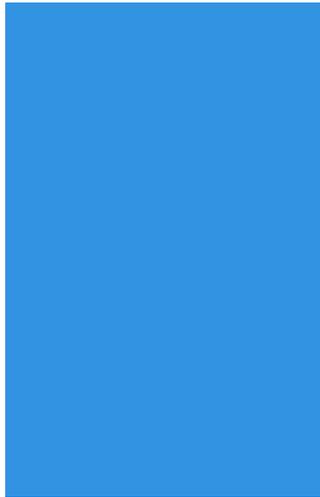


# The sixth national communication of France to the United Nations Framework Convention on Climate Change



## EDITORIAL

**«Tackling global warming is a world objective. It is a European commitment. It must be a «fervent» national obligation.»**

French President, François Hollande, 19 August 2013

A year ago, at the first Environmental Conference, François Hollande charted a course: to make France a nation of environmental excellence. Since then, the French President has committed France to a shared ecological transition bringing about a profound change in its development model and its individual and collective behaviour.

Of course, one of the main issues for such a transition is tackling global warming, an issue in which France is playing and will continue to play its part to the full.

France's objective is a four-fold reduction in greenhouse gas emissions by 2050. It is already fulfilling its commitments under the Kyoto Protocol. In the context of the EU Climate and Energy Package it is championing the setting of new greenhouse gas emission reduction targets, increased use of renewable energies and improved energy efficiency by 2020. Since 2012 the French President has declared his support for a more ambitious **European target of reducing greenhouse gas emissions by 40% by 2030 and 60% by 2040**. Of course, France intends to set an example in meeting these targets.

France also intends to devote the necessary resources to them, especially in those sectors which produce the most greenhouse gas emissions: construction and transport.

The residential energy efficiency renovation scheme aims to renovate 500,000 homes per year by 2017 in order to cut energy consumption by 38% by 2020. This scheme plans a single desk for advice on renovation to guide and support individuals and companies in their renovation works. It reinforces existing financial help to combat household fuel poverty. In the case of new buildings, the new thermal regulations RT 2012 which came into force on 1st January 2013 significantly increase the energy efficiency requirements.

With regard to transport, the progressive reinforcement of the bonus-malus scheme for cars will promote the use of more energy efficient vehicles with lower CO<sub>2</sub> emissions. The CO<sub>2</sub> cars labelling started on October 2013 provides information on the CO<sub>2</sub> content of transport that encourages more sustainable forms of transport.

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These measures prepare for the future and aim to limit global warming. But climate change is already here. To combat its effects from now on, France set up a national adaptation plan in 2011. Its 84 actions containing 240 measures are an international frame of reference.

In the wake of its national objective France has an international ambition. Climate change is global. It has the greatest effect on the men and women in those countries whose population are already facing many problems. France wants to include them in a collective project.

This is the spirit in which France proposed to host the 2015 United Nations Framework Convention on Climate Change, when ambitious new emission reduction targets for after 2020 are due to be decided.

I am convinced that we will make 2015 a successful meeting if, between now and then, with our European partners and the rest of the world, we move from a «burden sharing» attitude to emission reduction to one of «sharing opportunities» created by the development of new methods of production and consumption. By proposing an inspiring new road map we will bring about a positive vision of ecological transition based on solutions which will provide greener growth for the economic and social crises that most countries are facing.

I am convinced: by joining forces in a combined effort on ecological transition we will demonstrate that it brings the added benefit of well-being for all - for us today and also for future generations.

Philippe Martin  
Ministry of Ecology, Sustainable Development and Energy

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## A. Country-specific conditions

### A.1 A country rising to the climate change challenge

Tackling climate change is a priority target for France. The principle of a four-fold cut in emissions by 2050 has been written in French Law since 2005<sup>1</sup>. This imperative has since been reaffirmed and the measures to be implemented have been specified, particularly in terms of lowering the energy consumption of buildings and cutting greenhouse gas emissions from transport.

Since 2012 environmental conferences have become a new annual meeting place for all environmental stakeholders (NGOs, trade unions, employer organisations, local authorities, the State) with greater participation by members of parliament. One of the first projects after the conference in September 2012 was the launching of a debate on energy transition. The aim is to promote frugality and efficiency and also to develop renewable energies. The debates, which ended in July 2013, will act as a framework for investments to be made over the coming years through the energy framework law to be adopted at the end of it.

France is also very committed to the section on adaptation to climate change. It has adopted its first national adaptation plan which covers the period 2011-2015 and comprises 84 actions containing 240 measures.

As mitigation of climate change may only be effective if comparable actions are taken on a global scale France has decided to take a very active role in international climate discussions. It therefore made a bid to organise the 2015 Conference of Parties to the United Nations Framework Convention on Climate Change, the objective of which is to reach an attractive agreement for all States for the period beginning after 2020.

<sup>1</sup> Loi POPE, Framework Law n° 2005-781 of 13 July 2005 on setting the directions of the energy policy

At European level France has already declared itself in favour of a greenhouse gas emission reduction target of 40% in 2030 and then 60% in 2040.

### A.2 Recent social Changes

French population growth is moderate (annual increase of 0.5% between 1990 and 2013) but the number of households is increasing at a much faster rate (average of 1.2% per year over the period 1990-2009). This increase is explained by changes in the way people cohabit and by the ageing population. It has a direct influence on housing needs and energy consumption by homes and transport. If this trend continues the average number of people per household which fell from 2.6 in 1990 to 2.3 in 2009 will reach 2.1 in 2030 and 2.0 in 2050.

Urban areas occupied 22% of the country's land area in 2009 and housed 44.1 million people, i.e. 69% of the population. The influence of towns does not stop at the edge of large urban areas. Towns are centres of economic activity bringing in a large number of workers from the surrounding area on a daily basis. In 2010, 95% of the French population were living within the sphere of influence of a town.

In terms of land use the proportion of man-made landscapes is steadily increasing. In metropolitan France man-made areas covered 4.9 million hectares in 2010. This change is a continuation of trends observed since the 1990s and is largely at the expense of agricultural land and semi-natural environments.

Economically, France did not escape the serious economic downturn in the Euro zone in 2012, with zero growth in 2012 following 2.0% growth in 2011 and 1.7% in 2010.<sup>2</sup>

After a steep decline in 2009 followed by an upturn in the next two years the inland transport of goods fell again in 2012 (-4.4%).<sup>3</sup> Nevertheless,

<sup>2</sup> Source: INSEE (French national institute of statistics and economic studies)

<sup>3</sup> Source: French National Transport Audit 2012

the 2012 level was considerably higher than that of 1990 (+35.1%). Between 2008 and 2012 car traffic increased by 1.7% and public transport increased by 4.5%.

For a number of years there has been a marked increase in the number of diesel cars (72.4% of new registrations in 2012). Average conventional CO<sub>2</sub> emissions per km from new cars has continued to fall significantly, reaching an average of 124.1 g/km in 2012. The share of electric and hybrid vehicle ownership is increasing and reached 1.8% of registrations in 2012 (compared with 0.8% in 2011), but it is not yet sufficient to have a significant effect on average and total consumption by the car stock.

With regard to housing, the average surface area per person is increasing. It grew from 32 m<sup>2</sup> to 36 m<sup>2</sup> between 1999 and 2011<sup>4</sup>. Since 2003 energy consumption in kWh per m<sup>2</sup> has declined by an average of -1.9% each year, compared with -0.5% from 1984 to 2002. When taking into account climatic variations, this consumption fell significantly in 2011 (-1.7%). This progress is the result of changes in household behaviour, particularly due to volatile fossil fuel prices, but also to energy control measures (insulation, more economical equipment) in the existing housing stock and the successive implementation of thermal regulations in new builds. At the same time, specific energy consumption (lighting, household appliances, etc.) increased by 1.5 kWh per m<sup>2</sup> between 1984 and 2011. This change is partly explained by the increased use of domestic appliances, hi-fi and office appliances.

Primary energy consumption adjusted by climate variations fell by 2.3% in 2012.<sup>5</sup> It therefore fell below the 260 Mtep mark, i.e. below the 2009 level, the year in which the economic crisis was particularly acute. Primary consumption increased by an average of +1.5% per year over course of the 1990s, but then reached a plateau. Recent changes have been adjusted due to the 2009 crisis and the recovery which followed. It is therefore

difficult to confirm whether this is the start of a new underlying trend. Final energy consumption, all uses combined, fell slightly in 2012. It has fluctuated between 166 and 167 Mtep over the last three years, a level markedly less than the 175 Mtep of the first half of the first decade of this century.

As Europe's leading agricultural producer this sector accounted for 20.9% of French emissions in 2011. The total cultivated area has steadily decreased since 1950. This reduction has been to the benefit of wooded areas and uncultivated land which have increased by 75 and 51 thousand hectares on average per year respectively since 1950. The breakdown of agricultural land between arable land (63%), areas always under grass (33%) and permanent cultivation (4%) remains fairly stable. Between 1990 and 2011 the reduction of emissions reached 7.6%. France also had a forest sink of nearly 60 Mt CO<sub>2</sub> in 2011, compensating for 11.5% of the country's emissions in 2011<sup>6</sup>.

Total waste production, all types combined, is increasing (+2.9% between 2008 and 2010)<sup>7</sup>. 36.6% of household waste is recycled, 14.8% is incinerated with energy recovery and 40.8% is removed through storage or incineration facilities without energy recovery, the rest is spread or composted<sup>8</sup>.

<sup>4</sup> Source Housing Report 2011, December 2012

<sup>5</sup> Source: MEDDE/CGDD/SOeS, Energy Balance 2012

<sup>5</sup> CITEPA/MEDDE Inventory, 2013 submission, April 2013

<sup>6</sup> MEDDE/SOeS, Figures and Statistics, n° 385, January 2013

<sup>7</sup> MEDDE/SOeS, last waste statistics regulations, 2012

## B. Information on the GHG emissions inventory including information on the French national inventory system and national register

### B.1 Trends

Reference emission levels of French commitments under the Kyoto Protocol (Metropolitan France and Overseas Departments) have been set at 563.9 Mt CO<sub>2</sub> eq. Between 1990 and 2011 greenhouse gas emissions fell by 13.9% to 485.5 Mt CO<sub>2</sub> eq. in 2011. In tons per capita this is a reduction of 26% between 1990 and 2011 (9.6 t CO<sub>2</sub> eq./capita in 1990 and 7.5 t CO<sub>2</sub> eq. /capita in 2011), the population having increased by 12 % since 1990.

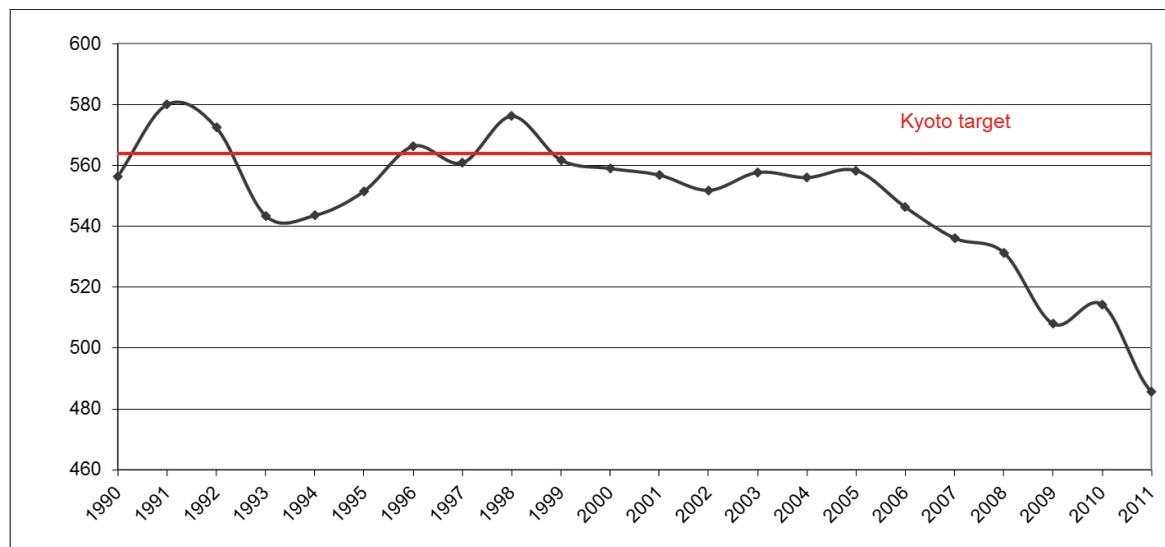
On the basis of an estimate for 2012<sup>9</sup>, the reduction in GHG emissions in relation to the Kyoto target is

10 Mt CO<sub>2</sub> eq. per year over the period 2008-2012 (average difference between recorded emissions and the Kyoto target).

This reduction is essentially explained by better industrial processes and policies enabling the upward trend linked to population increase to be overtaken.

