtCO_2e$ per year, of which about 80% is in building and 20% in furnishings. As a prospective analysis of French consumption of wood showed that there were prospects for significant development in construction, a project in this field is in progress; it includes the following four components:

- development of operations to promote timber in construction. This task has been entrusted to the National Committee for Timber Development (CNDB);
- removal of the factors blocking more widespread use of timber in building through research, development and "ad hoc" popularisation by the Technical Centre for Timber and Furnishings (CTBA);
- development of a strategy for the offering of industrial products or semi-products, using the strength of the sawn wood sector;
- establishment of a permanent monitoring tool that provides reliable information based on market observation and development of the use of timber in building (list of timber products, observatory of building companies that use timber).

Together, the four components gave rise to the "Construction-Environment-Timber Charter", which was signed by the professionals involved and by the government. The charter mobilises all of the forces available. Its objective is to increase the amount of timber used in construction by 25% by 2010. This measure will have three effects on greenhouse gas emissions:

- building with timber uses far less energy than other building methods;
- it enables the storage of carbon over a long period in the form of wood-material;
- it creates new outlets and encourages improved use of the French forest.

The new Forests Law also includes measures to make the "forest-timber" sector more dynamic, thereby having a positive effect on the development of the climate.

In particular, it has been recommended that the gathering of timber for construction be increased by 6 million cubic metres per year; it is therefore necessary to strongly develop the uses of wood and its transformation.

2.7 Other Measures

RT-0.8 Classification of District Heating Systems – Mandatory Connection
RT-4 – Renewable Energies
RT-4.1 Wood Energy

For information. Measures dealt with in "Energy production".

RT-4.2 Solar Power for Heating

Promotion of Solar-Powered Water Heaters in the Overseas Departments

Solar-powered water heaters would be very competitive in comparison with electrical water heaters in the Overseas Departments (DOM), if electricity were sold there at the local retail price and not at the same price as in mainland France, due to principle of standardisation.

To correct the effects of tariff standardisation, ADEME, EDF and the local authorities have joined forces to subsidise solar hot water as part of the "20,000 solar water heaters" operation: thanks to this, users pay 30% less for their hot water, the sector's industries have seen

their business develop, EDF is reducing its losses on sales, and CO_2 emissions and atmospheric pollutant levels are falling. Launched in 1996, the aim of the operation was to install 20,000 solar water heaters in five years, a saving of 10,000 TOE per year, the creation of a hundred local jobs and a one-third drop in the price of water heaters.

As early as the end of 1999, a total of 20,300 water heaters had been distributed under this programme, exceeding the targeted objective. The year 2000 confirmed the success of this operation with the sale of 9,628 appliances, thanks to skyrocketing sales in La Réunion (6,455 solar water heater sales in the year 2000 alone). To date, almost 30,000 water heaters have been sold in the DOM.

Thermal Solar Energy in Mainland France

At the request of the authorities, ADEME brought the Hélios 2006 programme into its operational phase. Its purpose was to distribute solar water heaters and solar water heater systems known as "direct solar platform" in mainland France.

The programme, launched by ADEME in partnership with five southern regions, is expected to gradually extend to all the regions in mainland France.

The Hélios 2006 programme, which was designed as a large-scale version of the action carried out in the DOM, calls for the market to be structured thanks to the implementation of two systems:

- labelling of the equipment eligible for ADEME grants;
- the creation of a "Qualisol" charter, which installers eligible for Hélios 2006 will have to follow.

Counting on the economies of scale that Hélios 2006 is expected to bring about, it has been decided that the equipment grants (presently between EUR 686 and EUR 1143 for an individual solar Hélios 2006 water heater, depending on the size) will be reviewed periodically. The aim of the programme is to install 15,000 solar-powered water heaters and 500 direct solar platforms per year by 2006.

The ADEME intervention budget for the programme is EUR 6.1 million per year.

As of 31 December 2001, six months after the launch of the campaign to promote the "Sun Plan" under Hélios 2006, 185 pre-diagnostic and pre-feasibility studies have been carried out on potential owners. For a budget of EUR 229 000, six hundred and ninety individual solar-powered water heaters (3,000 square meters of sensors have been installed and 110 installations of direct solar platforms have been financed with an ADEME grant of EUR 158,000. Also, 435 installers have signed the Qualisol Charter.

RT-4.3 Geothermal Energy

There are two sorts of geothermal energy in France:

- low-temperature geothermal energy that is used for supplying heat to grids: this field has experienced new growth since 1999, thanks to the extension, in the year 2000, of the long-term guarantee given to geothermal contractors in the Ile-de-France region;
  - extension of the life span of the long-term fund, thanks to additional funding supplied at par by ADEME and the owners;
  - revamping of the operating principles of the long-term fund.

Alongside this fundamental action, for which it has already mobilised EUR 2.3 million in 1999 and 2000, ADEME also launched a series of programmes to support the extension of district heating systems. The ultimate objective is to connect 30,000 additional unit equivalents in Ile-de-France to grids supplied with geothermal power.

- High-temperature geothermal energy, which can also produce electricity – today France has only one production facility, in Bouillante (Guadeloupe). Given the high quality of this site, there are plans to expand the unit to up to 10 MW, on the basis of the results obtained from the drilling campaign and production tests. In addition, prospective studies have been launched on comparable sites in Martinique and Réunion Island.

R&D is also being carried out in this field, on hot dry rocks on the Soultz-sous-Forêt site in Alsace. This is a European programme, which entered its "scientific pilot" phase in 2001, under the leader-ship of an industrial contractor with a GEIE status [Economic Interest Group]. The "pre-industrial" pilot phase with electricity production is planned for 2004.

RT-4.4 District Heating Systems

District heating systems are valuable vectors for exploiting renewable or final energies such as geothermal power, wood energy or waste incineration. As regards competition, they are at a disadvantage due to the application of the reduced-rate VAT on gas or electricity, which is not granted to them. However, the authorities want to develop the use of heat networks based on renewable energies. They are trying to increase the role of renewable energies in supplying existing networks, to promote their expansion while encouraging the reduction of unit consumption of connected housing, and to foster the development of new grids. To this end, the Decree of 5 may 1999 encourages the classification of district heating systems that use mainly inevitable or renewable energies. The classification makes it mandatory for certain buildings to be connected to the grid.

RT-6 Incentive Measures

RT-6.4 Grants for Condensation Boilers for Shared Use

RT-7 Tax Measures

RT-7.1 Environment Tax

RT-7.2 Reduced rate of VAT for the Sale of RES Heat

Services for heat delivery are subject to the normal VAT rate (20.6%), in compliance with Community directives. The application of the reduced rate to these services, preferably restricted to deliveries of heat from renewable resources (wood, geothermal energy, waste incineration), would be likely to encourage the promotion of these methods of production, which produce lower carbon emissions. The reduced rate should be applicable to both the fixed rate (access to services) and the charges calculated according to the amount of power supplied.

RT-7.3 Reduced rate of VAT: Energy-Saving Products and Services

For information. See the section dealing with this issue below (7.2).

3 Transport

Controlling the growth of emissions in the transport sector is the PNLCC's greatest challenge. Already responsible for 22% of total emissions of greenhouse gases in 1990, and 26% in 1999, this sector would account for 27% of emissions in the base scenario in 2010 if no new measures were taken. Moreover, the base scenario already took into account reductions in unit emissions from vehicles, resulting from the agreement between the European Commission and car manufacturers. The impact of the new measures planned by the PNLCC in the transport sector accounts for a quarter of the overall effort of the programme, that is, 9% of the emissions planned for 2010 in this sector. The following-up of these measures will therefore be very important for the success of the PNLCC. With the interministerial development of schemes for public transport services, concerns about the fight against climate change have been totally integrated into transport policy. The directions taken in these service schemes aim to stabilise CO_2 emissions from transport at a level

of about 141 $MtCO_2e$ in 2010 (multi-modal aggressive scenario). The major lines of France's action in this area are:

- technological improvements in vehicles and reduction in unit emissions;
- goods transport policy, especially the development of rail freight;
- policy on inter-city passenger trips;
- policy on city travel;
- transport pricing and taxation;
- relations with users;
- other operations, especially rail and air.

These axes have resulted in very important changes in funding distribution in the Ministry of Transport, resolutely in favour of the least polluting methods. Since 2000, results have been quite obvious in the changes in the distribution of the various methods of transport. Detailed monitoring of the measures planned by the PNLCC can only be carried out on each of the main focal points, at this stage. That is why we will first of all review all the PNLCC measures for each of these main groups and then we will provide the measures taken or planned. We will only rarely give details of the special suggestions for each measure.

3.1 The Role of the Various Partners in the Organisation of Transport in France

The organisation of transport in France is defined in the Law on the Organisation of Internal Transport (LOTI), approved in 1982 and revised several times since then.

The State's major objectives are set out in public transport service schemes, in compliance with the Law on Urban and Regional Planning and Development (LOADT). Corresponding investment projects are generally carried out within the framework of plan contracts (Contrats de plan) over several years between the State and the Regions.

Road Transport

The State is responsible for the national road network. Toll motorways are granted to operators that build, maintain and operate their networks. Other roads in the national network are built and repaired by the State and regional councils as part of the plan contracts between the State and the various Regions. They are maintained and operated by the State. The other roads (within the departments and towns) are enitrely managed by the relevant local authorities.

Rail Transport

The rail network is built and maintained by the French Rail Network (RFF).

The National Rail Company (SNCF) is responsible for operating trains.

Regional Passenger Transport Network

The organisation of regional transport networks is gradually becoming the responsibility of the Regions, as defined in contracts with the SNCF. Public road transport and school run buses are the responsibility of the Departments.

Urban Passenger Transport Network

In major conurbations, the organisation of transport within cities is the responsibility of an urban transport organisation authority for all transport within an urban transport perimeter. In conurbations of more than 100,000 inhabitants, this authority is responsible for developing a plan of urban travel, defining the main travel policy trends. The authority is also in charge of managing public transport within the scope of urban transport. Other actions, in particular regarding roads and traffic, are the responsibility of the various local authorities involved. These measures have to be compatible with the urban transport plan. Conurbations of less than 100,000 inhabitants can develop a UTP (Urban Travel Plan) on a voluntary basis.

3.2 Technical Improvements for Vehicles and Reduction in Unit Emissions

T-0.3.3 Promotion of Electricity-Powered Vehicles and Other Alternative Vehicles

T-1.4 Electrical and Alternative Vehicles

Ambitious measures have been taken to encourage the penetration of alternative vehicles (see insert below).

T-0.1.7 Research Efforts on Vehicles and Transport Organisation

T-0.3.1 Reduction in the Consumption Levels of New Vehicles

T-0.3.2 Technical Inspection of Vehicles

T.1.1.1. Monitoring of Agreements and Future Reinforcements

T-1.1.2 Extension to Lightweight Commercial Vehicles

T-1.1.3 Incentive to Replace Vehicles

T-1.1.4 Other Incentives (Vehicle Labelling, Tax Credits)

T-1.2 Alternatives to Air Conditioning

T.1.3 Controlling HFC Leakage

T-1.6 N_2O Emissions – Catalytic Converters

Technological improvements of vehicles are the responsibility of car manufacturers. However, the French government intervenes at several levels: by monitoring the implementation of the voluntary agreement between the European Commission and car manufacturers, through information to consumers, through technical inspection regulation and through the running of research programmes. A voluntary programme had been signed with French car manufacturers to reduce unit emissions from new

TAX MEASURES

1 - Exceptional Depreciation
Article 39 AC of the General Tax Law allows buyers of alternative vehicles (operating on electricity, natural gas, or liquid petroleum gas fuel) or new electric motorcycles to benefit from an exceptional depreciation, until 1 January 2003, over a period of 12 months. This measure also applies to accumulators, equipment specifically designed to enable the use of electricity, natural gas or liquid petroleum gas, material specifically intended for the storage, compression and distribution of natural gas and liquid petroleum gas, and to charging equipment for electric vehicles, the latter being provided for by Article 39 AE of the CGI.

2 - Reduction of the TIPP and TICGN
As of 11 January 1999, domestic taxes on natural gas and on the special mixture of butane and propane intended for use as fuel, were reduced to Community-wide minimal levels: EUR 10.02 per 100 kilograms (FRF 65.7) on liquid petroleum gas and EUR 8.38 (FRF 54.97) on natural gas for vehicles.

3 - Possible Exoneration from Differential Tax on Vehicles
Article 1599 Fb of the General Tax Law now allows the Conseil Général to fully or partially (up to 50%) exonerate from differential tax all vehicles that operate, whether exclusively or not, on electricity, natural gas or liquid petroleum gas.

4 - Possible Exoneration from Proportional Tax on Registration Certificates of Alternative Vehicles
Likewise, Article 1599 novodecies A (General Tax Law) allows the Conseil Régional to fully or partially (up to 50%) exonerate the aforementioned vehicles from proportional tax.

5 - Exoneration from VAT for Alternative Fuels
Article 298 of the General Tax Law allows users who cannot take deductions on VAT (meaning all users except drivers of buses, taxis and company-owned utility vehicles) to recover 100% of VAT paid on fuels made of natural gas or liquid petroleum gas. Article 273 septies B of the general tax law allows for an exoneration from VAT on electricity consumed for all cars operating only on electricity.

6 - Exoneration from Tax on Company-Owned Vehicles
Article 1010 A of the General Tax Law now provides for total tax exoneration on company-owned vehicles that operate on electricity and natural gas. The exoneration amounts to one-fourth of the total amount when the vehicle operates alternately on superfuel and liquid petroleum gas.

7 - Reimbursement of Domestic Tax on LPG and NGV Consumption
Article 265 sexies of the Customs Law allows operators of public transport networks, garbage trucks and taxis to obtain reimbursement of the TICGN on NGV and of the TIPP on LPG, for up to 40,000 litres per vehicle per year (public transport network) or up to 9,000 litres per vehicle per year (taxis, garbage trucks).

8 - Tax Credit for Vehicles Operating on LPG or Hybrid Systems
Article 200 quinquies of the General Tax Law states that taxpayers who fiscally reside in France can enjoy a tax credit of EUR 1 524 (FRF 10,000) for expenses incurred between 1 January 2001 and 31 December 2002 related to the purchase, first-time lease, or rental for less then two years of a new vehicle that operates exclusively or partially on liquid petroleum gas fuels, or combines electric power and a gas or gasoil engine.

vehicles. This agreement has been replaced by the agreement between the European Commission and all car manufacturers established in the European Union (agreement with ACEA covering 140 grams of 2008, and with Jama and Kama covering 140 grams of CO_2 per kilometre in 2009).

As part of the follow-up to the European agreement, UTAC has been given responsibility for centralising information on new vehicles sold in France. At the same time, as part of the "Nation's Transport Accounts", the government has implemented particularly intensive monitoring of the effective consumption of vehicles circulating in France. It is necessary, in particular, to check whether the unit consumption of French vehicles remains 6% lower than the European average, despite the removal of the car tax disc (annual tax on vehicles in force until the year 2000), and to check whether consumption by the number of cars in circulation is following a development pattern similar to that of new vehicles, as has been the case until now.

The initiative to make technical inspections more rigorous is currently fully operational. The regulations require an inspection on all vehicles over four years old. State-approved inspection networks carry out the inspections. Repairs are mandatory if there are anomalies in pollutant emissions; otherwise the car can no longer stay on the road.

In addition, under PREDIT II, a research programme that brings together the government and car manufacturers, considerable efforts have been devoted to vehicle energy consumption. Studies and research relating to energy account for 27% of public finance (excluding ANVAR), EUR 48.78 million (FRF 320 million) excluding tax, out of EUR 175.32 million (FRF 1150 million). Almost 95% have been allocated to technological improvements. The most significant research has been into improvements in traditional vehicles (internal combustion engines) and new vehicles (hybrid, fuel cell battery, batteries). The fight against climate change is now the priority challenge for the new PREDIT, launched in June 2001.

Contact has been made with French car manufacturers to measure real emissions of N_2O) in recent vehicles, because they may have been incorrectly assessed. France is envisaging applying to the European Commission to integrate N_2O into emission standards.

Emissions resulting from the use of air conditioning have been measured as part of the PREDIT programme. Their analysis is expected to lead to the launch of another action programme.

Discussions have been undertaken at European Union level to foster a change in user habits, so that they buy cars that consume less. Because the market has opened up and users can buy their vehicle anywhere in the EU, it has become essential to harmonise measures.

France has proposed technical specifications to Geneva on an adjustable speed regulator (ASLD), which would enable drivers to remain below their chosen speed. The document received the approval of the technical group of experts and must now be adopted by the EEC-UN WP29, with the prior agreement of the Member States of the European Union. France has set about convincing its European partners of the value of the system, in terms of both road safety and energy savings and will continue its action to improve speed control conditions by the driver or by the vehicle manufacturer.

3.3 Policy on Transport of Goods

T-0.2.2 Development of Intermodal Transport of Goods
T-3.1.4 Combined Transport and Grouping of Shippers
T-2.4 Facilitating Marine Navigation
T-4.1 Organisation of Community Space
T-4.2 Other Aspects of Interurban Infrastructure Supply
T-4.3 Intermodal Facilities for Combined Transport

Inter-city transport of goods accounts for about one quarter of the emissions from the transport sector. If no action is taken, it is thought that the amount of goods transported by road will nearly double between 1996 and 2020, from 214 to 396 billion kilometre-tonnes (km-t). This rise is due in large part to the increase in international traffic and long-distance traffic. That is why the promotion of efficient alternatives to road transport and the long-term preservation of resources and environmental quality are two of the major focuses for public service goods-transport schemes, the implementation of which is to a large extent dependent on concerted action at European Union level. The main actions proposed are:

- organisation of freight rail services on a European scale, that take into account:
  - the economic, social and environmental costs of the various methods;
  - the need to harmonise technical functions and conditions of access of operators to the network;
- development of a national and international rail transport offer, acting as competition to roads, in particular as regards:
  - routes that fulfil client needs (speed and times);
  - improvements in productivity and quality of service in freight transport by rail, without which it could not develop in the long term;
  - capacity increases in rail infrastructure in a certain number of bottlenecks, taking into account the concentration of traffic and its prospects for growth;
- development of potential for sea transport, in particular making reception and development of sea navigation easier;
- full use of the potential of river transport on itineraries where the demand for freight transport remains high, especially those involving large vehicles.

Within this framework, a number of concrete measures have already been implemented;

- the SNCF has started to purchase equipment specially for freight;
- new routes have been cleared for freight, in particular in line with the freight corridors in trans-European networks;
- actions to support the development of combined transport have been continued and reinforced, in line with the PNAEE;
- during France's presidency of the European Union, an agreement was reached on the methods of implementation of the rail package.

The Ministry of Transport is currently developing a plan for complementary measures with a precise schedule, aimed at achieving the objective of doubling rail freight between now and 2010.
The decision was made to experimentally implement a "rail expressway" between Lyons and Turin as early as 2002, with a complete service from 2005-2006.
Actions for developing sea and river transport have also been pursued.
Already, river traffic has increased by 26% since 1997.
Lastly, these priorities are reflected in the way the Ministry of Transport's budgetary allocations have changed (see below).

3.4 Policy of Intercity Passenger Travel

T-0.3.5 Regional Express Travel
T-0.3.6 Development of the TGV Network
T-2.3.1 Management of the Main Inter-city Routes
T-2.3.5 Passenger Information

The rapid development of light vehicle inter-city road traffic has led to an average increase of 4.6% per year on the national route network over the last twenty years. Similarly, air traffic is experiencing strong growth, of more than 10% between 1970 and 1980, 5% between 1980 and 1995, and between 6% and 7% since then. International traffic has risen much more rapidly than internal traffic. That is why the passenger transport service scheme calls for the following measures:

- technical regulation of noise and polluting emissions in vehicles and planes: standards for new vehicles, technical inspections of vehicles in circulation, research on clean vehicles and noise reduction, and certification of aircraft;
- design of new infrastructures and renovation of existing infrastructures, taking into account protection against noise, avoiding sensitive natural environments, limiting breaks with the environment and better incorporation in the landscape;
- promotion of methods of transport that save energy and are low in pollutants, especially rail; this implies the implementation of a transport offer that can compete with the road and which is attractive in terms of quality (times, reliability) and price.

This last aspect has led to reinforced action, since 1988, on the development of rail services for passengers. The investments into new TGV routes (TGV-Est in 2006) were carried on. They allowed for the opening of TGV Méditerrannée in June 2001. Also of note is the increasing success of Thalys (Paris-Brussels) and Eurostar (Paris-London). SNCF is improving the attractiveness of its services – a more dynamic commercial and pricing policy, new services (like the night TGVs that are gradually being introduced).

Decentralisation to the Regions of the organisation of regional transport for passengers has continued. It should lead to a greater balance between the regional express train offering (TER) and customer demand, in particular on home-work commutes. The framework for the decentralisation was set by the SRU Law and should be fully implemented by 1 January 2002.

Action has been taken to manage the main intercity routes, so as to reduce congestion, for many years (the "Bison Futé" operation). They are regularly improved and reinforced, notably following approval of the development plan on the operation of the route and the more recent development plan for road and traffic news.

3.5 Policy on Urban Transport

T-0.1.5 Tolls in Urban Environments
T-0.1.6 Air and UTP Law (Urban Travel Plans)
T-0.3.4 Urban Travel
T-2.3.2 Regulation of Lights and the Progressive Signal System
T-2.3.3 Priority for Public Transport
T-2.2.4 Regulating Urban Fast Lanes
T-3.1.1 Controlling Urban Development
T-3.1.2 Documents on the Urban Environment and in Cities and Localisation of Activities
T-4.4 Public Transport and Alternative Transport Modes
T-3.1.3 Impact of the Waste Management Scheme
T-5.3 Corporate Responsibilities

The development plans on services have insisted on priority being given to the development of urban public transport. This development is based, in particular, on the implementation of Urban Travel Plans (UTP). Revived by the Air Law of December 1996, these encourage:

- a reduction in the use of cars in towns;
- development of public transport and other means of travel, such as cycling and walking, and an improvement in points of exchange between these methods;
- sharing of routes by the various methods of transport.

Taking into account the possible developments in the other sectors (energy production, industry, building), the development plans show that the targets on reducing greenhouse gas emissions also imply a change in urban organisation methods, so as to give users equal satisfaction, all the while limiting the distances covered by car.

Concrete measures have already been introduced:

- a first generation of Urban Travel Plans is being developed by the local authorities. By mid-June 2001, about 40 Urban Travel Plans had been approved, or more than half of those required;
- a methodological guide on the environmental assessment of Urban Travel Plans ("UTPs – Taking into Account Air Pollution, Noise and Energy Consumption") was published in November 1999. It includes the impact on greenhouse gas emissions;
- the first review of the implementation process was carried out at the end of 2000. It precisely analyses the directions taken in a certain number of Urban Travel Plans. It shows a gradual improvement in recognition of environmental concerns. CERTU and GART (Grouping of authorities responsible for transport) have launched a review of a simplified method that would allow environmental concerns to be integrated into existing Urban Travel Plans without gathering additional information.

In addition, it appeared necessary to reinforce the objectives of the Urban Travel Plans. The Law of 13 December 2000 on solidarity and urban renewal (SRU) set the new Urban Transport Scheme objectives, in particular as regards parking, and gives the organising authorities a role in running all the transport in the conurbation. In particular, they will have to foster the elaboration of mobility schemes by companies. The law also instates mandatory compatibility between town planning and travel schemes.

Today the priorities are:

- completion of the Urban Travel Plans that have not yet been approved;
- implementation of the approved Urban Travel Plans;
- integration of the new measures of the Solidarity and Urban Renewal Law in particular concerning travel safety, parking and goods transport in towns.

ADEME is financing preliminary studies for the development of Urban Travel Plans (they themselves being eligible for grants from the Ministry of Transport).

The setting of State subsidies for measures taken by the Urban Travel Plans will encourage their implementation: EUR 76.22 million per year (or FRF 500 million) have been set aside to support local authorities in addition to ADEME funding. They will be managed by the Decentralised State Services (DDE), in conjunction with ADEME's regional delegations. Action in favour of public transport has also been reinforced with FRF 76.22 million per year for the numerous tramway projects. Moreover, some local authorities are considering the development of tram-train projects (vehicles that can circulate both on SNCF lines and on tramways).

The implementation of Urban Transport Scheme observatories and of monitoring indicators in conjunction with CERTU, should make it possible to quantify these efforts. It will be particularly useful to be able to make precise evaluations of the impact of Urban Travel Scheme measures on the evolution of greenhouse gases.

An interministerial mission was set up in 1998 to promote the use of bicycles. Numerous authorities organising inner city transport developed combined cycling/public transport actions (Strasbourg, Paris etc.). In addition, the Minister for Public Works has decided to set up funding for the developing of networks to structure bicycle lanes.

3.6 Pricing and Fiscal Aspects of Transport

T-0.1.1 Catching up on Diesel Taxation
T-0.1.4 Changes in Fiscal Policy on Vehicles
T-3.2.1 Tax on Kerosene Oil
T-3.2.3 Tax Differential between Fuels
T-3.2.4 Fiscal Treatment of Fuel Used by Public Transport
T-3.3.1 Internalising the Costs of Carbon
T-3.3.2 Pricing of Urban Travel

In September 2000, the very significant rise in the price of oil resulted in decisions intended to limit its social and economic impact: the implementation of a "floating" TIPP (Inland Duty on Oil Products) and the suspension of the annual increase of 7 centimes (1.07 cent) in tax on diesel oil as opposed to petrol. At the end of 2002, it was decided that the catching-up process would be suspended until 2002 and the energy-carbon ecotax project was suspended until further notice (see paragraph 7.1).

However, it should be noted that the increase in the price of oil meant that users had to pay much higher prices than those that would have resulted from the originally planned tax increase for fuel or road transport of goods. The increase in the price of fuels, in a sense, occurred without it being necessary to intervene. The effect on fuel consumption is obvious, as was seen in the stagnation in road traffic in 2000, for the first time since the first oil crisis. Recent decisions do not call into question the direction set out in the PNLCC, especially the ultimate objective of reducing the IPOP (TIPP) differential between petrol and diesel and the internalisation of the cost of carbon, as part of the fight against the greenhouse effect, in the fiscal measures on fuel, all the while taking into account the European competition context.

In the absence of a European decision regarding the taxation of energy and an increase in excise, France has had to take account of unfair competition between French and foreign road haulage companies. This illustrates the need for Europe to progress in this respect. Moreover, at least as regards commercial transport, tariff policy is only one of the factors in transport prices; personnel costs also play a significant role in the development of prices. The situation is now such that there is a real risk of road transport being "delocalised" (transport carried out in France by foreign companies). Despite recent advances in the working hours of drivers of road vehicles, additional efforts have to be made to harmonise and manage labour regulations. Lastly, it is necessary that haulage companies be in a position to reflect rises in costs in their prices. This requires that contracts be adapted, something requiring co-ordinated action at the European level. It is vital for the work to be carried out following the publication of the White Paper by the European Transport Commission take into account the objectives relating to the fight against the greenhouse effect. Tighter rules on access to the profession and professional training should enable company directors and main parties responsible to respond more effectively to the challenges of European competition and to absorb the hazards of the economic climate, which are inherent to the market.

It would also be useful to assess the possible impact of the removal of the tax disc, which occurred in 2000, and which was one of the PLNCC's existing measures.

As regards kerosene taxation, France participated very actively in the work carried out by the European Union and the International Civil Aviation Organisation (ICAO). It put forward its preference for a worldwide fuel tax. It took cognisance of the various studies comparing possible solutions (tax on kerosene, adjustable duty depending on the environmental features of planes, voluntary agreements and tradable permits). It will support the adoption of strong measures by the ICAO and the implementation of complementary or alternative measures within the European Union.

3.7 Relations with Users

Road Professionals

T-0.2.1 Regulating and Controlling Working Hours

T-2.1.1 Monitoring of Speed on Heavy-Goods Vehicles

T-2.1.2 Technical Control of Heavy-Goods Vehicles at Roadside

T-2.1.3 Limiting the Speed of Light-weight Utility Vehicles

T-3.2.2 Compliance with Work Rules in Road Transport Professions

T-5.1 Training Professional Drivers

The efforts launched to improve working conditions in road transport have continued. Following the tightening of requirements for entry into the profession, the promotion of the electronic tachograph and the increase of penalties against those who do not respect rules on driving time and rest time, new actions were launched within the framework of the "Progress Contract" and the implementation of the reduction in working time, which had made it necessary to reinforce labour laws on road transport. They were accompanied by measures to reinforce inspections on the respect of the regulations and the corresponding administrative means.

Nonetheless, the progress expected on social harmonisation at the European level has been far from sufficient and does not yet guarantee fair competition between carriers in the various European states. In this area too, France intends to make the issue a priority in the implementation of the European Commission's White Paper on Common Transport Policy.

Private Drivers

T-0.3.8 Controlling Speed of Light-weight Vehicles

T-1.7 Speed Limits on Lightweight Vehicles

T-5.2 Instruction for the Driving License

Improvements in driver training as a whole have been undertaken, with a first drafting of the new knowledge test for driving license applicants, improvements in professional training for driving school teachers and inspectors. In addition, actions to limit speed were reinforced following the October 2000 meeting of the Interministerial Committee on Road Safety, and experiments with the automatic control systems have been launched. France is also continuing its efforts to request the introduction of speed blocks in newly-built cars (see paragraph 4.1).

3.8 Other Actions

Rail Transport

T-1.5 Emissions Specific to Rail Transport

The SNCF will carry out a call for tenders to find more effective diesel motors.

Air Transport

T-0.3.7 Reduction of Emissions Specific to Air Transport

T-2.2.1 Consumption on Airport Platforms

T-2.2.2 Improvements in Combined Use of Air Transport and Public Transport

T-2.2.3 Pre- and Post- Conveyance By High-Speed Train

Direct lines linking high-speed train stations to the airport were set up at the Roissy-Charles de Gaulle and Lyon-Saint-Exupery train stations. Advance check-in was also enabled, most notably on the Brussels-Roissy line.

3.9 A Budget that Resolutely Favours the Least Polluting Modes

T-0.1.2 Financing Methods – FITTVN

T-0.1.3 Allocating Investments to the Various Modes of Transport

The Ministry of Transport's Budget reflects a major change in the financing of the least polluting methods. The FITTVN has been budgeted and incorporated into all of the budget lines related to transport, thus guaranteeing its lasting

effect. In addition, all of the transport lines have been brought together under a single budget, thereby allowing for side-by-side display of the various modes and facilitating future redistribution between the modes.

The State supplies financing of EUR 259 million (FRF 1.7 billion) to rail transport, making for an increase of over 10% as compared to the year 2000. The efforts underway since 1998 to foster the development of rail transport were seen in the doubling of the funding devoted to rail investments, when compared to those of 1997. A contribution of EUR 83.5 million (or FRF 548 million) is intended to fund the restoration and improvement of working railways, also showing an improvement of 10% in 2001, and bringing the total increase in funding devoted to the system to nearly 60%, compared to its 1997 levels.

With an increase of over 60%, loans to aid investment in urban public transport, including loans intended for the development and modernisation of the system, reached EUR 305 million (FRF 2 billion) within the national budget. That amount includes a grant of EUR 84.6 million (FRF 555 million) to aid in the implementation of the Urban Development Plans, as well as to facilitate actions intended to improve, modernise and ensure safety in urban public transport.

Beyond the efforts undertaken to modernise rail infrastructures and restore working railways, the development of alternative modes of transport for freight includes the expansion of integrated transport, which will be the driving force behind the development of rail freight transport. The Budget for 2001 will make it possible to continue the efforts underway to foster this development through:

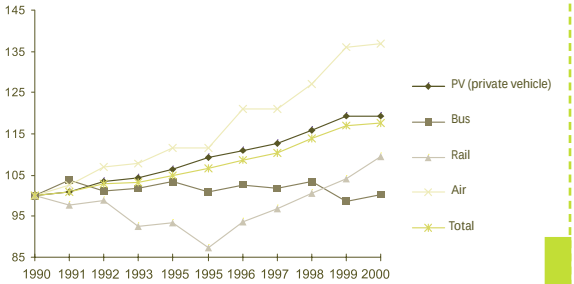
- a contribution of EUR 94.5 million (FRF 620 million) in favour of integrated rail-road transport, intended to compensate for part of the difference between the external costs of rail and roadways;
- a grant of EUR 18 million (FRF 118 million), which will make it possible to finance the construction and redesigning of terminals in order to remedy the overloading of existing terminals on the one hand, and incentives for the purchase of equipment specific to integrated transport, on the other.

The grants given to Harbour Authorities amount to EUR 129 million (FRF 847 million), as compared to FRF 804 million in 2000 and FRF 620 million in 1999. In addition, the economic calculating procedures used to choose projects will soon be updated, following the General Planning Commission's last report, to better take into account environmental problems (and, in particular, the cost of carbon).

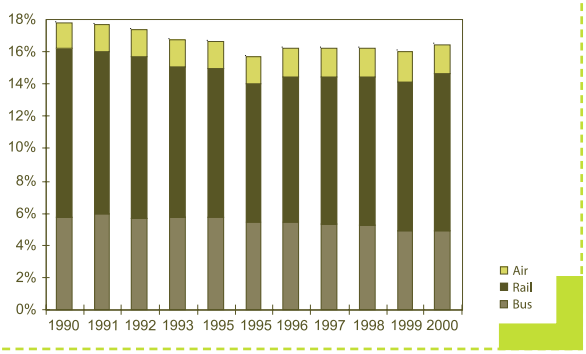
3.10 Concrete Results

Detailed analysis of the first preliminary figures regarding transport in 2000 shows that the actions carried out heretofore are already having a significant effect. Some of the changes that occurred in 2000 were, of course, due to the strong increase in the price of oil, which in turn affected the price of fuel. Nonetheless, the change carries on the trend observed since 1995.

Trends in Passenger Transport (base rate 100 in 1998)

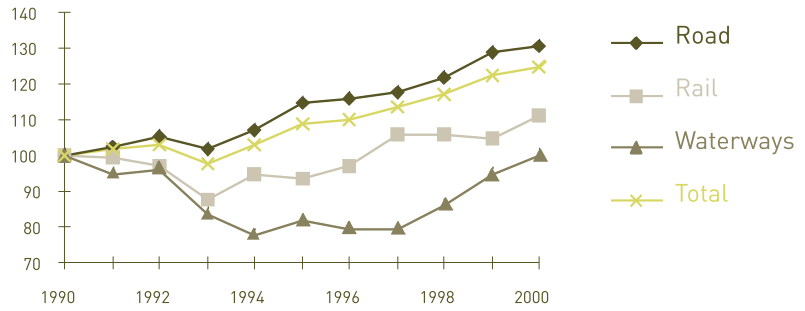


Share of Passenger Transport Not Using Roads



The most visible change is that which occurred in passenger transport: the percentage attributable to railways, after falling to an all-time low of 8.5% in 1995, has grown consistently and reached 9.7% in 2000. In contrast, the percentage of individual transport fell from 84.5% in 1995 to 83.5% in 2000. The trend in freight transport is less distinct, but it must be said that efforts in that field began much later. It is therefore understandable that the effects only become noticeable in 2000. Nonetheless, it is important to take notice of the constant and rapid increase in usage of transport via working railways since 1998 and that of sea freight, which improved by 3.9% between 1999 and 2000.

Trend in Freight Transport (base rate 100 in 1990)



Lastly, as concerns urban public transport, a strong increase is to be emphasised:

- In the Paris region, the Autonomous Parisian Transport Authority (RATP) recorded an increase of 5.1% in the number of passengers per kilometre in 2000, following an increase of 3.2% in 1999;
- In the provinces, we observed a rise of 3.9%, following a rise of 1.9% in 1999.

Overall, we observed, in 2000 and for the first time since 1974, a slight decrease in CO_2 emissions resulting from transport.

These first achievements, which come immediately after the budgetary reinforcements carried out since 1997, confirm the value of the measures taken, and confirm that our objectives in the fight against climate change through policy changes in Transport are, as a whole, being integrated.

4 Industry and Refrigerant Gases

Much like production in this sector, the sources of greenhouse gas emissions in Industry are extremely varied. The data with which we will deal in this chapter include emissions resulting from the production of energy by Industry for its own needs, but do not include the electricity that it purchases. CO_2 is preponderant in these emissions, but N_2O also ranks high on the list. Fluorinated gases (HFCs, PFCs and SF_6) account for 4% of these emissions, just as methane does. However, the latter gas will not be taken into account, as it results almost exclusively from the production of energy (extraction of coal and losses in the gas pipelines).

The data presented are those that resulted from the work carried out by the General Planning Commission. This ensures consistency between past estimates on emissions and projections for the future.

The industrial sector accounts for 23% of greenhouse gas emissions in France.

Industry ranks third amongst the sectors studied.

The emissions generated by Industry result mostly from a small number of branches, said to be "energy-intensive". In the past, these emissions showed a strong decline between 1970 and 1993, then stabilised. After declining by approximately 10% between 1990 and 1993, industrial emissions have now returned to levels closer to those of 1990. During the same period, the output of manufacturing industries increased by approximately 20%.

In addition, the consumption of electricity by Industry, including the steel-making industry, has significantly increased over the past few years, having gone from 18.7 MTOE in 1973 to 28.9 MTOE en 1997. Today, it accounts for 36% of electricity consumption in France.

4.1 Measures Relating to Carbon Gas Emissions

Existing measures

I-0.1 Public Grants in Favour of Industry

The public grants to industry that have a positive effect on the greenhouse effect include the system of exceptional depreciation for energy-saving equipment and grants offered mainly via ADEME and Regional Directorate for Industry, Research and the Environment. In early 1998, the French authorities decided to strengthen their policy on energy efficiency. The resulting decisions are described in further detail in the section on "New Measures", as they were decided upon after the 1997 Programme.

I-0.2 Voluntary Commitments

Several industrial federations have voluntarily committed to reducing greenhouse gas emissions.

In 1996, **Pechiney** committed to reducing the total amount of carbon gas emitted per tonne of aluminium produced by 19%, between 1990 and 2000. It further pledged to reduce CF4 emissions by 73%.

On 19 December 1996, **the French Steel Federation** committed to reducing: total annual C02 emissions by 10% as compared to 1990; specific consumption of agents reducing and combining fossil fuels by 16%; and C02 emissions per tonne of steel produced by 15%.

On 2 July 1996, **the National Syndicate of Manufacturers of Rich and Magnesium Limes**, committed to reducing to 5% per tonne of lime produced, both the quantity of carbon gas emitted (in kilograms of C02 per tonne) and the quantity of thermal energy used (TOE).

The French Cement Industry Union plans to reduce all of its C02 emissions resulting from the consumption of fossil fuels by 25% between 1990 and 2000, making for a decrease of 10% in the same emissions per tonne of cement of products produced (10 October 1996).

The French Mechanical Glassworks Union, which represents the field of glass used in packaging, plans to reduce carbon dioxide emissions by 10% between 1990 and 2005 by recycling glass, improving the efficiency of its glass ovens, and improving the equipment on its dual-energy systems (commitment signed in February 1997). This agreement provides for intermediate objectives to be set every three years, starting from the time of its signing.

Given the pivotal role that Industry plays in setting objectives, on the one hand, and the difficulties inherent to control and individual sanctions, on the other hand, the effectiveness of such agreements where the environment is concerned might be called into question. In light of how ambitious our objectives are for 2010, we do not feel that voluntary commitments of this kind should be given priority by the government as part of the new programme to fight against the greenhouse effect. However, in certain cases, agreements between companies and the State might be used, in particular to limit emissions on the basis of annual objectives, when accompanied by an inspection plan and specific penalties in case of non-compliance.

I-0.3.2 Regulations on Boiler Output

As regards C02 resulting from energy sources, the Law on Air and Rational Energy Use serves as the legal foundation for regulatory action. The decrees issued on 11 and 16 December 1998, designed to enforce this law, rendered mandatory an increase of nearly 10% in the energy output levels of boilers whose power is between 400 kW and 50 MW. It also simplified and modernised the inspection procedures by approved third parties, with which all companies using combustion equipment of over 1 MW must comply. Specific instructions were provided so that this mandatory inspection procedure on large combustion units is better respected. The mandatory inspection of energy-use conditions for major users, which existed previously, has been replaced by an incentive mechanism that offers guidance to SMEs, as part of the work of the Regional consulting grant funds(FRAC).

I-0.4 Existing Taxes Having a Bearing on the Greenhouse Effect

In France, Industry, and especially "energy-intensive" industry, still enjoys special status when compared to other sectors, as stated in the White Paper on the Modalities of Extending General Tax on Polluting Activities to Intermediate Energy Consumption by Companies. The Paper also specifies that companies are often subject to lower taxes in France than in other countries, where energy consumption is concerned.

Regarding natural gas, taxes in France (Inland Duty on Natural Gas Consumption – TICGN) only applies once consumption levels go beyond 5 TWh, with the monthly limit being 0.4 GWh. In fact, of the 400 TWh of natural gas consumed in France in 1997, 126 TWh were subject to the tax. 98% of these 126 TWh were consumed by the 2,900 industrial companies that are subject to the TICGN. Overall, most industrial consumption of natural gas is subject to tax (the TICGN), but at a rate lower than the Community's average of 40%.

As regards heavy fuel and coal, the usage of which mainly involves Industry, the taxes charged in France are either lower than the Community average, as is the case with heavy fuel, or non-existent (as is the case with coal).

New Measures

I-1 Measures Relating to Grants for Industry

The following actions have been listed in ADEME's enterprise plan for the period between 2000-2008, as well as in the National Programme for Energy Efficiency Improvement (PNAEE).

I-1.1 Revival of Aid in Decision Making through ADEME and FRAC

The average annual endowment will be approximately FRF 40 million (EUR 6.1 million), and will be taken out of ADEME's overall budget. The Regional Consulting Grant Funds will also offer credit for this initiative.

I-1.2 Research and Development

This section includes orientation of long-term choices, and improvement of technologies and processes using financial grants for R&D (average annual budget of FRF 20 million, or EUR 3 million).

I-1.3 Technological Demonstrations

This section deals with support for exemplary demonstration projects (average budget of FRF 30 million, or EUR 4.6 million).

I-1.4 New Methods of Financing

Along with the banking sector, ADEME will participate in the elaboration of new methods of financing for companies. The Guarantee Fund for Investments in Energy Control (FOGIME) and the Intervention Fund for Environment and Energy Control (FIDEME) will provide the support needed for investment projects. They will, respectively: guarantee loans that SMEs contract with banks for actions designed to better use energy; and offer support through quasi-equity to projects that are both profitable and

beneficial to the fight against the greenhouse effect, and which would not be able to be benefit from bank financing. When deployed in this manner, the annual investment plan might involve up to EUR 229 million (FRF 1.5 million), 3% of which would come from ADEME, in the form of a guarantee for FOGIME.

I-1.5 A Single Operating Mode for ADEME and FRAC

In order for this programme to have all of the effectiveness that one is entitled to expect of it, it will be necessary for it to be promoted and handled in accordance with a single operating procedure. From the user's point of view, procedures and policies must be completely identical, regardless of whether the funds come from ADEME or from Regional Consulting Grant Funds.

I-2 Regulatory Measures

If necessary, the new regulatory measures concerning CO_2 will be implemented along with a set of tradable permits.

Measures are being taken so that they can be implemented within the framework of the "Best Available Technologies". These are currently under debate within the European Union, as part of the process leading up to the implementation of the IPPC Directive.

It must also be emphasised that not all of the sectors could be addressed. This was, in particular, the case with electrical motors and their output. Normative or regulatory measures will have to be studied regarding the use of industrial electric motors, used for instance, in the circulation of fluids, as well as on equipment for the production of compressed air, machine tools, transport of materials, and refrigeration equipment.

I-3 Taxation of Energy and the Case of Energy-Intensive Industries

In the industrial sector, the PNLCC called for the implementation of tax measures on energy, on the same basis and at the same levels as for other sectors. In light of the events that have taken place in the field of energy since the adoption of the programme, the government has been forced to suspend the implementation of these fiscal measures (see paragraph 7.1).

Our reasoning is based on the context established by the European Draft Directive, which restructures the Community's framework on taxation of energy products, and the contribution of the French government to the Draft Directive, dated April 1999 and known as the French Memorandum.

There exist no regulatory or restrictive measures toward these industries in the proposed Finance Law for 2002. However, the implementation of fiscal measures such as those planned in the PNLCC, and according to the terms listed above, may still occur. We will also make efforts to encourage industrial players to sign voluntary or negotiated agreements as early as 2002, in view of the upcoming establishment of a European emissions permit market, set to take place in 2005, and possible experiments at the national level, starting as early as 2003.

Labelling, Information and Training

I-5.1 Labelling and Standardisation

The continuation and reinforcement of a labelling policy play an important part in policymakers' decisions, especially in highly technical fields such as these. In particular, as was recommended in the Assessment Report on Energy Control, it is advisable to ensure that the requirements for the obtaining of the NF label be designed in such a way that they evaluate actual energetic efficiency in a sufficiently thorough manner. Similar rationale will be used where electrical motors are concerned.

Including energy control amongst the requirements for commercialised equipment is, in our view, an unavoidable step if we are to reduce energy consumption. At the end of 1998, the State Secretariat for Industry requested that AFNOR launch a major standardisation programme on energy control. A Steering Committee, headed by ADEME and composed of representatives from the government and from Industry, was created for this purpose. A General Strategy Document was published in

2000 and a joint action plan was elaborated. The Steering Committee submitted a request to the European authorities so that an equivalent structure could be set up at the European level.

I-5.2 Information for Companies

We will continue to develop actions to inform companies. These actions will have a broader scope than those designed for the Quality Labels. The objective is to allow companies to make their own choices, in particular when replacing heating or combustion equipment or when making new investments, on the basis of up-to-date information about the energy saving and the fight against the greenhouse effect. The areas in which it seems particularly important to make progress include certain equipment or combustion units on which, for the moment, there is not sufficient efficiency-related information. This is particularly true of the combustion units and electric motors used by SMEs.

I-5.3 Training and Qualification

The qualification of workers has a direct influence on the quality and effectiveness of certain measures taken as part of the fight against the greenhouse effect. This is particularly true of the engineers responsible for installing and operating boilers and electric motors in the SMEs. Some topics that might be covered include optimal installation and running conditions for equipment, as well as the choices that must be made to find the most effective materials and the benefits that can result from those decisions for users, in particular where energy saving is concerned.

4.2 Controlling Nitrogen Protoxyde Levels in the Chemical Industry

Existing Measures

I-0.3.1 Regulation of N_2O Emissions

The reference framework for current regulations is composed of: in French legislation, the Law on Air and Rational Use of Energy and the law relating to plants that have been classified as protecting the environment; and, in European legislation, the IPPC Directive, issued in 1996. Where N_2O emissions generated by industrial complexes are concerned (production of adipic acid, glyoxal and glyoxilic acid), the regulations are applied on a case-by-case basis, by order of the prefect, as specified in the legislation on classified installations. An incentive effect on industrial players to treat their waste has been observed. Where the production of nitric acid is concerned, the Ministerial Decree of 1 March 1993, later taken up by the Decree of 2 February 1998, limits N_2O emissions to 7 kilograms per tonne of nitric acid produced.

I-0.4 Existing Taxes

N_2O emissions from industrial sites are currently subject to tax under the TGAP, which amounts to 250 francs per tonne emitted, or EUR 0.125 (FRF 0.82) per tonne of CO_2 equivalent. The same amount applies to other nitrogen oxides. No other specific tax was identified by the Working Group on Industry.

Effects of Existing Measures

Emissions from the various factory floors (production of adipic acid, glyoxylic acid, nitric acid and glyoxal) **developed according to the following trend:**

- In 1990: 89 600 tonnes of N_2O, or **27.8 $MtCO_2e$** (5% of total emissions of greenhouse gases in 1990);
- In 1999, 35,875 tonnes, or **11 $MtCO_2e$**, thanks to the measures adopted under the First Programme for the Fight Against the Greenhouse Effect.

The objectives set regarding **adipic acids** in the 1995 Greenhouse Programme, have nearly been reached: thanks to the opening of a treatment facility in 1997, the level of emissions, which stood at 60,000 tonnes in 1990, fell to 14,600 tonnes. The result appears low because it concerns only one operating facility. However, it does enable significant **reductions** in CO_2 equivalent levels, of **approximately 14.3 $MtCO_2e$**.

New Measures

It is important that these complement existing measures for the reduction of nitrogen protoxyde in the chemical industry by making use of techniques such as thermal cracking and catalytic decomposition. The efforts must extend in the two following directions: maintaining present efforts to optimise waste treatment systems on sites that produce adipic acid, glyoxal and glyoxylic acid; and implementing catalytic waste treatment systems in nitric acid production facilities, with the aim of reaching an optimal efficiency level of 90%. The devices to be used include the legislation on installations classified as protecting the environment (decrees for the enforcement of the 1976 law); the general tax on polluting activities (Finance Law); and the government investment grants, managed by ADEME.

I-2.1 N_2O: Strengthening of Regulatory Requirements within the Framework of the ICPE Legislation

This measure will be implemented through decrees issued by the Ministry for the Environment and by order of the prefect.

I-4.2 Increase in the Generalised Tax on Polluting Activities (TGAP) in the case of N_2O

Very large reductions in emissions, already incorporated into the projections issued under the last programme, are currently being implemented where N_2O emissions of industrial origin are concerned. They are based on the actions implied by the legislation on classified installations. The current tax, which is part of the TGAP, is very low (amounting to approximately EUR 0.125 per tonne of carbon equivalent) and will be increased in order to better reflect the contribution of N_2O to climate warming.

The expected benefits to greenhouse gas emissions include the continuation of reductions already achieved and a reduction of up to 25 $MtCO_2e$ between 1990 and 2010, making for a total emission reduction of nearly 90%.

(As for the actions undertaken since the beginning of the year 2000, they are expected to lead to 6.6 $MtCO_2e$.)

As concerns **the cost of the new measures**, it amounts to **approximately EUR 1.1 per tCO_2e avoided** for the factories producing nitric acid, or an increase of a few percentage points in the production cost of this product. The cost is lower for other materials produced. The table below illustrates these changes.

In tonnes	N_2O Emissions 1990	N_2O Emissions 1990	N_2O Emissions 2010
Adipic Acid	57,500	14,600	12,000
Gyoxylic Acid and Glyoxal	6,400	8,000	500
Nitric Acid	25,600	13,000	1,300
Total	**89,500**	**35,600**	**13,800**
Total CO_2 Equivalent	**28 $MtCO_2e$**	**11 $MtCO_2e$**	**4,3 $MtCO_2e$**

This scenario, as established by the government, reflects optimal levels and must be negotiated with the relevant professional players. The actions will involve mainly:

- **The production of adipic acid:** the objective is to fine-tune the treatment system currently used in Chalampé to offset the possible increase in production levels;
- **The production of nitric acid:** numerous discussions between DPPR, ADEME and the industrial sectors (in particular, the company Grande Paroisse and Hydro Azote) are being held in order to make decisions pertaining to the nitrogen protoxyde treatment facilities. A high-temperature catalytic destruction process has been defined. It is expected to enable a 90% reduction in N20 emissions. Industrial-scale trials are

underway on one of the sites. If the process proves successful, several nitric acid production sites could be equipped with the system. Thanks to this, it is likely that the facilities needed to bring about the expected reductions in N20 levels in the nitric acid production sector will be up and running within a few years, and well before 2010.

4.3 Industrial Fluorinated Gases

With regard to these different industrial gases, a strategy has been defined to take into account the diverse situations of the industries involved, the highly open nature of a certain number of markets (semi-conductors, foams), the need to give priority to **solutions that are effective in the long term,** and the share of each sub-sector in total greenhouse gas emissions. In addition, in each sector, it is recommended that an **integrated approach** be adopted in the fight against the various forms of pollution in order to avoid a situation where a measure intended to limit one pollutant actually fosters the development of another one.

It is nonetheless important to recall, as the Member States of the European Union declared at workshop in Utrecht, that **in the long run, HFCs, PFCs and SF_6 cannot be considered viable substitutes to substances that alter the ozone layer.** This implies that research will have to be an important component of future policies, with a view to ultimately developing technologies that make it possible to do without greenhouse gases entirely.

At the request of the French Ministry for Urban and Rural Development and the Environment, a **study on the potential of actions to reduce emissions in France** was carried out in June 2000 by CITEPA for all of these sectors. On the basis of those results, discussions were launched with the industrial players.

In addition, by the end of 2001, **it will be mandatory to declare, each year, all polluting emissions** from classified installations subject to authorisation. This requirement was established by the European Registry of Pollutant Emissions. This declaration should make it possible to keep track of emissions from substances that result from industrial manufacturing, as well as measure them.

It is also intended that certain measures be taken mainly at the Community level, as a result of the opening of the markets: semi-conductors, foams, aerosols and fire-extinguishing materials fall under this category. The regulatory requirements are expected to act as reinforcements for the measures voted at the European level and, if necessary, as a replacement, when the Community-wide measure cannot be fully executed.

According to a study carried out by CITEPA, the combined effect of these actions is expected to bring about the following reductions in emissions in 2010:

Gas, Application	Recommended measure	Emissions avoided ($teCO_2$)	Cost ($F/teCO_2$)
SF_6 used in magnesium foundries	Replace SF_6 with SOP2 (by voluntary agreement and decrees for the protection of personnel working on the sites	1,365,000	1.75
PFCs in the production of first fusion aluminium	Replace of the anode in carbon with an inert anode (Encourage research with a view toward improving the process in the short term)	855,000 81,000	58.6
SFC and PFCs used in electrical equipment	Reduce gas release during filling procedure and during maintenance operations	1 380,000	123
HFCs used in (non-medical) aerosols	Limit the usage of JFC 134-a to critical applications where inflammability is limited (15% of current use of fluorides)		

Source : CITEPA, 2000

I-2.2 PFCs in the Production of Aluminium

A regulation will be established in co-ordination with the concerned industrial players in order to ultimately limit average PFC emissions (in the present case, CF4) per tonne of aluminium produced (to be studied according to the technologies involved) and guarantee the proper monitoring of emissions levels.

A major technological leap was achieved in 1993, thanks to the completion of a technique using cells with pre-baked anodes and automatic direct supply to the center of the cell. As the situation stands, no additional technological leaps can be expected in the very near future.

Heretofore, no specific measure has been voted upon, seeing as the production of aluminium belongs to the set of incentive measures that are supposed to compensate for an attenuation in the energy component of the TGAP. It is nonetheless possible to foresee two avenues:

- In the short term, measures for the optimisation of the industrial process, which Industry sees as workable at a low cost, should make it possible to reduce emissions by 10% as compared to a scenario in which no measures are taken;
- In the medium term, the continuation of research and development efforts on promising techniques, such as inert anodes, could lead to the elimination of CF4 and C2F6 emissions.

I-2.3 SF_6 and PFCs from the Electronics Industry

Regulations will be established using the 1976 legislation on classified installations for the protection of the environment, with a view, in particular, toward reaching a satisfactory recovery or elimination rate for gases emitted in the new units, but also to ensure proper monitoring of emissions.

In April 1999, all of the employers' unions within the semi-conductor industry, under the aegis of the World Semiconductor Council, signed a unilateral commitment to reduce emissions from fluorinated gases used in the semiconductor industry by 10% as compared to the levels recorded in 1995 (in CO_2 equivalent).

The final report of the European Programme for the Fight Against the Greenhouse Effect (Group 5 – Industry) proposes that this agreement be recognised and monitored at the European level. The very open nature of the markets, which will breed strong international co-ordination amongst industrial players, can but lead to similar co-ordination within the European political arena.

Several written exchanges and meetings have already taken place with French representatives of the semiconductor industry in 1999 and 2000. These led to the conclusion that, at the present time, the reduction technologies that would be the most viable in the long term are not yet operational. It is therefore the duty of the Ministry for Urban and Rural Development and the Environment, along with the Regional Authorities on Industry, Research and the Environment, to perform annual emissions inspections, site by site, and to evaluate to what extent the agreement is being respected and what its prospects are. A review will be carried out in two years' time, taking into account the developments in research and in actions carried out at the European level by that time (see above). If necessary, actions will be decided at the national level, combining voluntary agreements and complementary decrees, within the framework of the legislation on classified installations.

I-2.4 SF_6 in Magnesium Foundries

Regulations will be elaborated in co-ordination with the affected industries, on the basis of the 1976 legislation. The policy on limiting emissions should be applied at two levels. In the short term, a policy to improve the industrial process could be implemented and, if necessary, be bolstered by the regulations intended to reduce consumption of SF_6 per tonne of magnesium produced. At the same time, this should be handled at the European level by developing a "Best Available Technology" under the IPPC Directive. In the medium term, given the high cost of SF_6 and its high global warming potential, it seems advisable to plan for facilities that make it possible to use sulphur dioxide once again as a replace-

ment for SF_6, while fully protecting workers from the emanations. This solution, along with the search for other products that can replace SF_6 appears the most economical in the end for certain sites (see aforementioned CITEPA study).

I-2.5 SF_6 in Electrical Equipment

Given that the number of players concerned is very low and that no replacement product has yet been identified, it will be necessary to reach an agreement on emissions levels. Technical regulations that ensure proper monitoring of emissions and limit fugitive gases, in particular on equipment that is at the end of its life cycle, should be considered when necessary. Discussions held with industrial representatives and EDF provided an opportunity to define the efforts needed from now until 2010. These include measures designed to limit emissions during the production and maintenance of equipment, and to recover SF_6 once the equipment reaches the end of its life cycle.
A voluntary agreement is currently being discussed with the equipment manufacturers (GIMELEC), and could be extended, whenever needed, to include EDF for all matters relating to the transportation and distribution of electricity. If it is not possible to reach a voluntary agreement, or if the said agreements are not upheld, ICPE legislation or other measures of regulatory nature can be used.

I-2.7 HFCs in Foams, Aerosols and Fire-Extinguishing Materials

On the basis of broad foundation studies currently being performed by CITEPA and ADEME, measures intended to limit emissions in these sectors are being examined with industrial representatives. In addition, emissions limits on HFCs (rubric 1185) will be proposed within the framework of the 1976 legislation on classified installations, as will limits on refrigerating and compression equipment (rubric 2920).
As regards the conditioning of fluids in the various types of equipment, the current regulations on classified installations intimate that gases emitted during the production process should be recovered. Annual fluid losses should be limited to 2%. Requirements will thus be adopted, either in the form of decrees that complement the present enforcement decrees, or in the form of decrees specific to the installations subject to mandatory declaration requirements (to be issued by the end of 2001).
In addition, discussions already underway with professionals regarding applications such as extruded polystyrene foams, polyurethane foams and non-medical aerosols are expected to lead to the definition of actions that complement the requirements already existent within the ICPE regulation. Amongst these actions, we will consider the possibility of limiting the use of HFCs to applications where, for security reasons (inflammability if hydrocarbons are used) or other technical reasons, no other fluid can be used. We will also promote products that do not make use of HFCs and encourage the development of recovery facilities for fluids at the end of their life cycle. This type of action will be carried out both at the European level (via the Directive to be adopted) and at the national level.
Already, The European Aerosol Federation has elaborated a Code of Good Practices, regarding the usage of non-medical aerosols. In this document, it sets out the essential uses of HFCs. The extruded polystyrene foam industry has also proposed a voluntary agreement at the European level.

4.4 Refrigerant Gases

Existing Measures

I-0.3.3 Regulations Relative to Refrigerant Gases

The decree issued on 7 December 1992 establishes requirements on the sealing of refrigeration equipment containing more than 2 kilograms of HFCs. It affects approximately 2 500 companies, most of which are of commercial nature.

New Measures

The PNLCC calls for several sets of measures, with the aim of limiting the increase of HFC emissions in the cold storage and air conditioning sectors. Together, and when enforced fully, these measures are expected to ultimately limit emissions to 2.9

$MtCO_2e$, as compared to 8.8 $MtCO_2e$, for a maximal improvement of 5.9 $MtCO_2e$, according to projections established by the Energy Centre at the Ecole des mines in Paris.

F-3.1 Reinforcing Controls

In order to pave the way for broader application of the 7 December 1992 decree, a policy expanding inspection procedures has been issued. Reviews will be carried out, and will be followed by more rigorous inspections in the years to come. The services of private establishments may be used if deemed necessary.

F-3.2 Limiting Emissions from Air Conditioning Equipment in Motor Vehicles

A working group guided by the Ministry for Urban and Rural Development and the Environment is studying measures that will make it possible to limit the increase of emissions resulting from automobile air conditioning systems. The measures currently being considered include the partial extension of the 7 December 1992 decree (prohibiting degasification in the atmosphere while adjustments are being made by engineers and making it mandatory to recover whatever gases are lost), and compliance inspections, along with actions to increase public awareness.

F-3.3 Efforts toward Standardisation

The EN 378 standard is currently being revised, with a view toward ensuring greater quality in the piping systems, and protecting equipment from excessive pressure.

F-3.4 Actions Facilitating the Recovery of Fluids at the End of Life Cycle

The Energy Centre of the Ecole des Mines in Paris performed a study at the request of the Ministry for Urban and Rural Development and the Environment. The study concluded that work needs to be carried out along two lines: reinforcing the 7 December 1992 decree where large equipment is concerned and, specifically, the obligation to recover fluids at the end of the life cycle; and implementing a refund system on fluids that will provide financial incentive for recovery.

On this basis, an interministerial working group is preparing a set of measures that complement the 7 December 1992 decree, in order to establish the accountability of relevant players in the cooling industry, as concerns the recovery of fluids at the end of equipment life cycles.

Alongside that, three types of initiatives should be noted:

- The European Directive of 18 September 2000 regarding vehicles that are no longer in use requires that, when a vehicle is demolished, the fluids be collected and recovered separately, in particular, CFCs and HFCs. A decree is currently being prepared to incorporate this text into French law;
- A European draft directive relating to electrical and electronic equipment at the end of its life cycle is currently being discussed. Its is also expected to cover some refrigerating equipment;
- Lastly, the convention between MATE, ADEME and the cooling professions on the recovery of cooling fluids is currently being revised, so as to make the recovery of fluids at the end of equipment life cycles more appealing.

F-3.5 Training and Qualification of Companies Working on Refrigeration or Air-Conditioning Equipment

A Working Group on the revamping of the 7 December 1992 Directive relating to cooling fluids is studying measures that will make it possible to improve the text's current provisions regarding certification to be issued to companies by the Prefect and the associated qualifying conditions. Training programmes and, if necessary, conditions for qualifying automobile air conditioning operators might also be elaborated.

Amongst the most cogent measures studied by the working group, we should mention the prohibiting of fluid sales to any company not complying with the

conditions defined in the decree. This measure, which has already been applied successfully in The Netherlands, is also expected to be included in the future directive proposed by the European Commission, as part of the European Programme for the Fight against the Greenhouse Effect.

F-3.6 Fiscal Measures

The implementation of a tax on fluorinated gases (which is expected to come as an extension of the air component of the TGAP) and its economic impact on the cooling sector were the focus of a study that was submitted to the Ministry for Urban and Rural Development and the Environment by Dominique Ami, in 1999. This study shows that the tool's effectiveness varies from sector to sector, insofar as the ratio between the cost of cooling fluids and the cost of equipment can vary greatly according to the application used. The same is true of the viability of alternative fluids, which, in order to prevent fires, cannot currently be used in several subsectors of the cooling industry. In addition, the possibility of creating a European taxation system on these gases has been discussed within the framework of preparations for the European programme on the fight against the greenhouse effect. While some countries (Italy and Denmark) are in favour of this, the majority of Member States have stated that they oppose such an initiative.

Given this background, it is more likely that an extension of the TGAP at a very low rate will be included in the upcoming Finance Acts, the purpose being to send a powerful message.

F-3.7 Research and Development

ADEME devotes research resources totalling FRF 10 million per year to this sector, and organises its work along two lines: enabling the usage of existing fluids with greater energetic efficiency; developing fluids with low global warming potential.

In addition, the Energy Centre at the Ecole des mines in Paris is working to develop alloys that have low global warming potential (lower than 700) and are not inflammable.

5 Agriculture and Forestry

5.1 Emissions and Removals in the "Agriculture – Forestry" Sector

Contrary to the other sectors taken into consideration in the programmes designed to reduce greenhouse gas emissions, the fields of Agriculture and Forestry, and the products that result from them, do not only constitute sources of carbon gas, methane and nitric oxide; they also encompass the sinks where carbon gas is absorbed, thanks to photosynthesis.

The use of biomass for energy-related purposes (biological fuels), as a replacement for fossil fuels, along with the usage of biological materials in lieu of other materials with higher energy content but greater polluting potential during their production and usage, also make it possible to reduce carbon gas emissions.

The "Agriculture – Forestry" sector is responsible for nearly 18% of France's overall greenhouse gas emissions.

However, the net increase in carbon stored in UTCFs is not taken into account in this figure. In 1997, they represented CO_2 removal of approximately 10% in the figure quoted above.

The emissions generated by the agricultural sector were relatively stable over the period between 1990 and 1997, and the projections developed heretofore show that this trend should continue until 2010. The net result for the forestry sector, as currently defined by the Kyoto Protocol, in the first commitment period, is expected to be 2.4 $MtCO_2e$ by 2010.

5.2 Main Existing Measures

Agricultural Sector

France's 1997 Programme for the Fight Against the Greenhouse Effect included few resolute actions for the control of emissions in the agricultural sector, as the said emissions had not yet been well identified at the time it was elaborated. However, it did describe the impact of certain changes in agricultural policy on greenhouse gas emissions. These included the continuing intensification of milk production, the relative extensification of bovine production, the increase in production beyond French borders, the development of government policy on storage of liquid manure, limits on the usage of nitrogen-enriched manure (mandatory crop rotation, the fight against nitrate-based water pollution through improvements in fertilisation processes). At the same time, the research and development programme AGRIGES was developed in order to learn more about this sector and, ultimately, be in a position to intervene effectively. This programme received incentive credits of approximately FRF 2.5 million (EUR 381,000) per year from 1992 to 1998. The GICC Programme followed from that.

Lastly, France engaged in an industrial-scale experiment to test new methods for producing and distributing bio-based fuels (ethanol and vegetable oil methylester). This undertaking uses approximately 400,000 hectares of land and reduces emissions by 1 $MtCO_2e$ per year.

Forestry Sector

The actions described in the 1997 programme in this area were built around three main ideas:

- *Storing carbon in forests, through the revival of the policy on afforestation farmland (doubling of the annual rate, with aid possible up to 30,000 hectares per year);*
- *Storing carbon in products from forestry, by developing the usage of wood in the buildings sector;*

Usage of wood energy, in particular for collective heating, within the framework of the "Wood Energy and Local Development" Plan.

5.3 New Measures

A-1.1 Reducing Emissions of CH_4 from Cattle Breeding

In the breeding sector, there exist no viable technical actions that might reduce CH_4 emissions resulting from enteric fermentation in ruminating animals. However, technical solutions do exist to limit CH_4 and N_2O emissions resulting from the handling of excrement from intensive breeding, which will amount to approximately 3.3 $MtCO_2e$ in 2010. The section pertaining to Breeding in the Programme for the Control of Pollution of Agricultural Origin, implemented in 1994, was designed to improve the management of animal waste and to reduce all forms of water pollution, and in particular, water pollution resulting from nitrates. After an assessment of the programme, the Prime Minister decided to adjust its objectives, so as to improve its environmental effectiveness and equity. While it is possible that the increase in storage capacity necessary to avoid spreading during periods where water quality is particularly threatened, may bring about an increase in CH_4 emissions, the improvements achieved in handling nitrate fertilisers will lead to a decline in N20 emissions. *The Ministry of Agriculture and Fishing will review the technologies that make it possible to control these emissions, making use, if necessary, of the appropriate research bodies (INRA, CEMAGREF, IFP, etc.) in order to develop research and development initiatives. Concrete recommendations on how these emissions can be reduced will have to be issued in 2002.*

A-1.2 Reduction of N_2O Emissions in Soils

With the proposed law on water, which is currently being studied, *France is headed toward implementing a fee on excess nitrogen of mineral or organic origin, based on overall production of each farm, in order to protect water from nitrate pollution. This measure would carry the additional benefit of limiting nitrogen protoxyde emissions.*

A-1.3 Integration of Concerns Relating to the Greenhouse Effect in Agricultural Policy

Preliminary analyses show that the way in which the bovine breeding sector is organised (in particular, its degree of intensification) has a strong impact where the emission and removal of greenhouse gases is concerned, through complex interplay of a number of reactions.

The Ministry of Agriculture and Fishing is exploring this topic further, in both its technical and economic aspects, so that the "prevention of climate change" aspect can be fully taken into account as the national support programme for bovine breeding is elaborated.

A-1.4 Actions to Improve Knowledge

This involves, in particular, the following areas:

- *the replacement of fossil-based products with biomass, in particular bio-based fuels (including wood energy), and raw materials for the chemical industry;*
- *options available for limiting CH_4 emissions resulting from enteric fermentation of ruminating animals: taking into account the high volumes involved, this area will have to be one of the main priorities of INRA in the field of bovine breeding;*
- *causes of N20 emissions in soils, the objective being to carry actions beyond the sole topic of nitrated fertilisers;*
- *CO_2 emissions and removal in soils (simplified working of soils, better handling of residues from cultures, promoting the use of compost based on household waste or from sludge made by purification plants, etc.), including the launching of long-term experiments.*

The Forestry and Wood Sectors

A-2.1 Afforestation of 30,000 Hectares of Farmland Per Year

This measure reasserts the increase in grants for the afforestation of farmland, with the aim of reaching an annual rate of 30,000 hectares per year by 2006. The project had to be modified to make allowance for the 1999 storms, but the initial objective will be maintained in the longer term. *The National Plan for French Forests, adopted after the two storms* of December 1999, *provides, in particular, various forms of aid for the replenishing of 300,000 hectares of forest over 10 years. The redistribution of financial and human resources initially led to a decline in the afforestation of farmland, which fell to less than 10,000 hectares per year*, a level that is in compliance with the recommendations listed in the Kyoto Protocol (Article 2.a.II), to the benefit of the forest replenishment effort. The annual afforestation rate is expected to increase and reach approximately 20,000 hectares per year in 2006. Beyond that, the human, technical and financial resources needed to reach an annual afforestation rate of farmland equivalent to 30,000 hectares after 2006 will be re-evaluated in 2005.

A-2.2 Studies, Research and Experiments

It is important to remember that a systemic approach, including sectors such as that of energy, is necessary to identify the true possibilities for reducing greenhouse gas emissions, including all gases and at the national level (in particular, the possibilities of wood energy and wood-material).

THE SUBJECTS THAT REQUIRE FURTHER STUDY INCLUDE, IN PARTICULAR:

- *Economical planting methods for farmland that has already become fallow*
- *Potential for developing trees outside forests*
- *Improvement in the estimates of change in carbon storage resulting from the various land use changes.*
- *Reasons for and possibilities of limiting detimbering.*
- *More systemic studies with a view toward clarifying the overall effect of various agricultural methods, more or less intense production systems and agricultural policies on the warming of the atmosphere.*
- *Studies on analysis cycles of product life span, incorporation dimensions such as land use, transport, potential for change in agrarian systems; possibilities and methods for taking into account, in land exploitation contracts, the production or gathering of wood and various other forms of biomass by farmers.*
- *Studies intended to better quantify variations in flow and storage of greenhouse gases will also be undertaken.*

6 Waste Management

Greenhouse gas emissions from the Waste sector come from two main sources: methane emissions resulting from the anaerobic fermentation processes on landfill sites; CO_2 emissions due to the incineration of waste of fossil origin (mainly plastic matter). The share of the Waste sector in greenhouse gas emissions in France is relatively low, at approximately 3%. The emissions generated by the Waste sector declined by 20% between 1990 and 1997 and, in 2010, are expected to be 25% lower than in 1990, under the impetus of the measures described hereafter. As compared to a scenario "with existing measures", we would achieve a decrease of 4.8 $MtCO_2e$ per year in 2010.

6.1 The Principal Existing Measures

In 1997, France's Programme was *based on strict application of the "Waste" Law adopted in 1992, which was interpreted as prohibiting the storage of any putrefiable waste in dumps starting in 2002. This change was made possible thanks to significant developments in incineration. In addition, it called for important investment efforts where the capture of bio-gases was concerned, a requirement that was to apply to 80% of sites in 2010. Given this background, and seeing as a significant increase in waste production and the share therein of plastic materials was expected, the decrease in CH_4 emissions was more than balanced out by the increase in fossil CO_2 emissions resulting from incineration. Overall emissions generated by the sector were therefore expected to grow from 11.7 $MtCO_2e$ in 1995 to 15 $MtCO_2e$ per year in 2010, whereas the amount of CO_2 emissions avoided thanks to the productive usage of heat generated by incinerators was to grow from 2.2 to 3.7 $MtCO_2e$ per year over the same period.* The latter effect was therefore not significant enough to outweigh the former.

6.2 New Measures

The PNLCC was elaborated on the basis of the new direction given to waste policy starting in 1998.

DE-1 Controlling Waste Production
DE-2 Developing Better Use of Materials and Organic Matter

Recycling half of waste materials into material or organic matter. The remaining quantities to be managed, half by incineration, half through storage, in 2010.

DE-3 Recovery of Heat Produced by Incinerators

An analysis will be carried out on the recycling of energy in each of the various professions, and in particular with a view to developing recycling in the form of heat from the energy produced. It should be noted that the final effect of incineration where greenhouse gas emissions are concerned depends on the way in which the energy will be re-used.

DE-4 Effectiveness of Capture Systems in 2000

Recovery rate going from 60% to 80% starting in 2000. The capturing of methane in waste dumps will make it possible to prevent CH_4 emissions to the tune of 15 $MtCO_2e$ per year in 2010 and 9.5 $MtCO_2e$ per year in 2020.

To complement this, plans have been made to go further in the assessment of capture systems (including the implementation of a campaign to measure CH_4 emissions at dump sites, with a view to acquiring the necessary technical references) and to continue research on the materials, network design, and operating conditions that make it possible to improve capture (exploring the possibility of attaining and surpassing the targeted 80% recovery rate).

DE-5 Assessing the Potential of a Biological Pre-Treatment Method

Such a treatment would make it possible to reduce methane emissions on dumps that are still operating, in other words, before the capture system is implemented.

DE-6 Analysis and Control of Biochemical Reactions on Dump Sites

DE-7 Agronomic Recycling of Organic Waste

This measure involves *studying the level of quality that such an avenue could reach (economic and environmental conditions, acceptability at the local level). Given these conditions, the emissions levels would be the following in 2010 and 2020:*

$MtCO_2e$ per year	2010	2020
Dumps	5.5	4.8
Incineration	4.4	5.1
Energy Replacements	- 2.9	- 3.3
Result	**7.0**	**6.6**

7 Inter-Sector Measures

7.1 Ecological Tax on Energy and Carbon

The PNLCC's centrepiece is the introduction of an ecological tax on energy and carbon. This excise was originally supposed to apply to the intermediate energy consumption of companies starting in 2001, then be extended, over the course of the programme, meaning by 2010, to all forms of energy consumption in all sectors of activity.

Given the rise in the price of oil and natural gas since the programme was adopted, the project was suspended until further notice. The government is working to come up with compensatory factors, which will be based on the reinforcing of the other components of the programme: voluntary or negotiated agreements, national markets for tradable permits, regulations and incentives may be implemented to this end.

The purpose of the ecological tax was to support, via an economic incentive and a strong signal, all of the technical, regulatory, incentive and structural measures planned elsewhere in the programme. In an environment where the price of energy is high, the need to quickly implement a tax-based measure is not as strong, as the incentive to take action is already provided by the market. For this reason, in 2000, we saw greenhouse gas emissions generated by the Transport sector decline for the first time since the first oil crisis. This confirms, in the longer term, the value of such an ecological tax, which might result anyway from the work being carried out at the Community-wide level.

The various measures pertaining to this initial taxation project have been included in this national communication because, over the span of the programme as a whole, they have not been discarded. It is nonetheless appropriate to bear in mind the reservations expressed herein.

7.2 Reduced rate of VAT for Products and Services Contributing to the Fight Against Climate Change

RT-0.3 Reduced rate of VAT on Renovation of Existing Buildings

This measure is dealt with in the section on "Buildings".

Introduced in September 1999, the application of the reduced rate of VAT on improvement works in existing buildings falls under the Community-wide policy on the fight against unemployment. A list of services that are highly intensive in labour has been established by the Union and incorporated into the Directive on VAT as a temporary measure.

RT-7.3 Reduced rate of VAT: Energy-Saving Products and Services

E.2.6 Tax-Related Measures: Reduced rate of VAT

The possibility of developing a complement to existing measures on the application of reduced rate of VAT for the improvement of old buildings remains to be discussed with the Commission and the Member States. The measure would entail extending the already existing measure and giving this extension a very strong impetus toward energy savings and the fight against the greenhouse effect. More precisely, it would mean allowing the temporary or permanent application of the VAT at a reduced rate for all products and services that contribute to fighting against the greenhouse effect. Such a measure would cover materials with a high energy output in the fields of heating, lighting and household appliances.

With regard to the classification system introduced by the "Energy Label" (European Directive 92/75/CEE), certain household appliances in Category A may be eligible, as might certain high-output lighting appliances.

Services that offer assistance in decision-making and guidance might also be eligible, or even certain types of renovation that are not covered by the measures concerning work on existing buildings.

It should be noted that this measure would require that the Member States unanimously approve a modification of the Directive on VAT, and could constitute one of the lines along which the States elaborate a common policy in the fight against the greenhouse effect.

7.3 Energy Information Stands

PNAEE 1) a Energy Information Stands

The aim here is to create a local information network, made up of Energy Info Stands, targeting individuals, small companies and towns. ADEME has taken responsibility for manning the stands, which have been developed gradually, in partnership with local authorities, professional organisations and associations. 500 people will be recruited for this purpose.

7.4 Information Campaigns

PNAEE 1) b National Information Campaign on Energy Control

This undertaking will involve running a national information campaign, via the national and regional media, to make the French people aware of the need to modify their habits where energy consumption is concerned. Over EUR 5 million (FRF 32.8 million) will be set aside for this campaign.