Calculated on the basis of the Kyoto framework, CO<sub>2</sub> accounts for 358.2 Mt or 74% of France's GHG emissions. In 2011, methane emissions were 51 Mt CO<sub>2</sub> eq. and accounted for 10 % of French GHG emissions. N<sub>2</sub>O emissions were 59.6 Mt CO<sub>2</sub> eq. and accounted for 12 % of French GHG emissions. F-gas was 17 Mt CO<sub>2</sub> eq. and accounted for 3 % of France's total GHG emissions. CO<sub>2</sub> emissions fell by 9.8 % between 1990 and 2011, N<sub>2</sub>O and CH<sub>4</sub> emissions fell by 30 % and 17 % between 1990 and 2011 respectively. F-gas emissions increased by 66 % between 1990 and 2011 despite implementation of the existing European regulations (European regulations no. 2037/2000 and no. 842/2006,

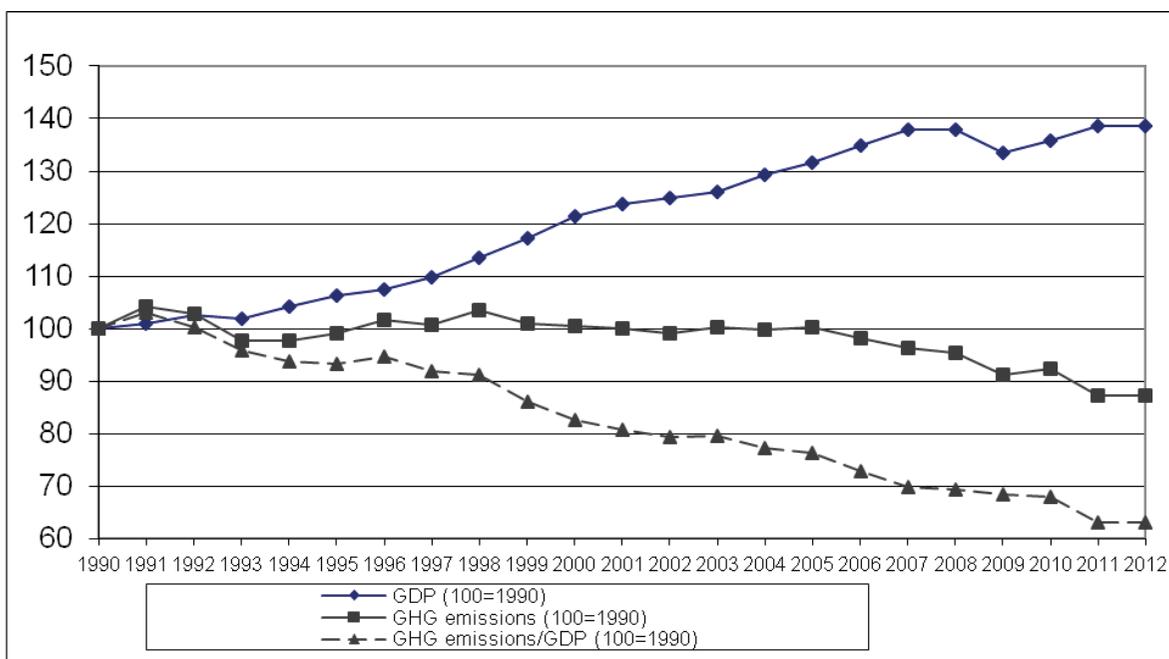
Figure 1: Trend of GHG emissions between 1990 and 2011 in Mt CO<sub>2</sub> eq



Source: 2013 Submission, French National Programme on Tackling Climate change format to the Kyoto framework, CITEPA / MEDDE

<sup>9</sup> Loi POPE, Framework Law n° 2005-781 of 13 July 2005 on setting the directions of the energy policy

**Figure 2: Separating economic growth and greenhouse gas emissions (GDP change by volume; GHG emissions and GHG intensity - 100 = 1990)**



Sources: INSEE, emissions inventory, PNLCC format to the Kyoto framework, CITEPA, 2013 submission, DLCEs/General Directorate of Energy and Climate calculation - 2012 emissions are estimates

Directive 2006/40/EC). In France, this legislation was supplemented in 2011 by Decree 2011-396 which specifies regulatory provisions on use other than in refrigeration and air-conditioning. In addition, a new regulation on f-gases is under discussion at European level. This legislation will strengthen further the stage of the maintenance, filling and end of life stages of equipment.

The graph of the shows increased separation between GHG emissions and the growth of France's GDP. The French economy is therefore becoming more carbon-friendly despite the economic crisis.

### Analysis by sector of activity

Transport accounted for 27% of France's total emissions, i.e. 138 Mt CO<sub>2</sub> eq., in 2011, with a sharp increase between 1990 and 2001 (+22%) followed by stabilisation. Road transport is responsible for

95% of these emissions, 57% of which is from cars alone.

Direct emissions from residential and tertiary sectors account for 17.5% of France's greenhouse gas emissions (2011), 90% of which is CO<sub>2</sub> and 7% f-gases. When the share of emissions associated with electricity production and urban heating is taken into consideration the building sector accounts for 23.5% of France's total emissions<sup>10</sup>.

In 2011, the manufacturing sector accounted for 90.8 Mt CO<sub>2</sub> eq., i.e. 18.6 % of France's total greenhouse gas emissions. These emissions are 38.3% below their 1990 level.

Emissions from the energy production sector (electricity generation, urban heating, oil refining, solid mineral fuel transformation) were 57.3 Mt CO<sub>2</sub> eq. in 2011, i.e. 11.7 % of France's total emissions. That is over 96 % of CO<sub>2</sub> emissions. This sector's contributions to France's national emissions is less

<sup>10</sup> DGEC calculations from Citepa and Base Carbone (Carbon database) data

than in other countries due to the dominance of nuclear and hydroelectric power stations in French electricity production. Wind power accounted for 18.9 % of French renewable energy production in 2011<sup>11</sup>.

The agricultural sector is the third largest producer of greenhouse gas emissions, with over 21% of France's emissions in 2011. Methane (CH<sub>4</sub>) and nitrous oxide (N<sub>2</sub>O) emissions caused by biological processes linked to nitrogen fertilisation of agricultural soil (47 % of the sector's emissions), as well as enteric fermentation and livestock manure (41 %), account for the sector's main emissions. Between 1990 and 2011 the reduction in agricultural emissions (including energy consumption) reached 7.6 %. This is mainly due to less use of nitrogen fertilisers, the reduction in the cultivated area, a drop in the number of cattle and a fall in energy consumption.

Emissions linked to waste treatment (apart from energy recovery) accounted for 12.8 Mt CO<sub>2</sub> eq. in 2011, i.e. about 2.6 % of France's total greenhouse gas emissions.

In 2011, transport was the sector with the largest CO<sub>2</sub> emissions with a 36.4 % share of CO<sub>2</sub> emissions. The agricultural sector contributes 74% of methane emissions. Agriculture is also the greatest producer of N<sub>2</sub>O with a share of France's total emissions estimated at 89%.

## B.2 National inventory system

France has created a national inventory system: SNIEBA (National system for air emissions inventories and GHG balance) defined by an inter-ministerial decree dated 24 August 2011 in accordance with Article 5.1 of the Kyoto Protocol. The French deposits and consignment fund (Caisse des Dépôts) was designated holder of the French national register by Decree n° 2004-1412, and was given responsibility for developing information systems designed to use the register and taking

care of system security. The French national register has undergone some changes since the fifth French national communication. Decree n° 2004-1412 was amended by decree no. 2012-343 of 3 December 2012 in order to include changes in European Directives, in particular the replacement of national registers by a single system developed by the European Commission. This amended decree confirms the national register public service concession awarded to the Caisse des dépôts for the period 2013-2020.

Since migration to the European Union register in June 2012, the European Commission is now responsible for supplying, maintaining and securing the national register information system concerning the commitments of European Member States as Parties to the Kyoto Protocol (KP register) and as participants in the European Union Emissions Trading System (EU-ETS Register)

## C. Policies and measures

The policies aiming at reducing greenhouse gases emissions have been gathered in the «Climate Plan», corresponding to the French action plan for complying with its European (Climate and Energy Package) and international (Kyoto Protocol) commitments. The Climate Plan has been revised every two years in accordance with article 2 of the French framework law setting the directions to be followed by the energy policy of 13 July 2005. In the same law, France has set itself the target of a four-fold cut in emissions by 2050 (article 2 of the Law of 13 July 2005).

In accordance with UNFCCC guidelines the policies and measures implemented by France are classified according to two categories in the sixth French national communication:

- Existing measures, which are policies implemented before 1st January 2012 ;
- And additional measures, which encompass policies decided since 1st January 2012 and sectoral policy targets that have been introduced in a framework law even if they are not yet backed by sufficient policies to be reached.

<sup>11</sup> MEDDE/CGDD/SOeS, *Key renewable energy figures, 2013 edition*

In this summary we present the existing measures which taken alone, enable French commitments under the Kyoto Protocol and France's European commitments under the Climate and Energy Package to be achieved.

In order to assess the impact of policies and measures the French Ministry of Ecology, Sustainable Development and Energy (MEDDE) has developed its own tool. It enables the evaluation by comparison with a business as usual scenario by changing technical input data (e.g.: changes in road traffic, housing stock, building insulation) in accordance with planned policies and measures. This tool (known as SceGES for Scénarisation des Emissions de GES or GHG emissions scenario writing) has been developed with the Ecole des Mines in Paris, CITEPA, Energies Demain and Solagro engineering and design firms and INRA (French National Institute for Agricultural Research). Evaluations made through SceGES are based on three principles:

- Methodologies used for calculating emissions are compatible with those used for carrying out the French national inventory, sent by France to the United Nations under its international climate change commitments;
- Calculation methodologies are updated at the same time as those of the French national inventory to ensure consistency of assessments over time;
- Emission calculations are based on the highest possible quality description of technical data in the majority of sectors (description of the housing stock according to year of construction, description of the vehicle stock according to capacity, vehicle age, rate of car ownership, description of the livestock in agriculture, etc.).

Except explicitly indicated, the assessments presented below have been calculated with the aid of this tool.

## C.1 Transport

France has set itself the target of bringing transport sector emissions down to their 1990 level by 2020 under framework law no. 2009-967 of 3rd August

2009 on implementing Grenelle Environment Round Table.

Various measures have been implemented or reinforced to reach this target.

**Development of alternative modes of transport:** there are plans to modernise and in certain cases to create new infrastructures to encourage the use of rail, river or sea transport for the carriage of goods. An HGV eco-tax, from January 2014, for use of the main non-conceded road network will enable the external costs of road transport to be better managed. Impact: the implementation of this eco-tax will reduce GHG emissions of 0.26 to 0.6 Mt CO<sub>2</sub> per year<sup>12</sup>.

**Energy efficiency of cars:** the European Union has set itself the target of cutting unit CO<sub>2</sub> emissions from new cars with a first stage of reduction to 130 g CO<sub>2</sub>/km progressively applicable from 2012 to 2015 and a target of 95 g CO<sub>2</sub>/km in 2020. A French national target of cutting the CO<sub>2</sub> emissions of the entire car stock has been set at 120 g CO<sub>2</sub>/km in 2020. These targets will be achieved by implementing the European regulation on car emissions which provides penalties for manufacturers which do not meet their obligations and through national provisions aimed at encouraging people to buy the most low-carbon vehicles, including the bonus-malus system for cars.

The **bonus-malus system for cars** that has been implemented since January 2008 is a progressive provision. It encourages people to buy vehicles that produce the lowest CO<sub>2</sub> emissions by paying a bonus to cars emitting less than a certain threshold (less than 105 g of CO<sub>2</sub>/km in 2013) and subjecting cars with the highest emissions (over 135 g of CO<sub>2</sub>/km in 2013) to a purchase tax adjusted according to vehicle emissions (purchase tax of €100 to €6000). Impact: -9 Mt CO<sub>2</sub> eq. in 2020 for all measures aimed at cutting emissions from cars<sup>13</sup>.

<sup>12</sup> French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 140 [http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_...pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013_...pdf)

<sup>13</sup> *id.* pages 143-144

**Development of biofuels:** as part of its European commitments France has a target biofuels take-up rate of 7% since 2010. To achieve this target, the General Tax on Pollution-generating Activities (TGAP) has to be paid by operators not meeting these targets. This component of the TGAP<sup>14</sup> was instituted by the French Finance Law of 2005 and the tax changes each year. Since 1st January 2012 only biofuels meeting sustainability criteria can be taken into account for calculating the deduction from the TGAP rate. Partial exemption from the TICPE compensates for the extra costs of producing biofuels compared with fossil fuels (article 265 bis A of the Customs Code).

Ex-post impact: -6.3 Mt CO<sub>2</sub> eq. in 2009 for all the bioethanol and biodiesel consumption<sup>15</sup>.

## Residential and tertiary

Policies and measures put in place since 1990 have enabled emissions from the residential and tertiary sector to be stabilised. Improvements to the energy efficiency of the existing housing stock, new thermal standards for new buildings (in particular RT 2012 in force since January 2013) and use of a greater share of low-carbon energy sources (coal has almost disappeared and heating oil has fallen dramatically in favour of gas and electricity) have been able to compensate the greater nominal surface area of housing, which increased from 32 m<sup>2</sup> to 36 m<sup>2</sup> per person between 1999 and 2011, and to the increase in the number of homes (+10 %).