EXISTING MEASURES

PNLCC #	2°CN or PNLCC #	NAME OF MEASURE	OBJECTIVE AND/OR ACTIVITY TARGETED	GHG TARGE-TED	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING ENTITY	Mt CO_2 1995	Mt CO_2 2000	Mt CO_2 2005	Mt CO_2 2010	Mt CO_2 2015	Mt CO_2 2020	SECTORS AFFECTED	COST
MANAGING ELECTRICITY DEMAND															
E-0.1	20	Nuclear Investments	Energy substitution	CO_2	Investment decisions on EDF's part	In force	EDF		46	46	46	46	46	Energy	
E-0.2.1	21	Development of Co-generation	Energy substitution, with a target of 4 GW in 2010	CO_2	Mandatory purchase of electricity produced through co-generation	Underway	EDF		5,8		3,7		4,4	Energy	
E-0.3	22	Reduction of Peaks on Load Curve	Energy substitution, CED, by broadening the scope of the Tempo rate and using an ADEME-EDF agreement	CO_2	Pricing, public incentives and pricing	Underway 30,000 Tempo subscriptions recorded in 1996, EDF/ADEME agree-ments dated 1993 and 1996	Ademe, EDF		1,3		1,8 à 2,9			Energy	
E-0.5 E-0.6	24	Reduction of the Negative Effects of the Standardisation of Electricity Rates	Energy substitution, CED in Corsica, in the overseas departments and territories and in certain rural areas	CO_2	Government aid	Underway	EDF		0,04					Energy	FRF 100 M/year under the FACC
E-1.1	32	Leakage from Natural Gas Grids	Reduction of fugitive methane emissions	CH_4	Investment decisions on the part of GDF	Underway	GDF	0,34	0,43	0,54	0,64	0,64	0,64	Energy	
E-0.2.2 E-4.1	26	Development of Wind Energy	Energy substitution (EOLE 2005 programme)	CO_2	Regulation	Underway. Reinforced by the objectives of the PNLCC	Minefi				0,7			Energy	
A-0.2.3 RT-4.1.1 RT-4.1.2 E-4.2.1	27	Wood Energy	Energy substitution (wood energy plan and local development)	CO_2	Government grants, contracts with local authorities	In force	Map-METL		0,2	0,2	0,2	0,2	0,2	Energy	FRF 1 500 over 1995 and 1996
A-I.4 in part	28	Bio-based Fuels	Energy substitution by developing the production of agricultural biomass for energy-related purposes	CO_2	Government grants, tax regimes	In force	Map		1					Energy	
E-0.4	34	Increase in Incineration Capacity	Energy substitution	CO_2	Equipment, regulations	Achieved (1992 Law on Waste, which sets limits to dumping of non-reu-sable waste)	Mate							Energy	
BUILDINGS, HOUSING, SERVICES															
RT-0.1	1, 2	Thermal Regulation	Improvements in energy efficiency in buildings (also applies to new services buildings)	CO_2	Regulations	Decree adopted on 29 November 2000	METL		0	0,9	1,5		2,4	Construction	
RT-0.10	3	Display of Energy Consumption in Buildings	Reward improvements in energy efficiency in buildings	CO_2	Regulatory	Planned	METL							Construction	
RT-0.2 RT-0.5 RT-0.6 RT-0.7	4	Financial and Tax-Related Incentives for Work on Existing Buildings	Provide incentive for work that improves energy control, reduce IR, State grants for home improve-ment, ANAH and PALULOS grants (PNLCC, p. 103)	CO_2	Economic instruments	Adopted	METL, Minefi		1,5	2,2	3,7		6,6	Construction	FRF 2 500 million in 1992
RT-09 RT-3.1	5	Actions on State-owned Buildings	Improvements in energy efficiency	CO_2	Regulatory	Initiated			0,7	0,7	0,7		0,7	Construction	
A-2.4	7	Development of the Usage of Timber in Construction	Carbon storage outside of forests, reduction CO_2 fossil emissions	CO_2	Information, research and regulations	Initiated	Mate				2,6			Construction , Agriculture	

4 Policies and Measures

PNLCC #	2°CN or PNLCC #	NAME OF MEASURE	OBJECTIVE AND/OR ACTIVITY TARGETED	GHG TARGE-TED	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING ENTITY	Mt CO_2 1995	Mt CO_2 2000	Mt CO_2 2005	Mt CO_2 2010	Mt CO_2 2015	Mt CO_2 2020	SECTORS AFFECTED	COST
RT-0.3	NM	Reduced rate of VAT forImprovement of Old Buildings	Encourage home improvement; reduced rate of VAT on improvements of housing older than two years	CO_2	Fiscal	Inquiry into the DLF of 15 September 1999	Minefi							Construction	
RT-0.8	NM	Classification of District Heating Systems	Improve energy efficiency by requiring new housing to be connected to the heating grid	CO_2	Regulatory	Planned	METL, Minefi							Construction	
RT-0.11	NM	Improvement of Existing Housing. Institutional Actions Concerning Road Freight	Improve existing housing	CO_2	Economic	Underway	METL							Construction	
TRANSPORT															
T-0.2.1 T-3.2.2	11	Institutional Actions Concerning Road Freight	Establish the best competitive conditions for freight through regulations, inspections on driving time and sanctions. Profession-wide progress contract	CO_2	Regulation	Regulation voted in 1993	MTEL							Transport	
T-011 T-3.2.3	NM	Recovery of Fiscal Dues on Gasoil and Increase of Minimum Tax Levels on Fuel	Reduce the gap in taxing on gasoil and gas to meet the European average, and change tax measures on fuel at the European level	CO_2	Fiscal regime	Initiated	Minefi							Transport	
	10	Technical Arrangements Relating to Heavy-Goods Vehicles	Reduce specific emissions through technical inspections and mandatory reconditioning	CO_2	Technical regulation	Enforced	METL			1,5	1,5		1,8	Transport	
T-0.2.2 T-3.1.4 T-4.3	12	Development of Inter-Modal Freight Transport	Develop inter-modal transportation alternatives, by using grants and technical measures (financing provided by FITTVN)	CO_2	Combination	Underway	METL		1,3	2,6	3,3		5,9	Transport	
T-0.3.1 T-1.1.1 T-1.1.2	13	ACEA Agreement	Reduce emissions from individually-owned cars	CO_2	Voluntary agreements	ACEA Agreement of 27 July 1998. Conclusions from the Council approving the agreement: 6 October 1998	European Commission, METL, Mate		0	5,1	10,3		17,2	Transport	
T-0.3.2	14	Technical Inspection of Light Vehicles	Reduce polluting emissions by making repairs mandatory	CO_2	Regulation	Decrees dated 5 July 1994 and 1 January 1995	METL		4,4	3,7	3,1		2,9	Transport	
	15	Renewal of Vehicles in Use	Bolstering renewal of cars in use by offering a government premium for retiring cars older than 10 years	CO_2	Economic	Measure in effect from 30 June 1995 to 31 December 1999 not renewed	METL							Transport	
T-0.3.3 T-1.4	17	Alternative Vehicles	Broaden use of alternative vehicles	CO_2	Law on Air, fiscal measures	Underway. Objectives far from being reached (in particular electric vehicle	METL				1,1		1,8	Transport	
T-0.1.6 T-3.1.1 T-3.1.2 T-4.2 T-4.4	18	Urban Transport	Optimise urban transport through the implementation of UTPs and local initiatives	CO_2	Law requiring local authorities to establish UTPs	Law on Air and Rational Use of Energy from 30 December 1996 – circulars dated 27/01 and 13/05/98 on UTPs	METL, local authorities				2,6		4	Transport	
T-0.3.6	19	High-Speed Trains	Offer an alternative to road and air transport	CO_2	Combination, including investment	Underway	METL, SNCF		0,4	0,5	0,6		0,8	Transport	
T-0.3.5	T2	Regional Express Transport	Improve conditions in daily travel	CO_2	Investment, infrastructures	Underway	METL, SNCF							Transport	

PNLCC #	2°CN or PNLCC #	NAME OF MEASURE	OBJECTIVE AND/OR ACTIVITY TARGETED	GHG TARGE-TED	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING ENTITY	Mt CO_2 1995	Mt CO_2 2000	Mt CO_2 2005	Mt CO_2 2010	Mt CO_2 2015	Mt CO_2 2020	SECTORS AFFECTED	COST
T-0.3.8		Limiting Speed in Lightweight Vehicles	Road safety and energy consumption	CO_2	Inspection and repression	In force	METL							Transport	
T-0.3.7		Reduction of Emissions Specific to Air Transport	Improving air travel in Europe	CO_2	Technical measures, invest-ments	In force	METL, Eurocontrol							Transport	
INDUSTRY															
I-0.2	8	Voluntary Commitments	Reduction in emissions	CO_2, fluorinated gases	Voluntary agreements	Five agreements have been signed (aluminium, steel, lime, cement and glass)	Mate		4,4	4,4	4,4	4,4	4,4	Industry	
I-0.1, I-0.3, I-1 RT-0.4	9	Supporting Measures	Energy efficiency. Grants from ADEME-FRAC, regulations on boilers, etc.	CO_2	Economic, fiscal, regulatory	All in force, compliance to be checked	Minefi, Ademe				0,4		0,7	Industry	
I-0.3	33	Regulation on N_20 Emissions from Industry	Reducing industrial emissions of N_2O	N_2O	Regulation	Decrees of 1 March 1993 and 2 February 1998	Préfectures		22,9	22,9	22,9	22,9	22,9	Industry	
I-0.4, I-4.2	23	Tax on Nitric Oxide Emissions	Pollution control	N_2O N_2O	Fiscal	In force – TGAP	Map							Industry	
AGRICULTURE AND FORESTRY															
A-0.1 A-1.2	34	Control Spreading of Nitrogen Fertilisers	Indirect reduction of N_2O emissions	CO_2	Regulation, information, increasing awareness	In force	Map		2,5					Agriculture	
A-0.2.1	25	Afforestation of Farmland	Expansion of carbon sinks (policy decision to timber 30,000 hectares of farmland per year)	CO_2	State Grants	No financing, objective reiterated by PNLCC	Mate		1,3		2,5		3,66	Forestry	FRF 65 million in 1995
WASTE															
E-0.4	29	Conversion of Waste into Energy	Energy substitutes (doubling the incineration capacity of OM)	CH_4	Legislative measure	Law on Waste dated 13 July 1992	Mate		1,3	1,3	1,3	1,3	1,3	Forestry	
DE-3	30	Ban on Dumping of Ordinary Waste	Reduction in CH_4 emissions	CH_4	Legislative measure	Law on Waste dated 13 July 1992, circular dated 28 April 1998	Mate		3,35		12,2		15,55	Waste	
DE-4	31	Recovery of Methane at Dump Sites	Reduction in CH_4 emissions		Regulatory measure	Decree dated 9 September 1997								Waste	

ADDITIONAL MEASURES

PNLCC #	2°CN or PNLCC #	NAME OF MEASURE	OBJECTIVE AND/OR ACTIVITY TARGETED	GHG TARGE-TED	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING ENTITY	Mt CO_2 1995	Mt CO_2 2000	Mt CO_2 2005	Mt CO_2 2010	Mt CO_2 2015	Mt CO_2 2020	SECTORS AFFECTED	COST
District Heating Systems are dealt within the "Buildings" section.					**ENERGY PRODUCTION ELECTRICITY DEMANDE CONTROL**										
E-1.2.1		Consumption in the Nuclear Fuel Cycle	Energy efficiency	CO_2	EDF investment decisions	Adopted	Minefi / Electricity Department								
E-1.2.2		Losses in Electricity Lines	Reduction in losses from electrical lines	CO_2	EDF investment decisions	Adopted	Minefi / Electricity Department								
E-2.1		Promotion of a European Regulation to Improve Electrical Appliances Intended for Public Sale	Changing European regulation	CO_2	Regulation	Initiated	Minefi / Serure				1,3			Construction	
E-2.2		Promotion of Energy-Efficient Appliances	Energy savings	CO_2	Information	Adopted	Ademe								
E-2.3		Specific Regulation on Electricity and Heating	Regulation in the field of lighting and pumps	CO_2	Regulation	Initiated	METL							Construction	
E-2.6		Reduced rate of VAT on Products and Services	Encourage renovations that slow the green-house effect in existing buildings	CO_2	Tax measures	Initiated	Minefi				0,9				
E-3		Substitutes for Traditional Heating	Replacement of fuel- and coal-powered electri-city plants with gas plants	CO_2	EDF Investments	Initiated	Minefi / Electricity Department				5				
E-4.1	26	Production of Wind Energy	Encourage the production of wind energy by establishing a minimum purchase price for electricity distributors (reinforcement of an existing measure)	CO_2	Regulation	Enforced	Minefi				2,6				
E-4.2.1	27 part	Production of Heat: Wood, Electric Heating and Tempo rate	Encourage the development of wood heating in lieu of electric heating in rural areas with sparse population	CO_2	EDF Pricing (Tempo)	Initiated	Minefi (et Ademe-METL)								
RT-4.1.1		Wood Energy for Collective Purposes, District Heating Systems	Continuation of the Wood Energy Plan, with an increase of 50,000 TOE in 2000	CO_2	Grants, tax measures	Applied	Ademe-Minefi				1,1			Construction	
RT-4.1.2		Wood Energy in Individual Housing	Actions on heating appliances and on fuel	CO_2	Information, grants, research, regulation	Initiated	Ademe-Minefi				0,3			Construction	
E-4.2.2	27 part	Production of Electricity Using Wood	Call for offers by EDF for the supply of electri-city from biomass, for a capacity of 10 MW, in order to allow the realisation of one or two experimental s	CO_2	R&D	Initiated	Ademe-Minefi								
E-6		Programme for Overseas Territories and Departments and Corsica	Replacement of diesel with renewable energy sources	CO_2	Government grants	Applied	Ademe				0,45				

PNLCC #	2°CN or PNLCC #	NAME OF MEASURE	OBJECTIVE AND/OR ACTIVITY TARGETED	GHG TARGETED	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING ENTITY	Mt CO_2 1995	Mt CO_2 2000	Mt CO_2 2005	Mt CO_2 2010	Mt CO_2 2015	Mt CO_2 2020	SECTORS AFFECTED	COST
The measures related to controlling energy demand are dealt with in the "Energy" section.		**BUILDINGS, RESIDENTIAL, SERVICE SECTOR**													
RT-1.1	1	Reinforcement of Regulation on Heating (Recent Buildings)	Reinforcement of regulation on heating adopted in 2000 (follow-up to RT-0.1)	CO_2	Regulation	Launched	METL				1.1				
RT-1.2		Technical Standards and Regulations on Components	Standards on windows with a view to reducing emissions	CO_2	Standardisation	Launched	Minefi-METL				0.85				
RT-1.3		Audit of Buildings in the Existing Services Market (for sale or for rent)	Development of tools to standardise measurements of energy consumption	CO_2	Regulatory requirement	Initiated	METL								
RT-1.4		Strengthening of Inspection Tools and Procedures	Improve enforcement of the regulation	CO_2	Regulation	Initiated	METL								
RT-2	7	Voluntary Agreements	Encourage action on the part of the construction industry (wood as material, windows)	CO_2	Voluntary agreements	Launched	METL								
RT-3.2		Actions on Pilot Sector Buildings	Partnership agreements	CO_2	Information	Applied	METL-Ademe								
RT-4.2		Solar Heat Energy	Develop the usage of solar heat energy within "continental" France. The three applications targeted are hot sanitary water for individual use, heating and hot sanitary water for collective use	CO_2	Grants	Applied	Ademe-Minefi				0.04				
RT-4.3		Geothermal Energy	Measures to encourage the use of geothermal energy	CO_2	Grants	Planned	Ademe-METL-Minefi				0.07				
RT-4.4		Heat Grids	Optimisation and extension of heat grids	CO_2	Grants	Applied	Ademe-METL-Minefi								
RT-5.1		The Rental Market	Allowance for energy efficiency in the evaluation of monthly rent	CO_2	Regulation	Planned	METL								
RT-5.2		Allocation of Heating Costs (condominiums and collective services)	Allowance for energy efficiency in the evaluation of expenses	CO_2	Regulation	Planned	METL-Ademe								
RT-6.1		Planned Initiatives for Improving Heating in Buildings	Operations requiring local impetus, as the main contractor will be the relevant town or group of towns	CO_2	Negotiated agreements	Launched	Ademe-METL								
RT-6.2		Conditions for Receiving Grants for Real Estate Purchase	Development of quality labels to condition grants	CO_2	Quality labels	Initiated	METL								
RT-6.3		Grant System for Services Buildings	Extension of existing grants for inhabitants to the services sector	CO_2	Grants	Planned	Ademe-METL								FRF 100 million/year
RT-6.4		Grants for Condensation Boilers for Collective Use	Subsidies for this type of boiler	CO_2	Grants	Initiated	Ademe-METL				0.14				FRF 20 million/ year
RT-6.5		Support for Quality Label Policy	Incentives for certain categories of contractors	CO_2	Grants	Initiated	METL-Ademe								FRF 145 M/ year
RT-7.2		Reduced rate of VAT on the Sale of Heat Produced by an ENR	Convince the European Commission to modify Annex H of the 6th Directive on VAT so that those connected to the heat grid and those who use heat from biomass benefit from a reduced rate of VAT of 5.5%, thereby improving the competitiveness of wood energy		Fiscal measures	Planned	Minefi								
RT-7.3		Reduced rate of VAT, Energy-Saving Products and Services	Extend already existing measure and give the extension a very strong impetus toward energy savings and the fight against the greenhouse effect	CO_2	Fiscal measures	Under consideration	Minefi								
RT-8.1		Quality Labels and Public Awareness	Covers the HPE label for new housing, but also the quality of products (for example, wood-burning heaters) and certification of workers	CO_2 HFC	Information	Initiated	Ademe-METL								
RT-8.2		Environmental Quality of Products for Construction	Training and information for workers	CO_2 HFC	Training	Initiated	METL								

Policies and Measures

PNLCC #	2°CN or PNLCC #	NAME OF MEASURE	OBJECTIVE AND/OR ACTIVITY TARGETED	GHG TARGE-TED	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING ENTITY	Mt CO_2 1995	Mt CO_2 2000	Mt CO_2 2005	Mt CO_2 2010	Mt CO_2 2015	Mt CO_2 2020	SECTORS AFFECTED	COST
RT-9		"High Environmental Quality" (HQE) Approach	Approach intended to integrate environmental concerns in rental contracts	CO_2 HFC	R&D	Enforced	Ademe-METL-CSTB								
B-2.1		Effects of the TGAP on Services		CO_2	Tax system	Suspended	Minefi				1.4				
B-2.2		Effects of the TGAP on Housing		CO_2	Tax system	Suspended	Minefi				2.2				
TRANSPORT															
T-1.1.1		Follow-up on Agreements and Future Reinforcement	Check actual compliance levels on ACEA Agreement in France	CO_2	Inspection	Proposed	METL-Mate								
T-1.1.2		Extension of Voluntary Agreements to Two-Wheeled and Lightweight Utility Vehicles	Reduce emissions in all vehicles covered	CO_2	Voluntary agreement	Launched	METL-Mate								
T-1.1.3		Incentives for the Replacement of Light-Weight Vehicles	Incentive to replace vehicles with more efficient vehi-cles	CO_2	Economic	Planned	METL-Minefi-Mate								
T-1.1.4		Other Incentive Measures to Replace Old Lightweight Vehicles	Labelling of vehicles, tax credit for "alternative" vehi-cles	CO_2	Economic	Proposed	METL-Minefi-Mate								
T-1.2		Alternatives to Air Conditioning and New Cycle	Limit the increase in CO_2 emissions from motors and the increase of HFC emissions resulting for air condi-tioning	CO_2	R&D, Regulation	Initiated	Mate-METL				0.2				
T-1.4		Electric and Alternative Vehicles	Drafting of governmental decisions on alternative "clean" vehicles	CO_2	R&D	Launched	Mate-METL-Minefi-Ademe				0.4				
T-1.5		Emissions Specific to Rail Transport	Increase the usage of electrically-run transport, replacement of Diesel engines, etc.	CO_2	Economic	Initiated	METL				0.4				
T-1.6		N20 Emissions From Catalytic Convertors	Improve understanding of these emissions and the means by which they can be reduced	N_2O	R&D	Planned	Mate-METL								
T-1.7		Speed Limits on Lightweight Vehicles	Speed limits integrated in newly constructed vehicles so that the difference between the speed they can reach and the maximum speed limit is not so signifi-cant	CO_2	Regulatory	Initiated	METL-Mate								
T-2.1.1		Monitoring of Speed in Heavy-Goods Vehicles	Reinforcement of speed checks at roadside and pro-motion of chronodactylograph use	CO_2	Regulatory	Launched	METL-Ministry of the Interieur-Ministry of Defense				0.8				
T-2.1.2		Technical Inspection of Heavy-Goods Vehicles at Roadside	Proper tuning of vehicles	CO_2	Regulatory	Launched									
T-2.1.3		Speed Limits on Lightweight Utility Vehicles	Study the feasibility and impact of a speed limit on lightweight utility vehicles	CO_2	R&D	Initiated	METL-Ministry of the Interieur - Defense								
T-2.2.1		Energy Consumption on Airport Platforms	Reduction in routing time through better signalling systems and improvements in allocation of energy	CO_2	Technical	Initiated	METL-Mate METL				0.2				
T-2.2.2		Improvement of Combined Usage of Air Transport and Public Transport	Improvements in public transport service to and from airports	CO_2	Economic	Initiated									
T-2.2.3		Pre- and Post- Conveyance by Rapid Train	Development of agreements between air and rail companies	CO_2	Negotiated agreements	Launched	METL								
T-2.3.1		Management of Large Inter-City Routes	Assessment of the various experiments to be carried out, in terms of CO_2	CO_2	R&D	Launched	METL				0.04				
T-2.3.2		Running of Traffic Lights and Progressive Signal Systems	Higher penalties for speed violations, leading to ave-rage reductions in speed of 10%	CO_2	Technical	Launched	METL				0.3				

PNLCC #	2°CN or PNLCC #	NAME OF MEASURE	OBJECTIVE AND/OR ACTIVITY TARGETED	GHG TARGE-TED	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING ENTITY	Mt CO_2 1995	Mt CO_2 2000	Mt CO_2 2005	Mt CO_2 2010	Mt CO_2 2015	Mt CO_2 2020	SECTORS AFFECTED	COST
T-2.3.3		Giving Priority to Mass Transport	Encourage the usage of collective transport, by increasing its speed and reducing its fuel consumption	CO_2	Economic	Launched	METL				0.07				
T-2.3.4		Regulation of High-Speed Urban Routes	Optimisation of speeds observed on high-speed urban routes	CO_2	Regulatory	Launched	METL				0.2				
T-2.3.5		User Information	Information systems and development of computerised tools	CO_2	Technical	Initiated	METL								
T-2.4		Facilitation of Coastal Traffic	Development of a mode of transport that consumes less energy than road transport, per tonne-kilometre transported	CO_2	Economic	Initiated	METL								
T-3.1.1		Controlling the Development of the Urban Environment	Definition of methods to help local authorities prioritise infrastructure projects, according to how much traffic they create and assistance in identifying problems	CO_2	R & D, Economic	Launched	METL-Mate (D4E)				1.5				
T-3.1.2		Urban Planning Documents and Localising Activities	Allowance for the impact on transport in these documents	CO_2	R & D, Planning	Launched	METL-Mate (D4E)								
T-3.1.3		Impact of the Waste Management System	Optimisation of routes and usage of the least polluting modes of transport	CO_2	R & D	Launched	METL-Mate (D4E)								
T-3.1.4		Integrated Transport and Grouping Loaders	Structuring demand for integrated transport	CO_2	R & D	Launched	METL-Ademe								
T-3.2.1		Taxation of Kerosene Oil	Implementation of a tax or fee system at the European level	CO_2, O_3	Tax System	Planned	METL-Minefi-Mate				0.4				
T-3.2.2		Compliance with Labour Rules in Road-Related Professions (follow-up to T-0.2.1)	Compliance with labour standards by these professions and European harmonisation in this field	CO_2	Regulation	Launched	METL				0.5				
T-3.2.3		Recovery of Tax Revenue from Gasoil (follow-up to T-0.1.1)	Gradually bring taxation on gasoil to the level of that on gas	CO_2	Tax System	Initiated	Minefi				2.7				
T-3.2.4		Tax system on Fuel in Public Transport	Extend partial reimbursement of the TIP on gasoil to public transport	CO_2	Tax System	Applied	Minefi-METL								
T-3.3.1		Internalisation of Cost of Carbon	Allowance for the cost of carbon in the TIPP	CO_2	Tax System	Initiated	METL-Minefi-Mate				3.7				
T-3.3.2		Control of Urban Travel (strengthening of T-0.1.5)	Continuation and extension of licenses on usage of road infrastructures	CO_2	Tax System	Blocked	METL								
T-4.1		Organisation of Community Territory	Allowance for emissions from transport in the SDEC	CO_2	Planning	Initiated	METL-Mate								
T-4.2		Inter-City Infrastructure Offering – Other Aspects	Measures within the framework of service schemes	CO_2	Planning	Initiated	METL				3.7				
T-4.3		Inter-Modal Facilities for Integrated Transport (follow-up to T-2.2)	Organisation of integrated transport	CO_2	Planning	Launched	METL-Ademe				0.7				
T-4.4		Public Transport and Alternative Urban Modes (follow-up to T-0.3.4)	Acceleration of programmes in this area	CO_2	Planning	Launched	METL-Ademe-Mate				0.55				
T-5.1		Training of Professional Drivers	Experiments enriching initial and continued training for drivers	CO_2	Education	Launched	METL								
T-5.2		Training for Driving License	Improving driver awareness about energy savings	CO_2	Education	Initiated	METL								
T-5.3		Corporate Responsibilities	Allowance for the greenhouse effect in corporate environmental plans and assessments	CO_2	Information	Launched	Ademe-METL								

PNLCC #	2°CN or PNLCC #	NAME OF MEASURE	OBJECTIVE AND/OR ACTIVITY TARGETED	GHG TARGETED	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING ENTITY	Mt CO_2 1995	Mt CO_2 2000	Mt CO_2 2005	Mt CO_2 2010	Mt CO_2 2015	Mt CO_2 2020	SECTORS AFFECTED	COST
INDUSTRY															
I-1.1	9 part	ADEME-FRAC Guidance in Decision-Making	Revival of incentives to limit emissions	All	Economic	Launched	Ademe				0.45				FRF 40 M/year
I-1.2	9 part	Research and Development FRF 20 million per year	Support for R&D on technologies and processes that contribute to lowering emissions levels	All	Economic , R & D	Proposed	Ademe-MENRT								FRF 20 million/ year
I-1.3	9 part	Technological Demonstrations FRF 30 million per year	Support for outstanding technological demonstrations	All	Economic , R & D	Proposed	Ademe-MENRT								FRF 30 million/year
I-1.4	9 part	New Methods of Financing	Foster ban financing for projects that limit emissions (FOGIME, FIDEME)	All	Economic	Launched	Ademe-Mate-Minefi								FRF 100 million/year
I-1.5	NM	Single Procedure for ADEME and FRAC	Improve the effectiveness of supporting measures	All	Organisation	Initiated	Ademe-Ministry for Industry								
I-2.1	33	N_2O : Reinforcement of ICPE Requirements	Additional reduction in industrial nitric oxide emissions	N_2O	Regulation	Launched	Mate				1.8				
I-2.2		PFCs (CF4) in the Production of Aluminium	Limitation of PFC emissions in the production of aluminium	PFC	Regulation	Initiated	Mate				1.8				
I-2.3		SF_6 and PFCs in the Electronics Industry	Measures specific to the electronics industry	SF_6 and PFC	Regulation	Initiated	Mate								
I-2.4		SF_6 in Magnesium Foundries	Measures specific to magnesium foundries	SF_6	Regulation	Launched	Mate								
I-2.5		SF_6 in Electrical Equipment	Relevant measures	SF_6	Negotiated agreement	Launched	Mate								
I-2.7		HFCs in Foams, Aerosols, etc.	Relevant measures	HFC	Regulation	Launched									
I-3		Tax on Energy (TGAP)		CO_2	Tax system	Suspended	Mate Mate -Minefi				7.3				
I.4.2		N_2O : Increase in TGAP	Additional reduction in industrial emissions of nitric oxide	N_2O	Tax system	Launched	Mate -Minefi				1				
I-5.1		Quality Labels and Standards	Changing industrial standards and practices to advance in the fight against the greenhouse effect	All	Information	Proposed	Industrie-Ademe								
I-5.2		Corporate Awareness	Changing industrial standards and practices to advance in the fight against the greenhouse effect	All	Information	Launched	Ademe								FRF 3 million in 2000
I-5.3		Training and Qualification	Development of energy audits in the industrial sector	All	Education	Launched	Ademe-Ministry for								
F-3.1		Strengthening of Inspection Requirements	Additional reductions in HFC emissions	HFC	Regulation	Proposed	Industry				0.7			Transport, Construction	
F-3.2		Inspection of Automobile Air Conditioning Equipment	Reductions in emissions of cooling gases resulting from automobile use	HFC	Education, Regulation	Launched	Mate				0.7			Transport, Construction	
F-3.3		Work towards Meeting Standards	Limiting leakage of refrigerant gases	HFC	Information	Initiated	Mate-METL				1.1			Transport, Construction	
F-3.4		Recovery of Fluids	Developing a channel for recovering used refrigerant fluids in the automobile industry	HFC	Economic	Launched	Mate				0.7			Transport, Construction	
F-3.5		Training and Qualification of Companies	Tightening of requirements for qualifying operators	HFC	Education	Initiated	Mate				0.6			Transport, Construction	
F-3.6		Study of Fiscal Measures	Encourage usage of substitutes	HFC	R & D	Initiated	Mate				1.4			Transport, Construction	
F-3.7		Research and Development	Improving understanding of emissions, equipment, possibility of moving toward other procedures and recovery methods	HFC	R & D	Launched	Mate-Minefi							Transport, Construction	

PNLCC #	2°CN or PNLCC #	NAME OF MEASURE	OBJECTIVE AND/OR ACTIVITY TARGETED	GHG TARGETED	TYPE OF INSTRUMENT	STATUS	IMPLEMENTING ENTITY	Mt CO_2 1995	Mt CO_2 2000	Mt CO_2 2005	Mt CO_2 2010	Mt CO_2 2015	Mt CO_2 2020	SECTORS AFFECTED	COST
The measures relating to the re-use of forest products for energy are dealt with in the "Energy" section. The measures relating to timber in construction are dealt with in the "Buildings" section.					**AGRICULTURE AND FORESTRY**										
A-1.1		CH_4 Emissions from Animal Breeding (and N_2O Emissions)	Preparations of recommendations by MAP to reduce these emissions	CH_4 N_2O	To be determined	Initiated	Map				0.9				
A-1.2	34	N_2O Emissions in Soil	Reduction of N_2O emissions from spreading of nitrated fertilisers	N_2O	Tax measures	Initiated	Map-Mate				1.3				
A-1.3		Integration of the Greenhouse Effect in Agricultural Policy	Inclusion of the greenhouse effect on MAP's part in elaborating the national programme on bovine breeding	Tous	Economic	Initiated	Map								
A-1.4		Actions to Improve Understanding	Reinforcement of research and development efforts, improvement in quality of statistics gathered	Tous	R&D		Map-Mate-MENRT								
A-2.1	25	Afforestation of Farmland	Incentives to timber 30,000 hectares of farmland per year	CO_2	Economic	Launched	Map				0.55				FRF 135M/year
A-2.2		Studies, Research and Experiments	Strengthening of research and development efforts in relevant areas	Tous	R&D	Initiated	Map-MENRT								
					WASTE										
DE-1		Control of Waste Production		CO_2, CH_4	Regulation	Launched									
DE-2	30	Reinforcing Recycling of Materials or Organic Matter		CO_2, CH_4	Regulation	Launched									
DE-3	29	Make Heat Recovery from Incinerators a Widespread Practice		CO_2	Regulation	Launched									
DE-4	31	Efficiency of Gas Capture Systems in Dumps		CH_4	Regulation	Launched									
DE-5		Biological Pre-Treatment as an Inhibitor during the Operating Period		CH_4	Regulation	Initiated									
DE-6		Analysis and Control of Biochemical Reactions in Dumps		CH_4	Regulation	Initiated									
DE-7		Agronomic Recycling of Organic Waste		CH_4, CO_2	Regulation	Launched									

CHAPTER 5

Projections and Overall Effect of Policies and Measures

INTRODUCTION

In order to reach these projections, three scenarios were used:

- **A "Without Measures" (WOM) scenario, which reflects the change in the level of emissions, taking into account only the measures that were adopted until 31 December 1989 (start year: 1990);**
- **A "With Existing Measures" (WEM) scenario, which reflects the change in level of emissions, taking into account all measures adopted and implemented as of 31 December 1999, seeing as the listing of emissions included in the present document shows emissions in 1999;**
- **A "With Additional Measures" (WAM) scenario, which takes into account the measures considered and adopted over the course of 2000, meaning the National Programme for Tackling Climate Change and the National Plan for the Improvement of Energy Efficiency.**

This chapter presents the methodology behind the projections, the overall results and the breakdown in projections, sector by sector.

1 Projection Methodology

These projections were produced by CITEPA (see Report 488, Projections on Direct Greenhouse Gases in 2020; the complete and detailed version of the projections appears in this report). A second report was made, discussing prospects in the field of energy, by the company Enerdata (see the report dated 28 September 2001: "Impact of the National Programme for Tackling Climate Change on CO_2 Energy in 2010 and 2020"). CITEPA referred to this report for its data on energy. When making forecasts about greenhouse gas emissions, CITEPA adhered to the 2000 Edition of the Inventory of Greenhouse Gases (1: J.-P. Fontenelle, J.-P. Chang, N. Allemand, N. Audoux, S. Béguier, C. Clément: "Inventory of Greenhouse Gas Emissions in France Over the 1990-1999 Period." CITEPA, December 2000. Available at www.citepa.org.) This inventory covers, over the period extending from 1990 to 1999, all of the sources required by the Framework Convention on Climate Change, and lists them in Common Reporting Format (CRF).

Given the period covered by this inventory, the greenhouse gas emissions from 1990 to 1999 are exactly those that are taken into account in the "With Existing Measures" (WEM) scenario—this is the logical result of the definition. Therefore, throughout the rest of this study, it will be important to ensure that the emissions levels established for the WEM scenario are consistent with those in the UNFCCC 2000 inventory, for the time period from 1990 to 1999. The projections are presented according to the CRF categories (six in all). The study looks at all of the main emissions sources identified in the inventory established for the UNFCCC in 2000.

It should be noted that biomass combustion is listed separately, as is the result of the land use changes and forestry. In accordance with the guidelines issued by GIEC regarding the elaboration of inventories, the emission factor of wood energy is 0, because wood is gathered in a sustainable way in France (the amount of wood gathered amounts to only 70% of forest growth each year).

A few specifications will be given as concerns the model used for the energy projections, as well as on the macroeconomic assumptions used as a basis for study.

(1) J. P. Fontenelle, J. P. Chang, N. Allemand, N. Audoux, S. Béguier, C. Clément: "Inventory of Greenhouse Gas Emissions in France from 1990-1999." CITEPA, December 2000. Available at the following Web site: www.citepa.org.

1.1 The Model Used for CO_2 Resulting from Energy

A model was used to calculate projections on carbon gas emissions resulting from the consumption and production of energy.

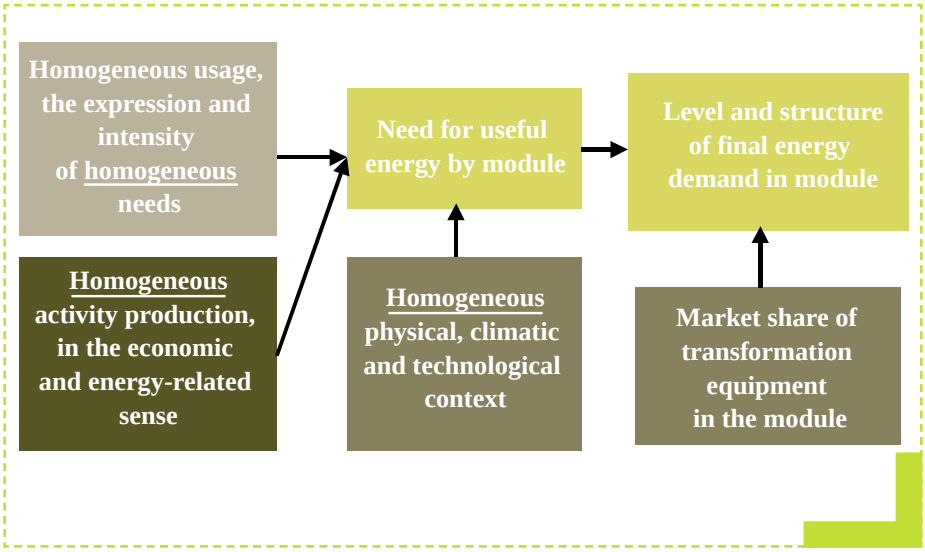
General Characteristics of the Model

The projections on CO_2-energy emissions are calculated based on energy projections, taking into account first the projected demand by sector or usage, then the projected result on energy. Figures on projected energy demand are based on the model Médée–ME, already used in previous prospective studies carried out by the CGP, the DGEMP and the MIES, and using existing strategic studies on energy efficiency carried out for ADEME.

The Médee-ME model used is a long-term forecasting tool (maximum of 30 years) for energy demand. It is of technical and economic nature, and is non-deterministic.

The model is highly dis-aggregated, and approaches energy demand by looking at the main uses and services linked to energy, for each of the major consuming sectors: industry, transport, habitat and services. Each demand module is established using tightly-defined conditions regarding the economic players, the way in which they use energy and the climatic and technological contexts in which they operate.

As much as possible, the model bases its calculation of energy demand on technical and socio-economic factors, as reflected by physical indicators, which are the only type of data that can be spelled out and interpreted clearly over the long term. This is important as Médée-ME was



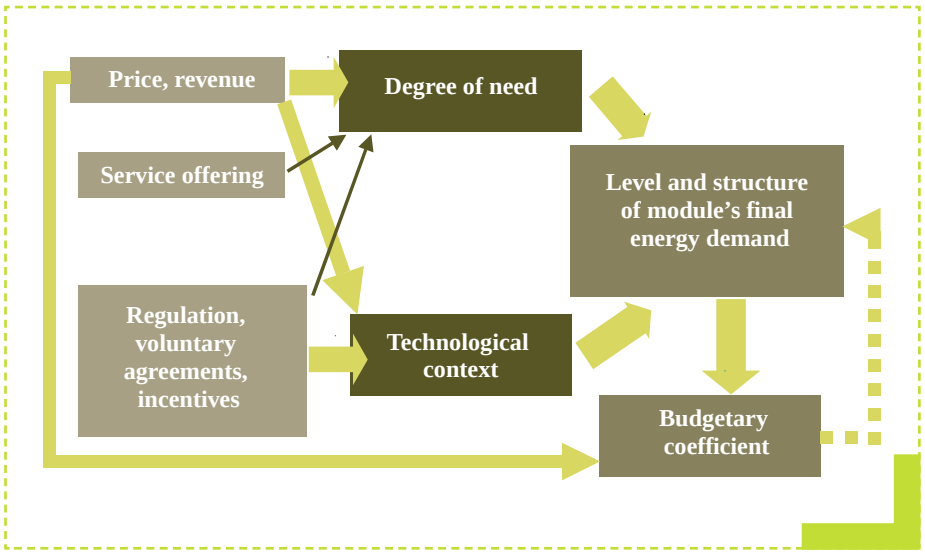
designed to explain energy demand, rather than provide statistics on it.
The exact characteristics of the model in each of the sectors studied are described in the aforementioned report "Impact on CO_2 Energy in 2010 and 2020", by the National Programme for Tackling Climate Change.

The "Without Measures" Scenario and Its Definition

As regards CO_2 resulting from energy use, the study carries on from many preceding studies, and in particular, from the 2nd National Communication.
The socio-economic, general and sector-related assumptions used for 2010 and 2020 are those listed in the DGEMP's base scenario (see Energy Prospects for France – A Trend-Based Scenario, DGEMP Energy Observatory, March 2000). These assumptions are similar to those of the preceding prospective study, realised for the 2nd National Communication, aside from the assumptions on IGCE production, which are based on the CGP's S2 scenario, a number of actual changes between 1992 and 2000, and the new sector-related forecasts issued by the BIPE (DIVA model).

Assessment of the Impact of the Measures

The assessment of the impact of the measures on Energy and CO_2-energy was performed, as previously (2nd National Communication), by referring to the "Without Measures" scenario. In order to develop this scenario, we used the technical and behavioural assumptions of the "Without Measures" scenario described in the 2nd National Communication, in other words, eliminating the impact of all of the measures to reduce greenhouse gas emissions, adopted after 1990.
With regard to the measures decided and implemented as of 31 December 1999 ("with existing measures" scenario) and those that are planned but have not yet been integrated into national law or regulation ("with additional measures" scenario, including the new measures issued by PNLCC), the purpose was to assess their impact in the relevant technical and economic categories defined by Médée-ME: change in specific or unit-based consumption, indices on efficiency for each usage, share of each mode, market share of the type of energy, etc.
The chart below summarises the process by which the effects were calculated.



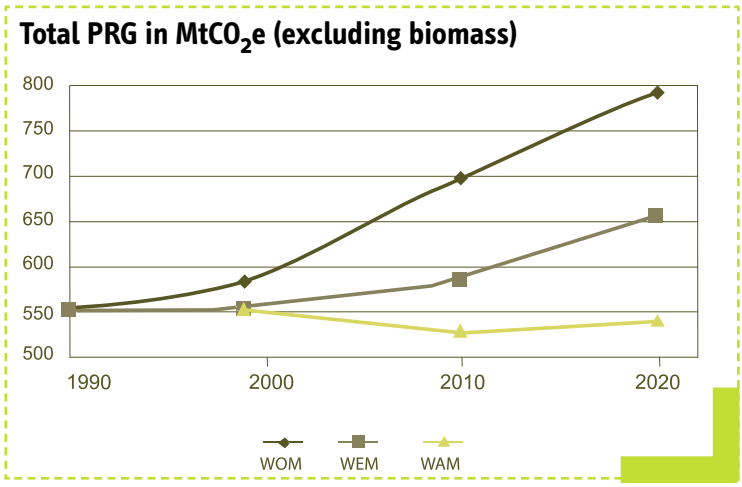
1.2 Macro-Economic Assumptions and Variables

The table below lists the main macro-economic assumptions and variables used in calculating the No-Measures scenario.

Years/Period	1990	2000	Average 1997-2010	Average 2010-2020
Growth in GDP	2.6 %	3.2 %	2.3 %	2.3 %
1999 oil price per barrel (exchange rate in euros: USD 1 = EUR 0.9	23.7	28.3	17	25
Price of coal (imported to France) in USD/M	49.7	34.2	30	40-50
Price of gas (imported to France) in USD/t	2.5	2.4	2.2	3.3
Population (in millions of inhabitants)	56.6	59.4	61.7	63.5
Construction of new housing (thousands per year)	280	240	240	220
Average specific consumption of new lightweight vehicles (index)		100 (1997)	99	98
Aggregate average specific consumption by lorries (vehicle/km)		100 (1997)	100	100
Change in domestic air traffic		1992 -1997 5%/year	4.1%/year	4.1%/year
Freight traffic: Share of road travel		79 %	87 %	90 %

2 Aggregate Figures

The overall results of the projections are presented in the graph below.



France's objective, as established in the burden-sharing decision adopted by the European Union's Council of Ministers of the Environment on 18 June 1998, is to stabilise greenhouse gas emissions during the first commitment period: 2008-2012. These are thus expected to reach an average, over the period, of 545 Mt CO_2 equivalent. With this deadline in mind, the "with existing measures" scenario (all measures actually adopted or implemented as of 1 January 2000) shows the expected effect of the measures already implemented: the level reached in 2010 would be 577 Mt CO_2 equivalent. Emissions levels compared to 1990 would thus rise by 5.8% in 2010.

The "with additional measures" scenario estimates the effect of measures under consideration since the beginning of 2000. Under this scenario, greenhouse gas emissions would reach 519 Mt CO_2 equivalent in 2010, and 531 Mt CO_2 equivalent in 2020. In other words, in 2010, we would see a decline of 4.6% as compared to the level seen in 1990.

The difference with the PNLCC's estimate (which forecasts 0%) is of little significance, given the uncertainty inherent to prospective studies. This confirms that the PNLCC's new measures will make it possible to maintain emission levels in France at 1990 levels. The "Without Measures" scenario, which was elaborated – it is important to remember – using the same basis as that of the 2nd National Communication, leads to emission levels of approximately 688 Mt CO_2 equivalent in 2010 and 783 Mt CO_2 equivalent in 2020.

2.1 Aggregate Change 1990-2020, with Breakdown by Gas and by Sector

Emissions in millions of tonnes of CO_2 equivalent ($MtCO_2e$)

Pollutants	Sectors	1990 observed	1999 observed	2010			2020		
				WOM	WEM	PNLCC	WOM	WEM	PNLCC
Energy-related CO_2	Exclud. biomass	360.1	384.0	444.9	406.0	376.8	526.5	468.4	388.5
	Biomass	50.0	49.0	38.8	41.9	54.1	34.4	38.8	54.8
CO_2 not resulting from energy	Industrial processes	21.3	17.2	18.6	17.5	17.5	19.2	18.0	18.0
	Waste	2.1	2.3	2.5	3.1	3.1	2.5	3.3	3.3
	Usage of solvents	1.9	1.6	1.0	1.0	1.0	1.0	1.0	1.0
CH_4	Energy	10.2	7.8	7.0	7.2	8.0	6.9	7.2	8.2
	Agriculture	34.3	32.2	32.0	32.0	31.1	32.2	32.2	31.3
	Waste	18.7	17.5	36.3	7.4	7.4	36.9	5.2	5.2
	Other	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
N_2O	Energy (including transport)	3.8	6.1	9.0	9.0	8.0	11.0	10.0	9.0
		1.2	3.2	5.4	5.2	5.0	6.2	5.9	5.7
	Industrial processes	27.8	11.0	48.5	13.9	2.6	48.6	14.0	2.6
	Agriculture	56.1	54.3	53.0	53.0	51.2	53.8	53.8	52.1
	Other	1.0	1.0	1.1	1.1	1.1	1.1	1.2	1.2
HFCs, PFCs, SF_6		7.6	9.1	34.0	26.0	11.1	43.3	32.5	10.9
Total excluding biomass		**545**	**544**	**688**	**577**	**519**	**783**	**647**	**531**
Total including biomass		**595**	**593**	**727**	**619**	**573**	**817**	**686**	**586**

The 1999 emissions reflect emissions observed. Source : CITEPA.

Note that the combustion of biomass (mainly wood) is counted as part of the emissions resulting from UTCF. An assessment of net emissions can be obtained by adding the total emissions excluding biomass and the total result relating to UTCF.

Land Use, Land Use Changes and Forests

The final result on emissions and removals resulting from the changes in land use and forest areas is listed hereafter:

	Sink			Emissions			Total		
	Without Measures	WEM	WAM	Without Measures	WEM	WAM	Without Measures	WEM	WAM
1990	- 135	- 135	- 135	91	91	91	- 44	- 44	- 44
1999	- 151	- 151	- 151	91	91	91	- 59	- 59	- 59
2010	- 157	- 156	- 156	98	98	98	- 65	- 57	- 59
2020	- 166	- 166.7	- 168	92	102	102	- 73	- 64	- 66

WEM: With Existing Measures. WAM: With Additional Measures.

3 Analysis by Key Sector

Here, the projections are reviewed with a focus on each of the sectors studied in the previous chapter ("Policies and Measures"). Only the greenhouse gases whose emissions are most significant to the sectors studied will be mentioned. For a complete breakdown, readers may refer to CITEPA's aforementioned report, dated 4 October 2001.

3.1 Carbon Gas Emissions Resulting from Energy

Total Projections in UNFCCC Inventory Format (CRF 1)

	1990	1999	2010			2020		
			WOM	WEM	PNLCC	WOM	WEM	PNLCC
CO_2 Energy	360	384	445	406	377	526.5	468.4	388.5

Notable developments can be seen in the following areas: Energy Production, Construction, Transport and Industry

In order to better take into account the ideas elaborated about prospects for energy, the sectors examined (except for energy production and air transport, where CRF format is maintained) will be presented in the format used by Enerdata, which is also that used by the Observatory on Energy, or Eurostat. As a reminder, all of the information regarding the data presented is available in CRF format in the CITEPA study.

Energy Production

The assumptions used are as follows:

Production of Electricity

The assumptions regarding the structure of electricity production under each of the scenarios and within each of the time periods, are based on the work carried out by the General Planning Commission (Energy 2010-2020) and on the assumptions used in the trend-based scenario developed by the DGEMP. These assumptions set the foundation for projections on domestic demand, net production and fuel consumption, as listed below.

Demand TWh	1995	Without Measures		With Exist. Meas.		PNLCC	
		2010	2020	2010	2020	2010	2020
Final consumption	348	487	584	469	545	444	494
Energy	20	32	17	32	17	32	17
Losses from grid	29	42	50	40	47	40	47
National consumption	397	561	650	541	608	516	558
Export	70	50	50	50	50	50	50
Pumping	4	9	4	10	11	10	11
Total demand	**471**	**620**	**704**	**601**	**669**	**576**	**619**

Offer TWh	1995	Without Measures		With Exist. Meas.		PNLCC	
		2010	2020	2010	2020	2010	2020
Hydraulic	76	75	76	75	76	75	76
Nuclear	359	433	405	433	405	399	404
Other	37	112	223	93	188	102	139
Coal	22	23	25	22	16	10	10
Fuel + TAC	2	2	2	1	1	2	2
HF Gas	2						
CCG		46	150	18	111	5	26
Auto- or co-generation	11	35	40	35	40	50	52
Wind energy		1	1	8	8	23	37
Various		5	5	9	12	12	12
Total offering	**471**	**620**	**704**	**601**	**669**	**576**	**619**

Fuel Input MTOE	1995	Without Measures		With Exist. Meas.		PNLCC	
		2010	2020	2010	2020	2010	2020
Coal	5.7	5.2	5.7	5.0	3.6	2.3	2.3
Fuel	1.1	0.5	0.4	0.2	0.2	0.5	0.4
Gas co-generation	1.1	8.0	9.1	8.0	9.1	11.4	11.8
CCG gas		7.8	25.9	3.1	19.2	0.9	4.5

The following trends were established where CO_2 (CRF 1A1) is concerned:
In the energy transformation sector, total "corrected" (using CRF standards) CO_2 emissions were as follows:

- **Without Measures Scenario:** CO_2 emissions would increase by 41.4% in 2010, as compared to 1990 (for a difference of 26.7 Mt CO_2 equivalent with 1990 levels) and by 124% by 2020.

CO_2 Emissions (Mt) WOM Scenario	1990	1997	2010	2020
Refineries	16.4	19.2	22.9	23.6
Heating plants	37.7	26.9	57.6	102.9
Urban heating	5.8	6.7	6.7	6.7
Other	4.6	4.3	4	3.9
Total	**64.5**	**57.0**	**91.2**	**137**

- **With Existing Measures Scenario:** under the WEM scenario, CO_2 emissions would be, respectively, higher than those of 1990 by 22% and 75% by 2010 and 2020:

CO_2 Emissions (Mt) WEM Scenario	1990	1997	2010	2020
Refineries	16.4	19.2	22.9	23.6
Heating plants	37.7	26.9	45.3	78.9
Urban heating	5.8	6.7	6.7	6.7
Other	4.6	4.3	3.9	3.8
Total	**64.5**	**57.0**	**78.8**	**112.9**

With Additional Measures Scenario : the increases in excess of 1990 CO_2 levels in 2010 and 2020 are "limited" to 10.5% and 24.8%. CO_2 emissions would increase by less than 9 Mt CO_2 equivalent as compared to 1990, the difference resulting mainly from the thermal energy plants. Two reasons are behind this: the decrease in electricity demand resulting from policy changes, which make it less necessary to call upon coal-fired plants; and the development of the combined cycle as a replacement for coal-fired plants, as recommended by the National Programme for Tackling Climate Change.

CO_2 emissions (Mt) WAM Scenario	1990	1997	2010	2020
Refineries	16.4	19.2	22.9	23.6
Thermal energy plants	37.7	26.9	38.4	47.2
Urban heating	5.8	6.7	6.7	6.7
Other	4.6	4.3	3.4	3.1
Total	**64.5**	**57.0**	**71.3**	**80.5**

Buildings, Housing/Services (excluding agriculture and forestry)

CO_2 emissions (Mt) WOM Scenario (housing/services)	1990	1997	2010	2020
Without Measures Scenario (excluding biomass)	82	87	108.3	117.5
With Existing Measures Scenario (excluding biomass)	82	87	101.1	106.6
PNLCC Scenario (excluding biomass)	82	876	92.8	92.4

When the without measures scenario is applied, the emissions produced by the housing and services sectors increase by 32% in 2010, as compared to 1990. This is based on an average increase in energy consumption of 1.3% per year in the housing sector and 2.1% per year ni the services sector over the period. The growth rate used for the period between 2010 and 2020 is 0.9% for the housing sector and 2% for the services sector.

The measures already secured make it possible to prevent 7 Mt CO_2 equivalent in 2010, while the measures planned since 2000 (PNLCC and Plan to Improve Energy Efficiency) enable significant benefits: 15.5 Mt of CO_2 equivalent in 2010 and 25 Mt of CO_2 equivalent in 2020.

For both of the scenarios discussed, 4.2 Mt of CO_2 equivalent (1.1 MtC) of the emission reductions expected by 2010 are attributable to a shift from fossil energy toward forms of energy that are believed not to emit CO_2 (solar energy, wood, urban waste), while 11.4 Mt CO_2 (3.2 MtC) are attributable to a decline in individual consumption, thanks to changes in both technology and behaviour.

Transport

If there were no measures expressly designed with energy efficiency and a reduction in CO_2 emissions in mind, the energy consumption level of Transport would increase by 19.4 MTOE (1.9% per year) between 1990 and 2010, and by 9.5 MTOE (1.4% per year) between 2010 and 2020. In large part, the growth in consumption would result from road transport (respectively 14.3 MTOE and 7.3 MTOE between 1990 and 2010, and 2010 and 2020), although air transport would have recorded the highest growth rates (respective annual growth rate of 3.4% and 1.7% over the two periods).

Excluding electricity and international sea and air transport, CO_2 emissions due to transport would increase by 46 Mt CO_2 between 1990 and 2010, and by 26 Mt CO_2 from 2010 to 2020.

The measures implemented before 31 December 1999 to reduce CO_2-energy emissions are expected to limit the growth of energy consumption in transport via road, rail and waterways by 15 MTOE between 1990 and 2010, and by 8.1 MTOE between 2010 and 2020. The most significant portion of these changes in consumption as compared to the "Without Measures" scenario would come from road transport. However, CO_2 emissions would continue to grow considerably and stabilise at 27 Mt CO_2 in 2010, above the 1990 levels (excluding air and water transport, and excluding electricity). Between 2010 and 2020, the increase in emissions would still amount to 19 Mt CO_2.

CO_2 emissions (Mt) from Transport (Excluding marine, domestic and international air, and transit)	1990	1997	2010	2020
Without Measures Scenario	111	129	153	176
With Existing Measures Scenario	111	129	138	158
PNLCC Scenario	111	129	131	130

The additional measures are expected to enable greater reductions in energy consumption in the Transport sector: 4.6 MTOE in 2010 and 9.7 MTOE in 2020. Road transport is then expected to play a far smaller part in the increase of consumption between 1990 and 2010 (40%), and its consumption levels are expected to drop slightly afterwards. Air transport, including routes to the overseas departments, would then gradually become the dominant mode in the increase in energy consumption.

Excluding international air and sea transport, and excluding electricity, CO_2 emissions would continue to grow between 1990 and 2010 (+18 Mt CO_2), reaching 129 Mt CO_2, and would increase only slightly after 2010 (+1.5 Mt CO_2 between 2010 and 2020). In 2020, emissions generated by the Transport sector, excluding sea and international air transport, would reach 130 million tonnes of CO_2 equivalent, or less than 38 Mt of carbon equivalent, the threshold established by the National Programme for Tackling Climate Change.

It should be noted that the tax measures included in the National Programme account for 5 Mt CO_2 equivalent out of the total decrease.

Initial analyses show that the existing measures enforced as of 31 December 1999 should make it possible to prevent 16.3 Mt CO_2 (4.4 MtC). The technical and regulatory measures listed in the PNLCC (With Additional Measures scenario lead to reductions in CO_2 emissions from the Transport sector of 32 Mt CO_2 in 2010 (excluding electricity, sea transport and international air transport), or 8.7 MtC.

National Air Transport

Note the strong increases in emissions from this sector, resulting mainly from the increase in transit with the overseas departments and from predicted stability in individual consumption. On this basis, the increase for 2020 would amount to +66% (2.3% per year) under the "With Additional Measures" scenario, and to +93% (3% per year) for the "Without Measures" scenario.

CO_2 Emissions (Mt) National Air Transport (CRF 1A3a)	1990	1997	2010	2020
Without Measures Scenario	4,5	5,8	8,3	11,2
With Existing Measures Scenario	4,5	5,8	7,8	10,2
With Additional Measures	4,5	5,8	7,3	9,6

CO_2 Emissions Resulting from Energy Consumption in Industry

If there were no measures expressly designed with energy efficiency and a reduction in CO_2 emissions in mind, the energy consumption level of Industry would have increased by some 11 MTOE (1% per year) between 1990 and 2010, and by 10 MTOE (1.4% per year) between 2010 and 2020. Most of this growth would result from electricity (respectively 1.6% and 2% average growth), as the other forms of energy would have registered only very small amounts of growth (respectively, 0.3% and 0.5% average growth rate). Taking into account the replacement of combustible fuels with gas and excluding CO_2 emissions not related to energy, Industry would return to its 1990 level in 2010 (76 Mt CO_2) before stabilising.

The measures implemented before 31 December 1999 to reduce CO_2-energy emissions from Industry are expected to reduce the growth in energy consumption by approximately 2 MTOE between 2010 and 2020, two-thirds of which will come from fuels: excluding electricity, consumption would return to its 1990 level in 2010 and would increase by only 1.3 MTOE between 2010 and 2020.

At the same time, CO_2 emissions would amount to 4.3 Mt CO_2 in 2001, below the 1990 level (for savings of 4 Mt CO_2 when compared to the scenario), to rise to only 0.7 Mt CO_2 by 2020.

CO2 emissions (Mt) from Energy Consumption in Industry	1990	1997	2010	2020
Without Measures Scenario	76	73	76	76
With Existing Measures	76	71	72	73
With Additional Measures	76	71	68	67

The additional measures are expected to allow for more reductions energy consumption, amounting to 2.9 MTOE in 2010 and 4.6 MTOE in 2020, approximately half from electricity and half from other energy sources. Excluding electricity, consumption would barely return to its 1990 levels in 2002, and would be below that level in 2010, at 1.4 MTOE.

At the same time, CO2 emissions would decline to 8.5 Mt CO2, below 1990 and 2010 levels (for savings of 8.5 Mt CO2 as compared to the scenario) and 9.4 Mt CO2 below the 1990 level in 2020.

Initial analyses show that, together, the PNLCC's technical and regulatory measures would lead to a reduction in CO2 emissions in the manufacturing sector of 8.5 Mt CO2 (excluding electricity) in 2010, or 2.4 MtC, with existing measures alone (in effect since 31 December 1999) accounting for 4.3 MtCO2 (1.2 MtC).

3.2 Emissions from Gases Other than Energy-Related CO_2

Industry

N_2O Emissions in Industrial Processes (CRF2)

N_2O Emissions (in $MtCO_2e$)	1990	1997	2010	2020
Without Measures Scenario	27.7	28.3	48.5	48.5
With Existing Measures	27.7	11	13.9	14.0
With Additional Measures	27.7	11	2.6	2.6

The expected increase in production (in particular, of adipic acid) could lead to an increase in emissions between 2000 and 2010, as seen in the scenario. The implementation of regulations (decrees adopted within the framework of the regulation on classified installations for the protection of the environment) would allow a decline in emissions in 1999 ("with existing measures" scenario). By continuing along the same regulatory path, we would reach a limited level of missions in 2010 ("with additional measures" scenario).

HFCs, PFCs and SF_6 Emissions from Industry (CRF 2)

If no measures were taken, emissions of these gases would increase significantly between 2000 and 2020, but would still remain but a small portion of overall emissions. This trend is mainly due to the substitution of CFCs and, later, of HCFCs, with HFCs and PFCs, in particular in refrigeration, as well as to the development of air conditioning.

The scenario with additional measures makes it possible to limit the increase in these emissions, using heavy constraints that limit emissions in refrigeration and air conditioning equipment, along with innovative technologies that make it possible to avoid using fluorinated gases or to limit emissions from those gases.

HFCs, PFCs and SF_6 Emissions ($MtCO_2e$)	1990	1997	2010	2020
Without Measures	7.5	12.7	34	43
With Existing Measures	7.5	9	26	32
PNLCC Scenario	7.5	9	11.1	10.9

Agriculture

Methane (CH_4) Emissions

Methane emissions in the agricultural sector result mainly from enteric fermentation of grazing animals (90%) and from the storage of animal excrement. Trends in livestock are one of the deciding factors behind trends in emissions. Statistics in this area come from the Magali projections, a model that predicts supply levels in the French agricultural industry, and run jointly by the Forecast Department of the Ministry of Economy, Finance and Industry and by the Department of Financial and Economic Affairs at the Ministry of Agriculture and Fishing (see chart on page 35 of the CITEPA Report). These projections were completed, where necessary, with expert opinions.

Methane (CH_4) Emissions ($MtCO_2e$) CRF 6	1990	1997	2010	2020
Without Measures	34	32	32	32
With Existing Measures	34	32	32	32
PNLCC Scenario	34	32	31	31

Nitrous Oxide Emissions (CRF 4)

84% of N20 emissions in Agriculture come from soils, and result from the spreading of nitrated fertilisers, the remainder being made up of solid excrement from livestock. The projections relating to the amount of synthetic nitrated fertiliser dispersed come from the Ministry for Agriculture and Fishing. It sets the spreading ratio of fertiliser to farmed land at 114 kilograms of nitrogen per hectare in 2010. Note that a decline in N_2O emissions—the actual figure is difficult to predict—is to be expected following improvements in the management of animal waste (less use of

manure and risk-bearing fertilisers). Projections in the "with additional measures" scenario are dependent upon the implementation of a tax on excess mineral or organic nitrogen, which might bring about a decrease in mineral nitrogen spreading of 200 kilotonnes in 2010 and 2020.

N_2O Emissions ($MtCO_2e$) CRF 4	1990	1997	2010	2020
Without Measures	54,8	53,2	53,0	53,9
With Existing Measures	54,8	53,2	53,0	53,9
PNLCC Scenario	54,8	53,2	51,2	52,1

Waste

CRF 6

In producing estimates of greenhouse gas emissions from waste, we took into account a set of assumptions regarding the trends in volume and the nature of the waste produced, on the one hand, and the effects of the national policy on waste on the market share of the various treatment methods, as well as on the way in which equipment is managed. Nonetheless, the data gathered in this study provide but a first view of the situation. A certain number of methodological difficulties arose and will make it necessary to develop specific studies, in particular by ADEME, in order to have access to more reliable data.

Trends in the Amounts of Waste Treated

The trends in waste flows and their distribution are dependent on the reorientation of French policy in the field of waste, as defined in 1998. Whatever the scenario, the overall trend in waste flows to be treated is the same. The average increase in waste flows treated, which amounts to 2.8% per year between 1990 and 1998, is maintained until 2006. Following that, it is assumed that production levels will remain constant.

Aside from the waste recycling policy described above, the information herein is dependent on the wide-spread use of biogas capture, as required by government regulations. These lead to an assumed rate of capture of 100%, starting in 2000, with a recovery rate of 80%. 100% of biogases collected are to be recycled and/or cleaned.

Projections on Methane Emissions from Dumps (CRF 6)

Emissions were calculated using the first order cinetic method.

The Without Measures Scenario is based on the following parameters:

- a degradable organic portion of 200 kilograms per tonne of waste;
- operating conditions observed since 1990 are maintained over the whole of the period. 10% of quantities dumped are treated via a biogas capture network, with a recovery rate of 65%. Thus, 44% of biogases are thus collected and recycled and/or cleaned, and the remainder is released into the atmosphere.

Regarding the scenario with existing measures/with additional measures: aside from the waste recycling policy described above, the capture of biogas, which is becoming widespread as a result of a regulatory requirement, has been taken into account. As a result, starting in 2000, it is assumed that biogas capture will occur for 100% of waste, with a recovery rate of 80%, 100% of the biogas being recycled and/or cleaned. ■

Methane from Dumps ($MtCO_2e$) CRF 6	1990	1997	2010	2020
Without Measures	18.7	25.5	36.6	36.9
With Existing Measures and With Additional Measures	18.7	19.1	7.4	5.2

CHAPTER 6

Vulnerability Assessment, Climate Change Impacts and Adaptation Measures

INTRODUCTION

Since 1993, France has been developing study and research programmes with the aim of assessing the possible consequences of climate change within national borders (including overseas territories and departments), as well as the adaptation measures likely to be implemented in the most vulnerable geographical areas and business sectors. Herein, we first present the main findings of that research, and the resulting recommendations with a view toward adapting to future climate conditions. We then mention the existence of a number of regional and local schemes relating to land planning and the integrated management of natural lands, milieus and resources, and to the prevention of natural risks. These schemes take into account, amongst other factors, current climate conditions (both average and extreme) and can be revised according to advances in our understanding of future developments in the climate and their impact at this level.

1 Main Programmes and Study Results on the Possible Impacts of Climate Change, Vulnerability and Adaptability

A review of present knowledge on the "Potential Impacts of Climate Change in France in the 21st Century", based on research launched in 1993, within the framework of the "Regionalisation of Climatic Effects" Programme, and carried on since 1999 under the "Management and Impacts of Climate Change" Programme, was published in 1998 by the Ministry of Urban and Rural Development and the Environment and the Interministerial Task Force on Climate Change, then re-issued in 2000. A series of colloquia organised by the Interministerial Mission and open to a broad audience (see Chapter 9, "Education, Training and Public Awareness") provided an opportunity to fine-tune our understanding and better identify the challenges that the mountainous and coastal regions face. Other valuable lessons on vulnerability and adaptability were drawn from the storms that struck France in December 1999, particularly in the fields of forestry, production and distribution of electricity, construction and insurance. The main conclusions are listed hereafter.

1.1 Observed and Simulated Climate Change

The most striking results involve the progress made in climate change simulation models, which can now provide information region by region within a given zone, in this case, that of Western Europe and Mediterranean Basin. Two models were used as references in these studies: the dot-matrix model designed by the Laboratoire de météorologie dynamique (LMD) with zoom, and the Arpège-Climat model, designed by the Centre national de recherche météorologique (CNRM), with variable meshing. The results are consistent with the findings of two other international teams, with a standard scenario in which CO_2 would double between the beginning of the 20th century and the 2060s. CNRM's findings show warming of approximately 2 degrees in Western Europe, and slightly more in the Mediterranean regions and in the summer, with an increase in winter precipitation and a decrease in

summer precipitation, with the strongest effects seen in the Mediterranean regions. LMD's findings lay emphasis on the pluviometric contrast between North and South, with an increase above the 45th parallel and a decrease to the south. This contrast is magnified in the hydric balance measurements taken in the soil. To provide a reference point for all of the studies, Météo-France designed a climatological dot-matrix system charting temperatures and precipitation in France. In particular, it shows an average increase of 1 degree in minimal temperatures over the 20th century (uniform for all of France) and of 0.6 degree for maximal temperatures (particularly noticeable in the South). Alongside these average warming trends, precipitation during winter and autumn increased, while precipitation during summer decreased. Research on the regionalisation of climate change (average and extreme conditions) will be extended under the PNEDC and GICC programmes, pitting different approaches against each other (statistical methods "versus" dynamic models).

1.2 Predicted Effects of Changes in Climate and Possible Adaptation Measures

The warming trend would lead to the withdrawal of snow cover in the Alps and the Pyrenees, which would, in turn, have major socio-economic consequences (decline in recreational activities relying on snow).

As the melting of the snow (and glaciers) quickens in the Spring, the risk of avalanches and mudslides in mountainous regions will increase, as will that of intense flooding in the Rhone and Garonne valleys.

Generally speaking, the intensification of the hydrological cycle would increase the risk of floods in winter and spring, while lengthening the periods during which water level is low (from June-July to October-November). This would bring about a decline in the production of electricity by nuclear plants and dams, while also modifying the ecological characteristics of rivers. It is therefore necessary that the "new climatic deal" be integrated into the National Planning and Water Resource Management Schemes (SAGE) at the level of the basins, so as to preserve the many functions and uses of this resource.

A decline in the level of water stored in soils during the summer vegetation season would lead to considerable deterioration and losses in production for the farming and forestry sectors, particularly in the South. These losses would not be entirely offset by the "fertilising" effect of the increase in CO_2. For instance, the intensive growing of corn and maritime pines in the Landes region (south-western coast) could be threatened, while the Mediterranean forest could be severely damaged by bouts of intensified drought and more frequent forest fires. Dendroclimatic studies (focusing on the relationship between climate and land cover) show that beech forests in the plains, and at average altitude in the Lorraine region are also particularly sensitive to hydric stress, as are the Scots pines and Aleppo pines that grow in certain parts of the southern Alps. The deterioration of the forests due to drought could be worsened by infestation by insects or pathogenic fungal species (elm bark beetles, armillaria, etc.). Fortunately, adaptation measures can be taken and will be implemented forthcoming years. These will include: limiting intensive irrigated farming and/or improving the efficiency of irrigational systems; implementing varietal or genetic selection; reducing the density of monospecific forest planting; associating plant species to that newly-planted forests in vulnerable areas are resistant to drought; etc. It should be noted that some of the measures intended for forests might also limit storm-inflicted damage. Monitoring of the condition of our forests will have to be reinforced.

Regarding prairie land and bovine-meat breeding in the Massif Central region,

simulations show an increase in average annual grass production of approximately 20% (not taking into effect the risk of dry spells) and modifications in the quality of fodder. This might lead breeders to convert temporary pastures into permanent pastures, thereby increasing the storage of carbon in the soil.

If the sea level were to rise (by 30 to 50 centimetres) along the French coast and that of the overseas departments and territories, a number of consequences are to be feared: a worsening in the immersion of low-lying coastal land, in particular the deltas (Rhone Delta, etc.), coastal lagoons, maritime swamplands, coral reefs (which, moreover, may suffer from global warming: see Coral Whitening in Polynesia); acceleration of erosion of cliffs and beaches; reinforcement of the salinisation of estuaries; reduction in volume of fresh groundwater. These trends could become worse if, as the models seem to show, waters brutally and temporarily go beyond danger levels more frequently than they presently do, as a result of the expected intensification in storm and tropical cyclone activity.

As regards the consequences in terms of health, the forecast is mixed: the increase in the number of deaths, which will be particularly high on the hottest summer days, will be compensated for by a decline in the number of deaths resulting from severe cold in winter. The intense heat will make it necessary to keep a closer watch on pregnant women nearing term and to tighten inspections on refrigeration equipment and food safety. Pollen-related allergies will move north as certain plants do. Birds and mosquitoes that come from Africa, bearing the West Nile virus, already seem to reach the Mediterranean coast at certain times, and an inter-departmental co-operation effort to stamp out mosquitoes has been launched in the Herault region. Other vector-borne infectious diseases, including leishmania, which is currently limited to the Mediterranean zone, could move north. The propagation of dengue and, to a lesser degree, paludism might also sprout, in particular in the overseas departments and territories. It is therefore necessary to reinforce the epidemiological monitoring of these illnesses, while also monitoring their vectors (birds, mosquitoes, ticks, mites, etc.) and the environmental factors (including changes in climate) that are conducive to their propagation.

1.3 Socio-Economic Consequences

Assessment of the socio-economic consequences of the climate changes predicted in France must expand in the years to come, to include, in particular, the quantifying of the costs (or benefits) of the expect biophysical impact (for example, losses or gains in farming or forestry, decline in the number of tourists to outdoor recreational activities due to less snow, increase or decrease in health

IN THE FACE OF THE AFOREMENTIONED RISKS IN COASTAL REGIONS, TWO ADAPTATION STRATEGIES ARE POSSIBLE IN THE UPCOMING DECADES: RESISTANCE OR RETREAT

- **Resistance is a must whenever it is necesary to protect an urban area from being invaded by the sea. For example, the coastline can be artificially built up using sedeiments, a "gentle" method of compensating for the rise in sea level (the method limits itself to assisting natural mechanisms and, in so doing, does not deteriorate the environment);**
- **Retreat is a must where the coast is unoccupied. For example, in Petite Camargue, where the coastal areas have remained, in large part, untouched, voluntary retreat from the coast (which the sea tends to invade) would guarantee its permanence, by simply allowing the gradual re-establishment of the milieus that make up the area. However, in this case, the owners whose property is encroached upon, would have to be given compensation.**

spending resulting from climate-dependent illnesses, etc.). This raises the difficult challenge of linking, at the appropriate levels, different types of models (physical, biological, socio-economic).

Presently, only the statistical approach (probability-based assessment) seems possible, when based on the analysis of available historical data, including that relative to extreme events. For example, according to a study carried out in 2000 by the French Federation of Insurance Companies (following the two storms that occurred in late 1999, generating costs of FRF 44 billion to the profession), the "damaged assets" branch as a whole might have to deal with an intensification of claims over the next 50 years (of approximately 20% on average as compared to claims levels between 1986 and 1999) due to storms and flooding, if the most negative of the theories suggested by scientists comes into being: an increase in the number of storms affecting France and the intensifying of strong precipitation. This heightening could amount to an additional cost of FRF 30 to 100 billion for insurers and their clients. In addition to this estimate, the study indicates that an event similar to the one that occurred in December 1999 could re-occur within the next ten years.

In light of our present knowledge on the various potential impacts described above, it would appear that the regions and zones in France most vulnerable to the expected forms of climate change are the overseas departments and territories (which have already had to deal with relatively frequent tropical cyclones and infectious climate-dependent diseases) and, in mainland France, the Mediterranean South (as a consequence of increased drought periods) and areas in the northern half of the country that are most exposed to storms and/or flooding. These conclusions are consistent with those of the European report, Acacia.

2 Adaptation Strategies and Allowance for Climate Change in Programmes for the Protection and Integrated Management of the Environment

France has not (yet) established a specific programme to adapt to climate change. However, laws already exist regarding country planning and the protection of the environment, as do schemes (resulting from these laws) for the prevention of natural risks and the integrated management of natural lands, milieus and resources. By progressively integrating our knowledge of the future characteristics of the climate and its potential impacts on the milieus and sectors concerned into these schemes, we will be able to adapt them to the "new climatic deal". They will thus contribute to the precautionary policies and measures needed in the fields described hereafter.

2.1 Prevention of Natural Risks

The 1995 Law on the Reinforcement of Environmental Protection and the September 2000 Environmental Code require the elaboration, under the supervision of the Prefect, of schemes to prevent of predictable natural risks (PPR) in areas deemed vulnerable to extreme weather conditions (storms, cyclones, tidal waves, flooding, drought, etc.), on

the basis of either past history or risk analysis. The identification/mapping of risk areas and the definition of measures to be included in the PPR (bans on construction in flood zones or avalanche paths, reinforcement of flood warning tools, on-site rescue schemes and action plans) are based on current climate conditions (past 100 years). However, the PPR may be revised in accordance with the progress that is made in predicting the potential impact of climate changes on the frequency and characteristics of extreme wind and precipitation conditions. This is one of the major (though difficult) research areas that the GICC programme will have to take up in the coming years. Another research programme, directed by the Ministry for Urban and Rural Development and the Environment, is intended to improve the effectiveness of warning systems and to develop a culture of risk by keeping the public informed, as is already the case on the island of Reunion, in particular when dealing with tropical cyclones.

2.2 Urban and Rural Development

The Guidance Law on Urban and Rural Development and Sustainable Development (June 1999) made it mandatory for each region to elaborate planning tools covering a 20-year period, widely known as "collective service schemes". After conferring broadly and drawing up numerous amendments, the government adopted the schemes presented by the regions. These cover the nine policy sectors that make up the national territory and take into account climate constraints in the sectors involved: natural and rural land (restoring or enlarging river beds, maintaining or recreating holding areas such as alluvial zones, carrying out hydraulic works, etc. to decrease the risk of flooding); energy (guaranteeing the security of electricity transport in the face of storms); freight and traveller transport (during the planning of new rail lines, analysing the pluviometry of the geographical areas to be crossed in order to calculate the dimensions and strength of structures and equipment needed). The collective service schemes are to be re-evaluated with the same frequency as the State-Region plan contracts (every five years).

2.3 Water Resource Management

On 27 June 2001, the Council of Ministers approved the new bill on water, which acts as an update to the two founding laws ratified in December 1964 and January 1992, respectively. The new law responds to an increasing demand for transparency, equity and solidarity in the management and various uses of water. In addition, this undertaking will make the French legislation compliant with the new European policy on Water (see Framework Directive adopted by the European Union, late 2000). The law reinforces the principle of proportional billing, dependent on the volume of water consumed, applying also to the fees charged to farmers (who previously paid very little as compared to other users). This will incite all parties to save water, and act as an indirect responsive measure to risks of drought and water scarcity. In particular, this should incite farmers to improve the effectiveness of irrigation systems for intensive farming, or even to adopt new farming techniques that are less dependent on available water supply. In addition, thanks to this law, towns will be able to better manage flood zones by setting up flood-related community service tasks, in particular to adapt the areas around flood zones. ■

CHAPTER 7

Financial Resources and Transfer of Technology

In order to prevent the greenhouse effect, international co-operation and solidarity must be strengthened. With this in mind, France has built its policy around two objectives:

- maintaining an active development aid policy;
- supporting additional and specific mechanisms intended to fight against the greenhouse effect.

1 French Public Development Aid

It is fitting to encourage financing by wealthy countries of actions specifically designed to reduce greenhouse gas emissions in poor countries, but it is just as important to accelerate the development process in these countries: demographic expansion is, in the very long term, the major factor behind future greenhouse gas emissions. Furthermore, even if development is not sufficient on its own to control demography, it is at least one of the necessary conditions. France is one of the most generous countries where Public Development Aid (PDA) is concerned. In 2000, it ranked fifth on the list of donating countries, in terms of volume supplied, with EUR 4.5 billion. It ranks first out of the seven most industrialised countries (G7) in terms of share of gross domestic product (GDP) devoted to State Aid. France devoted 0.32% of its GDP to PDA efforts in 2000, with the total amount donated by the countries on the OECD's Development Aid Committee at 0.22%.

France's policy aims, in particular, to bring the poorest countries into the world trade arena and to help them attain sustainable and socially acceptable economic development thanks to incoming public and private funds.

France's bilateral co-operative actions are the joint undertaking of the ministries concerned, as well as of public establishments in the fields of finance (such as the French Development Agency—AFD), research (such as the International Co-operative Agronomic Research Centre for Development - CIRAD - and the Research Institute for Development - IRD), and the Agency for the Environment and Energy Control (ADEME), as well as certain local authorities.

1.1 Bilateral PDA

France's net contribution under the category of bilateral aid amounted to EUR 3.1 billion in 2000, or the equivalent of 69% of its overall PDA.

State aid was devoted mainly to the essential sectors of local, urban and rural development, as well as access to basic services such as education, health and drinking water.

It also encourages the creation of a dynamic and competitive private sector in the developing countries, in order to ensure the long-term existence of a productive sector—a guarantee of sustainable and balanced growth.

The strategic priorities of French aid centre on the fight against poverty, in particular in the least advanced countries, the promotion of sustainable growth, development of institutional capacity and the protection of the environment.

Where the environment and sustainable development are concerned, France defines its action along the lines of the principles voiced during the 1992 Rio Summit, which charted the evolution of our planet against a background of sustainable development. That background was since fortified by the Kyoto agreements, the re-establishment of the Global Environment Facility (GEF) and the founding of the French Fund for the Global Environment (FFEM). Within this context, economic and social development needs to go hand-in-hand with long-term management of the local and global environment, in order to avoid any irreversible occurrences. These concerns have particularly sensitive applications in developing and

emerging countries. Moreover, their character differs from region to region.

In Africa, in particular, contrary to the situation in our industrialised societies, natural resources (sub-soils, soils, vegetation, continental and sea water) make up the bulk of production materials. The challenge thus consists of promoting resource management systems that ensure their continuation, all the while working toward a diversification of the economy. In the emerging countries of Asia and Latin America, the challenge is rather to ensure a smooth transition between a system of rural economies, which are efficient from an environmental standpoint, and a system of very rapid economic development, where natural resources are sometimes abandoned, or even ignored, in favour of an urban and industrial development pattern that does not take into account environmental constraints, for lack of appropriate regulations and technical capacity. Lastly, the very particular problem of countries currently moving toward a market economy (ex-Eastern bloc countries) is that of managing an industrial heritage that was sometimes very loose-handed with environmental resources and, on occasion, dangerous to the environment and the population (nuclear energy).