**Thermal regulations:** a new thermal regulations (RT2012) have come into force with the aim of strengthening the thermal requirements for buildings for which planning permission applications were filed after 1st January 2013. Impact: -3.5 Mt CO<sub>2</sub> eq. per year in 2020 for the residential sector alone<sup>16</sup>.

<sup>14</sup> Article 266 -15 of the Customs Code

<sup>15</sup> Transport in 2010: 48th report of the National Transport Auditors, volume 2. [http://www.developpement-durable.gouv.fr/IMG/pdf/Ref\\_CCTN\\_2010\\_tome\\_2.pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Ref_CCTN_2010_tome_2.pdf)

<sup>16</sup> French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 132 [http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_...pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013_...pdf)

The average primary energy consumption of new buildings must now be under 50 kWh/m<sup>2</sup>/year. From 2020 the primary energy consumption of all new buildings will have to be less than the quantity of renewable energy produced in these buildings (positive energy buildings).

Thermal regulations for renovations also contribute to energy performance improvements. The regulations define minimum performances for replaced or installed parts, as well as a total performance target for extensive renovations to buildings of over 1000 m<sup>2</sup> built since 1948.

Energy performance labels: certification measures (energy labels) are recognised in order to promote the use of the most efficient building systems and techniques (high and very high performance buildings) and prepare professionals for the progressive strengthening of the thermal regulations (e.g. the Low Consumption Building label, with criteria similar to those of RT2102, which made public support provisions eligible during the years preceding the entry into force of the regulation).

**Financial support for renovations:** a «sustainable development» tax credit has been available to individuals since 2005 to help them buy the most energy efficient materials or equipment (in existing buildings only) or renewable energy production units (in new and existing buildings). These provisions were widened to include landlords and extended until the end of 2015. To encourage extensive redevelopment, an adjustment to the sustainable development tax credit (CIDD) according to the extent of works was introduced from 2012.

Impact: The implementation of this measure between 2009 and 2012 will bring about an annual reduction in 2020 of 3.76 Mt CO<sub>2</sub> eq.<sup>17</sup>

A zero rate eco-loan (for a maximum of 10 years and for up to €30,000) is also aimed at encouraging owner occupiers and landlords to finance extensive renovation work. It is conditional upon a range of work that has to be carried out and a total energy

<sup>17</sup> *id.*, page 135

efficiency level being reached after the renovation and can be combined with other support provisions subject to resources.

Impact: The implementation of this measure between 2009 and 2011 will permit an annual reduction of 0.33 Mt CO<sub>2</sub> eq. to be achieved by 2020<sup>18</sup>.

From 1st July 2014 the main support measures (CIDD and zero rate eco-loans) will be subject to eco-conditionality criteria.

The distribution of **energy performance contracts** (supplier's guarantee of energy saving volumes) was particularly promoted by the law of 12 July 2010 which introduces the obligation to study such a contract after the mandatory joint-owners' audit. The Investment Plan (2013) for housing provides for the implementation of a third party investment system and other household support measures for carrying out renovation work (one-stop shop, energy renovation ambassadors, etc.).

**Renovation of the social housing stock:** France aims to renovate the 800,000 highest energy consuming social housing units by 2020. In this context the subsidised rate social housing eco-loan (eco-PLS) was implemented between February 2009 and May 2011 for social housing landlords. A second generation social housing eco-loan has been distributed since February 2012. The implementation of the March 2013 Housing Investment Plan will reinforce the system for improving the energy performance of France's building stock.

Impact: in total, 123,000 social housing eco-loans were distributed up to 1st January 2013, permitting an annual reduction of 0.29 Mt CO<sub>2</sub> eq. to be achieved by 2020<sup>19</sup>.

<sup>18</sup> *id.*, page 133

<sup>19</sup> *id.*, page 135

### C.3 Energy

Alongside sectoral energy consumption management policies (particularly in the residential and tertiary and transport sectors) a number of cross-sectoral measures are helping to reduce energy demands. This includes the following actions in particular:

■ → **Energy saving certificates (CEE):** implemented since 2006, this system is under-pinned by a requirement imposed on the main energy suppliers (vendors of electricity, gas, domestic heating oil, etc.) to make energy savings. The system was substantially reinforced for the second period, between 2011 and 2013 (255 TWhcumac compared with 54 TWhcumac for the period between July 2006 and June 2009), and extended to car fuel suppliers (up to 90 TWhcumac). It principally supports insulation work and distribution of the most efficient heating systems in renovations. It also serves as a support for professional training and provides information for individuals.

Impact: Measures which have benefited from CEE issued during the first two periods will permit an annual reduction of 6.2 Mt CO<sub>2</sub> eq. to be achieved by 2020<sup>20</sup>.

■ → **Eco-design and energy labelling:** the progressive withdrawal of incandescent light bulbs over the period 2010 to 2012, limitation of standby mode on appliances, reduction of street and office lighting, improved performance of chargers, external supply and electrical chargers are examples of energy efficiency advances which have been achieved through the implementation of the eco-design directive. Energy labelling will add to the measure by helping to direct the consumer to the lowest-carbon products. The range of products subject to such requirements is being steadily expanded (in 2011 and 2012 European regulations defined the rules to be applied to air-conditioning units and tumble-driers).

<sup>20</sup> *id.*, page 147

Impact: total of -4.05 Mt CO<sub>2</sub> eq. by 2020 in France purely from the withdrawal of incandescent light bulbs<sup>21</sup>.

■ → **Development of renewable energies:** France's target is to increase the share of renewable energies in energy consumption to at least 23 % by 2020, by an increase of 21 million tons oil equivalent (Mtep) of the annual renewable energy production compared with 2005 as part of its climate and energy package commitments. Implemented measures should enable renewable energy production to be doubled in 12 years, especially increasing the contribution from wood by more than 45%, and changing the scale of solar power and heating networks.

The France uses a wide range of instruments to support the development of renewable energies:

- Budgetary expenses, especially in support for thermal renewable energies. A billion euro «Fonds chaleur renouvelable» (Renewable Energy Heating Fund) for the period 2009 to 2013 has enabled considerable development of heat production in the tertiary and manufacturing sectors from renewable sources such as wood, geothermal energy and solar power while improving and diversifying heating sources in multiple dwelling units. It will enable 2.7 Mt of CO<sub>2</sub> emissions to be cut per year from 2015.<sup>22</sup>
- Tax expenses. The «sustainable development» tax credit in particular, which helps individuals to buy renewable energy equipment: solar powered water heaters, heat pumps, solar panels, etc., has been extended until 2015;
- Consumer financing measures: implementation of electricity buy-back tariffs to make investment in the various renewable energies profitable. A considerable increase in the number of wind pumps in Metropolitan France is due to these measures. In this sector alone annual emission reductions in 2020 will be 5.37 Mt CO<sub>2</sub> eq.<sup>23</sup>

- Regulatory measures such as the use of solar heating to cover at least 50% of the hot water requirements of new homes built in Overseas Departments from 1st May 2010.
- **Considerable research efforts** in the energy sector have been agreed as part of the Investissements d'Avenir (Future Investments) (budget of 3.6 billion euros.).

#### C.4 Manufacturing

France's policy on energy efficiency and cutting greenhouse gas emissions in the manufacturing sector is based on five key areas:

- Market instruments and in particular implementation of European Directive 2003/87/EC establishing an emissions trading system with the European Union. The review of the system by Directive 2009/29/EC specifies the arrangements for the period 2013-2020 (quota ceiling dropping by 1.74 % per year, progressive move to a quota bidding system, etc.);
- Financial incentive packages such as ADEME'S call for Manufacturing, Agriculture and Tertiary Biomass Heating (BCIAT) proposals since 2009;
- Regulatory measures and in particular Directive 2010/75/EC on industrial emissions (IED)
- Support for standardisation processes in the field of energy efficiency (European standard EN 16247 on energy audits published in September 2012 reiterating the main criteria of the French term of reference, etc.) and classification of stakeholders, particularly in the use of f-gases (Decree 2011-396 which specifies the regulatory provisions relating to their use other than in refrigeration and air-conditioning, etc.);
- Support for the development of strategic sectors of the green economy in terms of growth and employment potential, particularly through the (Investissements d'Avenir) Future Investments system.

<sup>21</sup> *id.*, page 149

<sup>22</sup> *id.*, page 152

<sup>23</sup> *id.*, pages 154-155

## C.5 Agriculture and Forestry

### Agriculture

While fertilizer deliveries have fallen in France in the last 20 years (at an average rate of 0.5 % per year, i.e. more than 10 % in total), as have provisions of organic fertiliser of animal origin (-9 %), the reduction of N<sub>2</sub>O emissions through better control of nitrogen fertilisation and tackling organic nitrogen surpluses, remains a priority issue for the agricultural sector. Of particular help here are nitrates action programmes, some actions of the Plan végétal pour l'environnement (plant plan for the environment) and aid allocation measures under the common agricultural policy.

Several actions are bringing about a reduction of emissions caused by livestock, in particular the livestock buildings modernisation scheme, launched in 2005 which helped to modernise more than a third of cattle farms before the end of 2012. The Plan énergie méthanisation autonomie azote (methane recovery and use scheme) (EMAA) launched in 2013 provides for recovery of one of the largest constituents of effluent. The setting up of a thousand methane recovery units by 2020 should bring about a reduction of 0.95 Mt CO<sub>2</sub> eq./year by that time. This one of the sections of renewable energy development based on agricultural sources, alongside the development of biofuels.

While greenhouse gas emissions associated with energy consumption account for only 10% of emissions from the agricultural sector they are also the subject of specific measures in the sector (in particular the farm energy performance plan for the period 2009-2013).

Finally a number of provisions and measures of the common agricultural policy contribute indirectly to the maintenance and growth of carbon stores on parcels of land and in soils (especially measures promoting soil cover in autumn and winter, measures promoting hedges and agroforestry, or the agro-environmental grassland payment)

### Forestry

Mitigation in forestry is different from other sectors.

Firstly, mobilisation of the biomass means it can bring about emissions reductions in other sectors through the effects of substitution. Secondly, it can, as now, make a net overall positive contribution to climate change mitigation, with emissions (originating in particular from the oxidation of dead wood and felling) lower than sequestration. France's forest sink is nearly equal to 60 Mt CO<sub>2</sub> per year, corresponding to 11.5 % of the country's GHG emissions in 2011.

Schematically, forestry's contribution to the greenhouse gas emissions reduction policy is based on three sections:

- The forestry policy which ensures the sustainability of carbon stores in forests and their mobilisation. The current forest sink is due to the fact that French forestry is not balanced, due in particular to its relative youth from a global perspective. The over capitalization of older populations should however be noted as this makes accrued mobilisation possible from a sustainable management perspective.
- Carbon storage in wood products. In France this amounts to about 4 Mt per year. This storage is likely to increase with the development of green technologies and in particular the use of wood in the construction of buildings, encouraged by labels such as the bio-sourced building label. These uses also have the positive effect of substituting for materials of fossil origin or energy consuming.
- Substitution of wood for fossil fuels. Already the primary renewable energy source in the French energy mix (41% of final energy produced from renewable sources in 2011 was from wood). Its increased mobilisation is planned to contribute significantly to the national target of 23% of energy production from renewable sources in 2020.

The forthcoming Agriculture Bill, subject of stakeholder consultation between April and September 2013, the implementation of which will coincide with that of the reform of the common

agricultural policy, will add to and reinforce these measures.

## C.6 Waste

In law no. 2010-788 of 12 July 2010 on the national environmental commitment France has set itself the targets of:

- Cutting annual production per head of population by 7% within 5 years;
- Increasing recycling to achieve a rate of household waste recycling of 35% by 2012 and 45% by 2015;
- Directing 75% of household packaging waste and ordinary commercial waste to recycling;
- Cutting the amounts of incinerated and stored waste by 15%.

The 2009-2012 waste action plan defines the guidelines for implementing these targets per treatment sector. Prevention is the priority of the European waste policy. France is fully signed up to this view point and wants to bring about the necessary disconnections to reverse waste production trends. Numerous measures have been implemented from this perspective.

All local authorities that collect or treat household or similar waste are required to carry out a household or similar waste prevention scheme. This scheme lays down the waste reduction targets and details the measures implemented to achieve them. Generalisation of a public service incentive tariff for waste elimination by 2014 was also introduced in the law. Local authorities can institute such a system by introducing a variable portion of the household waste collection tax. A tax incentive has been possible since its institution in 1999. This variable portion can be calculated according to the type, weight and volume of waste or the frequency of collections.

The general tax on pollution-generating activities (TGAO) is an important lever of action. It was amended in 2012 to encourage waste prevention and recycling. It was also adjusted according to the environmental and energy performance of storage and incineration facilities. In 2013 discussions are

in progress under the environmental conference to define new targets for each treatment sector by 2020.