In this context, the preservation of the environment can only be guaranteed in a sustainable manner if it is perfectly integrated into development as a whole and contributes to the vital needs of the populations or economic players (companies, States, etc.). This undertaking centres, in particular, around the following objectives:

- support sustainable development of partner countries for the infrastructures or business sectors where long-term challenges are particularly sizeable, for instance, in situations where human action can lead to irreversible damage or when poorly controlled industrial development can bring about industrial and environmental disasters;
- support the inclusion of criteria relating to the environment and sustainable management of natural resources in bilateral and multilateral financing of development projects, while applying strategies consistent with the expectations of receiving countries;
- contribute to the preservation of the global environment. As a complement to its direct contribution to the Global Environment Facility, France has established a similar fund at the national level, and run bilaterally. Known as the French Fund for the Global Environment, it was designed to ensure that world-wide environmental concerns are made part of its bilateral aid programmes.

UNDERTAKINGS ON THE PART OF THE FRENCH DEVELOPMENT AGENCY (AFD)

The French Development Agency is a specialised financial institution whose capital is held exclusively by the State. It contributes, through long-term loans and subsidies, to economic and social development in 60 countries throughout Africa, the Indian Ocean region, the Caribbean, the South Pacific and Asia. It finances productive public or private investment in all sectors of the economy. It also finances structural adjustment programmes on behalf of the State. Lastly, it carries out technical assistance projects and offers high-level training for managers.

In 1999, AFD's commitments abroad amounted to EUR 973.8 million, EUR 628.7 million of which went out in the form of project assistance. Out of the total amount devoted to projects, 25% went out in the form of subsidies, 48% went out in the form of concessional or highly concessional loans, and 27% went out in the form of loans at or near market conditions. AFD commitments that involve environment-targeted financing amount, for the year 1999, to a total of EUR 125.6 million, or 18.4% of project-related commitments. Over half of these projects involve the field of drinkable water and decontamination, which remains a leading priority for the countries that are part of AFD's focus.

A significant number of projects, sometimes not classified as undertakings with an environmental target, in fact have a favorable impact where climate warming is concerned.

In 1999, these included, in particular:

- **two projects dealing with farmland management and the implementation of rural land schemes;**
- **two projects dealing with sustainable forest management;**
- **three projects dealing with urban development and the protection of drinkable water resources;**
- **five projects on the improvement of decontamination systems in urban areas;**
- **two projects targeting protection from flooding.**

1.2 Multilateral PDA

The volume of financial resources allocated by France in the form of multilateral aid in 2000 amounted to EUR 1.39 billion. The main channels through which this aid was used were the United Nations, the European Commission and international financial institutions.

France participates in all components of the multilateral development aid programme, its main objective being to provide the financial, institutional and operational means that are essential to effective aid. In this globalised world, multilateral aid has become essential in allowing for effective action on the part of the international community, implementing co-ordinated aid with significant leverage, and taking action quickly in emergency situations. France plays a full part in this effort, ranking on average fourth amongst donating multilateral institutions for development. Its contributions to multilateral institutions account for 11% of total French aid for development in 2000.

In particular, France values the principle of equitable burden sharing, the cornerstone of the multilateral system.

France demands the same effectiveness of international development institutions as it does of its bilateral aid. It supports the reform efforts these institutions have launched to improve the effectiveness of aid, the implementation of institutional reform when necessary, and the definition, by the institutions involved, of operational strategies that are in line with the objectives of sustainable development, focusing efforts on the least advanced countries, fighting against poverty and respect for the environment.

Regarding the protection of the environment, France supports the reinforcement of activities and financing of multilateral organisations that work for the durable management of natural resources. In addition, it is in favour of better integration of environmental concerns from the very inception of development projects.

France's Financial Contributions to the Major Multilateral Institutions and Programmes in 1997, 1998, 1999 and 2000

in millions of euros	1997	1998	1999	2000
EEC				
Overall Budget	488.22	379.92	481.60	586.35
European Development Fund	292.27	317.63	267.99	272.53
World Bank				
International Finance Corporation	9.7			
AID	248.87	208.83	210.70	258.61
Regional Banks				
European Bank for Reconstruction and	24.27	23.95	23.95	23.95
Development		1.52	1.59	1.72
Asian Development Fund		26.64	26.87	
African Development Bank	26.73		3.05	3.07
African Development Fund	65.72	81.41	83.52	83.52
Interamerican Development Bank	6.68	7.03	8.34	
UN				
Mandatory contributions	62.87	67.40	69.50	88.26
Voluntary contributions	38.45	39.62	41.90	47.19
Total General Multilateral PDA	**1,354.73**	**1,388.9**	**1,418.9**	**1,384.54**

2 French Aid for the Protection of the Global Environment and Prevention of Climate Change

France provided the impetus for the creation of the Global Environment Facility, which finances all excess costs that arise from efforts to preserve the planet's environment within the context of development projects. The fund intervenes in four areas: the fight against the greenhouse effect, the preservation of biodiversity, the protection of international waters and the protection of the ozone layer. Created as a pilot programme in 1990, GEF has been endowed with an additional USD 2 billion for the period spanning 1999-2002, as part of its second re-establishment. France, with USD 144 million dollars, is the fourth contributor to GEF. To this day, 35% of GEF's financing has been devoted to projects relating to the greenhouse effect.

France's Contributions to GEF

in millions of dollars	GEF - Pilot phase (1991-1994)	GEF-1 (1995-1998)	GEF-2 (1999-2000)
French contribution	150	143	144

THE FRENCH FUND FOR THE GLOBAL ENVIRONMENT FACILITY (FFEM)

Demonstrating its involvement in the field of climate change in developing and transitional countries, France has established a bilateral financial tool specifically devoted to the global environment.

FFEM's priorities are as follows:
- **Africa as the top priority: in light of the specific needs in this region and the overall geographical priorities of France's foreign aid;**
- **economic and social development as important targets: FFEM was designed to finance the excess costs related to the protection of the global environment in development projects. Its direct aim is thus one of development and it must fulfil and comply with this objective;**
- **emphasis on reproducible projects: given the necessarily limited impact of any global environment project, the heads of FFEM and its Scientific Committee give priority to projects that show high potential for being reproduced and disseminated in other sites and countries. In doing so, FFEM aims to play an active part in promoting and facilitating innovations;**
- **emphasis on innovation in projects: FFEM takes action to encourage the dissemination of innovations in favour of the protection of the global environment. This innovation can be scientific, technical, technological or institutional. Most often, it entails direct or indirect costs that call for a specific financial effort. That effort is thus intended to foster a true learning dynamic.**

These priorities apply very directly to the field of climate change, an area in which the FFEM's Scientific Committee has identified the three following criteria: learning dynamic of the synergy between development and global environment; institutional and social experimentation of conditions in which generally mature techniques can be acquired; ensuring that the said techniques or acquisition techniques can be reproduced.

In 1994, as a complement to its grant to GEF, France created the French Fund for the Global Environment Facility (FFEM), endowed with EUR 67 million over 1995-1998 and renewed with EUR 67 million over 1999 to 2002. FFEM's portfolio includes 100 projects, which translate into commitment capacity of EUR 114 million, EUR 58 million of which are related to the prevention of climate change.

Looking at the 48 "Greenhouse Effect" projects currently being reviewed or implemented, the geographical spread is as follows:

- Sub-Saharan Africa 19%
- North African countries 8%
- Asia/Latin America 15%
- Eastern European countries 4%
- Other 2%

Looking at the sectors concerned, the Energy-Electricity and Forestry sectors are the most developed (with 16 and 9 projects, respectively), followed by Housing and Urban Development (household waste). This financing completes the aid and co-operative measures and projects carried out by France's aid partners, in the form of a project on the prevention of the greenhouse effect. In the Energy sector, French State Aid applies to situations where renewable energy and energy efficiency are economic alternatives. In particular, this includes rural and decentralised electrification (notably, of the photovoltaic variety), bioclimatic construction, recycling of household waste for usage as energy (usage of methane) and biofuels in certain specific contexts.

Example of an FFEM Project: Development of Ecological Farming and Carbon Stocking in Intertropical and Mediterranean Farming

Countries: Brazil, Indonesia, Laos, Madagascar, Mali, Tunisia, Zimbabwe.

Beneficiaries: CIRAD (Components 1, 2 and 3);
Establishment selected following call for tenders (Component 4).

French Institutions: French Development Agency, Ministry of Foreign Affairs.

Theme : Fight Against the Greenhouse Effect.

Area of Application: Forest planning/management.

Expected Duration: 5 years.

Total Coast : EUR 3.04 million.

FFEM Contribution:
EUR 0.76 million.

This project aims to provide support for the implementation of pilot experiments in research and development in the fields of ecological farming, a farming technique that is conducive to the sequestering of carbon.

Background and Project Objectives

Background

In inter-tropical regions, characterised by demographic growth and pressure on sustained resources, disruptions have been observed in the equilibrium of traditional peasant production systems. This is true of sub-Saharan Africa, whether in the Sudan-Sahel region (over-running of fallow land, stagnation in output levels, etc.), the savannah and forest regions of Guinea (decline in the viability of clearing-burning systems), or in numerous other areas (farming of low-value soils, as in Madagascar). It is also true in the Mediterranean region (erosion due to rain farming, overloading of pasture courses, etc.).

Ecological farming is one possible response to these challenges and, as a result of its economic results, has already been adopted on a large scale in certain countries (the United States and Brazil, in the 1960s and 1970s). The term encompasses a wide range of farming techniques and practices, all of which respect three basic principles: the land is not worked over; the land is constantly protected by a layer of vegetation; sowing of farm products takes place directly, through the aforementioned plant cover.

The joint action plan "Ecological Farming" (overseen by MAE, AFD, CIRAD and FFEM) is designed to devise the modes by which ecological farming techniques will be transferred and developed in the countries to which French aid is distributed (in particular, regions of "high-priority solidarity"). The pilot projects for the adaptation of ecological farming techniques will be supported by a transversal implementation programme.

Expected Benefits of the Project

- *Socio-economic:* at the local level, yield for the farmers will be greater and more consistent (plants will be more resistant to momentary hydric insufficiency, thanks to better storage of water in the farming profiles; decrease in cost of intrants; less time devoted to actual farming; longer periods of access to lots thanks to improvements in the structure and conveyance of the soils, spectacular growth in the results of worn-down systems).
- *Ecological:* at the national level, increase in the level of organic matter in oils and limitation of deforestation, thus leading to an increased in amount of carbon stored as compared to traditional farming methods. At the local level, slowing of hydric or wind erosion, reduction in pollution of groundwater, waterways and coastal areas, decrease in strain on natural resources.
- *Institutional:* at the international level, development of a network for sharing experiences in ecological farming.

Project Description

Designed to guarantee consistency between the pilot projects, the transversal programme is made up of four sections:

- **Support in identifying projects:**
  - Expertise in ecological farming, socio-economic studies, raising awareness of decision-makers in Southern countries
- **Supporting actions within projects:**
  - One-time projects to provide supervision and expertise as necessary;
  - Methodological studies on adaptation of techniques – crop rotation, land cover, technical planning – to dry and Mediterranean tropical areas;
  - Follow-up/assessment of programmes (identification of obstacles to the widespread use of ecological farming).
- **Capitalisation, training, publicising of results:**
  - Training and experience sharing (workshops, study and training trips for partners and doctoral students from the South);
  - Communication and promotion of results (Web site, network of farmers from the North and South and publication of documents for the layman).
- **Evaluation of the sequestration of carbon:**
  - Definition of methodologies to complement CIRAD's agronomic systems, with a view toward estimating the sequestration of carbon using ecological farming techniques, as opposed to traditional techniques. The "Identification of Projects" component will be financed using AFD/MAE funds. CIRAD provides supervision for the "Supporting Actions" and "Training" components, while the "Sequestering of Carbon" component is to be entrusted to the winner of the call for tenders. The project (EUR 3.04 million) is jointly financed by AFD (EUR 0.76 million), CIRAD (EUR 0.76 million), FFEM (EUR 0.76 million) and the Ministry of Foreign Affairs (EUR 0.76 million).

Rationale Behind Action on the Part of FFEM

Ecological farming techniques make it possible to increase the sequestering of carbon beyond the levels obtained through traditional farming techniques, by maintaining or increasing the amount of organic matter in the ground, putting a stop to the hydric or wind erosion that leads to losses in organic matter, and limiting the clearing of unused land by fire (a technique that emits carbon).

France's Bilateral Financial Contributions with the Objective of Enforcing the Climate Convention (in millions of dollars) for 1998

Name of agency	Beneficiary countries	Transport and storage	Energy	Overall protection of the environment	Urban development and construct.	Rural dev., forests, fight against desertification	Total
AFD	Brazil		0.36				**0.36**
	Ivory Coast			0.02			**0.02**
	LDCs			1.49			**1.49**
	Lebanon			0.05			**0.05**
	Mauritania		0.85				**0.85**
	Morocco	4.22	51.13	0.05			**55.41**
	Tunisia		1.27				**1.27**
Total AFD		**4.22**	**53.61**	**1.62**			**59.45**
FFEM (M€)	Chile					1.66	**1.66**
	Palestine		1.80				**1.80**
	Dominican Republic	0.12			1.91		**0.12** **1.91**
	Tunisia						
Total FFEM (M€)		**0.12**	**1.80**		**1.91**	**1.66**	**5.49**
MAE	Africa		0.40			0.90	**1.30**
	Cameroon					0.70	**0.70**
	Ivory Coast					0.30	**0.30**
	Gabon					0.40	**0.40**
	Central African Republic					0.30	**0.30**
	Senegal		0.10			0.10	**0.20**
	Sahel		0.57	1.19		0.30	**0.30**
	LDCs						**1.75**
Total MAE			**1.07**	**1.19**		**3.00**	**5.25**
Total Bilateral Aid		**4.34**	**56.47**	**2.81**	**1.91**	**4.66**	**70.19**

3 Scientific Co-operation

Scientific co-operation at international level contributes to improving overall knowledge and identifying areas of vulnerability to climate change, along with the action that can be taken to bring about developments that emit lower amounts of greenhouse gases. Of the various research areas, those relating to more efficient land usage have been given particular attention: the fight against deforestation, the storage of carbon in biomass, the use of biomass as a form of energy, etc. The undertakings of the following bodies deserve to be elaborated upon.

CIRAD (Centre for International Co-operation in Agronomic Research for Development) is a scientific body that specialises in agriculture and rural development in tropical and sub-tropical regions. Its budget amounts to approximately FRF 1 billion, two-thirds of which come from public subsidies. It employs 1,800 people, approximately 40% of whom work in developing countries.

The work being carried out to improve annual crop yields and forestry (approximately FRF 200 million in public credit) was not specifically designed to fight the greenhouse effect, but does contribute to preventing climate change by working toward the preservation or the development of carbon stored in the soils and forest biomass of tropical countries. This work is intended, in particular, to:

- enable the stabilisation of farmers' work, intensify agriculture and, thereby, reduce the deforestation brought about by the need for new farmland;
- develop, protect and enhance tropical forest ecosystems, and contribute to the sustainable management of wood-material and wood energy production channels in the southern countries;
- maintain or restore the fertility of soils by developing and spreading innovative farming techniques, such as direct sowing under plant cover (ecological farming).

More short-term initiatives (approximately FRF 12 million) were also designed with the direct prevention of the greenhouse effect in mind:

- production of liquid fuels using vegetable oils and alcohols; recycling of sub-products from farming and agro-industries into fuels;
- optimisation of line biomass use for the production of energy, development of co-generation in the wood industries;
- research on the determinants of greenhouse gas emissions in tropical ecosystems.

IRD (Institute for Research on Development) is a public establishment focusing on scientific and technical research in inter-tropical milieus: terrestrial and maritime ecosystems, agricultural systems, human societies, etc. Its budget amounts to approximately FRF 1.1 billion and it employs 780 researchers based in locations spread out over 40 countries. IRD programmes related to the prevention of the greenhouse effect involve:

- the working of soils linked to various farming systems, with the aim of preserving their fertility and, sometimes, their restoration. this includes the biological workings of the soils, the storage of organic matter and methane emissions, in particular, those resulting from rice paddies;
- the fight against desertification;
- management of natural resources, including forests.

ADEME (Agency for the Environment and Energy Management): ADEME's contribution to national efforts toward scientific,

technical and institutional co-operation with developing countries, during the period at hand, can be broken down along the following thematic lines:

- control of energy demand: improving the efficiency of refrigeration, lighting and irrigation systems;
- rational use of energy in construction: optimisation of heating, air conditioning and production of hot water;
- rural decentralised electrification: development of roving platforms intended to train individuals in the usage of photo-voltaic and hydro-electrical generators, electrification of health centres; creation of decentralised service companies for the promotion of small-scale electrification networks; optimisation programmes on photo-voltaic generators;
- urban environment: study on air pollution and urban transport plans, usage of clean fuels, strategies for urban waste treatment, composting and recycling of agronomic products.

Each year, ADEME devotes approximately FRF 4 million to research-based training initiatives, concerning the establishment of technical networks and exchange or support programmes with bodies such as the Asian Institute of Technology (AIT) or Morocco's Centre for the Development of Renewable Energy Sources. This contribution also encompasses assistance and studies (water, waste, environmental management, research on energy). In order to implement its initiatives, ADEME combines its capital with the contributions of its major institutional or technological partners, including the Ministry of Foreign Affairs (MAE), Electricité de France (EDF), Gaz de France (GDF) and the French Fund for the Global Environment (FFEM). As part of the fight against the effect of climate change, its co-operation with FFEM involves designing the best implementation method for clean development mechanisms.

CNRS is a public fundamental research body that encompasses over 11,000 researchers and uses a budget of over FRF 16 billion. Two research units are of particular interest in the present context:

- The International Centre for Research on the Environment and Development (CIRED) is a joint research team, made up of researchers from CNRS and the Ecole des hautes études en sciences sociales (EHESS). It includes 40 researchers and has an annual budget of approximately FRF 12 million, of which some 20% are devoted to "Climate" activities. It focuses on themes that have a direct impact on the issue of how development in developing countries influences the greenhouse effect. It plays a significant part in the North-South debate on the role of developing countries in the future of greenhouse gases, as well as in the elaboration of the policies and instruments that make it possible to combine the objective of the Climate Convention with the developmental needs of those countries;
- The interdisciplinary programme "Research on Technologies for Ecological Development" was established in May 1997. It carries on from the Ecotech programme. Each year, it uses FRF 35 million (one-third from CNRS, two-thirds from partners) and works with over 750 researchers (the equivalent of approximately 300 full-time positions) on three major themes: energy systems, industrial technologies, and living environments (housing, rural environments, transport). Its undertakings in the form of partnership with developing countries include, in particular, the Franco-African Information Exchange Network (REC).

In addition, France supports research and assistance efforts for meteorology in Africa, via AGRHYMET and ACMAD centres (approximately FRF 10 million each year). ■

CHAPTER 8

Research and Systematic Observation

INTRODUCTION

France's research initiatives on the climate have been structured around the National Programme for Research on Climate Dynamics (PNEDC), in which ten organisations participate: CEA, CEMAGREF, CNES, IFREMER, IFRTP, INSU, the Ministry of Research, Météo-France, the Ministry for the Environment and IRD. The PNEDC responds to achieve an integrated understanding of the interactions between the various components that make up the climate (atmosphere, ocean, cryosphere, biosphere, etc.). It has been placed under the aegis of the National Institute for Universe Sciences (INSU) at CNRS. On an international level, the World Climate Research Programme (WCRP) coordinates studies relating to anthropogenic climate change. In this chapter, we will also look into observation initiatives that have been grouped under GCOS (Global Climate Observation System).

Research

1 National Research Programme on Climate Dynamics (PNEDC)

The international programme CLIVAR, was designed to predict the future development of our environment. The research carried out at the national level as part of the PNEDC took place against this background. The objective is to better understand the dynamics of the global climate system and to identify the coupling that takes place between its various components (atmosphere, ocean, cryosphere and biosphere).

PNEDC research is based on the acquisition and analysis of new observational data and on numerical simulations. It focuses on the climate's natural variability and spatio-temporal teleconnections, the sensitivity of the climate system and the determination of forcing levels, predictability at a monthly, seasonal and interannual scale, as well as on imbalances recently brought about by man's activity (greenhouse gas emissions and aerosol emissions, connection between the climate and the carbon cycle, deforestation). The regions selected for specific study were tropical latitudes, the North Atlantic and Europe, and the austral and polar regions.

Furthermore, this programme brings forth expert analyses that can be used in defining and implementing future space missions and networks for the observation and monitoring of the climate (GCOS and climate-related component of GOOS), as well as for engaging in discussions with the socio-economic sector in areas such as long-term forecasting or anthropogenic climate change.

Other programmes deal with the water cycle (GEWEX-radiation balance), the dynamics of the world ocean (WOCE) and the linkage of tropical oceans with the atmosphere (TOGA-COARE).

In addition, certain topics that are complementary to or border on climatology are dealt with in the following programmes, run by INSU: PATOM, PROOF and PNTS which are presented below, while the National Programme on Atmospheric Chemistry (PNCA) is presented after the PNEDC.

The Multi-Scale Atmosphere and Ocean Programme (PATOM) aims to understand and characterise the physical processes involved in the atmosphere and the ocean, using experimental, theoretical and numerical methods. It studies the atmosphere and the ocean for time scales spanning less than one season, and focuses in particular on coupling dynamics and chemistry (or hydrology, when the atmosphere is concerned), and dynamics and bio-geo-chemistry, when oceanography is concerned.

The Proof Programme (Bio-geochemical Processes in the Ocean and Flows) carried on the work of the JGOFS-France programme in 1998. It was designed to study the processes that regulate the fluxes of chemical and biochemical elements that are exchanged between the atmosphere, the ocean and the marine biosphere, with a particular effort being devoted to the improvement of coupled models in the areas of physics and bio-geochemistry. These models make it possible to better describe the working of the past and present climate system and will be able to be used in evaluating future climate systems. This programme is built around four topics: CO_2 fluxes at the air-sea interface; the coupling of physics, chemistry and biology at meso-scale; identification of biological fluxes and their regulation by natural and anthropogenic fluxes; understanding of the mechanism by which the fluxes pushed out towards the ocean sediment or coastal regions are memorised.

The National Programme for Space Remote Sensing (PNTS) is used in the field of climate, as described in the second section ("Systematic Observation", paragraph 5, "Space Observation").

Lastly, **ACI, Concerted Incentive Action for the Climate** was launched recently. It covers climatic variability, the physical processes and dynamics that characterise the atmosphere and the ocean, the chemistry of the atmosphere and bio-geochemical cycles.

The importance of the modelling component should not be forgotten. In France, it is handled conjointly by the teams from two laboratories : LMD (IPSL) and CNRM (Météo-France, Arpège model), working for the complementarity, which is essential in this field.

1.1 The Climate of Past Millennia

The work carried out on interannual climate variability in the Pacific Ocean (Palenso Project) is based on two types of records: on the one hand, marine records, which are taken from sticks of coral; and on the other hand, atmospheric records, taken from ice cores in the Andes, at very high altitude. Since 1998, 50 samples from live coral masses were collected in the Pacific Ocean, along a transect from 5°S to 19°S. Reconstitutions of the salinity level have shown that, in this region of the Pacific, the influence of El Nino-like events was tempered from 1900 to 1975 by the decennial oscillation of the Pacific; however, a different pattern seems to have prevailed over the past 20 years. As regards ice, samples were taken from within the rock base at an altitude of over 6 000 meters in Bolivia (Sajama and Illimani) and in Ecuador (Chimborazo). On the Illimani site, the first 100 meters cover approximately 200 years, while the remaining 37 meters make it possible to go back some 20,000 years. The acid deposits from major tropical volcanic eruptions, detected using electric conductivity, made it possible to evaluate the fluctuations in the accumulation of the glaciers in the past. The first isotope profiles from the two samples taken in Bolivia show similar climatic variations, representative of change at the regional level, as opposed to the strictly local levels. Other environmental parameters are currently being determined through the analysis of these ice cores.

In the North Atlantic, the paleo-climatic research is based on the analysis of the mollusc shells collected each year for the past 200 years by the Natural History Museum (Muséum National d'Histoire Naturelle).

Using these, we were able to study the statistical signatures and spatio-temporal characteristics of climate variability, from the seasonal scale to the decennial scale in the North Atlantic-European region. These also reflected the influence of the Atlantic Ocean's surface temperatures (tropical and extra-tropical) on the atmospheric variability at low frequency. We noted the North Atlantic Ocean's response to the variability of atmospheric forcing. We identified the role of oceanic and atmospheric teleconnections in decennial variability. Lastly, we interpreted the variability, as simulated through coupled models, by examining the physical mechanisms in action, using simplified approaches.

The theme of the Eclipse Programme is "The Environment and the Climate of the Past", and is designed to trace back the history and evolution of the climate. It analyses glacial and sedimentary archives (from lakes or seas). It approaches paleoclimatology from a pluridisciplinary angle, which includes human, life and social sciences. It provides a means for documenting natural climate variability and for understanding how it works at key periods in the history of the Earth. In so doing, it contributes to the development of coherent and quantifiable scenarios that link the major terrestrial environmental changes to their various possible causes (internal or external forcing).

1.2 The Glacial Climate and its Variations

The "Glacial Climate: Extremes and Variability" Programme aims to gain a better understanding of the mechanisms that govern the glacial climate and its variability. The data gathered during the IMAGES (marine sediment) and EPICA (Antarctic drilling) campaigns were modelled as part of the international intercomparison modelling programme, PMIP. Significant progress has been made in two areas:

- The ability of the models to simulate the climate of the last glacial maximum, in particular in Europe and in the Tropics, has been improved, even though some uncertainties remain regarding the reconstruction of ocean surface temperatures (North Atlantic and Tropics);
- The mechanisms underlying the rapid variation in climate during the glacial periods and their propagation from the high latitudes to the rest of the globe are starting to be elucidated.

Research on the last four climate cycles are based, in part, on in-depth analysis of various atmospheric parameters (CO_2, CH_4, etc.) found in the air bubbles of the Vostok ice core; as well as on high-resolution marine observations which make it possible to characterise-sea-surface temperatures and sea level. The most significant results involve the reconstruction of austral temperatures over the last 400,000 years, the phase relationships between paleoclimatic signals, the climatic forcing and the North-South relationship, and the modelling of the evolution of ice sheets in the Northern hemisphere. The scenarios that prevailed during the transitions between glacial and interglacial climates have now been identified, and the comparisons between the Northern and Southern hemispheres, whether glaciological or marine, now show that, at glacial time scales, the climates of the two hemispheres were sometimes in opposite phases. The ocean appears as an essential vector in the redistribution of energy between the two poles.

1.3 Climate Variability Along Tropical Latitudes

The "Atlantic Tropics and African Climate" programme was designed to gain a better understanding of the oceanic and atmospheric mechanisms (and their coupling) involved in the Tropics, over a set of time periods ranging from one season to an interannual scale. Areas of study include the Pacific equatorial region (ENSO) and the Indian Ocean (LOTI). As part of this programme, researchers evaluated possible tele-connections between tropical and extra-tropical regions, and developed assimilation methods for oceanic data (ECLAT). The results of the programme include:

- The demonstration of the major role of salt in the ocean, which, through the ocean's dynamic response to wind, can have a significant impact on the variability of ENSO;
- A demonstration of the existence of redistribution paths for heat between the Tropics and the extra-Tropics, which emphasise the role of ENSO in the heat balance on the Tropics;
- The regional impacts on climate variability, in particular that of ENSO in the Pacific Southeast (Chile) and Pacific Southwest (in New Caledonia, for instance);
- The interactions between phenomena of high frequency and small spatial scale and phenomena of low frequency and large scale, as exemplified in the role of westerly winds in the Pacific West on ENSO, or the

interaction between intra-seasonal oscillation and the Indian dipolar mode.

Lastly, researchers developed three data assimilation methods that make it possible to evaluate the role of both in situ and altimetric data in the reconstruction of past oceanic variability. This demonstrates that the forcing fields computed from satellite data allow for a better simulation of the upper layers of the ocean in the tropical regions, than any re-analysis by operational centres.

National testing on the predictability of the tropical climate at the seasonal scale were successfully carried out for the first time at CERFACS, using the OPA-Arpège ocean-atmosphere coupled model.

As regards the work carried out by French teams in these regions, the following programmes should be noted:

- The "Atlantic Tropics" component of the ECLAT (Climate Studies in the Atlantic Tropics) programme is part of the international programme, CLIVAR. Its objectives include: the study of the variability of oceanic circulation and transport; and the study of interactions between ocean and atmosphere, through analysis of various in situ measurements, satellite measurements taken as part of the international projects Topex/Poseidon, Jason and Envisat, and results from modelling performed as part of the national projects Clipper and Mercator;
- The research and observation activities carried out as part of the PIRATA Atlantic Tropics Observatory, with a strong operational emphasis, are described in the second section "Systematic Observation" (paragraph 3 on "Oceanographic Observation");
- The EQUALANT and MAAT programmes are coordinated by LODYC, with the participation of foreign laboratories. They focus on the study of the time evolution of the energy and its transfer within the Atlantic Ocean, as well as on the circulation of various water masses;
- The African Climate Project, in coordination with European programmes on monsoon (WAMP, then PROMISE), aims to study the predictable mechanisms and components of the Atlantic-African monsoon system at the different spatio-temporal scales (inter-annual and regional, synoptic, meso-scale). Synergies have been developed around the uniting project SCIAMEX;
- The Climate Variability group is coordinated by the Climatology Research Centre at the University of Burgundy. A number of interesting results have already been obtained. The direct impact of Atlantic variability on general circulation of the atmosphere has been analysed using Météo-France's Arpège-Climat model, at the global scale, but also at the regional scales of Western Africa and Austral Africa. The real-time forecasting of seasonal rains in 1999 and 2000 yielded very good results, and several trial forecasts on crop farming in Senegal have been carried out. The dipolar coupled structure (surface temperature of sea and wind) of the Indian Ocean has also been recorded, as has its relationship with Austral and Oriental pluviometry. The effect of the characteristics of continental surfaces (water content, energy gradients, vegetation) on the variability of precipitation was clarified, particularly for Austral Africa.

The group coordinated by the LTHE, which worked on convection, brought together 10 people during four years. Using infrared images taken by Météosat, they carried out a detailed study of rain-related events in the Epsat-Niger region (a square of 1°x 1°), and were able to characterise rain-producing cloud systems. A great deal of work has been carried out on easterly wind regimes and their interactions with convection in Western Africa and on the tropical zones of the Atlantic Ocean. In addition, a sudden "leap" in the intertropical convergence zone was illustrated using pluviometric data from IRD. Using IPSL general circulation model, researchers demonstrated that the sensitivity of tropical convection to processes on the continental surface could be seen in the frequency of the convective occurrences and modified their characteristics. Thus, while the ocean surface temperature is the main factor controlling interannual variability, processes at the surface can affect monsoon patterns through intense convection. Lastly, it should be noted that, after solving problems with calibration, researchers were able to use their observations of water vapour to study

the interaction between convection, large-scale dynamics and distribution of humidity in altitude, as illustrated by a general circulation model.

Surface Processes

By applying the variable mesh technique employed in CNRM Arpège-Climat model to equatorial regions, researchers were able to validate the technique on the propagation of equatorial waves, first within the setting of an "aqua-planet", the Indian monsoon, then on the African monsoon, by setting the maximal resolution on Western Africa (simulation of the 15-year period between 1979 and 1993, using observed sea surface temperatures). As part of the GSWP programme, a global climatology study of the ground's water content between 1987 and 1988 was used as a reminder of the deep reservoir that appeared in the ISBA ground scheme in simulations of the Arpège model. The results of the modelling suggest that the initialisation of water content is important for seasonal forecasting in sub-Saharan Africa. The Arpège model was coupled with the OPA (LODYC) oceanic model and the GELATO ice floe model to carry out a controlled experiment and produce a climatic scenario from 1950 to 2100. That simulation uses observed concentrations of greenhouses gases in the first period up to 2000 and the SRES-B2 scenario (IPCC) for the second period from 2001 up to 2100.

All the work carried out along tropical latitudes illustrated the strong connection that exists between the African continent and the Atlantic Ocean zone, through the circulation of the monsoons. The LOTI project, which deals with the Indian Ocean, is also part of the picture, given the role of that ocean in the pluviometric variability in Eastern and Austral Africa.

The CATCH experiment, currently underway, deals with the coupling of the tropical atmosphere and the hydrological cycle, while the experimental project, SCIAMEX, on the African monsoon, was intended to unite the various programmes (climate, hydrology, atmosphere-ocean, atmospheric chemistry), while remaining open to international collaboration.

1.4 Austral Regions

Through the formation and exportation of masses of water, an intense atmospheric circulation and a strongly marked seasonal cycle of sea ice, the austral regions play a fundamental role in the equilibrium of the world ocean.

In connection with foreign teams, the French teams have played an active part in gathering and analysing data from the Indian region. Efforts to produce global models and analyse satellite data have since strengthened present knowledge. As a result, over the past few years, it has become possible to make more thorough scientific use of all the data and numerical simulations available. A number of programmes, including ROSAME (Network of Tide Gauges in the Austral Region), OISO (hydrological and geo-chemical measurement to quantify CO_2 balance) and ARGAU (CO_2 balance in the South Atlantic region), are worthy of note. Using a set of models, the BILBO project studies the physical mechanisms involved in the ocean-ice-atmosphere and ocean-sea ice systems in the Austral regions (south of 40°S), with the aim of explaining variability, from the seasonal to the interannual scale. This has enabled:

- The development and validation of the global ocean model ORCA and the improvement of its physical parameterisations (free surface, friction and bottom boundary-layer, double diffusion, speed induced by vortices, according to baroclinic instability, sea ice);
- The development and validation of IPSL marine ice model (including the dynamics of sea ice);
- The implementation and validation of the coupling of ORCA, with the marine ice model developed by the Catholic University of Louvain-la-Neuve;
- Participation in the development and validation of the atmospheric zoom model, LMDZ.

By analysing the trajectories between the four sections that mark off the Indo-Atlantic sector (Drake's Passage, section

at 20°N in the Atlantic, the Indonesian Throughflow, and the South of Australia), researchers were able to supply a detailed description of the upper branch of the "conveyor belt" in this area. In addition to quantifying the circulatory paths, the study has shown a contribution to the branch from the South of Australia that had never been noted before, but which was confirmed by direct observation. This conclusion was also applied to the global ocean. The intensity of the inter-basin thermohaline circulation, as shown in models, is fully consistent with observations. This conclusion made it possible to distinguish between actual mass transmissions from mere re-circulations, and reveals the paths used for exchange between the basins. It also lays emphasis on the key role that the Austral ocean plays in the redistribution of the water masses and illustrates new linkages between the various basins.

A series of studies carried out on the basis of forced oceanic and atmospheric simulations or atmosphere-ocean coupled simulations showed that:

- The circumpolar Antarctic wind simulated in ORCA, in forced mode, is basically a response to anomalies in wind stress. It is the dominant mode in low-frequency variability, at the surface as well as underwater;
- Oceanic lateral physics exert control over the intensity and period of the variability of the coupled system, by affecting the average state of the ocean. It also affects the equilibrium of the oceanic mixed layer, and thus strongly influences the transformation of water masses in the Austral ocean;
- The Pacific/South America mode is responsible for part of the strong variability observed in the carrying of humidity from the South American continent (South of Brazil and Argentina);
- Tropical variability of the ENSO type, as simulated by the LMDZ model coupled with the oceanic mixed layer model, leads to significant anomalies in surface temperature in the Pacific sector of the Austral ocean, via an atmospheric "bridge".
- The coupled system ocean-ice, developed in the BILBO project, now shows the average state of the Austral ocean as strongly improved, in particular as regards the formation of intermediate Antarctic water and that of Antarctic bottom water.

It was shown that the Antarctic ice sheet had still not stabilised following the warming during the Holocene era, and was thus not stationary. For the first time, variations in sea level were linked to variations in the Antarctic mass at the seasonal scale. However, the most outstanding results pertain to dynamics.

Using a model of ice drifting patterns, constrained by the high-resolution topography of the geodesic orbit of ERS-1, we were able to develop an estimate on the draining of the Antarctic. It shows that nearly 80% of the ice sheet were drained by about 20 glaciers that account for only a few per cent of the coast. The signature of the largest glaciers reaches up to the domes. This has marked consequences for the dynamics of the ice sheet, and especially on its ability to react to climate variation. On the one hand, the glaciers will react very quickly to variations in sea level and pass these variations back upstream. On the other hand, much of the ice sheet is characterised by an extremely slow drift rate and is thus almost inert. One of the consequences of this very particular combination is the increase in mean relaxation time: the Antarctic will respond to natural fluctuations in the accumulation rate by sending a low-frequency signal that might make a significant contribution to variations in sea level. These results have been confirmed and corroborated by the new radar interferometric system developed at the laboratory. It has, for instance, been demonstrated that the Mertz glacier drifts at a rate of over 200 meters per year in the middle of ice, whose average speed is no higher than a few meters per year. Clearly, these areas need to be given priority in our monitoring programmes.

The CLIOKER project was designed to monitor the variability of the Antarctic zone, near Kerguelen, on a seasonal and interannual scale, using monthly observa-

tions from two fixed CTD stations since January 1999. We will thus be able to study the teleconnection between this local variability and ENSO events, with a view toward understanding Antarctic variability in a context of global change. These stations are also used as a basis for validating satellite altimetry, as part of the Topex/Poseidon and Jason-1 projects.

Interannual variations are determined at this site using a combination of hydrological Clioker data and data from the Kerfix station, over the 1992-1994 period. The average steric sea level rose by 3 centimetres between the two periods, as confirmed by the altimetric data.

The coastal regions of the East Antarctic are the site of intense exchange between the ocean and sea ice, the continental ice sheet and the atmosphere. An atmospheric observation project has been designed to record climate change on the Antarctic continent, with long-term meteorological observations in the coastal stations: a network of AWS stations will be established in this zone, the results of which will be compared with the observations at Dome C, representative of the high central plateau of the East Antarctic. A recent study of the 30-year meteorological series taken in three East Antarctic stations showed that a change in climate regime is likely to have occurred in 1972. Analysis of the data shows warming on all of the stations and a decrease in wind, which is consistent with a decrease in the number of depressions in the circumpolar vortices after 1972. A specific study confirmed that the warming could only be explained by depressions that were stronger or more extensive after 1972 than before. The changes observed would thus be due to a global warming effect that would strengthen the temperature gradient in the middle troposphere between the middle and high latitudes, as a possible result of the increase in the circumpolar vorticity, without increasing the number of depressions. Studies are underway to record the climate change observed using two numerical experiments with Arpège-Climat and with the observation, in the Antarctic, of secondary meridian circulation, linked with catabatic surface circulation. These catabatic winds have a direct effect on the formation and distribution of sea ice along the coast, and can also be important in the formation of deep water in winter.

Since 1992, French teams have been taking part in efforts to maintain a hydrographic department between Tasmania and Adelia Land as part of the Survostral Project, which involves French, Australian and American teams. Thanks to this, we have access to an altimetric and hydrographic database. The launch of XBT probes within short distance of one another and access to thermosalinograph measurements over 1992 –2000 now make it possible to analyse the flows of vortices along the Survostral line. Spatio-temporal analysis of these flows makes it possible to quantify energy transfers in the region.

The data recently yielded by Survostral have made it possible to draw more precise conclusions as to the seasonal structure of the surface temperature and salinity over the long term and to validate the climatologies prevailing in this region. The Survostral measurements show a good correlation between summer salinity near the Antarctic continent and the variations in sea ice cover during the preceding winter.