## C.7 Public authorities and local authorities

The **regional section** of France's climate policy is based in particular on:

- The implementation of regional climate, air and energy schemes (SRCAE) which connect regional targets to national targets and ensure that actions taken by local authorities in the fields of climate and energy are consistent across regions.
- Regional climate and energy plans (PCET) which are compulsory for all local authorities of more than 50,000 inhabitants.

SRCAE are developed jointly by the chief administrative officer of the region and the chairman of the regional council, in liaison with local stakeholders. They are available to the public before a final decision is made by the chief administrative officer for the region. SRCAE define regional scenarios to 2020 and 2050, compatible with European and national commitments, concerning greenhouse gas emissions reductions, adaptation to climate change and air quality.

Regional climate and energy plans (PCET) are compulsory for about 500 authorities. At the same time, about 200 smaller authorities have committed to development of voluntary PCET or Agenda 21.

In addition, since 31st December 2012 the State, regions, departments, urban communities, large towns and municipalities or groups of municipalities of over 50,000 inhabitants as well as other public corporations employing over 250 people have to draw up an assessment of their greenhouse gas emissions.

## C.8 Businesses

For businesses, new environmental requirements, particularly in relation to climate change, have been instituted.

The new economic regulations law (NRE) of 2001 had already introduced a requirement for businesses quoted on the stock exchange to include information on the social and environmental consequences of their activities in their annual report. These requirements were reinforced by the law of 12 July 2010 on the French national commitment for the environment which broadens the scope of businesses concerned (businesses employing more than 500 people and with an annual turnover of over 100 million euros). Compulsory information includes impacts relating to climate change.

In addition, since 31 December 2012 businesses of over 500 employees are required to draw up an assessment of their greenhouse gas emissions and an action plan for cutting them.

Since 1st October 2013 businesses selling or organising a transport service must give their customers information on the quantity of CO<sub>2</sub> emissions.

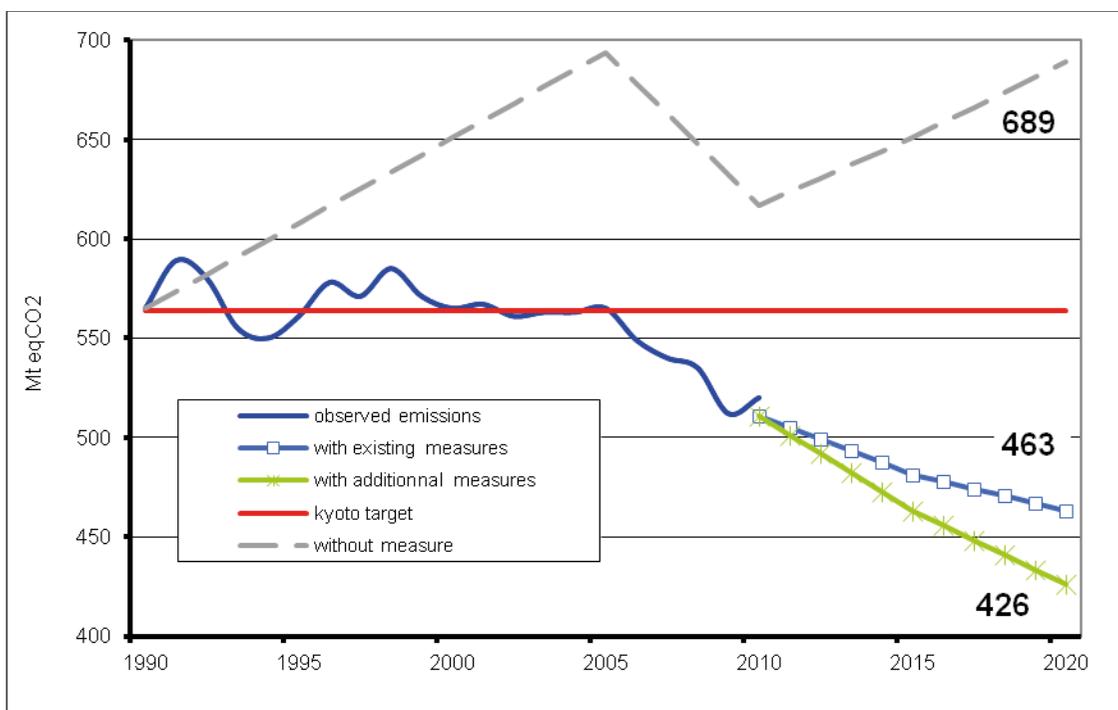
## D. Projection of GHG emissions and quantification of the impact of policies and measures

### D.1 Results of projections for 2010 and 2020

The government has built three projection scenarios for 2010 and 2020 in order to assess the impact of policies and measures:

- A “without measure scenario” (WM) which represents the change in French emissions if no policy had been implemented since 1990. It will be used, in accordance with UNFCCC guidelines to estimate the total effect of policies and measures;
- A “with existing measure scenario” or WEM which takes into account all policies and measures decided and implemented before 1st January 2012;

**Figure 3: Projections of GHG emissions (in Mt CO<sub>2</sub> eq.) for France, in the Convention framework in 2010 and 2020 for WEM and WAM scenarios and for a “without measure” since 1990 scenario**



Sources: UNFCCC inventory, CITEPA/MEDDE, 2013 MEDDE submission and emissions projections, 2013

- A “with additional measure scenario” or WAM scenario which, in addition to policies already considered in the WEM scenario, also considers new policies decided since 1st January 2012 and, above all, planned policies even if they have not yet been implemented.

In the context of the WEM scenario (cf. Erreur : source de la référence non trouvée), France’s emissions in 2020 (Convention perimeter, Metropolitan France, Overseas Departments and Overseas Collectivities) are 463 Mt CO<sub>2</sub> eq., i.e a reduction of 18.1 % compared to 1990 (565.4 Mt CO<sub>2</sub> eq. – Convention perimeter). In the results of the WEM scenario the Kyoto targets for the period 2008-2012 are met. In the WAM scenario they achieve 426 Mt CO<sub>2</sub> eq. in 2020, i.e. a reduction of 24.6 % compared with 1990. According to the without policy scenario the level of emissions would be 617 Mt CO<sub>2</sub> eq. in 2010, and 689 Mt CO<sub>2</sub> eq. in 2020.

The surprising change in emissions between 2005 and 2010 for the no policy scenario is due to the fact that the time interval used for modelling is only 5 years. As emissions are linearized between 2005 and 2010 the fall in emissions due to the crisis over the period 2008-2010 is shown from 2005. Modelling with an annual time interval would certainly have allowed a better representation of the change in emissions to have been obtained in the context of the no policy scenario.

An analysis of the change in emissions projected by sector shows that:

- Policies existing before 1st January 2012 have allowed the increase of emissions to stabilise or slow down in all sectors with a pronounced decline in emissions from the energy sector;
- The implementation of new policies as well as policies existing before 1st January 2012 permit an even greater reduction of emissions from the energy sector and a reduction of emissions from the agriculture (other than energy), industrial processes and waste treatment sectors of 37%, 20% and 10% respectively compared with 1990.

## D.2 Projection sensitivity analysis

### Sensitivity of the New Policies scenario

In the context of the WAM scenario there is a reduction of 24.6 % of total GHG emissions between 1990 and 2020. These results reflect France’s ambition in terms of combating climate change and in particular the ambitious nature of national targets. It is also in line with the EU’s ambition to reduce its GHG emissions by – 20 % as specified in the Energy Climate Package, and even to reach its GHG emissions to – 30 % between 1990 and 2020 in the event of a satisfactory international agreement; and the French President’s determination to see the EU set a new target of cutting GHG emissions by – 40 % by 2030 and – 60 % by 2040.

It should also be emphasised that effective achievement of this ambitious outcome is conditional upon the adequate treatment of several «vigilance points» and in particular:

- **The actual pace of thermal renovations of the existing building stock over the whole period.** Achieving the target of a 38% reduction of consumption by the existing building stock by 2020 requires a very ambitious pace of renovations, supported over the whole period. Like the WEM scenario, this scenario provides for a rate of 500,000 buildings per year, implementation of thermal regulation 2012 from 2013 and extending the sustainable development tax credit (CIDD) and zero rate eco-loan until 2015. The WAM scenario also presupposes a sustained rate of 900,000 extensive renovations per year between 2013 and 2020;
- **Maintenance of powerful incentive tools supporting this rate of renovations over the entire period, in an increasingly constrained budgetary situation:** even if residential energy efficiency improvement work is often identified as having low, or even negative, allowance costs there are many other restraints (access to credit for households, imperfect information, loss of use caused by the works) on the effective execution of work which make it necessary to put incentive tools in place for the renovation of houses. This is the purpose of the zero rate eco-loan and the sustainable development tax credit;

- **Reinforcement of the modal shift for goods.** The very ambitious target of a non-road and non-aviation modal share of 25% by 2022 is confronted by a change in industrial structure unfavourable to heavy goods rail transport by full train (which declined from 13% to 10.9% between 2005 and 2010 and only started to recover in 2011 to 11.7%);
- **Effective adaptation capacity of fields and sectors** (innovation, technological disconnections, etc.);
- **The level of mobilisation of all stakeholders and the effectiveness of the support provisions** (training, changing behaviour,...).

### Sensitivity to the economic situation

France's "WEM" and «WAM» GHG emission projection scenarios are based on the hypothesis of Gross Domestic Product (GDP) growth of +2.1% per year over the 2015-2020 period and on the 2020 fossil fuel price hypotheses from the International Energy Agency's (IEA) World Energy Outlook «Current Policy» scenario. A sensitivity study was carried out to see the impact of lower growth hypotheses (+1.6% per year over the 2015-2020 period) or high fossil fuel prices for gas and coal (scenario issued by the European Commission in September 2012). Thus, in these two variants, the levels of GHG emissions obtained for the Current Policies scenario in 2020 is less than -3 Mt CO<sub>2</sub> to -11 Mt CO<sub>2</sub> compared with emissions for the year 2020 in the reference WEM scenario.

For the WAM scenario the impact is the same but with a further reduction by 2020 within range of between -3 Mt CO<sub>2</sub> and -10 Mt CO<sub>2</sub> compared with the reference New Policies scenario.

### D.3 Quantification of policies and measures

The impact of all GHG emissions in 2020 under existing measures is 226 Mt CO<sub>2</sub> eq. compared with the level of emissions achieved with the no policy scenario. The impact of new policies in 2020 is equal to 37 Mt. CO<sub>2</sub> eq. compared with emissions level reached by the WEM scenario. These assessments

are conditional upon the points of vigilance and sensitivities stated above.

## E. Impacts, vulnerability and adaptation

### E.1 Impacts of climate change

Annual average temperature changes in France have the same characteristics as on the global scale: the average temperatures are markedly warmer. Until the mid 1980s the average annual temperature was lesser than the average for the period 1971-2000. Since the 1980s average temperatures have increased rapidly. 2011, at +1.8 °C above the average for 1961-1990, was the warmest year recorded in Metropolitan France since 1900, beating the previous record set in 2003 (+1.7°C). French overseas departments have experienced a similar trend, although less marked due to thermal inertia of the sea. Over the last forty years the temperature has increased from + 0.65 °C to + 1.5 °C depending on the region over.

The consequences of changing climate conditions are being felt in many areas. The glaciers of the French Alps and Pyrenees have seen a large decline in their mass balance over the years. This trend has speeded up considerably since the end of the 1980s.

Flora and fauna have also been affected by these changes. Vines and fruit trees are experiencing variations in their vegetative cycles (flowering dates on average 7 to 8 days earlier for apple trees and 10 to 11 days for pear trees since the end of the 1980s). Changes have been seen in the behaviour of birds, especially in migration. The Greylag Goose Anser now makes shorter migration journeys causing it to winter in France instead of Spain. Only a few geese were seen during the sixties but there were over 28,000 in January 2011.

## E.2 Expected impacts of climate change

The «Drias, Climate Futures» project, in France's National Climate Change Adaptation Plan (2011-2015), meets an urgent need expressed by all adaptation stakeholders in that it provides easily accessible information and support for supplying impact studies and identifying climate change adaptation measures.

Published in September 2009 the French National Observatory on the Effects of Global Warming (ONERC) report entitled «impacts of climate change, associated costs and adaptation measures» shows that annual costs linked to climate change could reach several billion euros per year for Metropolitan France if no adaptation measures are taken. The majority of adaptation measures are however largely dependent upon regional characteristics and must therefore be defined on a case by case basis at local level. For 2050 and 2100 the report puts forward losses for the agricultural sector, a decline in water resources in zones already under pressure, a sea-level rise, an extension of areas affected by shrinkage and swelling of clay soils and potential saving in energy consumption unless the use of air-conditioning in the residential and transport sectors increases.

### Water

An impact study on all the watersheds in Metropolitan France carried out as part of the Explore 2070 project indicates an almost general decrease in water recharging of between 10 and 25%. Two areas are more severely affected: the Loire Basin with a decrease of 25 to 30% over half its area and South West France with decreases of 30 to 50%. Conversely, winter recharging could increase in some northern basins.

### Heatwaves

Heatwaves could increase greatly to the point that the heatwaves of 2003 and 2006 could become the norm in summer at the end of the 21st century.

### Sea-level rises

The world's sea-level rose about 120 meters over the millennia which followed the end of the last glacial period (about 21,000 years ago) and then

stabilised about 2000 to 3000 years ago. Sea-level indicators show that the world's sea-level did not change much between then and the end of the 19th century. Measuring instruments for observing the current sea-level show that sea-levels began to rise again during the 19th century. Recent estimates indicate that the world sea-level rose at a rate of 1.7 mm per year during the 20th century<sup>24</sup>.

### Vulnerability assessment

On the national scale the population's exposure to climate risk is considered moderate for 30% of municipalities and high for 16% of municipalities. But the regional situation is very varied. With a high risk index for all their municipalities Guadeloupe and Mayotte are the departments most at risk.

The average number of climate risks per municipality is 1.3. Depending on the municipality this number varies between 0 and 5. The vulnerability of a risk is likely to increase with climate change because some events and extreme weather conditions (heatwaves, soil dryness, marine submersion, forest fires) will become more frequent, more widespread and/or more intense. The extent of future risks is strongly linked to development and town and country planning choices.

## E.3 Adaptation

Adaptation policy was set in motion at national level by the Ministry of Ecology at the end of the 1990s particularly under the impetus of the Climate Change Impacts and Management (GICC) research fund. This fund has financed research projects on emerging subjects relating to impacts of climate change and adaptation.

Tackling the intensification of the greenhouse effect and prevention of risks related to global warming were acknowledged as national priorities by a law voted unanimously by Parliament in 2001 (article L229-1 of the French Environmental Code).

Knowledge developed by the research community has enabled the development of a national climate

<sup>24</sup> Planton S. et al, *The climate of France in the 21st century Volume 3, Changes in sea-level, February 2012*

change adaptation strategy in 2006 on the basis of collection set of robust information and analysis.

The French national climate change adaptation plan adopted in 2011 after an extensive consultation process extends this strategy by scheduling operational measures aimed at:

- Public safety and health;
- Prevention of risk inequalities;
- Limiting costs, seizing opportunities and preserving the national heritage.

Adaptation is considered in the context of regional climate, air and energy plans (SCRAE) and also, increasingly, as part of local climate and energy plans (PCET) which are compulsory for local authorities of over 50,000 inhabitants (cf. section C8 for presentation of SCRAE and PCET).

Alongside these strategic planning documents cross-border (mountain ranges, drainage basins, marine basins) and inter-regional (5 large zones identified in Metropolitan France) studies were carried out with the aim of investigating the consistency of global measures (AMICE, ACClimate, Alpine Convention, etc.).

Governance and assessment issues are important subjects for iterative improvement of the adaptation process. Initial studies have revealed some partial elements that can be looked at in more detail in the coming years.

## F. Financial resources and technological transfer

In respect of its commitments (articles 4.3 and 4.5 of the climate convention) France has undertaken to facilitate technological transfers to emerging and developing countries, especially by supplying «new and additional» financial resources. In order to achieve this objective France provides financial aid and technological cooperation through a several of bilateral and multilateral channels, particularly through development aid. France's financing and technological transfer actions operate on several

levels and involve many stakeholders, multilateral institutions, local authorities, businesses and the private sector.

### F.1 Development aid - bilateral cooperation

France is a major player in bilateral development aid within the climate field with a very extensive sphere of influence, a recognised level of expertise and substantial financial commitment. In total, over the period 2009-2011, France has granted over 9 billion euros to activities with a positive shared benefit on the issue of climate change (help with cutting emissions, adaptation or implementation of new policies to tackle climate change) through the French Development Agency (AFD), a key operator of French bilateral development aid. For its financial contribution to tackling climate change over the period 2012-2016 the AFD has committed to a target of 50% of its grants to foreign countries and 30% of grants from PROPARCO, its subsidiary in the private sector. Furthermore, in October 2012 the AFD adopted a new energy strategy which lays down a target commitment of 2 billion euros to renewable energy and energy efficiency projects in developing countries for the next three years. In addition, 45% of commitments of the French Global Environment facility (FFEM), which is strongly inspired by the Global Environment Facility (GEF), for which the FDA provides the secretariat, is for projects with a positive shared benefit for the climate. This French fund has already committed 86 million euros since its creation in 1994.

### F.2 Development aid - multilateral cooperation

Sustainable development and climate are two of the five sectoral priorities for French development aid. For several years France has strengthened its international action in this area and also mobilised large and increasing funds to tackle climate change in developing countries through the main climate funds (Global Environment Facility, the World Bank's Climate Investment Funds, the Montreal Protocol) and is one to the world's 5 biggest contributors to the climate.

France committed 3.2 billion euros of financial resources in multilateral development aid in 2011. This aid was allocated through multilateral development banks, the European Union and the United Nations. France is therefore the 4th largest backer of the world in volume and is in the second rank of G7 countries in terms of share of Gross National Income. It was one of the States behind the creation of the Global Environment Facility, the main multilateral instrument for protection of the global environment. France is the fifth largest contributor to the GEF and is providing funds of 215 million euros over the period 2011-2014 (including participation to less developed countries fund-LDCF - managed by the GEF) which represents an increase of 57% of the French contribution compared with the previous reconstitution (2007-2010). On 30th June 2011 the GEF had financed 784 emission cutting projects in 154 developing countries for a total amount of 3.2 billion dollars since its creation in 1991. Over the period 2011-2014 the GEF has planned to devote a total of 1.35 billion dollars to tackling climate change (150 billion dollars had already been paid out in 2011). France has also contributed 203 million euros to the clean technology funds created in 2008 by the World Bank (which places it in 5th position over all backers).

Moreover, the General Directorate of the Treasury is financing the FASEP (Private Sector Aid and Studies Fund), which helps emerging countries with their development, in the form of donation, for services carried out by French companies (feasibility studies, technical help, pilot projects) linked to infrastructure projects. It also finances the Emerging Countries Reserve (RPE) which grants concessional loans to emerging countries for infrastructure projects (supply of French goods and services).

### **F.3 Technological cooperation**

In addition to bilateral and multilateral channels for public aid for development, France is also involved in many international projects and forums which generate extensive technological cooperation with a large number of stakeholders. This cooperation is intended as a transfer, in the broadest sense

of know-how, methods or tools necessary for implementing low-carbon transition technologies.

Since the fifth French national communication the technological situation has strongly evolved. Low-carbon sectors have been developed and deployed on a large scale especially in the renewable energy sector. More and more countries want to implement these technologies, in the North and in the South, as the number of countries with a renewable energy production target is estimated at 120<sup>25</sup>, half of which are developing countries.

Bilaterally, this cooperation is carried out through work with Africa in particular but also large emerging countries such as Brazil or China. Similarly, French local authorities are very active in technological cooperation and are involved in many projects and initiatives.

Bilaterally, France is developing strategic cooperation with an increasing number of fossil fuel producer and consumer countries in the field of renewable energy and energy efficiency.

In this public policy implementation phase the private sector and decentralised cooperation are playing a particularly important role as operational stakeholders developing the necessary capacities on the ground to support low-carbon projects and supporting these technological transfers. French businesses and local authorities are particularly active in the matter and are developing mature and innovative projects in an increasing number of countries.

**Multinationally,** France's technological cooperation is made through large international energy partnerships such as the International Energy Agency (IEA) and in particular within the IEA's international low-carbon technologies platform set up in October 2010, CEM (Clean Energy Ministerial) or even IPEEC (International Partnership for Energy Efficiency Cooperation). In the wider context of operationalization of the SE4All (Sustainable Energy for All) scheme, the increasing power of the IRENA (International Renewable Energy

<sup>25</sup> REN 21, 2012

Agency), a recent agency with a strong vocation of providing support to countries, to which France is the 6th largest contributor, deserves recognition. Extensive multilateral treaties should also be mentioned. The most important of these is the United Nations Framework Convention on Climate Change (UNFCCC) enabling technological transfer and the sharing of experiences to be supported and speeded up. It created and is in the process of operationalizing a technological mechanism promoting technological transfer to support developing countries in mitigation and adaptation to climate change. The work of the UNEP (United Nations Environment Programme) or the FAO (Food and Agriculture Organisation) also encourages the sharing of experience and useful tools for low-carbon transition.

The thematic spectrum of France's technological transfer has expanded since the last national communication. This sixth French national communication is an opportunity to point out the progress made in terms of exchanges and sharing on frameworks and tools for adaptation to the effects of climate change, even if there is still much to do before this dimension is successfully integrated. France shares its own experience in the planning of adaptation policies. France has participated in several projects including one on the islands of the Indian Ocean, particularly through the ACClimate project which aims to strengthen its Members' capacity to adapt to climate change.

## G. Research and observation

### G.1 Research

French climate research contributes significantly to the advancement of knowledge in many areas: understanding climate mechanisms for refining climate models in order to produce information at relevant scales for the various activities concerned by the impacts (confirmed or potential) of climate change and their management, technological research, which develops measures for adapting to and/or mitigating climate change. All these areas now benefit from a central place in French research

priorities both for long term objectives and for the implementation of relevant short term responses.

### The French national strategy for research and innovation

At the government's initiative, the French Ministry for Higher Education and Research (MSER) has developed a national strategy for research and innovation (S.N.R.I.) which enabled the main research themes to be defined for the period 2009-2012 (including environmental crisis and eco-technologies) as well as five guiding principles for long term research. The theme of «environmental crisis and eco-technologies» are found on the following broad objectives:

- Understanding and modelling climate and biodiversity change with the aid of measuring instruments, especially satellites, and simulation;
- Understanding how living things react to external aggression (toxicology and ecotoxicology) linked to human activities and provide them with greater protection;
- Developing eco-technologies and eco-design to design products and competitive services with low or even no environmental impact throughout their life cycle;
- Ensuring a carbon-less energy future by a balance between research on nuclear and research on renewable energy in order to protect the environment.

The implementation of this strategy was entrusted to the Alliances, including AllEnvi (National Environmental Research Alliance) and Ancre (National Energy Research Coordination Alliance).

### Financial Commitment by the French State

France's financial commitment to climate research can be assessed at 1 billion euros for 2011 and 2012<sup>26</sup>, through all the public aid to the various aspects of climate research. The framework law of 3rd August 2009 on the implementation of the Grenelle Round Table, followed by law of 12th

<sup>26</sup> Source: Cross-department policy document, Climate, MEDDE/DLCEs, 2013

July 2010 on the national commitment to the environment, enabled various financial instruments to be set up including a new tool illustrating the strength of France's commitment to environmental research: the Research Demonstrator Fund. This fund managed by ADEME was given a budget of 325 million euros over the period 2009-2012 and its purpose was to bring new projects linked to new energy technologies to the fore. A very great deal of research effort in the energy field (new technologies, renewable energies, vehicles of the future, etc.) has also been agreed as part of Investissement d'Avenir (Future Investments) (Budget of €3.6 billion).

In energy management a research programme financed by the Ministry of Ecology, Sustainable development and energy and the Ministry for Higher Education and Research on energy in buildings (PREBAT) was set up in 2005 for a period of 5 years. Focused on energy management in buildings this programme deploys its efforts in two directions: modernisation of existing buildings and construction of high performance new buildings. The budget allocated to PREBAT was 6 million euros in 2006, 15 million euros from 2007 to 2010. The French national research agency's (ANR) Sustainable Towns and Buildings programme (2011-2013) which aims to explore the ability of towns and buildings to mutate in order to transform today's environmental burdens into an asset while ensuring economic viability and social cohesion, supports and supplements this programme<sup>27</sup>.

### The structure of French Research

One of the original aspects of the French research system is a very diverse organisation of participants, consisting of university teams, agencies, national research and applied research bodies. The structure of the landscape of Alliances is a force for bringing together the skills of research bodies, universities and schools and creating a dynamic of excellence in France and taking it into Europe through involvement in Shared Planning Initiatives. The AllEnvi alliance, created in 2010,

brings bodies together on the Environment, and the ANCRE alliance on energy.

To stimulate innovation in the climate field France has developed a research system, since 2005, based on a regional structure around competitiveness clusters which bring together businesses, laboratories and training establishments as part of performance contracts with the State and regional authorities. In 2010 it also launched Investissements d'Avenir (Future Investments) to create critical mass and target facilities of excellence. This system is based on the action of the French National Research Agency (ANR) created in 2005 and OSEO-ANVAR<sup>28</sup>. It supplements the joint action of the French Environment and Energy Management Agency (ADEME), the Ministry of Ecology, Sustainable Development and Energy (MEDDE) and the Ministry of Higher Education and Research (MESR).

The large national operators (ANR, ADEME, OSEO, etc.) play a central role in the climate research system. The ANR has launched some thirty calls for projects, selected nearly 1,500 files and committed nearly 540 million euros in credits.<sup>29</sup> It also intervenes as part of calls for projects that contribute to European and global exchanges (ERANET set ups, involvement in Shared Planning Initiatives). The ANR was able to commit 739 million euros in 2012 of which 98 million euros was devoted to climate change research.