Lastly, it is possible to establish a relationship between surface fronts and deep-ocean fronts—an interesting development for the monitoring of fronts using the thermosalinograph or SMOS satellite technology, for instance.

2 Studies of Anthropogenic Climate Change

International research on this topic is coordinated by the World Climate Research Programme (WCRP), under the "Anthropogenic Climate Change" (ACC) component of the CLIVAR programme, and by IGBP. It contributes to the scientific evaluation of climate change carried out within IPCC. Teams from IPSL and CNRM have worked on this topic, using their respective models.

Two major series of simulations have been carried out using the IPSL model:

- Simulations of the system's response to an increase of 1% per year in atmospheric CO_2, up to the 4 CO_2 level, with two intermediate stages at a stabilised regime, one at 2 CO_2 and the other at 4 CO_2. These simulations gave a foundation for various diagnostic studies on the following four topics: analysis of cloud retroaction, analysis of surface-related retroaction, analysis of polar climates (continental and oceanic) and analysis of atmospheric weather regimes in the North Atlantic. The simulations that have been carried out show the negative impact of climate change on oceanic and continental carbon cycles;
- Simulations produced out in the format recommended by IPCC were carried out through complete and interactive coupling of the carbon cycle since 1850. The simulated CO_2 level and warming are both highly realistic throughout the historical period. In 2100, the warming reaches 3.2°C, or approximately 0.5°C more than what would have been reached using the IPSL model without carbon cycle coupling. Variations on this scenario were also simulated.

The IPSL model reveals rather unexpected complexity in the retroactions: in a warmer climate, the biospheric sink tends to decline, but the excess carbon that it leaves in the atmosphere then prevents the oceanic sink from declining in turn, even though the ocean is more stratified. The climate effect is preponderant for the biosphere and the carbon sink decreases with climate change. With the ocean, however, the reduction of the sink due to climate change is compensated for by an increase in the sink due to a higher level of atmospheric CO_2. This shows that the coupled system is more complex than it appears in offline simulations (e.g., those of CMIP), where researchers simulated a negative climate impact on biospheric and oceanic carbon fluxes. The IPSL project now aims to integrate retroactions resulting from the chemistry of sulphur (aerosols), ozone and methane into the simulations (which will henceforth be based on the zoom LMDZ model). To begin with, these simulations will be carried out on the 20th century.

Simulations of transitory climate change were also carried out by coupling Arpège-Climat model (from CNRM, Météo-France) with the LODYC oceanic OPA model, through the Oasis coupling model (CERFACS). Simulations were made of the climate "at equilibrium", based on the present climate, along with simulations of climate change, using the conditions that would apply if atmospheric CO_2 doubled.

A new coupled model was developed, integrating the estimated direct and indirect effects of aerosols. OPA serves as the oceanic component, and is coupled with a new dynamic and thermodynamic ice floe model. Four coupled simulations spanning 150 years each, and initialised using conditions representative of 1950, were carried out in order to reach the 2100 scenario. The results were as follows:

- Heat events, of El Nino type in the Pacific, seem to show low sensitivity to climate change, even if certain trends can be seen. In particular, in the coupled simulation when CO_2 levels double, the duration of the seasons is not as tightly controlled and regimes by which anomalies in temperature are propagated towards the West are more frequent than in the reference simulation. However, the

teleconnections over Europe and associated with ENSO can, in some cases, be intensified;

- The simulations with $2xCO_2$ levels reveal the high sensitivity of the climatic response at the regional scale to specifications in the climate's retroactions on the vegetation. The representation of evaporation in the simulated response is an important parameter, particularly in tropical regions. The uncertainties relating to surface processes are of a very different order, depending on whether one looks at the present climate or simulated climate change. Lastly, a study on the impact of the doubling of CO_2 on the Indian monsoons shows that this phenomenon is highly sensitive to surface schemes, due to modifications in the transport of water vapour, as well as to the change in efficiency of the precipitation;
- These simulations provided an opportunity to study the interactions between the respective changes in the concentration of stratospheric ozone and that of greenhouse gases. One of the most noticeable results relates to the dissipation of the Arctic ice floe, in the simulation scenarios, starting in the second half of the 21st century. The scenario including heterogeneous chemistry leads to a minimum of quantity of stratospheric ozone starting at the beginning of the 2000-2010 decade. The return to concentrations similar to those observed in the 1960s does not occur until 2070-2080 in Antarctica. Elsewhere, in the lower stratosphere, initial analyses show that the slowing effect of chemical reactions on the increase of ozone seems to outweigh the destruction due to chlorine starting in the decade 2030-2040;
- Lastly, as regards the study on the detection of climate change, initial work has been carried out to detect a possible trend in the frequency and intensity of the storms that have been affecting France over the last 50 years. The main finding shows that decennial variability exists with this indicator, but no trend can be identified over the period. The homogenised series of average daily temperatures show a North-South gradient, with warming over a 100-year period of approximately 1°C in the south and 0.5°C in the north of the country.

When the validation of the simulated regional climate is concerned, CNRM activities on the regionalisation of the climate (which are not part of the PNEDC) are included in the European project Mercury, and integrated in the Ministry for the Environment's GICC programme (described hereafter, in paragraph 5) for the simulations of scenarios with $2xCO_2$ levels.

The European project, Land Surface Processes and Climate Response (LSPCR), covers the realisation and interpretation of simulations of the impact of surface processes on climate change, under the conditions that would exist if CO_2 concentrations doubled. The international project, Coupled Models Intercomparison Project (CMIP), covers the analysis of coupled simulations, in particular scenarios when CO_2 concentrations increase at a constant rate (1% per year). This analysis was included in the latest report issued by IPCC Group 1.

3 National Programme on Atmospheric Chemistry

The National Programme on Atmospheric Chemistry (PNCA) studies the interactions between atmospheric chemistry, aerosols and climate, using complementary approaches: field experiments, laboratory studies and modelling.

Long-life gases (carbon dioxide, methane, nitrous oxide, CFC compounds and halons) contribute directly to the greenhouse effect through their radiative properties; the uncertainties as to their impact are related to the development of their sources and surface sinks. In contrast, aerosols and main reactive gases, including tropospheric ozone and its precursors, interact in a very complex manner with the climate, at different time and space scales.

Certain gases (nitrogen oxides, volatile organic compounds) emitted by human activities, vegetables or soils, lead to the production of tropospheric ozone, which is not uniform in space or time. Ozone is intrinsically a greenhouse gas, but beyond its direct effect, the tropospheric ozone content conditions the atmosphere's oxidizing ability and modulates the life span of other chemical constituents, thereby also modulating their contribution to the greenhouse effect. The oxidation of sulphur dioxide and certain volatile organic compounds leads to the formation of secondary aerosols, which combine with emissions in the form of sea spray, continental dust or organic aerosol, and increase the particle load of the atmosphere. These aerosols cover a very broad spectrum of physical, optical and chemical properties; they interact directly (absorption, diffusion) and indirectly (cloud physics) with their radiation and can modify the chemistry involved, for instance, through gas capture or by lowering the frequency of photolysis. Lastly, aerosols and gases are capable of being washed out through precipitation, whether stratiform or convective. These various couplings justify the great interest that the PNCA has shown in the experimental studies and modelling efforts that might improve our understanding in this area, one which is very closely related to the problem of air pollution on regional and continental scales. Our understanding of the coupled interactions between changes in the distribution of chemical species with short life span and aerosols and climate change is the result of a long-term effort, initiated over the past few years and destined to continue.

This programme includes the characterisation of these species, in particular through laboratory experiments, the study of processes in the atmosphere, using in situ and remote sensed observations (Envisat satellite) and, lastly, the modelling that will make it possible to integrate our knowledge. Researchers will thus determine the emission fluxes of these gas species and primary particles, characterise their optical, physical and chemical properties and, finally, study their multi-phase physical and chemical properties. The data assimilation techniques adapted to atmospheric chemistry models will make it possible to characterise the distribution of several chemical species in the stratosphere and troposphere, and also enable the evaluation of uncertainties regarding certain emission sources, using inverse modelling. One of the first examples of a field observation campaign is the Escompte experiment, which took place in Marseilles, in June-July 2001 (http://medias.obs-mip.fr), and focused on pollution in the Marseilles region. It will help researchers to become more familiar with the areas immediately surrounding emissions sources and their impact at a greater scale. A campaign is also planned in Africa (in 2004 or 2005), on transport through convection, the

washing out of soluble species and the interactions between nebulosity, aerosol and photochemistry. Lastly, as regards modelling on the international level, a new generation of global models of atmospheric chemistry is being developed, with the participation of the following French laboratories: Institut Pierre-Simon Laplace (IPSL, CNRS), with its LMDZ-Inca model; and the National Centre for Meteorological Research (CNRM, Météo-France), with its Mocage model. The specific characteristics of these coupled models associating dynamics and chemistry are: high resolution, detailed parameterisations, and interaction with the general circulation model, which allow the chemistry of the gases and aerosols to modify the dynamics through radiative transfer. These global atmospheric chemistry models were developed by the informal group Gaston (see http://wwww.gaston.lmd.jussieu.fr) and are part of the European perspective.

4 The European Project PRISM

The Prism Project (Programme for Integrated Earth System Modelling) is the result of the discussions held between the European partners for climate research on how Europe should contribute to the international CLIVAR (Climate Variability) Programme, which is part of the World Climate Research Programme. While waiting for a request for financing from Europe and a likely proposal to be part of the future "Excellence Networks" that are described in the draft texts of the 6th RTDFP, a memorandum of understanding for a "European Network for Earth System Modelling" has just been signed between the potential partners of a future European network for research on the climate. This European organisation on climate research clearly wants to enjoy the same standing as existing research projects on the climate in Japan (Earth Simulator) and the United States (Accelerated Climate Prediction Initiative, ACPI), which already make use of significantly greater calculating power (several tens of "teraflop" machines).

The Prism Project, which aims to establish a Community-wide infrastructure for numerical climate modelling that is flexible, effective, portable and easy to use, is a first step in the European strategy for greater integration in climate research. Financed by the European Union (with a total of EUR 4.9 billion), the project will officially begin on 1 October 2001. It involves 21 partners, including the major European climate research centres, but also the constructors of supercalculators. The Max Planck Institute of Hamburg is coordinating the effort. The work agenda provides for:

- The establishment of a managing structure for the development, coordination and execution of a long-term climate simulation programme at the European level and on a multi-institutional basis;
- The development of a set of community-wide portable climate models and associated diagnostic software, in accordance with standardised coding conventions and accessible to the whole of the European scientific community;
- The carrying-out of a set of joint simulations.

The French laboratories devoted to research on the climate, IPSL and CNRM, which make use of numerical climate models (LMD and Arpège), play an important role in the preparation of this European project.

5 Research on the Management and Impacts of Climate Change

As a follow-up to the projects initiated by the Ministry for the Environment (AGRIGES, SEES, REGCLIM), the umbrella programme GICC (Management and Impacts of Climate Change) has been developing finalised research since 1999, as a supporting measure for the international negotiations that followed the Kyoto Protocol and the implementation of the National Plan to Mitigate Greenhouse Effects (PNLCC). It is steered by the Ministry for the Environment, in close cooperation with MIES, INRA and ADEME. Its objective is to expand the knowledge, tools and methods that will enable better definition of the strategies to prevent the greenhouse effect and adapt to climate change.

Its broad topics are as follows:

- The international negotiation arena;
- Strategies for reducing greenhouse gas emissions and aerosols;
- Potential impacts of climate change and adaptation strategies.

The programme is linked to others and takes into account the work carried out by IPCC and other European programmes (ECCP, RTDFP, etc.), the aforementioned programmes relating to the problem of "the greenhouse effect and climate change", but also GESSOL, PRIMEQUAL and PREDIT. The uniqueness of the programme lies in the fact that it brings together teams from the pure sciences and human sciences, and examines three terms (2010, 2030, 2100). The modelling aspect (both economic and climatic) provides unity to the project by aggregating the data from each of the fields. Economic modelling is described below.

The research topics involve, more precisely, the following components.

The first topic pertains to the implementation of the Kyoto Protocol (by 2010), but also deals with what follows, with the convergence and contraction of emissions (by 2030) and the stabilisation of emissions by 2100.

The second topic deals with the political decision-making and implementation processes that result from the Kyoto commitments at different levels (Europe, France, local governments), technical developments and behavioural changes, preventive capacities and sustainable development and, lastly, changes in the usage of land, forests and agriculture (inventory-taking methods on greenhouse gas sources and sinks).

The third topic pertains to the regionalisation of climate change and the prevention of risks resulting from extreme phenomena, as well as predicted impacts on hydrosystems, agriculture, forests, coastal regions, biodiversity and health.

Although it is difficult to bring together distant communities, significant results have been achieved in economic modelling, agriculture (emissions, economy), physical inventory of greenhouse gases, and the study of the hydrological cycle of the Rhone basin, in cooperation with the GEWEX programme.

ECONOMIC MODELLING

Economic models are used in research on climate change in order to:

- **provide prospective quantification of greenhouse gas emissions associated with man's various activities;**
- **evaluate the cost of policies intended to control these emissions;**
- **take into account the impacts of climate change on economic activities.**

A variety of economic models are used: macro-economic or growth models, general equilibrium models, and sector-based models (optimisation for energy, agriculture, etc.).

The coupling of these models makes it possible to:

- **provide anthropogenic inputs for climate models, without retroaction of the simulated climate change on the simulated economy;**
- **evaluate the cost of reducing emissions as compared to a base scenario;**
- **develop integrated models through coupling with highly simplified climate models.**

The ultimate objective is to develop economy-climate coupled models for cost-benefit analysis, which can act as true expert systems for the climatic, economic (and political...) optimisation of greenhouse gas reduction levels, to be set or negotiated at the international level.

6 Technological Research Programme

The programme at hand is "Greenhouse Effect" technical research programme, conducted by ADEME and linked in particular with the Research and Technological Innovation Networks run by the Ministry of Research (combustible battery, PREDIT, water and environmental technologies, etc.). Aside from the PREDIT programme in the transport sector, which is presented below, this programme is made up of five key actions:

- **Action 1:** reducing the carbon content of energy;
- **Action 2:** improving the energy efficiency and controlling demand in Transport, Housing, Services and Industry;
- **Action 3:** reducing specific greenhouse gas emissions (CO_2, N_2O, HCFC, SF_6) in industrial processes;
- **Action 4:** CO_2 storage;
- **Action 5:** Controlling the impact of specific greenhouse gases (CH_4, N_2O, CO_2) in agriculture and in the organic waste recycling sectors.

A socio-economic component covering behavioural patterns and lifestyles, and the legal and financial framework of a CO_2 market, has also been planned.

Action 1 consists of:

- Promoting renewable energies (sea wind energy, photovoltaic solar energy, geothermal using medium and high energy, biomass, small-scale hydroelectricity);
- Introducing a secondary energy vector that does not emit greenhouse gases (hydrogen, combustible battery, etc.);
- Improving the management of demand through energy storage methods.

Where Action 2 is concerned, the National Programme on Energy Efficiency (PNAEE), which was designed to control energy demand, already exists, along with the PNLCC. The objective is now to provide a complement to existing programmes in order to achieve greenhouse gas reduction goals in the various sectors involved. In the Transport sector, which is the greatest contributor to CO_2 emissions, the initiative is broken down into two parts: technology (clean fuels and engines, reduction in polluting discharge, vehicle electrification) and organisation of transportation (effective intermodality, usage of new information and communications technologies, policy evaluation tools). In Housing and Services, responses include energy substitution, regulation of energy uses and improvement of equipment. The CSTB's specific research programme in this field aims, in particular, for a strengthening of regulations in this field (RT2000). Lastly, in Industry, it is important to guarantee the control of energy over the whole of the production line and seek out technological breaks.

Action 3 relates to heavy industries (petrochemical, basic chemistry, metal works, cement plants, glass works) and industries involved in the cooling sector. Research covers:

- The reduction of CO_2 (new combustion processes, integration of capture technologies, including solvent-based removal, membrane separation, adsorption of solids);
- The reduction of N20 (development of treatment processes involving catalytic decomposition or thermal cracking);
- The substitution of HCFC along the cooling line.

SF_6 emissions from the micro-electronics industry will also be examined.

Action 4 concerns CO_2 storage in saline aquifers, oil wells and depleted gas sinks, non-extracted coal seams and the ocean bottom. In this area, Japan (Ministry of Industry and Commerce) and the United States (Department of Energy) have a dominant position. However, significant achievements have emerged in Norway (the Sleipner operation in the North Sea on a saline aquifer), and in Canada (the Enhanced Oil Recovery Project, in Weyburn). National joint efforts are built along the following lines:

- Demonstrating the technological feasibility of CO_2 storage in the various sites and configurations considered;

- Mastering available techniques by studying the interactions between CO_2 and its environment, its stability and its long-term future, using an appropriate model.

The concept of CO_2 storage must be socially acceptable. Sociological studies must be carried out in order to deploy the related technologies.

Action 5 concerns organic waste resulting from agriculture (liquid manure, etc.) or stored in dumps, which constitute a source of methane emissions that remains to be controlled. This will entail carrying out metrology studies on CH_4 emissions so as to ensure that capture takes place under optimal conditions.

Regarding N_2O and CO_2, the emission levels of which depend mainly on farming practices, the objective is to distinguish links between impacts on the carbon cycle and that of related elements (nitrogen, phosphorus) on terrestrial ecosystems (soil and vegetation).

Lastly, the socio-economic component of the research programme aims to spark action within the human sciences on the problem of reducing greenhouse gases. It is built around the following ideas:

- The implementation of the Kyoto Protocol raises legal problems that must be solved, whether in terms of international law (fulfilling commitments and containing conflicts), public law (allocation of emission rights to private entities and local governments), or private law (the trade of emissions permits);
- National policies and measures designed to prevent greenhouse gas emissions make use of a set of tools (regulations, tax measures, incentives and awareness campaigns) that have yet to be proven effective. What is the expected impact of a given tax, decision-making measure, or initiative to raise awareness, and how can we optimise the combination of these various tools? At what level should these various policies be implemented (global, European, national, regional or local)?

The bulk of the work carried out in the social sciences regarding climate change take into account the challenges that will arise from the Kyoto Protocol by 2010. The Hague Conference (November 2000) distinguishes the short term as the main priority (giving a limit of 10 years to set off the protocol's ratification process) and, in the longer term, aims to stabilise emissions according to the objectives listed in the Climate Convention. The pursuit of equity at the international level means that developing countries must be part of the negotiation process.

THE PREDIT PROGRAMME IN THE TRANSPORT SECTOR

The main areas for research and development focusing on "Energy and the Environment" in the Transport sector were determined as a function of the four following objectives.
1. Reduce health-related and environmental hazards resulting from Transport.
2. Improve energy efficiency in order to reduce greenhouse gas emissions and diversify energy sources used by vehicles and modes of transport.
3. Develop modes of transport whose efficiency in terms of energy and the environment surpasses that of currently dominant modes.
4. Improve control over the scope of travel and manage demand for mobility.

The "Energy-Environment" theme is built around three main research areas: public policy and control of environmental hazards; improving vehicle technology; improving modal transfer capacity to favour more economic modes.
The first area will cover, in particular, greenhouse gases, air quality at local level, noise pollution and the alteration of the urban environment and landscape. This will encompass identification of the determinants of exposure to local and regional pollution and the assessment of impact of atmospheric pollution on health, ecosystems and building, as part of the joint programme PREDIT/PRIMEQUAL.
The second area will involve, mainly, the simultaneous reduction of specific CO_2 emissions through consumption, nitrogen oxides (and particles) and noise pollution. This is the main objective of the "economic, clean and safe vehicle" project. Note that one initiative will be specifically devoted to new motors and the production of portable power.
The third research area involves economic modes of transport. The goal is to increase their economic and commercial attractiveness by improving their time to market, reliability and comfort. The socio-economic aspect of this undertaking is not to be forgotten, and the project needs to be developed alongside other work on mobility, land development and freight.
Lastly, the actual effectiveness of these technologies and policies will be evaluated thoroughly and carefully.

7 European Prospects

Research at European level is being carried out as part of the 5th RTDFP (Research and Technical Development Framework Programme), with a budget of EUR 14.96 billion. Within the 5th RTDFP, the "Energy, Environment, and Sustainable Development" component amounts to EUR 2.125 billion. It includes six key actions, one of which is entitled "The Changing Planet, Climate and Biodiversity". Its budget amounts to EUR 301 million. The areas targeted by this key action are as follows:

- developments in, and understanding of, the processes behind global change;
- improving our knowledge of ecosystems (including interactions between the atmosphere and the ocean);
- scenarios and strategies;
- contribution to global observation systems.

The European Union's 6th RTDFP, planned for 2002-2006, is currently being negotiated, on the basis of a text issued by the Commission in February 2001. It clearly distinguishes itself from the previous programme through its structure and implementation methods. It is designed to foster large-scale undertakings, carried out at the European level and focused on a few major topics. Three main lines have been defined:

- integrating European research (which is made up of seven key themes, as well as a section intended to fulfil research needs specific to Community policy);
- structuring European research efforts;
- strengthening the foundations of European research.

The first component, "integrating European research", will make use of new financing and implementation tools: integrated projects, excellence networks and joint national projects.

"Sustainable development and Planetary Change" is one of the themes suggested as a priority to the European Commission. Subjects relating to local ecosystems are likely to be added to the Commission's initial proposal (at France's request, in particular). There appears to be no doubt that climate change will remain a priority within the Community-wide programmes of the European Union. It should also be noted that climate change is one of the priorities of the European Union's 6th Environmental Action Programme (adopted in 2001), and of the European sustainable development strategy, adopted in Göteborg in June 2001. The following actions are being considered as part of the work carried out under the 6th RTDFP, relating to global change:

- a technological component relating mainly to transport and energy;
- a section on "global change and ecosystems", which could include research on the impact and mechanisms behind greenhouse gas emissions, the water cycle, marine and terrestrial biodiversity, desertification and observation systems.

As regards the budget, the Commission has proposed that the 6th RTDFP be endowed with EUR 17.6 billion. In the proposed breakdown, the section on "Energy, Environment and Sustainable Development" would be given EUR 1.7 billion, which is down on the 5th RTDFP. This amount might increase following negotiations.

Report on Systematic Observation for the Climate

The Global Climate Observing System (GCOS) is a composite system designed to monitor the climate. It is made up of the four following components: meteorological and atmospheric, oceanic, terrestrial and spatial. They will be elaborated upon below, after the paragraph on Generalities. Note that this is the first time that France is issuing a National Overview on Systematic Observation of the Climate.

1 Generalities

Meteorological observation is one of the basic responsibilities of Météo-France, whose policy is defined by the framework programme on meteorological observation (1999) and the framework programme dedicated to climatology (2001). However, as a result of its composite aspect, GCOS is a system where operators can also come from other institutions, including laboratories under the aegis of the Ministry of Research or the Ministry for the Environment, oceanographic institutions and overseas institutions. The general policy about dissemination of data is concerned is defined by WMO's Resolution 40, relative to the dissemination of meteorological data. Concerning the global climate observing system, the issues of how to disseminate long series of data and how to ensure the permanence of observation networks will have to be addressed. Environment Observatories (operational or research) are presently trying to answer these questions.

2 Meteorological and Atmospheric Observation

Meteorological and atmospheric observation includes the following aspects: surface observation (GSN), upper air observation (GUAN) and physico-chemical measurements (GAW).

Global Surface Network (GSN)

Since 1999, the meteorological surface network GSN has been made up of the six following stations in continental France: Rennes, Strasbourg-Entzheim, Bourges, Toulouse-Blagnac, Marseille-Marignane, and Mont-Aigoual. The latter was selected as a mountain-based station. These six stations belong to the basic synoptic network at the WMO level, for the dissemination of data. As a result, the previous data series (monthly and daily averages), along with the meta-data and the daily observations, presented as Climate messages, are sent on a regular basis to the National Climatic Data Center in Asheville (United States). As regards overseas French stations, the GSN network includes the following sites:

- In Guyana: Cayenne-Rochambeau;
- In Guadeloupe: Le Raizet;
- In the Indian Ocean and Austral regions : Dzaoudzi-Pamanzi (Mayotte), Martin de Vivies (Amsterdam Island), Port-aux-Français (Kerguelen Islands);
- In Antarctica: Dumont d'Urville;
- In New Caledonia: Koumac, Nouméa, Hififo (Wallis Island);

In French Polynesia: Atuona, Tahiti-Faaa, Rikitea, Tubuai, Rapa.

Global Upper Air Network (GUAN)

This network is devoted to measurements taken in altitude. In continental France, there is no station. However, overseas, the following stations are used:

- Guyana: Cayenne-Rochambeau;
- In the Indian Ocean and Austral regions:

Serge Frolow (Tromelin Island), Martin de Vivies (Amsterdam Island), Port-aux-Français (Kerguelen Islands);

- In Antarctica: Dumont d'Urville;
- In New Caledonia: Nouméa;
- In French Polynesia: Atuona, Tahiti-Faaa, Rapa.

GAW: Physico-Chemical Network

This network is responsible for physico-chemical measurements of the atmosphere. It is made up of four observation stations on the continent, located in Abbeville, Gourdon, Carpentras and at the National Observatory of Haute-Provence. The acidity of precipitation (BAPMON programme) is measured in Abbeville and Gourdon, while radiation is measured in Carpentras.

Measurements of ozone (profiles and/or total columns) are performed on a regular basis by CNRS' Aeronomics Department at the National Observatory of Haute-Provence, in Dumont d'Urville (Antarctica), in Saint-Denis de la Réunion (in collaboration with the University) and in the Kerguelen Islands, as part of the NDSC (Network for Detection of Stratospheric Changes). Lastly, CO_2 is measured in Amsterdam Island (see also paragraph 4, below).

The Future GSN Network

The European Climate Support Network (ECSN), which encompasses the climatological centres of EUMETNET's member countries, is coordinating the development of a bank of daily climatological data, under the co-leadership of The Netherlands and Norway. France's planned contribution will involve the 14 following stations, all located in the plains: Besançon, Bordeaux, Bourges, Brest, Clermont-Ferrand, Lille, Lyons, Marseilles, Paris, Perpignan, Poitiers, Rennes, Strasbourg and Toulouse.

14 additional stations will be brought in to enrich the network and to offer a more representative view of France's topo-climates.

The selection process was based on long series of existing data on temperature and precipitation observations, and taking into account the recommendations issued by EUROCLIVAR. The data generally goes back to 1945, but on certain sites, can go back to approximately 1880, either at the same observation site or at a nearby one.

The network will be managed as part of an European Climatological Databank (ECD). Access will be available via CD-ROM, ftp or Internet.

3 Oceanographic Observation

The French contribution to oceanographic observation of the climate was developed within the framework of the GOOS programme and includes the following components: voluntary observation ships (VOS), ships of opportunity (SOOP), tide gauges, drifting and anchored meteorological buoys and, lastly, sub-surface floaters (CORIOLIS project).

Note the pre-operational nature of this ocean observation system, which includes the modelling project Mercator, the observation project Coriolis and the future data assimilation experiment GODAE (2002-2004).

Voluntary Observation Ships (VOS)

The VOS are part of the WMO's observation programme. There are approximately 80 vessels, all of which will eventually be equipped with the BATOS system, developed by Météo-France. They perform atmospheric observation, but sometimes oceanic observation too.

Ships of Opportunity (SOOP)

Here, measurements of the upper layers of the ocean are made using XBT probes launched by ships of opportunity. Four ships operate in the Atlantic Tropics, while eight are present in the West Pacific. The means for the programme were provided

by IRD, with the support of NOAA, which provided the probes. Nearly 300 profiles are disseminated each year through the ARGOS system, then inserted in the GTS in Toulouse. The data are archived in the TOGA/WOCE database at the Brest branch of IRD (www.brest.ird.fr/goos). IRD has also equipped twelve ships with thermo-salinographs to measure surface salinity. The data is disseminated post-time, but will soon be available in real time. The corresponding databases are managed by IRD (Brest and Nouméa). The data collected in the Pacific are available on CD-ROM, as well as on IRD's Nouméa server.

Tide Gauge Network (GLOSS)

Tide gauges provide data on sea level, which are used to determine the general circulation patterns of the ocean and to monitor the climate. In addition, these data can be used as a basis for analysing the data gathered via altimetric satellite (ERS-1, Topex/Poseidon, Jason). The GLOSS network of tide gauges includes 12 stations under France's responsibility: Brest, Marseilles, Nouméa, Nuku Hiva (Marquise Islands), Rikitea (Gambier), Matavai (Tahiti), Kerguelen, Amsterdam, Crozet, Dumont d'Urville, Clipperton, Fort-de-France, Pointe-des-Galets (La Réunion), Cayenne and Dzaouzi (Mayotte).

A databank including daily, monthly and annual average levels recorded by SHOM over the past 40 years, has been made available to the Permanent Service for Mean Sea Level (Proudman Oceanographic Laboratory, Great Britain). In 2002, SHOM will develop a server to make these data available on Internet.

Drifting Meteorological Buoys

Météo-France regularly deploys drifting meteorological buoys as part of its work within the Data Buoy Cooperation Panel (DBCP), which itself reports to WMO and IOC. Météo-France contributes to the studies of two groups within the DBCP: the European Group on Oceanic Stations (EGOS) and the International Buoy Programme in the Indian Ocean (IBPIO). These groups are responsible for verifying the quality of the measurements and the dissemination of information via the GTS, for allowing the exchange of information on the topic, and for defining new techniques.

The buoys measure atmospheric pressure, sea surface temperature (Marisonde B or SVP-B) and, in some cases, wind (Marisonde G or SVP-BW) and deep-sea temperature up to 200 metres (Marisonde GT). The ARGOS system is used to locate the probes and transmit the data they gather (hourly observations).

Each year, Météo-France deploys 15 buoys in the North Atlantic for EGOS. As part of IBPIO, Météo-France contributes to observation in the Indian Ocean by equipping 10 american SVP floaters per year with atmospheric pressure gauges, and by providing around five buoys. Météo-France takes responsibility for the coordination of the two drifting buoy networks at the international level.

Anchored Meteorological Buoys

In addition to the oceanic stations, Brittany and Gascogne, which are run in the Near Atlantic with the cooperation of the United Kingdom Meteorological Office, Météo-France has set up anchored oceanic buoys on three other sites since 1999: two off the Caribbean coast, at a depth of 5,500 metres, and another off the Nice coast, at a depth of 2,300 metres. A fourth site will be equipped in the Mediterranean's Golfe du Lion in 2001. Every hour, each of the acquisition systems makes observations, recording atmospheric pressure, temperature and humidity, surface wind and sea temperature at 1 metre below. The data are sent via Météosat. The localisation of the buoys is performed using GPS and an ARGOS beacon. Lastly, a buoy-beacon was set up in June 2000 in the Mer d'Iroise and anchored to the "rail d'Ouessant" (Lighthouse and Beacon Department). Two directional swell gauges are anchored near the Caribbean Islands, one in Guadeloupe and the other in Martinique. They observe significant heights, the period and spectrum of the swell, as well as the sea temperature every half hour and send them via the ARGOS system. The buoys anchored off the coast regularly send messages, which travel over the GTS and enrich the data exchanged throughout the world as part of the World Weather Watch.

The PIRATA Observatory

The PIRATA Observatory is an international meteo-oceanic real-time monitoring system, which was established in a vast sector of the Atlantic Tropics. The observatory, coordinated by IRD-Brest since late 1997, is part of the International CLIVAR Programme, but has a strong operational emphasis. PIRATA-France is one of the components of the French programme, ECLAT. Within this context, the Pirata Observatory is associated with the Equalant programme, but is also equipped with a current-measuring interface and sub-surface anchorages along the Equator. Over 30 ATLAS systems have been released at 12 key locations, through eight campaigns carried out between September 1997 and December 2000, using a number of oceanographic ships: Antea (5), Le Suroît (1), La Thalassa (1) and L'Atalante (1). Most of these launch trips departed from the Pirata-France base, in Abidjan. Today, the whole of the global climate community can reap the benefits of the information gathered by this observatory.

CORIOLIS: The Operational Oceanography Project

The seven French agencies involved in oceanography (CNES, CNRS, IFREMER, IFRTP, IRD, Météo-France and SHOM) have joined forces to develop a complete, coherent system for operational oceanography, designed along three lines: satellite altimetry (Jason), global numerical modelling with assimilation (Mercator) and in situ measurements (Coriolis).

The CORIOLIS project aims to build a pre-operational structure for the acquisition, gathering, validation and dissemination of global oceanic data (temperature and salinity profiles, current profiles) that fulfils the needs of modellers (such as Mercator) and the scientific community (as part of CLIVAR). The CORIOLIS project has four aims:

- To build a data management centre, which will be one of the two ARGO centres in the global experiment, GODAE, capable of supplying data in real- and post-time. The CORIOLIS Centre, currently being developed, centralises all of the temperature and salinity profiles, virtually in real time (three times per week and, in 2001, on a daily basis) that come from GTS and other sources. The data, which come from XBT probes, ATLAS, TAO and PIRATA buoys, floater-profilers and drifting buoys, can be found online (www.coriolis.eu.org).
- To contribute to the deployment of the ARGO network, especially in the Atlantic, with around 300 floater/profilers to be deployed between 2001 and 2003. A total of 20 PROVOR floater-profilers were deployed in the North East Atlantic in 2000. Furthermore 100 additional floaters will be purchased in 2001 and 140 will be purchased in 2002. These figures include the 40 floaters to be used as part of France's participation in the European programme Gyroscope (IFREMER), which calls for the deployment of 80 floaters in the North Atlantic to evaluate the need for a pre-operational measurement network at the oceanic basin scale and its working in real time;
- To develop and improve ARGO profilers. PROVOR is a self-ballasted floater, capable of remaining at a set drift depth, diving down 2000 metres and coming back up, and producing a precise temperature and salinity profile, which is then sent back on land via the ARGOS system. The PROVOR floater is capable of completing over 100 cycles during its life span of three years. A new generation of profilers, which would be smaller, less expensive and launchable from ships of opportunity or planes, is currently being studied, with a view to industrialisation in 2003;
- To acquire, validate and process in real time and using CORIOLIS, the other data that is routinely gathered by various French bodies, from surface floaters, anchored Pirata buoys, research ships (bathythermal XBT probes, thermosalinographs and ADCP current profilers).

In 2004, recommendations will be issued to turn the Coriolis pilot project into an operational activity that contributes to the permanent observation of oceans, depending on the progress of the ARGO/GODAE experiments. The deployment of ARGO will then be complete, and the experience acquired will make it possible to gain a better understanding of the ocean circulation and, in so doing, contribute to the

4 Terrestrial Observation

The Global Terrestrial Network (GTN) carries out observation of mountain glaciers, long-term monitoring of greenhouse gases (RAMCES), measurements of carbon flows as related to terrestrial ecosystems (FLUXNET) and, lastly, observation of forest ecosystems.

4.1 Observation of Mountain Glaciers

The Laboratory of Glaciology and Environmental Geophysics has been producing glaciological observations on alpine glaciers since 1956. These observations can be used to study the mass balance (accumulation versus ablation) of glaciers in the French Alps, and the modifications in the geometry and dynamics of these glaciers. These data serve as an indicator of climate change at high altitudes and are essential if we are to understand glaciary fluctuations (positions of fronts, thicknesses, speeds). In addition, they form the foundation for analysis of natural risk resulting from glacier activity. Since 1991, the Institute for Research and Development (IRD) has been operating a similar programme, but on tropical glaciers (Bolivia, Ecuador and Peru): it involves establishing mass balances and identifying modifications in geometry and dynamics, sometimes making use of a network of meteorological stations to calculate the energy balance at the surface.

LGGE Observation Network

Since 1995, the observation network of mass balances has been extended and the objective is now to ensure its continuance. It involves the systematic determination of winter and summer mass balances, in both ablation and accumulation areas, on four glaciers (Argentière, the whole of the Mer de Glace, Gébroulaz and Saint-Sorlin). This network makes it possible to gather observations on most of the mountains in the French Alps, on an altitude range of over 1,500 meters and with varying degrees of exposure. The data, which results from direct observation of mass balances, taken on the glaciers (core samples, beaconed areas) can be used, if validated, to determine variations in volume of the glaciers on a 10- to 15-year scale. The analysis of mass balances over the last 50 years now proves that these observations are suitable for detecting changes in energy balance (summer fusion) and in winter precipitation (through accumulation) in high mountains. The network also produces observations of fluctuations on the four glaciers. Since 2000, the network has been part of the Universal Sciences Observatory in Grenoble (OSUG).

Aside from LGGE observations, CEMAGREF produces measurements of mass balance on the Sarennes Glacier since 1949. Lastly, the Parc national des écrins, in conjunction with LGGE, produces observations of mass balance in the accumulation zone of the Blanc Glacier.

IRD Observation Network

IRD's Glacier Study Programme first began in Bolivia (1991), with two glaciers: the Zongo Glacier (monthly monitoring of the mass balance and hydrological balance, annual monitoring of variations in the glacier front and dynamics, and determination of surface energy balance since 1996) and the Chacaltaya Glacier (monthly monitoring of mass balance and annual monitoring of the position of the front). In 1995, a measurement system identical to that used on the Zongo Glacier, was installed on Glacier 15A of the Antizana Glacier, in Ecuador. The Carihuarazo Glacier is also monitored annually to check its mass balance. Lastly, since 1999, two glaciers in the Cordillera Blanca in Peru have been studied yearly for mass balance.

Prospective View: Observatory for Environment Research on Glaciers

In order to homogenise and preserve the network of measurements carried out on both alpine and tropical glaciers, LGGE and IRD launched a joint project in March 2001: the Observatory for Environment Research on Glaciers. Its purpose was to establish a data bank that can be used in the study of climate variations as well as for the validation of climate models. The glaciers selected for the ORE project represent a variety of climates and lie along a climatic meridian ranging from the Equator (Antizana) to the sub-tropics (Zongo) and the Alps (Argentière and Saint-Sorlin) and, finally, to the Poles (Dome C and coastal region near Dumont d'Urville). The polar portion of the project will be carried out in conjunction with the Polar Institute (IFRTP).

Dissemination of Information

The data stored in computer form has been available to the public since May 2001, on the LGGE server. Part of the data pertaining to mass balances and fluctuations in length appear in Fluctuations of Glaciers, a document published every five years by the Standing Committee on Fluctuations of Glaciers of the International Union of Geodesy and Geophysics (IUGG). Six volumes have been published since 1959. The annual mass balances of the Saint-Sorlin and Sarennes glaciers have been published since 1988 in the World Glacier Monitoring Service's bi-yearly publication, The Glacier Mass Balance Bulletin. Those of the Zongo, Chacaltaya and Antizana glaciers have been published since 1995.

Cooperation

The cooperation carried out between LGGE, CEMAGREF and IRD are part of the European Glaciorisk programme on natural risks resulting from glaciers. At the international level, an engineer from LGGE is a correspondent at the World Glacier Monitoring Service. In the Alps, LGGE maintains close relations with its Swiss counterpart, VAW[1], in Zurich. Cooperation also takes place with Italian and Spanish colleagues for the implementation of their observation networks in the Grand Paradis mountains and the Maladeta mountains. IRD also works with Andean partners in the countries where it operates. A researcher from IRD is a correspondent at the World Glacier Monitoring Service.

4.2 RAMCES Network

The long-term monitoring of greenhouse gases by the RAMCES network of atmospheric observatories fulfils two objectives:

- Understanding the cycle of the main greenhouse gases (CO_2, CH_4, N_2O) and their role within the climate system. By becoming familiar with these flows, we will be able to validate bio-geochemical models and socio-economic emissions scenarios, which can be used to predict the devolution of these sources and sinks in the future;
- Quantifying the carbon balance of a large region, along with its variability, as part of the verification of inspection policies or policies designed to reduce greenhouse gas emissions.

In order to achieve these objectives, it is necessary to regionalise CO_2 flows. CO_2, the leading greenhouse gas effecting climate change, is given priority, as it has increased by 30% over the last 100 years, in response to industrial emissions and changes in the way land is used.

It is not easy to convert CO_2 emissions (or CH_4 or N_2O) into different atmospheric concentrations, as these gases have natural cycles that regulate their abundance in the air. Anthropogenic disturbances must therefore be quantified separately from the natural sources and sinks that are sometimes much higher.

As concerns the carbon cycle, two reservoirs – the ocean and the continental biosphere – determine the air's CO_2 content, with very different response times. The objective is thus to regionalise CO_2 sources

(1) VAW : Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie der Eidgenössischen Technischen Hochschule

and sinks, in other words, determine which ecosystems and oceanic basins store or emit carbon.

The methodological approach developed by LSCE consists of measuring CO_2 regularly and very precisely using a global network of observatories to deduct the spatio-temporal distribution of the sources and sinks. This is because variations in concentration at a given point result from flows exchanged at the regional and global scale, and integrated by the circulation of masses of air. Using methods that invert atmospheric transport, it is then possible to translate the gradients in atmospheric concentration in terms of surface flows. Inversions are currently the most effective method for quantifying flows at the continental or oceanic basin scale.

An additional priority is the study of the balance of CH_4 and N_2O species. These two gases have a sufficiently long life span to be dispersed in the atmosphere on a global scale. Measurements of their concentration in the lower atmosphere, far from the sources, like those of CO_2, are thus just as appropriate for deducing flow patterns.

This will allow the long-term monitoring of these gases, a process that is justified by both physical and industrial reasons.

RAMCES for the Monitoring of the Background Composition of the Atmosphere

The first observatory for the continuous measurement of CO_2 was established in Amsterdam Island in 1981 (TAAF). A second observatory for the continuous monitoring of CO_2 was initiated in 1992, in Mace Head, on the West coast of Ireland. These two observatories of the troposphere were integrated into the WMO's GAW network and received labelling in 1995. In addition to CO_2, several other atmospheric compounds are measured in these observatories (radon 222, soot carbon, CO, CH_4), thus making it possible to carry out studies on the sources of these species, using a multi-tracer approach, and to trace back the origins of the air masses. The monitoring of N20, the third leading greenhouse gas, began in 2000. Furthermore CO, in particular, is very useful for separate deduction of CO_2 of fossil origin. In addition, LSCE regularly takes a set of samples from each of the observatories in order to quantify regional variability.

Since 1996, in order to have access to representative measurements of the lower atmosphere in the continental region, LSCE has established regular sampling from 0 to 3 000 metres above Orléans. This set of data is one of the first series of measurements on the continental atmosphere, and will make it possible to quantify the seasonal variability of CO_2 in the lower troposphere.

Future RAMCES Measures

The Indian Ocean was chosen to enrich the network in key regions. The new project involves the OISO observation system, based on the ocean-faring ship Marion-Dufresne, with three air sampling stations to be used in La Réunion, Tromelin (in operation since 1997) and the Maldives. These stations, which will be complemented by the Amsterdam (continuous) and Crozet (collaboration with NOAA) stations, are expected to enable good characterisation of the role of this region in the carbon cycle within three to five years.

The European Project "Aerocarb"

The second key region studied by Ramces is Europe. LSCE is co-ordinating the work of 13 laboratories in the Aerocarb project, which aims to raise the number of observatories of CO_2 above the European continent from 14 to 30 within three years. The programme was intended to demonstrate the feasibility of an integrated approach and to estimate and check the net carbon balance in Europe from the monthly to the decennial scale. This pan-European network on greenhouse gas monitoring aims to unify CO_2 measurement networks in Europe (to be completed with measurements taken from planes), and use extremely precise measurement techniques. The objective is to implement a new approach using a variety of tracers so as to separate the various origins of carbon flows: O2 and CO_2 concentrations (land-ocean interaction), CO_2 (contribution to fossil fuels) and CO measurements (validation as a less costly alternative for CO_2).

4.3 Fluxnet

Measurements of carbon flows in land ecosystems are carried out under the Fluxnet international programme and the various programmes associated with the Carboeurope group of projects described below.

Carboeuroflux

The aim of this programme is to improve our knowledge of the significance, location and evolution in time of carbon sinks and sources in terrestrial ecosystems and to understand their causes. This should make it possible to improve the European Community's ability to negotiate under the Kyoto Protocol. All these sites have similar equipment: a measurement mast (or tower) with several rapid sensors to measure movement quantity flows, sensitive heat, water vapour, CO_2. Measurements are carried out continuously at 20 Hz over periods of several consecutive years. Microclimatic measurements are also made (spread, temperature, humidity, wind, precipitation etc.) and eco-physiological (sap flows, photosynthesis, ground aeration, biomass, lead rate etc.).

Carboage

The aim of this programme is to analyse the role of forests in Europe as carbon sinks during their life cycle. Here we measure CO_2 flows on a certain number of sites (as in the case of Carboeuroflux), which will be used to estimate these flows on a higher scale. This will enable us to develop new options for managing carbon sequestration. We expect that disturbances in the soil resulting from tree cultivation (planting, maintenance, harvesting) produce carbon flows from the ground, which can have a significant effect on the development of these flows over time.

As regards these two programmes, France has six operational experimental sites that supply the databases. They can be seen in the following table.

Carbodata

These sites provide two types of data:

- unprocessed data (20 Hz), stored on CD for each participant;
- processed data (1/2 h), transmitted to the Carbodata programme, responsible for maintaining quality and storage. This is a database that supplies information on the carbon cycle for a broad range of ecosystems and places. It has to allow for day-to-day estimates of changes on various sites for studies of ecosystems. It can also validate remote sensing products. Eventually all this will make it possible to provide higher range carbon balances or supply European carbon flow maps. The final aim is to supply estimates of carbon sinks from models, in response to demand from users or Member States of the European Union.

Site	Place	Type	Manager	Programme	Start date
Bray	Gironde	Maritime pine		Berbigier (Inra)	Carbo-euroflux
Hesse	Lorraine	Beech		Granier (Inra)	Carbo-euroflux
Puechabon	Hérault	Evergreen oak		Rambal (CNRS)	Carbo-euroflux
Bilos	Gironde	Clear felling		Loustau (Inra)	Carboage
Laqueuille	Puy-de-Dôme	Meadov land		Soussana (Inra)	Greengrass

4.4 Observation of Forest Ecosystems

Forest ecosystems, which occupy 27% of land in France, are regularly observed using two systems: over a period of ten-twelve years, the national forest inventory assesses – as it has done for almost forty years - forest resources and productivity; for about ten years it has been gathering environmental data, mainly on forest flora and soil. For ten to twelve years, a regular monitoring mechanism (annual or infra-annual data), originally introduced to investigate acid rain, has been developed towards an universal system covering all environmental influences. These two systems periodically evaluate carbon deposits in the forest biomass and soils and will, in the long term, enable us to quantify the influences of environmental changes, especially climate change.

5 Space Observation

CNES was one of the pioneer organisations to observe the Earth from space. Its programme takes up almost one third of the budget. It cooperates internationally, under a bilateral framework, and also by participating significantly (22% to 25%, depending on the programme) in European Space Agency programmes. This programme is organised in "sectors" – series of projects with common objectives or requiring specific techniques, with a concern for innovation, fulfilling scientific needs and developing applications.

Earth Surface Imaging Programme

The high-resolution imaging sector, supported by CNES, contains a Spot optical imaging system (4 satellites launched between 1991 and 1995; Spot-5 will be launched in October 2001) and the ESA radar satellites (ERS-1 and 2 launched in 1991 and 1995; Envisat will be launched in October 2001), whose images are used for various applications. Apart from the Spot project, the CNES is preparing the Pléiades system with European cooperation; it will contain various optical imaging and spectral and spatial resolution radar projects to respond to the various needs of European users.

Without directly supplying data on climate, the observations acquired over a long period by Spot satellites, and especially by the Végétation sensor, which ensures global cover of the earth on a daily basis, will act as a reference basis for long-term monitoring of ground cover.

Distributed on a commercial basis, Spot and Vegetation data are provided for the European scientific community at a discounted price, and sometimes completely free.

Meteorological Programme

In the 1970s, the CNES set up a meteorological programme, Météosat, transferred to the ESA and then to Eumestat. Since then, it has focused on improving remits for operational forecasting of the weather, using new sensors, such as IASI, to be installed on the series of three European meteorological satellites in the polar orbit, METOP (to be launched in 2005) and the preparation of future missions, beyond MSG and METOP.

Data from the meteorological satellites and improvements in efficiency, especially for atmosphere sounding, are of direct use for climate.

Research Programme

Research programmes for understanding the Planet Earth system are a very important item in the CNES programme. Firstly, they aim to acquire global data sets needed for world research programmes on climate and global change and have other objectives, such as improvements in our knowledge of geodynamics and forecasting or reducing geophysical parameters. The measured parameters refer to:

- clouds, water vapour, radiation, aerosols, plant cover, water colour: this is the aim of the wide field system, with Polder-1 and 2, Végétation-1 and 2, ScaRaB-1 and 2, Meris;
- ocean circulation with the altimetric project series, including Topex / Poséidon, Jason 1, RA / ERS and Envisat, Cryosat;
- physical chemistry of the atmosphere, with the balloon and airborne instrument sector (Theseo, Strateole, Map campaigns) and the atmosphere-sounding sector (Wind II, Odin, Iasi, Envisat, Alissa, Picasso-Cena etc.);
- measurement of the field of gravity, the magnetic field, determination of the geoid; this is the subject of the geophysical programme, in which the Doris series (on Spot, Topex / Poseidon, Envisat, Cryosat) plays a role, and the Oersted, Champ, Grace and Goce missions. The data thus acquired help to determine ocean circulation derived from the data measuring the dynamic topography of the ocean through altimetry. All these programmes are equipped with data use support, in partnership with other bodies and at European level, especially thematic data production centres, such as Mercator for oceanography. Satellite data in the research sector is made available free to the scientific community. Processing, standardisation, validation and storage of data is managed by international research teams.

To guarantee the continuity of spatial observations on climate, in partnership with other organisations and at European level, CNES is entering into discussions to ensure that data remain operational. This is the case of NASA, with Topex / Poséidon and Jason-1 on the one hand, and of NOAA and Eumetsat on the other, with a view to transferring responsibility for the altimetry sector to these two bodies (Jason-2).

Participation in ESA Programmes

ESA is developing an Earth Observation Envelope Progamme (EOEP), to which France will make a 22% contribution. The first phase (1999-2001) includes "Earth Explorer" research missions that are all of direct use for climate study: fine resolution of the geoid (GOCE), ice cartography (CRYOSAT), experimental determination of ground humidity and of the surface salinity of the ocean (SMOS).

The second phase (2002-2007) of EOEP will be decided at the end of 2001. An Earth Watch programme may be introduced for this, with an application aim, including optical imaging and radar missions and an ocean surveillance mission in the polar orbit, expanding the ERS and Envisat missions.

National Programme for Space Remote Sensing

The National Programme for Space Remote Sensing (PNTS) illustrates the use of the satellite instrument for climate study and its research themes are presented along the different components of the environment (cryosphere, biosphere, atmosphere, ocean).

The cryosphere is an important component of the earth's system; it incorporates water in its various solid forms, snow or ice: snow, sea, river and lake ice, polar ice caps and mountain glaciers. This important element in the earth's system is to be found from the tropics to the poles. Because of its albedo and positive retroaction effects, its role in the climate system is of vital importance. It is thought that some of the climate warming measured in the upper latitudes of the Northern Hemisphere, especially in Canada, is conditioned by these effects. Snow and ice, whether permanent or

seasonal, also play a dominant role in the earth's hydrological system because of the amounts of potentially available water that they contain. The cryosphere is one of the main causes of rises in sea levels. These elements are sensitive indicators of any climate change that can be detected and followed from the tropics to the poles. In the case of sea ice, since 1992, the space-time coverage of ERS diffusiometers has supplied seasonal and inter-annual changes in surface humidity and roughness (due to the type of sea ice). Launched in June 1999, the SeaWinds diffusiometer on QuickSCAT monitors retro-diffusion on a daily basis and its resolution makes it possible to follow sea ice drift for the first year or over three years. As regards alpine or tropical glaciers, thanks to optical images, we can now identify accumulation and ablation areas. We can therefore find the position of the line of equilibrium in order to determine the mass budget. Although the extent of snow cover is easy to detect, its thickness is not so easy to identify. The two radiometer channels, 19 and 37 GHz, gives an approximate thickness value that does not include changes in snow cover. Using the snow temperature gradient, we can correct algorithms (work done by CESBIO). As for the altimeter, it can measure vanishing snow cover, and therefore, potentially, thickness (work by LEGOS). Concerning the antarctic mass budget, seasonal variations in the accumulation rates have been estimated in terms of variations in sea level: these create a sea-level signal to a maximum of 3 millimetres in magnitude at the end of December, which can be easily identified from the altimeter data (LEGOS).

For solid earth, we have explored new observation methods, such as airborne radar in band P, wide-field airborne laser telemetry and satellite altimetry in the continental area. These developments mean that we can, in particular, monitor lakes and medium-sized and major rivers. Similarly, we have extended the field of application of remote sensing to areas that have been little explored, such as the coastal dynamics with, for example, changes in coastlines and the emergence of rocky islets. Knowledge of them is vital for navigation. Finally, new approaches are directed at the urban environment, with combined use of optics and radar for integrated environmental studies of city environments.

Respective studies for the biosphere, which includes the water cycle and the carbon cycle, are as follows.

Water Cycle

Water is a vital element in the system because of the close coupling of its flows with those of energy, gas (including greenhouse gases, solutes, colloids, particles, genes etc.). Observation from space helps us to better understand how the soil works, the states of the ground surface in relation to run-off and erosion, hydrological conditions in the non-saturated area, and enables us to estimate water routes and, in particular, to study the major beds of the great rivers and to estimate flows at the outlet from the catchment basin by assessing balance terms. Microwave radiometry in band L enables us to characterise surface humidity. The development of the SMOS satellite programme is part of this framework. Interpreting radar data on rugged ground is progressing. We can thus estimate roughness and biomass in semi-arid areas in a dry ground situation.

Carbon Cycle

This concerns ecosystem productivity, dynamic and functioning, whether natural or developed by man. Important advances have been made in describing, understanding and using reflectance in the solar area. Inversion methods have been suggested to estimate biophysical surface characteristics (LAI, Fapar, albedo, soil humidity, biomass quantity), especially thanks to the use of directional variation to back up interpretation of Polder data. This work makes it possible to estimate variables that are part of the process for describing carbon and water

flows at different levels: local, kilometric and global.

As regards the meteorological atmosphere and climate change, understanding of the cloud-aerosol-water of vapour-radiation naturally depends on observation. Space missions on this topic have played, and will continue to play, a predominant role in the future. We have to study clouds, look at their optical and physical features, examine aerosols, the intensity of their sources and their radiative and physical properties, estimate the radiation balance, increase our understanding of the water cycle and quantify associated retroactions. We have obtained highly relevant results from the aerosol study. Firstly, the algorithms using Polder measurements have given us an excellent view from space of aerosols above the earth. Polder's polarised measurements are the first quantification of aerosols above the earth seen from space.

In the case of clouds, Polder's measurements enable us to analyse the anisotropy of reflected radiation. Observations mean that we can identify certain microphysical models. Moreover, with Polder's polarised measurements, we can unambiguously identify cloud phase. Finally, Polder's measurements provide a very precise measurement of the size of droplets at cloud summits.

For the ocean, methodological analyses on the same physical parameter from different satellite sensors (ERS, QSCAT, NSCAT for winds, ERS, SSMI for flows; ERS, Topex / Poseidon for sea level) improve signal release (work done by LODYC) and enable us to reconstruct ocean fields using the space-time capacities of each mission to their optimum (sea level). An inversion model for satellite surface temperatures, to produce high resolution fields of ocean surface current, has been developed and tested in the South Atlantic, together with an altimetry monitoring method of the vertically integrated transport of the current from the Falklands (work done by LEGOS and LODYC). ■

GENERAL CONCLUSION

These research and observation programmes for climate change cover a wide range of levels in space and time (past climate in particular), a large number of physical, chemical and biological processes and their interaction.
Observation is carried out in various environments (earth, atmosphere, ocean) and gives us a better understanding of the way the whole system works, while ensuring comparison with former climates. The advances suggested for ocean observation, with operational connotations, will also provide us with a better understanding of the way the ocean machine works, which plays an important role in climate. Moreover, the question of ensuring constant observation, which is vital for observing the climate, has been clearly posed in recent years.
For this purpose, Observatories have been set up (operation and research) in the environments. Finally GMES (Global Monitoring for Environment and Security) proposes to monitor the global environment within the framework of environmental treaties (Kyoto Protocol).

CHAPTER 9

Education, Training and Public Awareness

INTRODUCTION

The fight against the greenhouse effect can only be effective if the problem of climate change is known to and properly understood by the citizens, and in particular by national decision-makers. It can then be taken into account in public decisions and more generally in the behaviour of all. This can only be achieved through significant efforts to inform citizens and train the workers and decision-makers concerned.

It was with this in mind that the French Parliament, in February 2000, on the occasion of a draft law, conferred the status of "national priority" upon the fight against the intensification of the greenhouse effect, with the "unreserved" support of the government and all the country's political groups.

1 Primary, Secondary and Higher Education

Education in Earth and Life Sciences, in the course of which the phenomenon of the greenhouse effect is addressed, is compulsory for all pupils.

It fulfils several objectives, the principal ones being in-depth development of methodological skills, broadening of general knowledge, acquisition of rational principles that allow for critical analysis, and opening youngsters to the applications and implications of scientific knowledge, especially where the environment is concerned.

Education on civic responsibility in terms of health and the environment is one of the priorities of the teaching of life and earth sciences at secondary school and Sixth Form College. This part of the curriculum, often taught at the end of the year, from the first to the third year of secondary school, is centred on the notion of education. It calls on and, where necessary, deepens, the scientific foundations already acquired and builds on these a reflection on individual and collective responsibility in these areas.

Although the focus of this chapter is on educational goals, only some aspects, for example the problem of the greenhouse effect, are chosen for their importance in the life of each citizen and because they are linked to subjects already studied.

Until now, education on responsibility towards the environment, focused on the quality of life milieus, resource management, the formation of landscapes and the prevention of major catastrophes, has recently been extended to a more global level. Emphasis is therefore placed on the importance of long-term resource management that respects nature's equilibrium and biological heritage: the concept of sustainable development is addressed. Incidentally, this final section raises bioethical issues, which are to be addressed with the civic education instructor.

The scientific phenomenon of the greenhouse effect is generally dealt with in the Fifth Year, in the section "Planet Earth's Singularity". In science manuals, this is often dealt with in the chapter devoted to major climate zones. A definition of the greenhouse effect is introduced side by side with a structured course on life sources - sun, air and water. Pupils can thus read, for example: "The process of warming of the lower layers of the atmosphere, due to absorption of heat emitted by the sun and the surface of the earth through water vapour and some gases present in the atmosphere (CO_2, methane, nitrogen protoxyde, low-altitude ozone etc.). Current global warming of the atmosphere may, in part, be the result of an additional man-made greenhouse effect". As an addition, a module organised around a case study encourages pupils to undertake more in-depth study. At present, the work to be carried out encourages a response to the question: "Can Man disrupt the Earth's climatic equilibrium?" Scientific documents

are presented: charts showing recent variations in average atmospheric temperature; graph of the CO_2 concentration in the air; comparison of the extension of Alpine glaciers in the last two hundred years and comparison with temperature variations; excerpts from press clippings.

These scientific documents are a reflection of the skills that need to be developed in pupils: justifying the validity of measures taken on the environment on the basis of scientific data; discussing man's responsibility for the effects on the planet's environment, using scientific grounds.

Other information relating to the problem (international negotiations, policies etc.) may arise in the course of the questions and exercises set before the students. The goals targeted require well-suited teaching strategies, for example, involving pupils in realistic, concrete community service projects; the development of group work, with tasks being assigned and responsibilities shouldered; independent work outside class. It is as part of one such project that French pupils participated in the Youth Conference in The Hague in November 2000 (COP6).

More generally, the teaching of Earth and Life Sciences should help adolescents make a positive choice for their sixth-form curriculum and future concentration that corresponds to their aspirations and skills. It may encourage more pupils to choose a scientific school curriculum and scientific higher education, where the problem of the greenhouse effect will be looked at in greater detail.

2 Information Campaign

Thanks to the international meetings placed under the aegis of the UN, which received broad coverage in the media (the Earth Summit in Rio in 1992, the negotiations in Kyoto and The Hague, the latest publications of the studies and reports of the Intergovernmental Group on Climate Change), the population as a whole should be increasingly familiar with the notion of the greenhouse effect. Recent natural disasters have led the media to take up the topic once again and delve deeper into it.

2.1 Current Public Opinion

Since 1973, when a European opinion poll showed for the first time high public interest in the topic of the environment, the various surveys that have been carried out since have continued to illustrate this interest.

In 1998, IFEN (French Environmental Institute) asked CREDOC to compare priorities for State action and action in the areas where individuals think that they themselves can contribute to the protection of the environment, using the same list. The fight against air and atmospheric pollution is seen as a priority for State action. The percentage of those who consider it to be a priority has been rising constantly over the last few years, in a context where pollution peaks in cities have been abundantly covered by the media. The growing public awareness of the daily effects of air pollution has not fundamentally changed people's attitude as to what they can do to help to reduce it. Only 11% of French people think that they can act individually in this area. However, the percentage of those who think that they can do something individually to limit air pollution has shown signs of increasing over the last three years. It is also higher among those who designate air pollution as the main priority for State environmental action. Moreover, according to another 1997 survey, nine car drivers out of ten say that they are ready to abandon their vehicles in the event of pollution peaks (ADEME).

However, behind the concept of air and atmosphere pollution, that of the greenhouse effect is very vague. This is what emerges from a public opinion poll carried

out by ADEME in 2000. Although the concept is known because of its name, there is considerable ignorance as to the specific aspects of the problem, when cited individually. In fact, a whole series of different meanings are attributed to it. For many, it is actually more or less a direct consequence of pollution. For most people, the greenhouse effect is an established fact, and not a subject of scientific controversy, and the consequences of it are greatly feared, even the least probable ones. Paradoxically, although the causes of the problem are not correctly identified, the remedies suggested are quite realistic (e.g. car use).

This realisation has led us to encourage all the media to deal with subjects such as current scientific knowledge on the influence of human activities on climate, the policies adopted by States to fight against global warming, the status of international negotiations on the implementation of co-ordinated policies, etc.

At this stage, we will identify three types of audiences: actions that directly target decision-makers, those aimed at the public and those aimed at manufacturers – even though each of them can be addressed to each group and overlap. Lastly, we will look at the role played by other information vectors, those from the media and associations.

2.2 Regional and Local Decision-Makers

One of the central aims of greenhouse gas emission reduction lies in securing the participation and commitment of all local and regional players. The fight against the greenhouse effect has to be integrated into the decisions and investment choices made by these players. Thus, the will to reduce greenhouse gas emissions must exist when a local government makes choices pertaining to its heating methods, modes of transport and town planning, development of certain renewable energy sources in the development of conurbations, etc.

Local authorities are indeed engaged in the greenhouse effect issue through the commitments that bind them to the State. In the plan contracts agreed between the State and the regions, information and public awareness make up one of the four leading application areas in the fight against the greenhouse effect, especially in the sections on energy-saving, renewable energies and waste. The development plans must make it possible to collectively define and explicitly link the major sectoral policies that contribute to the structuring of towns. They will provide local authorities and private players with a common reference framework. The collective development plans on energy and transport also help to provide the co-ordination needed for these projects.

A more recent example is that of the "Solidarity and Urban Renewal" Law, whose goal is to revamp urban policy by combining, for the first time, the issues of town planning, housing and travel , challenges that are closely linked, within the boundary of solidarity that should characterise every conurbation.

To support and materialize this commitment, MIES has set up a task force called the "National Programme for Tackling Climate Change". Its objectives are to exchange experiences; to provide a formal, methodologically consistent framework that can be implemented by all the players in the field; to reinforce additional experimental collaboration with pilot towns and to provide the framework for decentralisation and the requirements in the fight against climate change.

Again as part of this goal, MIES has published a work called "Handbook for Decision-Makers", which is an operating tool enabling councils engaged in combating the greenhouse effect to direct their measures and quantify the effects of their decisions in terms of greenhouse gas emissions. This handbook provides them with guidelines for their actions, using thirty-two technical reports grouped around five main themes: town planning and transport; buildings; services; forests and agriculture; decentralised co-operation. This document has been widely distributed to regional Prefects and regional councils and is available to all councils who request it.

In 2000, several series of seminars and

conferences took place in the regions, in partnership with the association ATEE (Technical, Energy and Environment Association) and the RARE network (Network of Regional Environment and Energy Network). The aim was to disseminate information and to suggest measures aimed at the regions, so as to help local council members take into account the greenhouse effect in future contract negotiations with the State and to help economic players continue to move forward, while at the same time addressing the issue. On certain occasions, they led to the updating of reports on energy consumption and the drafting of a report on the greenhouse effect in each region.

More specifically, two regional conferences were organised to raise the awareness of local players, in particular those in the tourism sector, as to the effects of climate change. The first took place in Chamonix in June 2000 and dealt with the possible consequences of the greenhouse effect on the Alps mountain range. A second was held in Arles in October 2000, to explain how dangerous a rise in sea level resulting from climate change in estuary areas would be. The latter also provided an opportunity to discuss methods for preventing the risk of flooding in these areas and possible adaptation measures if the former were not effective.

These conferences also enabled the general public to concretely perceive the possible effects of climate warming for the country.

2.3 The General Public

For each citizen to participate in the fight against climate change, it appears fundamental that everyone have direct access to updated information on the issue of the greenhouse effect.

For this reason, the Interministerial Task Force on Climate Change (MIES) opened a Web site in September 2000, to offer an on-line service on the issue of the greenhouse effect: http://www.effet-de-serre.gouv.fr.

Thanks to its six modules and to its news ticker, the site is intended for use by all of the various publics affected by the fight against climate change: negotiators, scientists, politicians, civil society, academics, citizens, etc.

Its documentary content is mainly focused on information relating to the mechanisms and impacts of the greenhouse effect, statistics on greenhouse gas emissions in France and international negotiations. All of MIES' publications can be accessed or ordered on-line.

Its "News" modules allows it to provide information and present the latest information on the subject to optimum effect, by offering complete coverage of events underway (The Hague Conference, GIEC's work etc.).

Lastly, it offers an interactive component, in the form of regular forums and a "Contact" section, which allows Internet users to ask questions, offer suggestions or make comments.

Lastly, MIES offers links to its relational and operational partners' sites, such as the CNRS climate site, so as to optimise knowledge of the greenhouse effect.

Alongside this on-line and real-time information, a colour booklet – "Climate change – a major challenge" – has been produced in partnership with the Agency for the Environment and Energy Management. It is aimed at any public that wants to understand the scientific phenomenon, become familiar with its consequences, follow international negotiations and adopt new behaviours to fight the greenhouse effect. This booklet is distributed at special events and is also often sent out on request.

2.4 Associations

Taking into account the implications of the issue of the greenhouse effect in economic activity and everyday life, civil society plays a central role in spreading information about the subject.

That is why the Interministerial Mission maintains regular contact with representa-

tives of non-governmental associations, such as those of economic players, players in the protection of the environment and consumers. The associations' purpose is to inform the media and the public, to propose consistent public policy and to participate in international negotiations.

As regards environmental associations, it might be appropriate to cite the work carried out by the Climate Action Network (RAC), which brings together about twenty associations against climate change. Founded before the Kyoto Summit to make French associations heard during the international negotiations on climate change, it is the French link to CAN (Climate Action Network), the global network of ONGs on this issue.

In 2000, RAC launched two information and communication campaigns aimed at the general public.

The first is called The Challenge of the Greenhouse Effect (http://www.lepari.citeweb.net) and is aimed at schoolchildren who undertake to reduce their CO_2 emissions through simple actions. The second is called "SOS Climat" and its aim is to raise people's awareness of the reality of climate change, the significance of the risks involved and the need for everyone to take action at their own level (http://www.sosclimat.org).

Meanwhile, the French Association of Companies for the Environment encompasses forty-five large companies which take action in favour of better protection of the environment by seeking out effective approaches and promoting their skills. Its remit is also to express the corporate point of view on these issues and to participate in elaboration of environmental policies. It has issued a number of opinions on the topic of climate change.

2.5 Economic Players

Because of its role and interministerial status, the Interministerial Task Force on Climate Change maintains regular contact with the industries affected by energy and greenhouse gas emission issues and is also extending its scope of action to the banking sector.

The players are invited to participate in regular meetings to contribute to discussions on the implementation of post-Kyoto enforcement mechanisms and to propose effective tools for reducing greenhouse gas emissions. They are also brought into the working groups on the elaboration of the National Programme for Tackling Climate Change.

As a complement, MIES organised several events for them.

Of note is the October 1998 event at the Maison de l'Amérique Latine on the industrial issues at stake with regard to the greenhouse effect, which sought to gain a better understanding of the conditions in which industry at that time envisaged the enforcement of the Kyoto Protocol. The seminar was an official meeting for the exchange of information between the authorities and the company leaders from French industry likely to be affected by the decisions that may have been taken at The Hague.

The following year, in December, the French Fund for the Global Environment, in collaboration with MIES, addressed economic players at an exchange and information day organised at the Ministry for the Economy, Finance and Industry. FFEM's purpose is to encourage the protection of the global environment in development projects. It subsidises projects that reduce fossil or organic carbon consumption. The day was intentionally devoted in large part to: concrete examples (energy production, industry and services, urban development and construction, agriculture and forestry), intended to illustrate the various areas of eligibility and methods of operation of the FFEM; and discussions and exchanges with a view toward spurring economic players to develop such projects.

The European conference organised by MIES in September 1999 was aimed more particularly at financial players: "The Consequences of International Negotiations on the Greenhouse Effect: Financial Issues at Stake and Advantages for the Financial Community". The confe-

rence was a day of exchange and experiences between European financiers on the integration of environmental concerns and the fight against the greenhouse effect into their activities in banking, the stock market and insurance. It was intended to raise the awareness of French players on the issues at stake in the new financial strategies that emerged from international negotiations.

2.6 The Media

The influence of the media on the level of environmental awareness and information is not easy to measure. However, even without a precise evaluation, it is certain that the media in general, and television in particular, play a highly significant role.

Although, in 1997, the theme of nature, rather than that of air, was the central theme in daily and weekly papers, (first position, as opposed to fifth), it seems that, since then, the issues have become of equal importance. In the last few years, because of international activity (UNFCCC conferences) and the government's efforts to combat the greenhouse effect (National Programme for Tackling Climate Change, UN Conference in Lyons...), and because of the bad weather in France, numerous scientific popularisation works have been published on the subject.

Even though there are still language obstacles and a lack of media, the scientific community has generally been able to respond to journalists' requests for information, so as to attempt to explain the greenhouse effect mechanism to the general public and present it with a concrete explanation of the impacts over the upcoming decades.

To complete this information, a document published jointly by the Minister for Urban and Rural Development and the Environment and the Interministerial Task Force on Climate Change, entitled "Potential impacts of Climate Change in France in the 20th century" was issued in two editions (1998 and 2000).

However, it is regrettable that the quality of information on the topic supplied by the media was deemed mediocre. The results of the 2000 survey carried out annually by SOFRES as to French people's confidence in the media showed that the media's image had deteriorated as compared with the previous year. One of the factors that can explain this mistrust is the handling of scientific information in the same year. The same question was asked on the theme of environmental catastrophes, such as the "Erika" tanker, mad cow disease, cloning, the greenhouse effect and global warming: "Generally speaking, are you satisfied or dissatisfied with the quality of information in the media?" On the greenhouse effect and global warming, 39% declared themselves satisfied, as opposed to 52% who were not satisfied.

Our satisfaction rate is behind that of environmental disasters (63% satisfied) and mad cow disease (51%).

The complexity of the phenomenon and its impacts, and the problems involved in international negotiations can explain these results: the most concrete and localised issues obtain a higher satisfaction score.

3 Information Sources

While the Interministerial Task Force on Climate Change elaborates policies and domestic measures, and prepares the positions that France has to defend at the Community-wide and international level, it relies on experts who are at the source of scientific information.

By the scientific aspects of climate change, we mean research on the physical mechanisms that govern the climate, climate observation networks, assessment of greenhouse gas emissions, scenarios on future greenhouse gas emissions and climate forecasting, particularly at the regional level. Systematic observation on the state of the climate is, first and foremost, the responsibility of operational organisations,

and mainly Météo-France as regards the atmosphere and the oceans. This observation cannot, in practice, be dissociated from the information needed for weather forecasting; however, its scientific aspects where the climate is concerned may need, in some cases, to be reinforced. The long-term climate will not be better understood unless monitoring is extended to other parts of the climate apparatus that are a complement to the atmosphere: oceans, ice, the biosphere, etc. Experiments in observation specific to research, in the atmosphere, the oceans and continental surfaces, are of particular importance when it comes to understanding physical mechanisms, as a large number of them are still insufficiently understood.

Inventories of greenhouse gas emissions are drawn up by the CITEPA, under contract to the Ministry of Land Planning and the Environment. The former provides France with data, over the last ten years, on emissions of the different substances involved in increasing the greenhouse effect, and covered by the UN Framework Agreement on Climate Change.

It should also be noted that a National Observatory on the effects of global warming has been created. It will be responsible for gathering and disseminating information, studies and research on the risks of global warming and extreme climate phenomena in mainland France and in the DOM-TOM, in conjunction with the research establishments and institutes involved and the Intergovernmental Expert Group on Climate Change. The latter also has authority to carry out any information action aimed at the general public and local authorities.

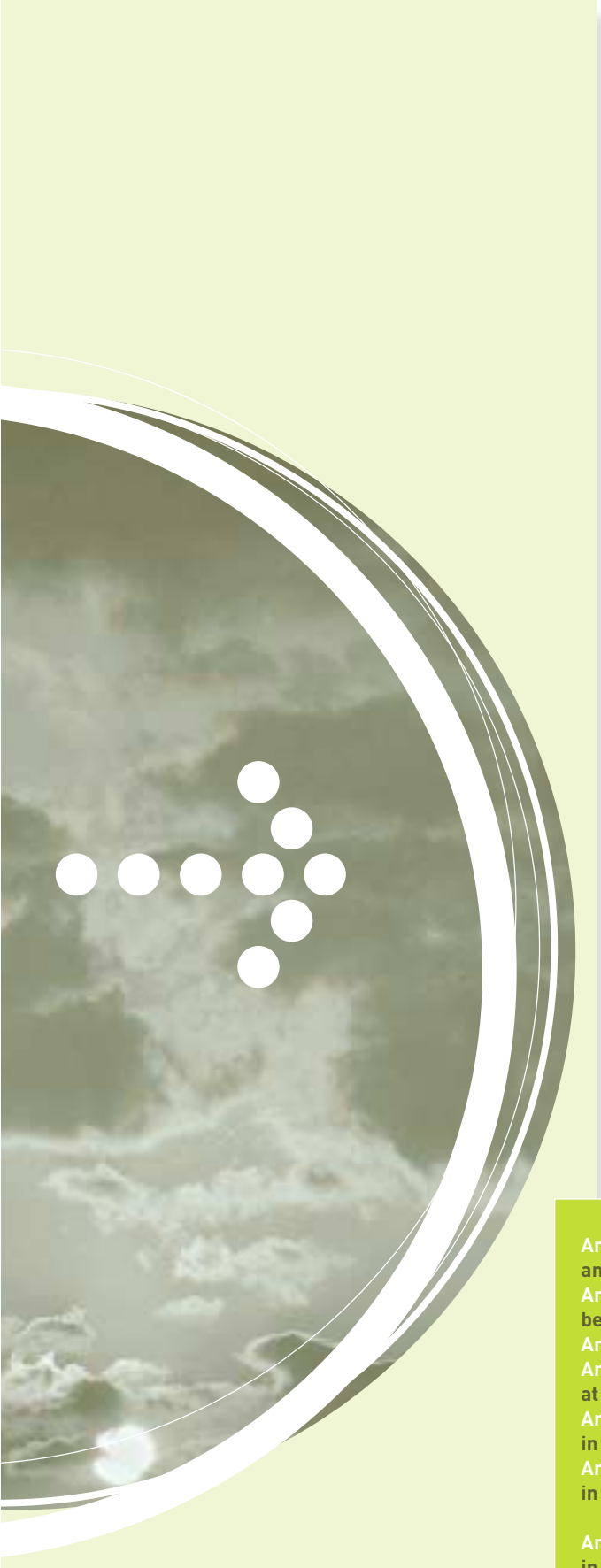
4 Training

Training within each business sector will have to be adapted so that workers' choices can be guided by the goal of reducing greenhouse gas emissions, amongst others. This type of approach will equip the various technical operators with the tools necessary to apply and adapt as required by their respective sectors the measures taken in the National Programme for the Fight Against Climate Change in the best possible way, and to implement their own initiatives. Training will be organised on a case-by-case basis, depending on the person's responsibilities. However, - and this applies as much to town planners, architects, designers of buildings with a long life span in design studios, heating manufacturers and thermal experts as to electricians, installers and repairers of refrigeration equipment – trained personnel will have to:

- know the various greenhouse gases and their relative global warming power;
- be informed of the technical efficiency of the equipment and grids as regards the reduction of greenhouse gas emissions;
- be aware of the importance of energy management as a means of reducing CO_2 emissions, especially in the long term;
- becoming accustomed to reasoning in terms of the greenhouse effect – as is the case for a building's energy efficiency -, not on the scale of a specific piece of equipment that may be efficient, but at that of a complete installation, as, in the case of town planners, a wider area of operation.

These issues have to be taught in the initial training courses and in ongoing training sessions. Thus the concepts of overall balance and overall cost must, little by little, settle in, first as reasoning tools and then as decision-making aids in the long term.