ADEME is responsible for managing financial resources from renewable heating development (223 million euros in 2012), waste management and the polluted sites treatment plan funds. It leads programmes on «Sustainable Consumption and Production» and «Sustainable Towns and Regions». ADEME's total budget devoted to «Energy and Climate»<sup>30</sup> for 2012 is estimated at 644.9 million

<sup>27</sup> French national research agency's plan for 2011-2013, 2012 edition

<sup>28</sup> OSEO was integrated in the Public Investment Bank (BPI) on 12/07/2013

<sup>29</sup> NRA Assessment Report – September 2012

<sup>30</sup> According to the framework defined in the Source document: Key data and figures 2009-2012, Activity Report, ADEME, 2013

euros, of which 236 million euros<sup>31</sup> was devoted to research.

Furthermore, on the subject of adaptation, ONERC (French National Observatory on the Effects of Global Warming), created in 2001 through the desire of Parliament and the Government to understand the issues relating to the effects of climate change, was given the task of collecting and disseminating information on risks and making recommendations on adaptation measures to be considered in order to limit the impacts of climate change. The IPCC's focal point in France, it works in a network with scientific bodies. In 2010 the ONERC piloted national consultation on adaptation to climate change and coordinated the preparation of France's first national adaptation plan, which was made public in July 2011. In line with this plan the DRIAS project (Giving access to regional French climate scenarios for the Impact and Adaptation of our Societies and the Environment) received huge support from the MEDDE. It was developed by Météo-France in collaboration with research from the French laboratories (CERFACS, IPSL), in close partnership with users from the regional authorities, the research world, large manufacturing groups or SMEs, design and engineering agencies or associations.

Private research is provided by businesses through their own research organisations. The State supports private research initiatives through 4 main systems:

- The research tax credit (CIR) which aims to stimulate expenditure on R&D by French companies. In 2009 the operation of this driving force for finance was as follows: the rate of tax credit applied to the volume of R&D expenditure was 30% for up to 100 million euros (40% the first year and 35% in the second). After this, businesses benefit from a tax credit of 5% with no upper limit. This credit is managed by OSEO and the budget dedicated to innovation assistance was 569 million euros in 2011.
- Support for competitiveness clusters has enabled

a total of 645 projects to be rolled out since 2005. These projects represent an expenditure of 3.6 billion euros on R&D, mobilising 13,000 researchers and about 1.3 billion euros in public finance (including over €830 million from the French State).

- Support for industrial foundations, following the example of the Building Energy Foundation founded by the four major stakeholders from the construction
- and energy sector (Arcelor, Edf, GDF Suez and Lafarge), has the aim of financially supporting research operations for a minimum of five years, as well as financing the assessment and development of the supported work. It has a budget of 8 million euros, half of which is provided by the French State;
- Support for innovation in small and medium-sized enterprises (SMEs) and very small enterprises through the OSEO agency<sup>32</sup>. New finance for medium-sized enterprises amounts to 300 million euros, thus enabling more than 10 research projects to be selected each year.

## G.2 Systematic Observation

France participates in the Global Climate Observing System (GCOS). This climate observation programme operates under the aegis of the World Meteorological Organisation (WMO, [www.wmo.int/pages/prog/gcos](http://www.wmo.int/pages/prog/gcos)), the International Council for Science (ICSU), the Intergovernmental Oceanographic Commission (IOC) and the United Nations Environmental Programme (UNEP). The purpose of the French national GCOS communication is to verify that the French system enables the climate to be monitored (spatial resolution, temporal frequency, working condition) and complies with specific aspects relating to the Climate Convention (Rio, 1992) and the Kyoto Protocol (1997).

<sup>32</sup> OSEO is a public establishment responsible for supporting innovation and growth of SMEs by simplifying their access to public and private finance. Its activities consist of allocating direct aid to innovation for risk taking linked to the development of innovation programmes with a technological component. It became BPI on 12/07/2013

<sup>31</sup> Source: Key data and figures 2009-2012, Activity Report, ADEME, 2013

### Observation Services

On the national scale, the Observation Services are services approved by the French National Institute of Universal Sciences (INSU) and managed by the Universal Sciences Observatories (OSU).

Since 2010 MESR has developed the concept of SOERE (Observation and Experimentation and Environmental Research Services). The purpose of this initiative is to encourage the creation of a network of multiple agency observation systems and the dissemination of available information. AllEnvi is responsible for their evaluation, organisation, approval and monitoring. The SOEREs are systems supported by one or more financial backers including research bodies and establishments and/or the MESR. The French systematic observation system has therefore improved its organisation since 2010.

**The system is progressive and aims to make existing observation systems permanent.**

### Observation systems

Météo-France occupies a central place in the systematic observation system due to its history, its links with WMO and its location. This body represents France on a number of European and international forums due to its climate observation role. At the same time as managing its networks the establishment does important work in finding and restoring long series of climate data from written archives.

The meteorological observation system managed by Météo-France comprises 6 surface GPS stations in Metropolitan France (daily data is regularly supplied to the world climate centre in Asheville (United States) in the form of CLIMAT messages) and 19 for the Overseas Departments and Territories. In altitude the network includes 9 GUAN stations Overseas. GCOS monitoring principles have been incorporated in the Météo-France quality monitoring system («observation» task).

Over the last few years France has developed the measurement of new variables for the terrestrial area such as the chemistry of rivers for which data

is collected in the SOERE «drainage basin network». Observation of peat bogs is now organised around the measurement of carbon flows and for the development of permafrost (PEAT BOG network). Concerning the chemistry of the atmosphere, RAMCES (French Network of Atmospheric Greenhouse Monitoring Network) developed by the Climate and Environment Science Laboratory (LSCE) and the French Atomic Energy Commission (CNRS) enables the CO<sub>2</sub> balance to be calculated over a region or a continent. The MACC (Monitoring Atmospheric Composition and Change) project following on from GEMS has the objective of building a system for comparison and forecasting of atmospheric pollutants, CO<sub>2</sub> and aerosols. Finally, France is part of the pan European ICOS composite GHG observation project (towers, aeroplanes, satellites) which should enable daily maps of concentrations of CO<sub>2</sub> and other GHGs to be drawn up.

For the oceanic component, its contribution is through the MERCATOR project, with its observational Coriolis component which includes databases from various sensors (buoys, ARGO profilers – EURO-ARGO project, XBT probes, etc.). Finally, France participates in the sea-level observation network GLOSS and in the PIRATA moored arrays in the tropical Atlantic. In the terrestrial domain, France is part of the international Fluxnet programme with 6 CO<sub>2</sub> flow measurement sites in ecosystems, the custodians of which are Meteo-France, CNRS, CEA, etc. Finally, concerning space observation, the French National Centre of Space Study (CNES) has made important commitments in specific response to CEOS (Committee on Earth Observation Satellites) in terms of the implementation of GCOS. In addition, France has invested in the European GMES project which aims to federate and rationalise European Earth observation activities consisting of a collection of thematic services, the first components of which should be progressively put in place between now and 2013.

### Cooperation projects concerning observation

In relation to GCOS in Africa, AMMA's international experience was extended from 2010. AMMA-CATCH, the observation system for long term monitoring

of the impacts of the monsoon in West Africa has been kept. It was initiated by the MESR and receives support from the IRD (French Institute for Development Research) and INSU (French national institute for universal science).

In addition, France has invested in the international MISTRALS programme. Launched in 2008 and expected last until 2020 MISTRALS was spread across the area in 2010. This is an international meta-programme of basic interdisciplinary and systematic research and observations dedicated to understanding how the environment in the Mediterranean Basin operates and develops under the pressure of global human-generated change in order to predict future change. In addition to its academic vocation, MISTRALS is also intended to transform the research objectives and results into concepts and data accessible to decision-makers, regional stakeholders and managers, in order to identify national and transnational needs and to respond to societal, environmental and economic issues for the sustainable development of countries and populations sharing the Mediterranean sphere.

## H. Education, training and raising public awareness

To continue on from the enormous increase in public awareness to the issue of climate challenge in 2007/2008, a wide range of public awareness, information and participation programmes continue to be carried out by all stakeholders involved in meeting this challenge. Climate change has become an unavoidable issue: it circulates through the political classes, mobilises business, citizens, associations, jurists and artists, etc. Initiatives are taken in schools, businesses, universities and the media. Local action is taken by associations and local authorities involving young people, citizens and families, etc. The largest number of people, in the whole range of situations of daily life, must be given the keys to understanding the issues so that each person can act according to his or her own level and abilities. And even be able to create new

prospects for our world. New development from this mobilisation: cutting emissions is not the sole purpose of this mobilisation and a special place is now reserved for the challenge of adapting to the impacts of climate change.

### State of public opinion

Although several surveys agree that the French people are aware of climate change and are interested in questions relating to energy, it must be acknowledged that in the current economic crisis the French people are concerned first and foremost by socio-economic problems while still reserving a degree of attention to the quality of their environment. Personal concerns such as health, safety, purchasing power and quality therefore predominate, pushing collective environmental concerns into the background.

ADEME conducts an annual opinion poll. Recent surveys<sup>33</sup> have shown:

- From a list of subjects, pollution, which was given top priority in 2006, fell to third position in 2012 (behind unemployment and social inequality);
- The years 2010 and 2011 were marked by a decline in French people's interest in climate issues and relative defiance towards scientific experts;
- Nevertheless, in 2012 there was a reversal in this trend: 41% of people interviewed considered that not enough is said about global warming compared with 48% in 2011.

### H.1 Education-Training

In this context, sustainable development education assumes a special place. It brings together a variety of complementary actions ranging from raising public awareness across the board to training in higher education or continuous professional development. Education aims to produce subject specialists in order to define a set of cross-curricular skills to be achieved by pupils in response to environmental challenges. Another shared outcome: enabling individual, group and

<sup>33</sup> ADEME, *ADEME and you, Strategy and Studies n° 35, Dec. 2012*

professional activities to support change in society. Environmental and sustainable development education (EEDD) has been on the timetable in French schools since 2004. The key concept of sustainable development is given priority over the environment, according to an international trend of applying this notion to the design of educational systems, such as the United Nations decade for education for sustainable development (2005/2014). Since 2008 science, humanist culture and geography programmes in primary schools have included sustainable development concepts as a basis for pupils to tackle «protection of the environment». Since 2009 climate and energy have been introduced in secondary schools. The theme of climate change is also enjoying success in higher education establishments. But it is in the field of training above all that development is significant. In order for France to have competent professionals to ensure the energy transition the President wants, numerous training courses have come into being so that building, energy, agriculture and town and country planning professionals can acquire the necessary new skills to steer their trade in a green direction. They also provide conversion courses for employees from sectors experiencing economic problems.

## **H.2 Raising awareness**

### **Information campaign**

Recognising the French people's strong motivation «to do something» provided they have concrete information on the type of action to take and in the light of the good results of the first part of the campaign in 2008 and 2011, the French government relaunched the national energy management and climate change awareness campaign, but with more emphasis on tax benefits such as tax credits. A number of regional versions have appeared on the subject, also promoting incentives for economic and regional stakeholders. This new campaign has strengthened the crucial role played by Energy Information Points in getting the public to actually take action for the first time. Energy labelling has been extended, even going as far as an experimental phase of environmental labelling on consumer products. In the case of transport

services, businesses are required to tell their customers and users how much CO<sub>2</sub> is emitted.

### **Public participation, civil society, access to information**

In view of the complex nature of the climate challenge and the considerable issues it raises for society, the principle of public consultation and participation has always guided the development of French national mitigation or adaptation policies. The development of the French National Adaptation Plan was subject to an enormous consultation exercise in 2010 which resulted in over 200 recommendations which were used as a basis for its creation. The year 2012 saw the launch of a new way: a law encouraging public participation by strengthening public involvement in decision-making when decisions affecting the environment was voted on, as provided by the Environmental Charter. In the same vein, the French President's desired energy transition began in 2013 with an enormous national debate involving the whole of civil society. This debate prompted all economic, social and individual stakeholders to take up the subject. Non-governmental organisations with a wide variety of outlooks such as the environment, science and trade unionism have become key intermediaries for reinforcing messages and directly involving people. All these stakeholders now act by carrying out greenhouse gas assessments before putting their own plans into action.

Numerous sources of scientific information are available to help these stakeholders understand the physical phenomenon of climate change in a way that is accessible to the largest number of people. French national mitigation and adaptation measures and policies are the subject of transparent debates and implementation monitoring.

Consequently, climate change is everywhere. The physical phenomenon has become a social phenomenon. While it continues to be relayed by the traditional media, but more moderately, the social networks constitute a new intermediary and source of information for an increasingly important subject. With books, films, exhibitions, theatre, video games, Internet games, etc. climate change

now comes in many forms. New developments: the adaptation section is getting more coverage and the tone is changing. After the catastrophic anxiety-inducing predictions humour is a new weapon for championing the cause of the climate challenge. Its off-centre stance makes an original impression.

### **H.3 Cooperation**

Due to its experience at national and regional level France is also acting at international level, through cooperation mainly with all French-speaking countries and in order to provide expertise in the field of information and training on the climate challenge. This cooperation takes the form of training workshops on key aspects of this challenge or providing French translations of essential information for understanding the challenge and international discussions on the subject. In particular, France helped to strengthen the capacity of the government of the Maldives by organising a training session on the French national inventory system in 2010. It also participated in and supported training on reducing the use of fuel and limiting deforestation organised by the NGO Geres in Benin in November 2012. The MEDDE plans to support the second part of this training in 2013.

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# Country-specific conditions

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## A. Institutions

### A.1 France is a member of the European Union and a decentralised Republic.

France is a constitutional republic, “indivisible, secular, democratic and social” (article 1 of the French Constitution of 4th October 1958) with a parliamentary system.

The President of the Republic is elected for 5 years by direct universal suffrage. He appoints the Prime Minister and, on the Prime Minister’s recommendation, the members of the Government. The President of the Republic presides over the Council of Ministers and promulgates Acts of Parliament. The Prime Minister directs the actions of the Government, which determines and conducts the policies of the Nation. He is accountable to the two houses of Parliament: the National Assembly, to which 577 MPs are elected by direct universal suffrage for 5 years, and the Senate, which has 348 senators elected by direct universal suffrage for 6 years.

In the constitutional review of 28th March 2003 the fact that the organisation of the Republic is decentralised was added to article 1 of the Constitution, thus marking a new stage in the process of decentralisation. This development was also accompanied by a growing deconcentration of Government services to the regions and departments. From 2009 and 2010 deconcentrated services have been subjected to thorough reorganisation as part of a reform of the whole of French territorial government. This reform was intended to anchor decentralisation and improve the performance of the territories in two areas:

- Simplifying and reducing territorial architecture,
- Clarifying skills and controlling funding.

The main administrative divisions in France are the 26 regions (22 of which are in Metropolitan France), the 101 departments (5 of which are Overseas) and the arrondissements. These arrondissements are subdivided into cantons (for the electoral colleges) or municipalities (36,681<sup>1</sup>) for local territorial government.

<sup>1</sup> Source: [http://www.collectivites-locales.gouv.fr/files/files/chiffrescles\\_2013.pdf](http://www.collectivites-locales.gouv.fr/files/files/chiffrescles_2013.pdf)

The Corsica region (which consists of two departments) has special territorial collectivity status.

The Overseas territorial collectivities consist of:

- Four Overseas departments and regions (DROM) in the Caribbean (Guadeloupe, Martinique and Guyana) and in the southern Indian Ocean (Réunion);
- Mayotte, which acquired department status on 31st March 2011 and which exercises the powers of an Overseas department and region;
- The collectivities of Saint-Barthélemy, Saint-Martin, Saint-Pierre-et-Miquelon in the Atlantic Ocean and French Polynesia and the Wallis and Futuna Islands in the Pacific Ocean;
- New Caledonia which has specific status as a sovereign territorial government and traditional government;
- The French Southern and Antarctic Territories (TAAF), Clipperton and the Scattered Islands.

Inhabitants of the Overseas territorial collectivities are European citizens. However, only Guadeloupe, Martinique, Guyana, Réunion and Saint-Martin have the status of EU Outermost Regions. Mayotte is expected to achieve EU Outermost Region status by 1st January 2014.

France’s emissions perimeter for the United Nations Framework Convention on Climate Change includes Metropolitan France and all the Overseas collectivities, but only those with EU Outermost Region status are considered in the emissions perimeter under the Kyoto Protocol.

### A.2 A country rising to the climate change challenge

#### Overview of the environmental issues

In 2004 France adopted its Environmental Charter, article 1 of which states that: “Everyone has the right to live in a stable environment which respects health”. Since the constitutional reform of 1st March 2005 the Preamble of the Constitution makes explicit reference to this charter which emphasises the need to promote sustainable development as part of public policy.



Source: photographic documentation

The French national sustainable development strategy 2010-2013 (SNDD), adopted on 27th July 2010 proposes a common architecture for all national stakeholders, both public and private, to help them to structure their own sustainable development projects around strategic choices and indicators that have been the subject of broad consensus.

The aim of this document is to ensure France's European and international commitments and national, sector and cross-sector, policies are consistent and complementary in order to develop a robust low-carbon economy that meets the challenges of fairness. A new national strategy which will now be called the national strategy for ecological transition is in preparation during 2013 and scheduled to come into effect on 1st January 2014. While the French national strategy on sustainable development consists of nine actions the new strategy concentrates on four major challenges including combatting climate change and adapting to its impacts. It is structured around nine key areas with particular emphasis on the

notion of a low-carbon economy, the development of new economic and financial models, the mobilisation of stakeholders, education, training and awareness raising.

Since 2012 environmental conferences have become a new annual meeting place for all stakeholders (NGOs, trade unions, employer organisations, local authorities, the State) with greater participation by members of parliament. One of the first projects after the conference in September 2012 was the launching of a debate on energy transition. The aim is to promote frugality and efficiency and also to develop renewable energies. The debate, which was completed in July 2013, took place across the whole of France. It will act as a framework for investments to be made over the coming years through the energy framework law to be adopted at the end of it.

### Objectives and instruments in the field of climate change

The fight against climate change was already part of the framework law of 13th July 2005 setting the directions of energy policy. The need for a four or five-fold cut in emissions in developed countries as part of a target of halving global emissions, had already been asserted together with a target of cutting national emissions by an average of 3% per year. The law also provided for the preparation of a Climate Plan, updated every two years, presenting all the national actions implemented to combat climate change.

This target was reaffirmed in the framework law of 3rd August 2009 on the implementation of the Grenelle Environmental Round Table. Priority was given to reducing the energy consumption of buildings and reducing greenhouse gas emissions from the transport and energy sectors. In particular France set itself the target of cutting emissions from the transport sector back to the 1990 level by 2020. Measures aimed at involving all stakeholders have been adopted, such as the regional climate, air and energy plans and requiring businesses and national and local governments to produce greenhouse gas emission reports. Details of the planned measures were set out in the law of 12th July 2010 on the national environment commitment.

Irrespective of the magnitude of the mitigation measures put in place the fact that climate change will happen anyway is justification for making a simultaneous commitment to resolute adaptation actions. Following the national adaptation strategy published in 2007 France adopted its first national plan for adaptation to climate change in 2011, consisting of 84 actions containing 240 measures. This plan is scheduled to be implemented over the period 2011 to 2015.

Concerning national commitment to reducing its greenhouse gas emissions, France should: On one hand, as part of the Kyoto Protocol, stabilise its emissions between 2008 and 2012 at the level measured in 1990, and on the other hand, contribute to the European Climate and

Energy Package which should bring about a 20% reduction in EU greenhouse gas emissions from 1990 levels.

Concerning the European target, the main greenhouse gas emitting installations are subject to an emissions trading system (ETS) in which allocations are being cut by 21% between 2005 and 2020. Concerning the other emissions, France has a target of reducing greenhouse gas emissions from sectors outside the emissions trading system by 14% by 2020 from 2005 levels (transport, housing, agriculture, waste treatment sectors, small industrial plants, etc.)

International commitments are on the way to being held or even exceeded, thanks in particular to the measures assembled in France's Climate Plan and presented in the "monitoring mechanism" report submitted to the European Commission in March 2013, and also in part due to the fact that economic growth has been low in recent years.

At the European level discussions on the targets to be set for 2030 in relation to climate and energy began with the publication of the European Commission's Green Paper in March 2013. In this respect, France is in favour of a target of cutting greenhouse gas emissions in Europe by 40% in 2030 and then by 60% in 2040.

In terms of international climate negotiations France wants to continue to make a full contribution. Along with the other European Member States and Australia it has committed to a second period of the Kyoto Protocol covering the period 2013-2020. Signed in Doha, Qatar, in November 2012, these commitments are currently in the process of ratification. France has now presented its bid to organise the 2015 Conference of Parties to the United Nations Framework Convention on Climate Change, which aims to reach a legally binding agreement for all States for the period from 2020.

### A network of public stakeholders in the fight against climate change

The French Ministry of Ecology, Sustainable Development and Energy (MEDDE) manages most

of the tools for combatting climate change. Its aim is to respond to the environmental and climate issues of the 21st century. Other ministries are also making an essential contribution, in particular the Ministry of Higher Education and Research, the Ministry of Industrial Renewal, the Ministry of Agriculture, Food and Forestry and the Ministry of Foreign Affairs.

The French Environment and Energy Management Agency (ADEME), under supervision of the ministries in charge of the environment, energy and research, the French National Research Agency (ANR), under supervision of the Ministry of Higher Education and Research, the National Housing Agency (ANAH), under supervision of the ministries in charge of housing and finance, the National Forests Office (ONF) under supervision of the Ministry of Agriculture, Food and Forestry are also playing a major role in the implementation of this policy.

Coordination and organisation of the policy to combat climate change fall under the responsibility of the General Directorate for Energy and Climate. The Ministry of Foreign Affairs (MAE) and the Department of European and International Affairs of the Ministry of Ecology are associated with European and international climate negotiations. The National Observatory for the Effects of Global Warming (ONERC), set up by the French Parliament on 21st February 2001, is tasked with collecting and disseminating information on global warming and extreme weather phenomena. It is attached to the General Directorate for Energy and Climate.

At international level a climate ambassador coordinates the actions of France and the various services. The French Development Agency is also involved as part of its "climate strategy" (see chapter VII). At local level the regional and department prefects are responsible for implementing these policies, especially in the context of new "environment and sustainable development" skill clusters, relying on local strategy.

At the territorial level, local authorities take over from national policy relying in particular on their local or regional energy agencies and are

encouraged to define real local strategies through Territorial Climate Plans.

## B. Demography

### B.1 Demographic dynamics

On 1st January 2013 the population of Metropolitan France and its overseas departments was 65.8 million (63.7 million in Metropolitan France and 2.1 million in the Overseas departments).

Between 1st January 2009 and 1st January 2013 the population increased by 1.3 million, i.e. an average annual increase of 0.49% with a slowdown in 2012 due to one of the lowest natural increases of the decade (positive increase of 251,000 with 822,000 live births and 571,000 deaths).

In 2012 the period fertility indicator was 2.01 children per woman. It has remained at over 2 since 2008, after increasing to a large extent since 2002. It is the highest rate in the European Union behind Ireland (2.05) and in front of the United Kingdom (1.97).

Life expectancy at birth in 2012 was 84.8 years for women and 78.4 years for men. Since the start of the 2000s life expectancy has increased by 3 years for men compared with 1.9 for women.

On 1st January 2013 24.7% of the French population was under twenty years of age, while 57.8% of French people were aged between 20 and 64. 26.5% of the population is over 65 years old, with 9.0% of these being over 75.

France is the second most populated country in the European Union with 13% of the EU's population, behind Germany (16.2% of the European population).

The table below shows how the demographic situation of Metropolitan France and the Overseas Departments has changed since 1990. Over the whole period the population has increased by 13.1%.

**Table 1: change in the demographic situation in thousands of people (Metropolitan France and Overseas Departments)**

	1990	1995	2000	2005	2009	2010	2011 (p)	2012 (p)	2013 (p)
Population on 1 <sup>st</sup> January (in 1000s)	57,996	59,281	60,508	62,731	64,305	64,613	64,949	65,281	65,586

(p) provisional results at the end of 2012

Source: INSEE (French national institute of statistics and economic studies)

The number of households grew much faster with 27.5 million households in 2009 compared with 21.9 million households in 1990, i.e. an increase of 25.5%. A third of households in 2009 comprised a single person, another third two people and the final third three or more people. Table 2 shows the change in the average number of people per household between 1968 and 2009.

**Table 2: change in household size**

	1968	1975	1982	1990	1999	2009
Average number of inhabitants per main residence	3.1	2.9	2.7	2.6	2.4	2.3

Source Insee

The growth in the number of one-person households is partly explained by changes in the way people cohabit. These changes occur mainly in the under 60s and are related to greater fragility of marriages. Thus, fewer people between the ages 30 and 59 lived as a couple in 2009 than in 1999 (down 4 points) and more often alone (up 3 points). One-parent families are slightly more numerous (21% of families with dependent children, i.e. up 4 points in 10 years). The increase in one-person households is also explained by an ageing population. After the age of 60 the proportion of people living as a couple increases with each age group as life expectancy increases but the proportion of people aged 60 or more living alone is increasing, connected with the decline in cohabitation between generations.

This increase in the number of households has a direct influence on housing needs and energy consumption by homes and transport.

The current changes are likely to continue over the course of the coming decades. If recent demographic trends are maintained the average annual growth would thus be an increase of 0.43% between 2010 and 2030 and 0.35% between 2010 and 2050<sup>2</sup>. Metropolitan France would have a population of 68.5 million in 2030 and 72.3 million in 2050 (i.e. 8.6 million more than on 1st January 2013). The proportion of people aged 60 or over would increase significantly, reaching 32% in 2050. The number of households could increase by 235,000 per year between now and 2030 and an average of 200,000 per year between now and 2050, to reach 31.9 million in 2030 and 35.2 million in 2050 respectively. The average number of people per household would be no more than 2.1 in 2030 and 2.0 in 2050.