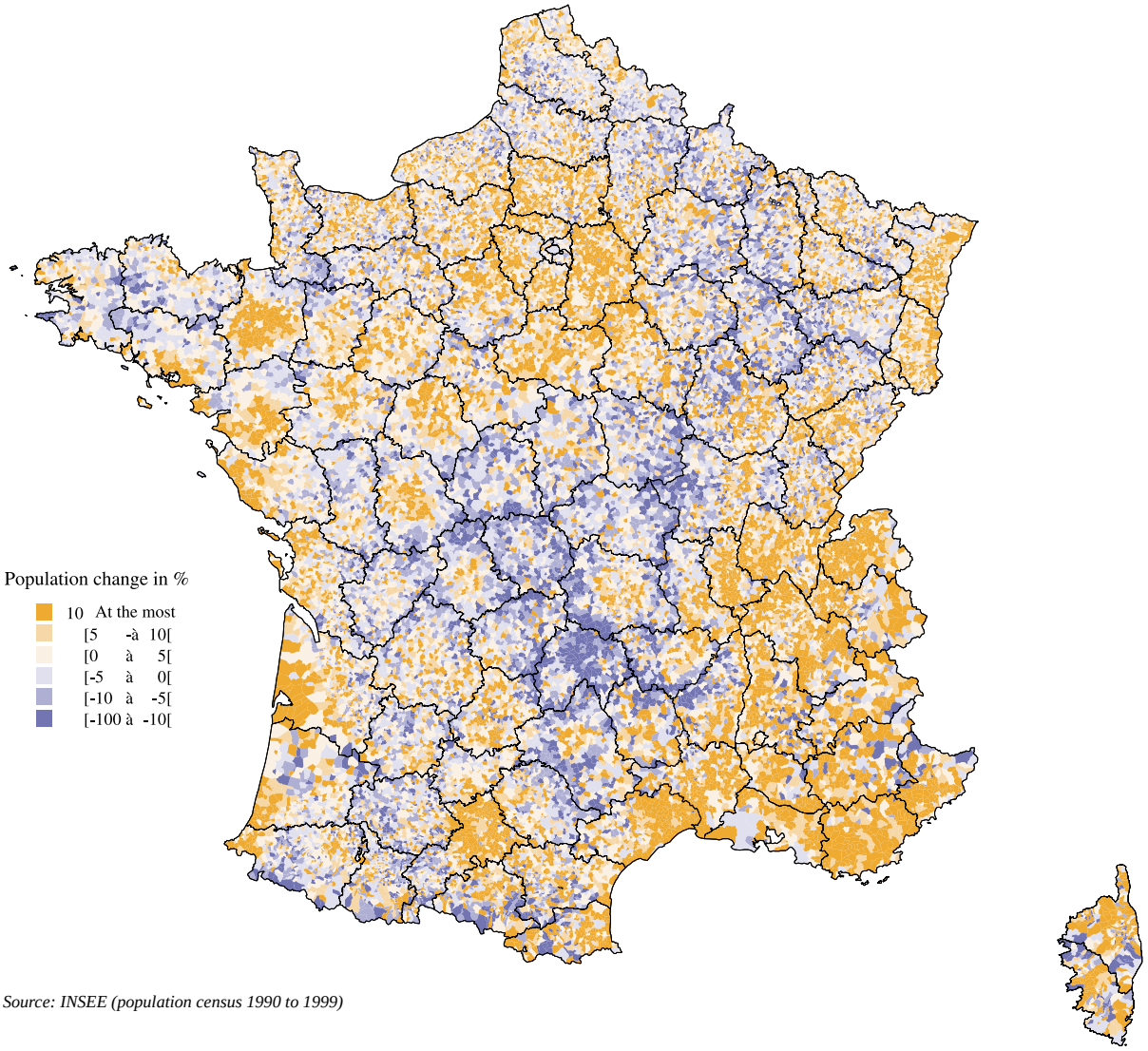
With this objective in mind, and in line with the revival the energy management policy decided by the government in 1998, ADEME has implemented actions to raise awareness, train and inform on the theme of "good energy practices". They are aimed at companies that want to launch a study on the energy efficiency of their facilities by improving their production equipment and managing their costs. ■



Annexes

ANNEX I TO CHAPTER 2 / PAGE 28

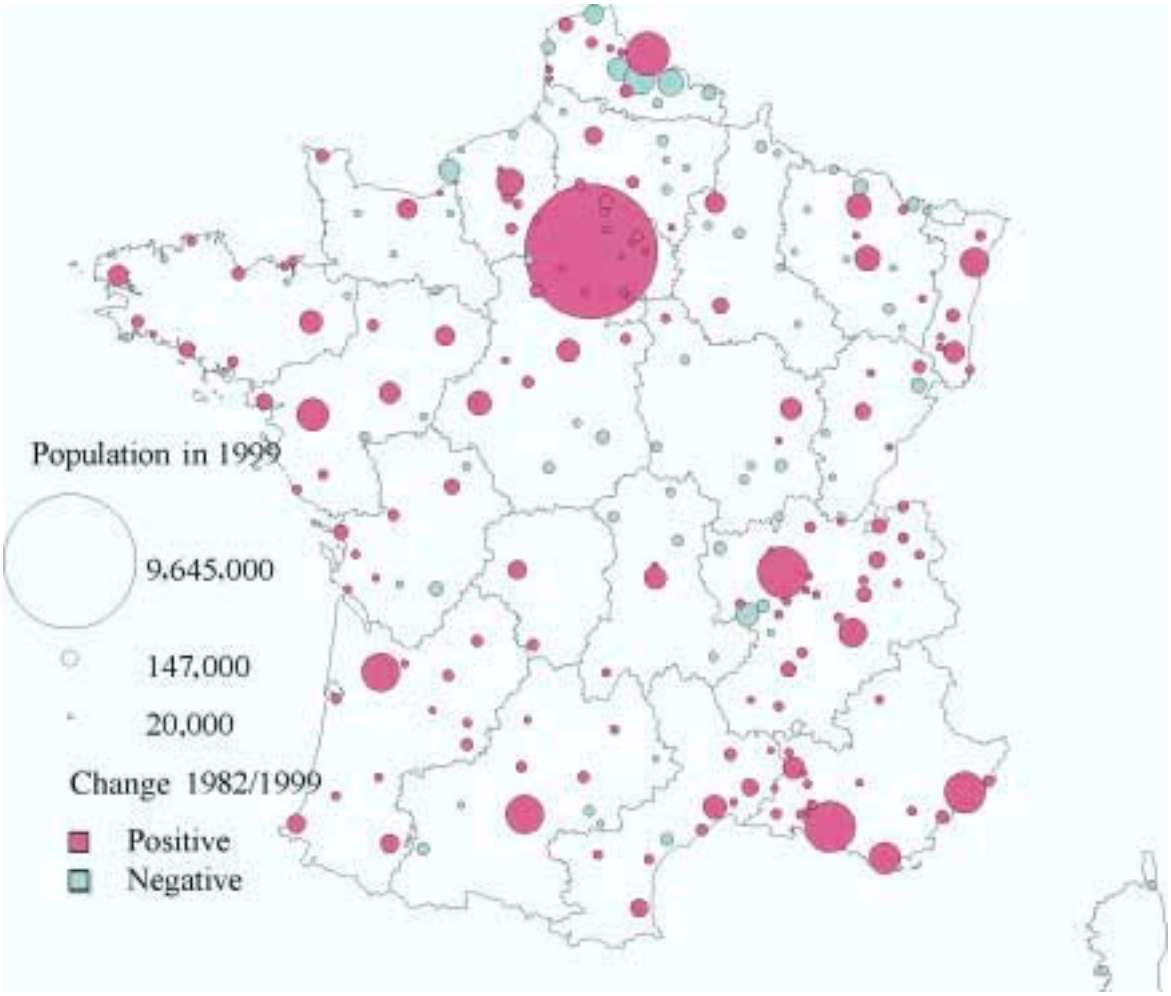
Population Changes between 1990 and 1999



Source: INSEE (population census 1990 to 1999)

ANNEX II TO CHAPTER 2 / PAGE 29

Town Planning Changes between 1982 and 1999

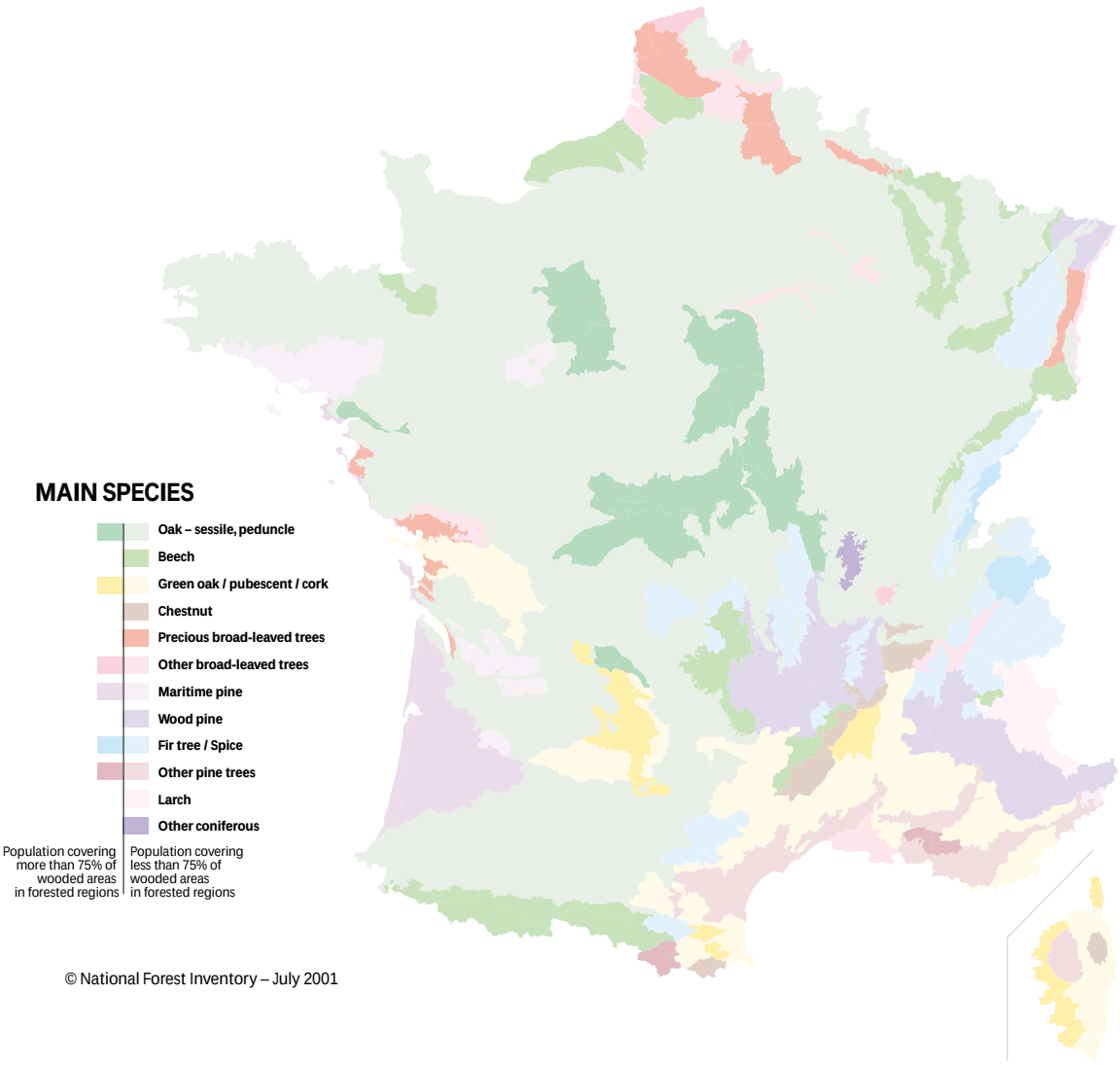


ANNEX III TO CHAPTER 2 / PAGE 29

CORINE Land Cover / Level 1 of the Inventory

ANNEX IV TO CHAPTER 2 / PAGE 44

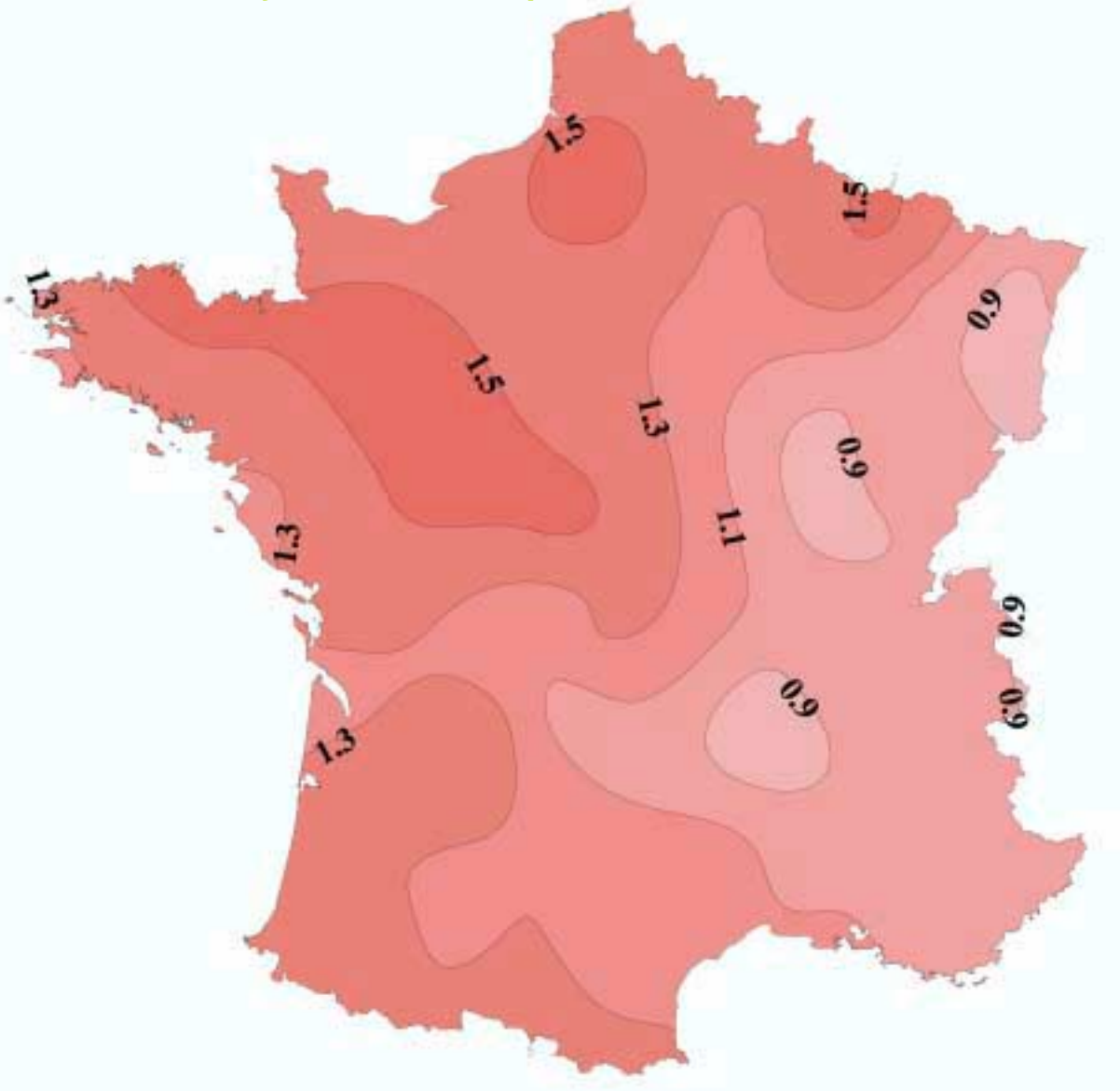
309 Forest Regions According to Scale



ANNEX V TO CHAPTER 2 / PAGE 32

Warming Observed in France in the 20th Century

Growth in daily minimum temperatures



The cartography of trends in the 20th century, established by Météo-France, shows a net increase in minimum temperatures both in the west and the east. These results show, in particular, that the warming effect is much greater at night than in the daytime. Maximum temperatures have increased to a lesser extent – practically not at all in the north of the country and about 1°C in the south. To interpret these two gradients, in the direction east-west and north-south respectively, we have to compare them with output from climate models and other types of observation.

The combination of the two gradients shows that:

- *average temperatures have increased more than in the south-west of the country (more than 1.1°) than in the north-east (less than 0.7°); an increase that is more marked than that provided by IPPC for the globe.*

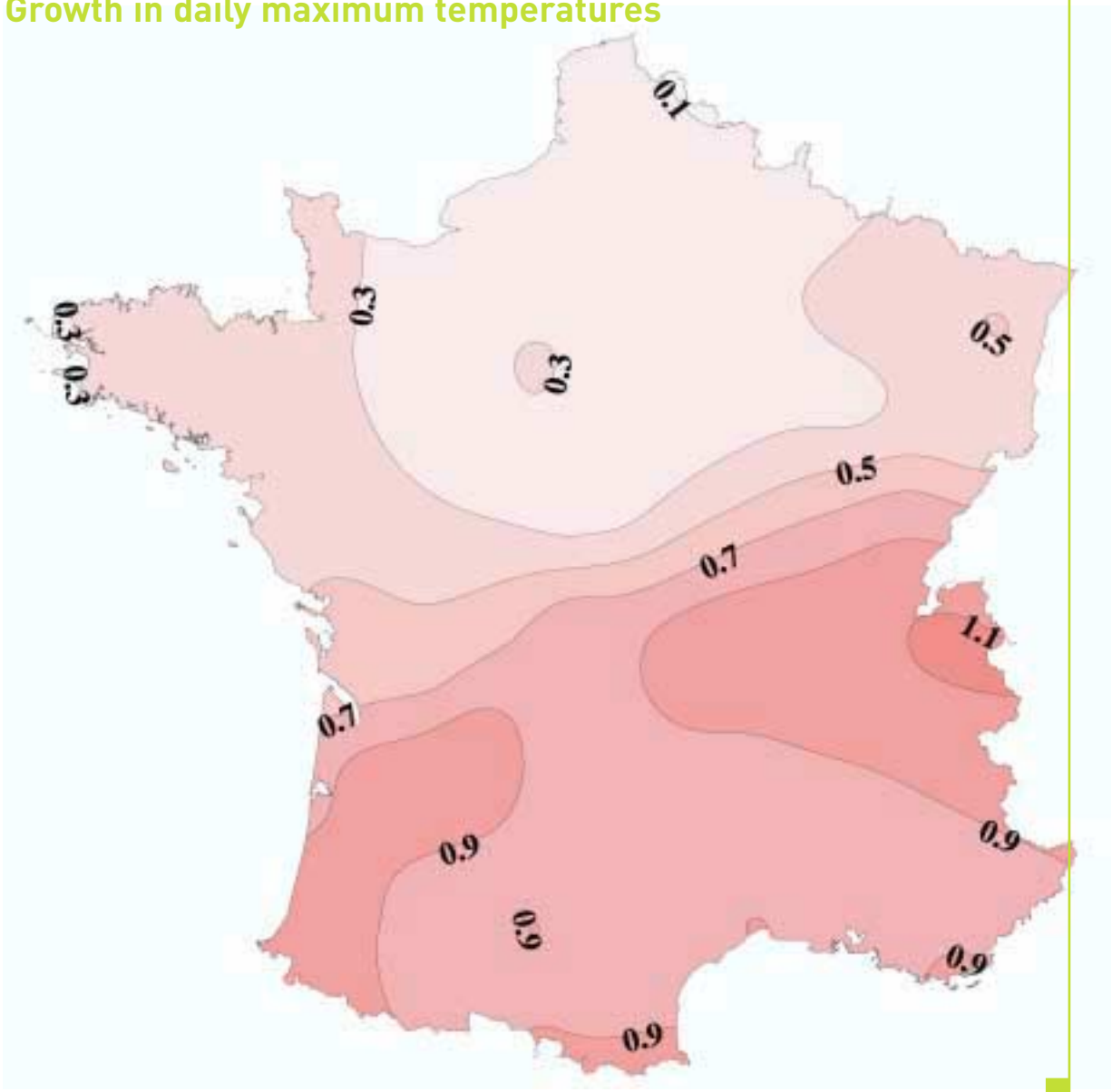
- *daytime temperature has fallen over almost the whole of the country in the course of the 20th century (falls attain 1.3°C per century in the north and north-west of the country).*

Source : Météo-France

ANNEX VI TO CHAPTER 2 / PAGE 32

Warming Observed in France in the 20th Century

Growth in daily maximum temperatures



Source : Météo-France

ANNEX I TO CHAPTER 3

Greenhouse Gas Emissions in France

(Mainland France and Overseas)

These values are regularly revised and completed to include continual improvements in knowledge and estimate methods. Users are invited to ensure the existence of more recent updates.

Source: Citepa / Coralie UNFCC format – updated 07/11/00

Sub-stance	Unit	1990		1999		1999-1990 (%) difference	
		Excluding LULUCF (c)	net (a)	Excluding LULUCF (c)	net (a)	Excluding LULUCF (c)	net (a)
Gases with direct greenhouse effect							
CO_2	Tg	386	326	405	336	5.0	3.0
	C eq. Tg C	105	89	110	92	5.0	3.0
CH_4	Gg	3,010	3,109	2,740	2,841	- 9.0	- 8.6
	C eq. Tg CO_2	63	65	58	60	- 9.0	- 8.6
	C eq. Tg C**	17	18	16	16	- 9.0	- 8.6
N_2O	Gg	288	306	236	254	- 17	- 17
	C eq. Tg CO_2	89	95	73	79	- 17	- 17
	C eq. Tg C*	24	26	20	21	- 17	- 17
HFC	Mg	258	258	2,739	2,739	962	962
	C eq. Tg CO_2	2.3	2.3	4.8	4.8	114	114
	C eq. Tg C**	0.6	0.6	1.3	1.3	114	114
PFC	Mg	452	452	268	268	- 41	- 41
	C eq. Tg CO_2	3.2	3.2	1.9	1.9	- 40	- 40
	C eq. Tg C**	0.9	0.9	0.5	0.5	- 40	- 40
SF_6	Mg	92	92	101	101	9.8	9.8
	C eq. Tg CO_2	2.2	2.2	2.4	2.4	9.8	9.8
	C eq. Tg C**	0.6	0.6	0.7	0.7	9.8	9.8
PRG(b)	C eq. Tg CO_2	546	494	545	483	- 2.1	- 2.1
	C eq. Tg C**	149	135	149	132	- 2.1	- 2.1
	kg CO_2/inhab.	9,351	8,460	8,944	7,937	- 6.2	- 6.2
	kg C/inhab.**	2,550	2,307	2,439	2,165	- 6.2	- 6.2
	g CO_2/euros GDP	544	492	397	352	- 28	- 28
	g C/euros GDP**	148	134	108	96	- 28	- 28
Gases with indirect greenhouse effect							
SO2	Gg	1,321	1,321	741	741	- 44	- 44
NOx	Gg	1,926	1,929	1,606	1,609	- 17	- 17
COVNM	Gg	2,526	2,963	1,845	2,295	- 27	- 23
CO	Gg	10,904	10,996	7,271	7,369	- 33	- 33

(a) Sinks, changes in use of soil and forest cultivation included
(b) Global warming incorporated over a period of 100 years and calculated on the basis of the following coefficients: CO_2 = 1, CH_4 = 21, N_2O = XX, SF_6 = XX, HFC and PFC = variable values depending on the relative proportion of the various molecules
(c) Excluding land use changes, excluding sinks and forest cultivation.
* Emissions from international marine traffic and international air traffic are excluded
** carbon equivalent Tg = (12/44) CO_2 equivalent Tg

	1990	1999	1999-1990 difference (%)
Population (1000 inhab.) (c)	58,536	60,882	4
GDP (current EUR 109) (c) (d)	1,004	1,373	37

(c) Source: INSEE – (d) Sources: INSEE and CITEPA

Summary Report for CO_2 Equivalent Emissions

(France 1990 Submission)

Greenhouse gas source and sink categories	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
			CO_2 equivalent (Gg)				
Total (Net Emissions) [1]	**325,872.52**	**65,288.50**	**94,841.15**	**2,252.62**	**3,195.36**	**2,194.86**	**493,645.01**
1. Energy	**360,251.17**	**10,155.66**	**3,838.65**				**374,245.48**
A. Fuel Combustion (Sectoral Approach)	355,945.32	3,624.90	3,838.65				363,408.86
1. Energy Industries	65,495.21	46.33	561.18				66,102.72
2. Manufacturing Industries and Construction	76,919.30	82.40	731.38				77,733.08
3. Transport	119,156.27	452.71	1,208.05				120,817.03
4. Other Sectors	94,374.54	3,043.45	1,338.04				98,756.03
5. Other	0.00	0.00	0.00				0.00
B. Fugitive Emissions from Fuels	4,305.85	6,530.76	0.00				10,836.61
1. Solid Fuels	0.00	4,331.42	0.00				4,331.42
2. Oil and Natural Gas	4,305.85	2,199.34	0.00				6,505.19
2. Industrial Processes	**21,253.84**	**53.42**	**27,774.76**	**2,252.62**	**3,195.36**	**2,194.86**	**56,724.87**
A. Mineral Products	13,015.95	0.00	0.00				13,015.95
B. Chemical Industry	3,007.37	53.42	27,774.76	0.00	0.00	0.00	30,835.55
C. Metal Production	4,549.52	0.00	0.00		2,293.70	1,135.25	7,978.47
D. Other Production	681.00						681.00
E. Production of Halocarbons and SF_6				2,230.06	559.60	0.00	2,789.66
F. Consumption of Halocarbons and SF_6				22.57	342.06	1,059.61	1,424.24
G. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Solvent and Other Product Use	**1,851.92**		**596.23**				**2,448.15**
4. Agriculture	**0.00**	**34,256.27**	**56,147.00**				**90,403.27**
A. Enteric Fermentation		30,057.62					30,057.62
B. Manure Management		3,537.42	3,249.22				6,786.64
C. Rice Cultivation		179.61					179.61
D. Agricultural Soils[2]		481.62	52,897.78				53,379.40
E. Prescribed Burning of Savannas		0.00	0.00				0.00
F. Field Burning of Agricultural Residues		0.00	0.00				0.00
G. Other		0.00	0.00				0.00

Follow-up to table on page 196

Follow-up to page 195

Greenhouse gas source and sink categories	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
			CO_2 equivalent (Gg)				
5. Land-Use Change and Forestry[1]	**-59,617.00**	**2,081.39**	**5,515,83**				**-52,019.78**
6. Waste	**2,132.59**	**18,741.75**	**968,68**				**21,843.03**
A. Solid Waste Disposal on Land	0.00	17,917.02					17,917.02
B. Wastewater Handling		259.14	612,06				871.20
C. Waste Incineration	2,132.59	319.57	356,62				2,808.79
D. Other	0.00	246.03	0,00				246.03
7. Other (please specify)	**0.00**	**0.00**	**0,00**	**0.00**	**0.00**	**0.00**	**0.00**
							0.00
Memo Items:							
International Bunkers	**16,754.60**	**0.00**	**81,32**				**16,835.92**
Aviation	**8,617.73**	**0.00**	**0,00**				**8,617.73**
Marine	**8,136.87**	**0.00**	**81,32**				**8,218.19**
Multilateral Operations	**0.00**	**0.00**	**0,00**				**0.00**
CO_2 Emissions from Biomass	**37,858.66**						**37,858.66**

(1) For CO_2 emissions from Land-Use Change and Forestry the net emissions are to be reported. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

(2) See footnote 4 to Summary 1.A of this common reporting format.

Greenhouse gas source and sink categories Land-Use Change and Forestry	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
			CO_2 equivalent (Gg)			
A. Changes in Forest and Other Woody Biomass Stocks	66,167.00	-141,497.00	-75,330.00			-75,330.00
B. Forest and Grassland Conversion	11,710.00		11,710.00	220.69	22.32	11,953.01
C. Abandonment of Managed Lands	0.00	-48.00	-48.00			-48.00
D. CO_2 Emissions and Removals from Soil	8,329.00	-4,278.00	4,051.00			4,051.00
E. Other	0.00	0.00	0.00	1,860.71	5,493.51	7,354.22
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	**86,206.00**	**-145,823.00**	**-59,617.00**	**2,081.39**	**5,515.83**	**-52,019.78**

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (a)	**545,664.78**
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (a)	**493,645.01**

(a) The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry.

Summary Report for CO_2 Equivalent Emissions

(France 1999 Submission)

Greenhouse gas source and sink categories	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
			CO_2 equivalent (Gg)				
Total (Net Emissions) [1]	**335,700.26**	**59,652.26**	**78,721.07**	**4,815.07**	**1,914.51**	**2,410.65**	**483,213.83**
1. Energy	**383,597.80**	**7,800.34**	**6,108.77**				**397,506.91**
A. Fuel Combustion (Sectoral Approach)	379,591.37	3,237.27	6,108.49				388,937.13
1. Energy Industries	61,389.24	28.08	682.54				62,099.86
2. Manufacturing Industries and Construction	77,212.63	80.72	796.12				78,089.47
3. Transport	138,822.12	311.65	3,173.84				142,307.61
4. Other Sectors	102,167.38	2,816.81	1,455.99				106,440.19
5. Other	0.00	0.00	0.00				0.00
B. Fugitive Emissions from Fuels	4,006.43	4,563.08	0.28				8,569.78
1. Solid Fuels	0.00	2,657.52	0.00				2,657.52
2. Oil and Natural Gas	4,006.43	1,905.56	0.28				5,912.26
2. Industrial Processes	**17,193.94**	**55.44**	**11,093.35**	**4,815.07**	**1,914.51**	**2,410.65**	**37,482.96**
A. Mineral Products	10,371.09	0.00	0.00				10,371.09
B. Chemical Industry	2,723.22	55.44	11,093.35	0.00	0.00	0.00	13,872.01
C. Metal Production	3,443.35	0.00	0.00		1,167.70	1,135.25	5,746.30
D. Other Production	656.28						656.28
E. Production of Halocarbons and SF_6				640.91	84.70	0.00	725.61
F. Consumption of Halocarbons and SF_6				4,174.17	662.11	1,275.40	6,111.68
G. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Solvent and Other Product Use	**1,616.73**		**613.48**				**2,230.21**
4. Agriculture	**0.00**	**32,231.32**	**54,261.50**				**86,492.82**
A. Enteric Fermentation		27,942.27					27,942.27
B. Manure Management		3,643.95	3,109.02				6,752.97
C. Rice Cultivation		162.69					162.69
D. Agricultural Soils[2]		482.41	51,152.48				51,634.89
E. Prescribed Burning of Savannas		0.00	0.00				0.00
F. Field Burning of Agricultural Residues		0.00	0.00				0.00
G. Other		0.00	0.00				0.00

Follow-up to table on page 198

Follow-up to page 197

Greenhouse gas source and sink categories	CO_2[1]	CH_4	N_2O	HFCs	PFCs	SF_6	Total
			CO_2 equivalent (Gg)				
5. Land-Use Change and Forestry[1]	**-68,995.00**	**2,116.77**	**5,576.86**				**-61,301.37**
6. Waste	**2,286.80**	**17,448.39**	**1,067.11**				**20,802.30**
A. Solid Waste Disposal on Land	0.00	16,440.05					16,440.05
B. Wastewater Handling		281.52	664.92				946.44
C. Waste Incineration	2,286.80	367.58	402.19				3,056.57
D. Other	0.00	359.25	0.00				359.25
7. Other (please specify)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
							0.00
Memo Items:							
International Bunkers	**23,063.75**	**0.00**	**93.09**				**23,156.84**
Aviation	**13,752.92**	**0.00**	**0.00**				**13,752.92**
Marine	**9,310.83**	**0.00**	**93.09**				**9,403.92**
Multilateral Operations	**0.00**	**0.00**	**0.00**				**0.00**
CO_2 Emissions from Biomass	**36,991.58**						**36,991.58**

(1) For CO_2 emissions from Land-Use Change and Forestry the net emissions are to be reported. Please note that for the purposes of reporting, the signs for uptake are always (-) and for emissions (+).

(2) See footnote 4 to Summary 1.A of this common reporting format.

Greenhouse gas source and sink categories Land-Use Change and Forestry	CO_2 emissions	CO_2 removals	Net CO_2 emissions / removals	CH_4	N_2O	Total emissions
			CO_2 equivalent (Gg)			
A. Changes in Forest and Other Woody Biomass Stocks	70,066.00	-154,927.00	-84,861.00			-84,861.00
B. Forest and Grassland Conversion	12,540.00		12,540.00	235,91	23.87	12,799.78
C. Abandonment of Managed Lands	0.00	-48.00	-48.00			-48.00
D. CO_2 Emissions and Removals from Soil	8,589.00	-5,215.00	3,374.00			3,374.00
E. Other	0.00	0.00	0.00	1,880,85	5,552.99	7,433.84
Total CO_2 Equivalent Emissions from Land-Use Change and Forestry	**91,195.00**	**-160,190.00**	**-68,995.00**	**2,116,77**	**5,576.86**	**-61,301.37**

Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (a)	**544,515,20**
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (a)	**483,213,83**

(a) The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report emissions and removals from Land-Use Change and Forestry.

ANNEX IV TO CHAPTER 3

Contribution of Source Types to Greenhouse Gases in France 1999

(mainland France and Overseas)

Definition of the types of sources and indication in brackets refers to the UNFCCC classification.

Source: Citepa / Coralie UNFCCC format – updated: 07/11/00

CO_2 excluding LULUCF (Tg)	405	CH_4 (Gg)	2 841
GIEC sources	**%**	**GIEC sources**	**%**
Transport (1A3)	34.3	Enteric fermentation (A4)	46.8
Resid., service, agric. combustion (1A4) (a)	25.2	Landfill sites (6A)	27.6
Indust., manufac. and constr. combustion (1A2)	19.1	Manure spreading (4B)	6.1
Energy processing combustion	15.2	Resid., service, agric. combustion (14A)	4.7
Industrial processes – mineral products (2A)	2.6	Extrac. and distr. of coal (1B1)	4.5
Other sources	3.6	Extrac. and distr. of oil and natural gas (1B2)	3.2
(a) Excluding biomass		Other sources	7.1
N_2O (Gg)	254	HFC (CO_2 equivalent Gg)	4 815
GIEC sources	**%**	**GIEC sources**	**%**
Agricultural land (4D)	65.0	Use of HFC (2F)	86.7
Chemical industry processes (2B)	14.1	Production of HFC (2E)	13.3
Transport (1A3)	4.0		
Manure spreading	4.0		
Other sources	12.9		
PFC (CO_2 Gg equivalent)	1 915	SF_6 (Mg)	101
GIEC sources	**%**	**GIEC sources**	**%**
Metallurgy processes (2C)	61.0	Use of SF_6 (2F)	53.0
Use of PFC (2F)	34.6	Industrial metallurgy processes	47.0
Production of PFC (2E)	4.4		
NOx (Gg)	1 609	CO (Gg)	7 369
GIEC sources	**%**	**GIEC sources**	**%**
Transport (1A3)	49.9	Transport (1A3)	44.8
Resid., service, agric. combustion (1A4)	21.5	Resid., service, agric. combustion (1A4)	27.2
Industry, manufac. and constr. combustion (1A2)	16.2	Industrial metallurgy processes (2C)	11.3
Energy processing combustion (1A1)	10.3	Industry, manufac. and constr. combustion (1A2)	11.1
Other sources	2.1	Waste incineration (6C)	4.0
		Other sources	1.6
COVNM (Gg)	2 295	SO_2 (Gg)	741
GIEC sources	**%**	**GIEC sources**	**%**
Transport (1A3)	28.2	Energy processing combustion	42.3
Use of solvents (3)	27.2	Industry, manufac. and constr. combustion (1A2)	28.3
Forests (5E)	19.6	Resid., service, agric. combustion (1A4)	12.4
Resid., service, agric. combustion (1A4)	12.9	Extrac. and distr. of oil and natural gas (1B2)	8.4
Extrac. and dist. of oil and natural gas (1B2)	4.1	Transport (1A3)	5.1
Other sources	8.0	Other sources	3.5
Global warming excl. LULUCF 6 gas, CO_2 , CH_4, N_2O, HFC, PFC, SF_6 (CO_2 eq. Tg)	545		
GIEC sources	**%**	**GIEC sources**	**%**
Transport (1A3)	26.1	Enteric fermentation (A4)	5.1
Resid., service, agric. combustion (1A4)	19.6	Landfill sites (6A)	3.0
Industry, manufac. and constr. combustion (1A2)	14.3	Chemical industry processes (2B)	2.5
Energy processing combustion (1A1)	11.4	Industrial processes – mineral products (2A)	1.9
Agricultural land (4D)	9.5	Other sources	6.6

* Emissions from international sea traffic and international air traffic are excluded.

Glossary

A

- **ACEA** European Motor Vehicle Manufacturer Association
- **ACI** Concerted Incentive Action
- **ACPI** Accelerated Climate Prediction Initiative
- **ADCP** Acoustic Doppler Current Profiler
- **ADEME** Agence de l'environnement et de la maîtrise de l'énergie (Agency for the Environment and Energy Efficiency)
- **AFD** French Development Agency
- **AFNOR** French Standardisation Agency
- **AGRIGES** Agriculture and Energy Management
- **ANAH** National Agency for Housing Improvement
- **APD** Public Development Aid
- **ARGAU** Carbon Cycle in the South Austral Atlantic Ocean
- **ARGO** Array for Real Time Geostrophic Oceanography
- **ARGOS** Système de localisation et de transmission de données par satellite (System for Localising and Transmitting Data by Satellite)
- **ARPEGE** Météo-France Model for Digital Forecasting

B

- **BAPMON** Background Air Pollution MOnitoring Network
- **BILBO** Role of Austral Regions in the Climate System
- **BTP** Buildings and Public Works

C

- **CAN** Climate Action Network
- **CEA** Commissariat à l'énergie atomique (Atomic Energy Agency)
- **CEMAGREF** Centre de machinisme agricole du génie rural et des eaux et forêts (Centre for Agricultural Machinery in Rural Affairs and Water and Forests)
- **CEREN** Centre for Economic Energy Study and Research
- **CERFACS** European Centre for Advanced Research and Training in Scientific Calculation
- **CERTU** Centre for Tunnel Studies and Research
- **CESBIO** Centre d'études spatiales de la biosphère (Centre for Spatial Studies of the Biosphere)
- **CGP** Commissariat général au Plan (General Planning Commission)
- **CIES** Interministerial Commission on the Climate Change
- **CIRAD** International Centre for Co-operation on Agronomic Research and Research Development
- **CLIOKER** Ocean Climate at Kerguelen
- **CLIPPER** Study of the Role of Medium-Scale Ocean Tornadoes in Air-Sea Exchanges
- **CLIVAR** Climate Variability and Predictability (WCRP)
- **CMIP** Coupled Models Intercomparison Project
- **CNES** National Centre for Space Studies
- **CNRM** Centre national de recherches météorologiques (National Research Centre of Météo-France)
- **CNRS** National Centre for Scientific Research
- **COI** Commission for International Oceanography
- **CRF** Common Reporting Format
- **CRYOSAT** Cryogenic Satellite
- **CSOA** INSU Specialised Commission on Ocean Atmosphere
- **CSTB** Scientific and Technical Centre for Construction
- **CTBA** Technical Centre for Wood and Furnishings

D

- **DBCP** Data Buoy Co-operation Panel
- **DGEMP** General Delegation for Energy and Raw Materials
- **DOM** Overseas Department
- **DPPR** Department for the Prevention of Pollution and Risk (MATE)
- **DRIRE** Regional Department for Industry, Research and the Environment

E

- **ECCP** European Climate Change Programme
- **ECD** ECSN Data Set

MIES Publications

→ **NATIONAL PROGRAMME FOR TACKLING CLIMATE CHANGE**
(available in French and English)
2000 – 220 pages

→ **HANDBOOK FOR DECISION-MAKERS**
(handbook for local and regional councils engaged in combating greenhouse gases)
1999 (2nd edition in progress) – 82 pages

→ **POTENTIAL IMPACT OF CLIMATE CHANGE IN FRANCE IN THE 20TH CENTURY**
(in collaboration with MATE)
2000 (2nd edition in progress) – 128 pages

→ **INTERNATIONAL NEGOTIATIONS FROM RIO TO MARRAKESH**
(to appear at the beginning of 2002 – 20 pages)

→ **CLIMATE CHANGE: A MAJOR CHALLENGE**
(under the aegis of ADEME)
2000 – 20 pages

→ **SOCIAL REPRESENTATIONS ABOUT CLIMATE CHANGE**
(under the aegis of ADEME)
2001 – 20 pages

→ **CLIMATE CHANGES AND THEIR EFFECTS ON THE MOUNTAIN ENVIRONMENT**
(Papers from the Chamonix Conference – 29 and 30 June 2000)
2000 – 100 pages

→ **CLIMATE CHANGES AND COASTS**
(Papers from the Arles Conference – 12 and 13 October 2000)
2001 – 98 pages

→ **1ST ANNUAL REPORT ON THE NATIONAL PROGRAMME FOR TACKLING CLIMATE CHANGE**
(Summary of the round tables at the conference – 19 and 20 June 2001)
2001 – 28 pages

Liberté • Égalité • Fraternité
RÉPUBLIQUE FRANÇAISE

Prime Minister

Interministerial Task Force for climate change

Created in 1992, the MIES was reformed in 1998 (Decree 98-441 of 5 June 1998). It focuses mainly on preparing the positions that France has to defend internationally, on presenting its positions in meetings of government experts, on identifying its own measures to enable France to achieve its objectives and on monitoring their implementation.

35, rue Saint-Dominique - 75700 Paris - France
Tél. : 33-1 42 75 87 14 - Fax : 33-1 47 53 76 34 - http://www.effet-de-serre.gouv.fr