## B.2 Territorial distribution of the population: urban dynamic

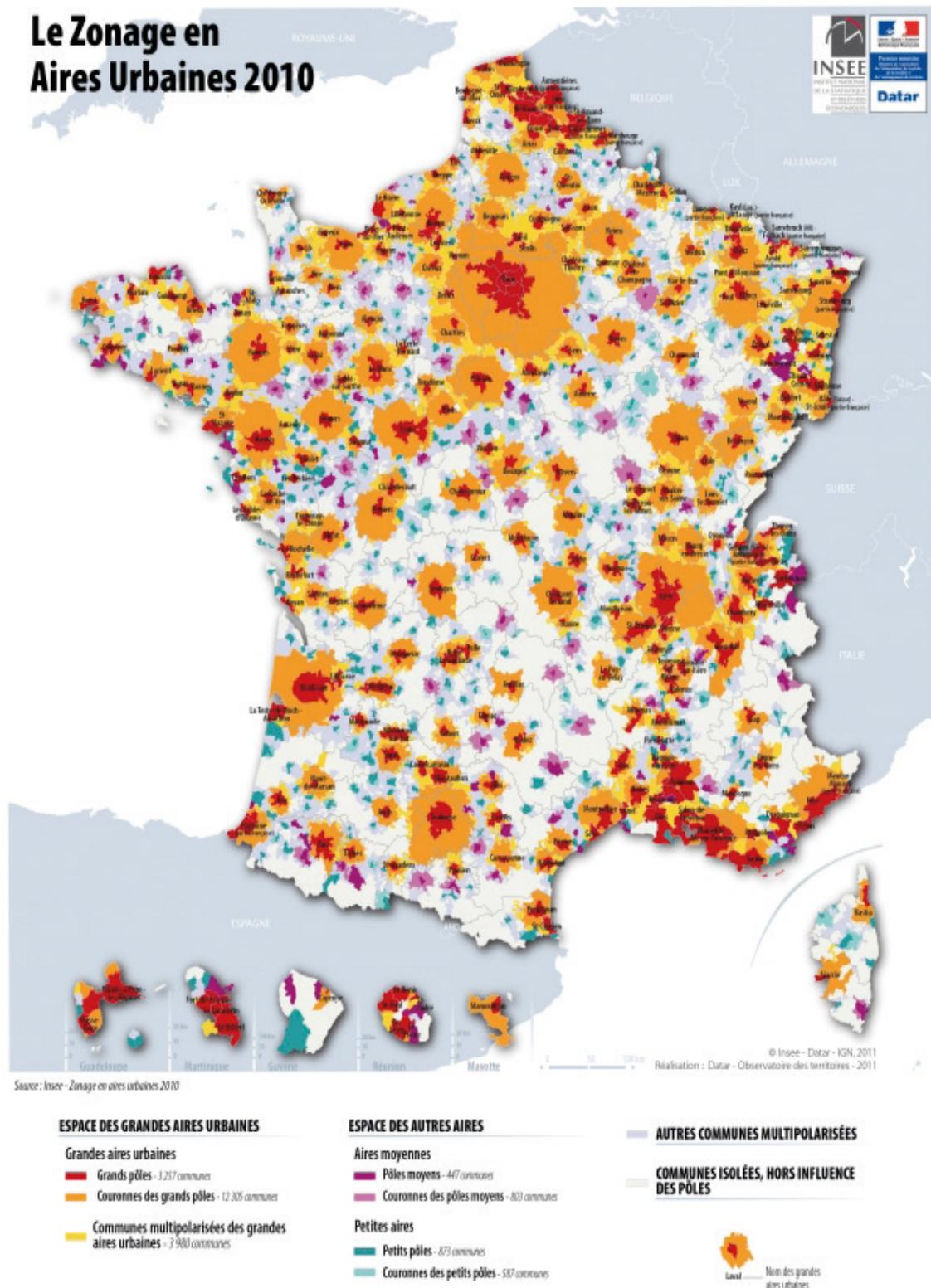
France is the largest of the 28 European Union countries in area, and second largest in population, behind Germany (see above). Of the six most populated EU States (Germany, France, the United

<sup>2</sup> This projection is based on a scenario which presupposes that recent demographic trends are maintained: in this scenario the number of children per woman is 1.95, net migration is 100,000 additional people per year and life expectancy increases at the rate observed in the past.

Kingdom, Italy, Spain and Poland) France has the 5th highest density with 113 people per km<sup>2</sup>, behind the United Kingdom (257 people per km<sup>2</sup>), Germany (229), Italy (201), Poland (123) and in

front of Spain (92). The presence of areas of very low density and a great diversity in types of land use have the potential of making French territories centres of attraction in Europe.

Figure 4: urban spheres of influence - zoning in urban areas 2010



In 2010 towns occupied 22% of the land area and housed 44.1 million people, i.e. 69% of the population. The main reason for this demographic increase is the absorption of former rural municipalities into urban areas. Between 1999 and 2010 1,368 municipalities changed from being rural areas to being urban areas, usually by being incorporated into a town. In addition, 231 rural municipalities reached the threshold of 2,000 inhabitants and therefore became urban. Whether through the expansion of existing built-up areas or the appearance of new isolated towns, the greatest increase in area has been in small urban units. These alone account for more than half of the increase in urban area, while only 16% of the urban population live in them. The greatest increase of urban areas has thus been seen in the part of the urban space with the lowest density and more particularly in the form of multi-municipality urban units.

The Paris conurbation with 10.3 million people distributed over 412 municipalities remains by far the largest of the urban units in France. A long way behind Paris come Marseilles - Aix-en Provence and Lyon with populations of over 1.5 million each. Metropolitan France now has 28 urban units of between 200,000 and one million inhabitants. The very large conurbations are growing more by extending their perimeter than by increasing their population density.

The influence of towns does not stop at the edge of large urban areas. Towns are centres of economic activity bringing in a number of workers from the surrounding area on a daily basis. In 2010 95% of the French population were living within the sphere of influence of a town. In the main these are people who live within the spheres of influence, areas of intensive exchange between places of work and places of residence.

## C. Geography

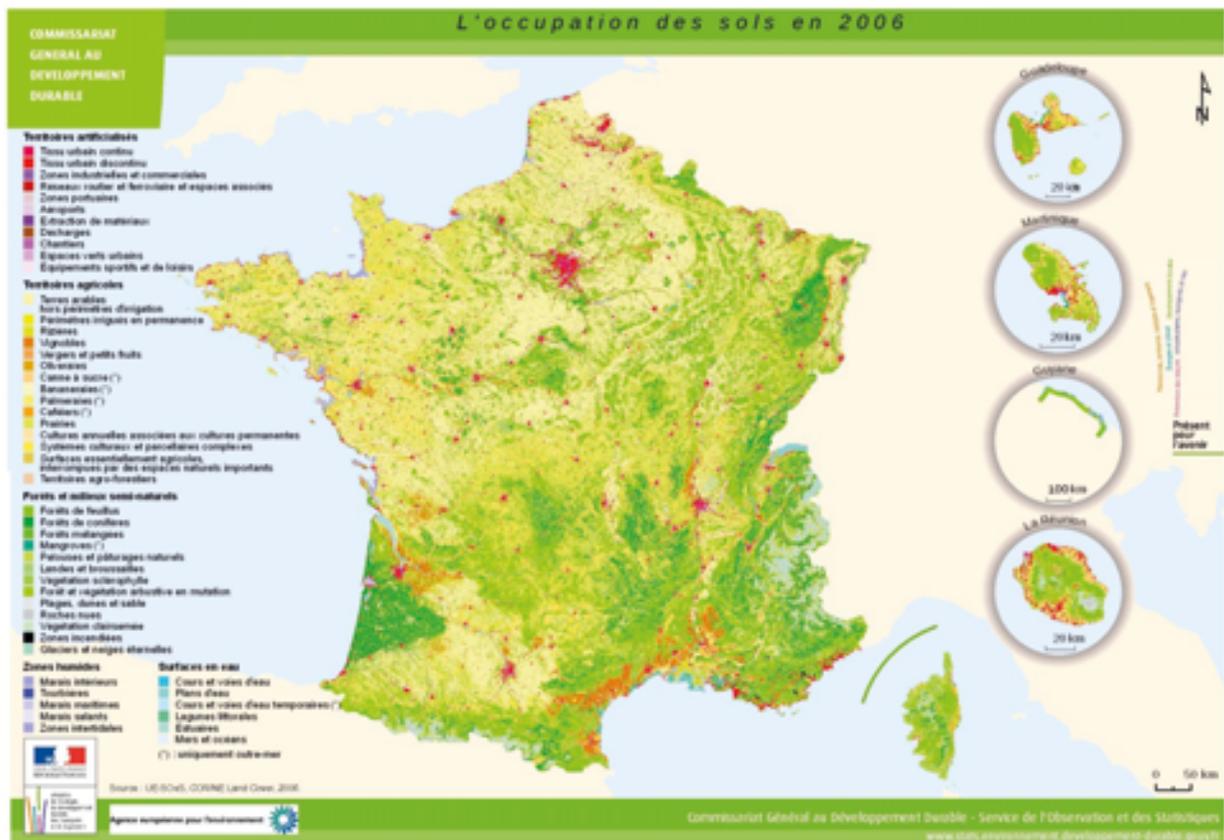
Metropolitan France is the largest EU country in area (550,000 km<sup>2</sup>) (about 13% of the area of the European Union). Situated between the Atlantic and the Mediterranean, between latitudes 41 °N and 51 °N, France has a coastline of about 3,200 km. A country of average altitude, where plains and hills occupy two thirds of the territory, it nevertheless has two mountainous barriers, to the East and to the South: the Alps and the Pyrenees. Mont Blanc (4,810 m), the highest point in France, is situated in the Alps, on the border with Italy. The Massif Central, in the middle of the country, disperses water into the four main drainage basins: the Seine to the north, the Loire to the north-west, the Rhône to the east and the Garonne to the south-west.

Agricultural land (cultivated and permanently under grass) occupies 51% of the area of mainland France. Natural areas (woodland, moorland, bare earth, wetlands and water) account for 40% and artificial landscapes 9% (built landscapes, covered or stabilised soils, other artificial landscapes)<sup>3</sup>.

The figure below corresponds to available data in the context of the CORINE Land Cover geographical database produced as part of the European environmental information coordination programme.

<sup>3</sup> Source: Teruti-Lucas land use survey,

Figure 5: land use in 2006



Source: UE-SOeS – Land Cover 2006

## D. Climate

Metropolitan France has a temperate climate, exposed to three main climatic influences: oceanic in the west, continental in the centre and the east and Mediterranean in the south. The oceanic climate is on the western side: temperature differences between summer and winter are not particularly great. The continental climate predominates in the east of France: winters are cold and summers hot, with frequent storms. The South-East is characterised by a Mediterranean climate: warm, dry summers, mild winters and abundant rainfall in spring and autumn.

The boundary between these climate zones is changing, under the influence of global warming,

in favour of the Mediterranean climate zone which is moving northwards. In the lowlands, the average annual temperature of France ranges from 9.5 °C in the North-East to 15.5 °C on the Mediterranean coast. Between winter and summer the temperature ranges from 9 °C on the coast west and north of Finistere to 19 °C in Alsace or in those alpine valleys most “sheltered” from oceanic influences. French Overseas territories are subject to contrasting climates. Most of the overseas lands are in tropical or equatorial regions (Caribbean, South America, the Indian Ocean, Polynesia, etc.). The others are in harsh cold climates (Saint-Pierre-et-Miquelon, the Southern and Antarctic Territories). Due to its geographical situation, Overseas France is more exposed to natural hazards, such as cyclones, earthquakes and volcanic eruptions than Metropolitan France.

### Climate report for the years 2009 to 2013

With an average temperature 0.8 °C above normal 2009 was Metropolitan France's 9th warmest year since 1900. There has been a shortage of rainfall across the entire country, with annual totals sometimes only 70 to 80% of normal values. Hours of sunshine in France were sometimes above average, slightly more significantly over the western than the eastern half of the country. 2009 was also marked by several meteorological events including an episode of very high temperatures in August.

With an annual temperature 0.3 °C below the reference average for 1971-2000, 2010 was the coldest year in Metropolitan France for the last two decades, alongside 1996. To find a colder year we have to go back to 1987, with an average temperature 0.5 °C below normal. These low temperatures affected the whole of northern Europe. The amount of water collected in 2010 over the country as a whole was slightly down but this global diagnostic masks certain disparities. Total hours of sunshine for the year were close to the average for the eastern half of the country and generally above average over the western half. Several exceptional meteorological events occurred in 2010, including Windstorm Xynthia on 27th and 28th February, accompanied by exceptional storm surges causing serious flooding.

2011 was the hottest year in mainland France since 1900. With an average annual temperature 1.5 °C higher than usual 2011 supplanted 2003 which previously held the record with a temperature of 1.3 °C above normal. With an exceptionally dry spring (the driest since at least 1959) and an equally dry autumn 2011 was one of the driest years France has known in the last fifty years.

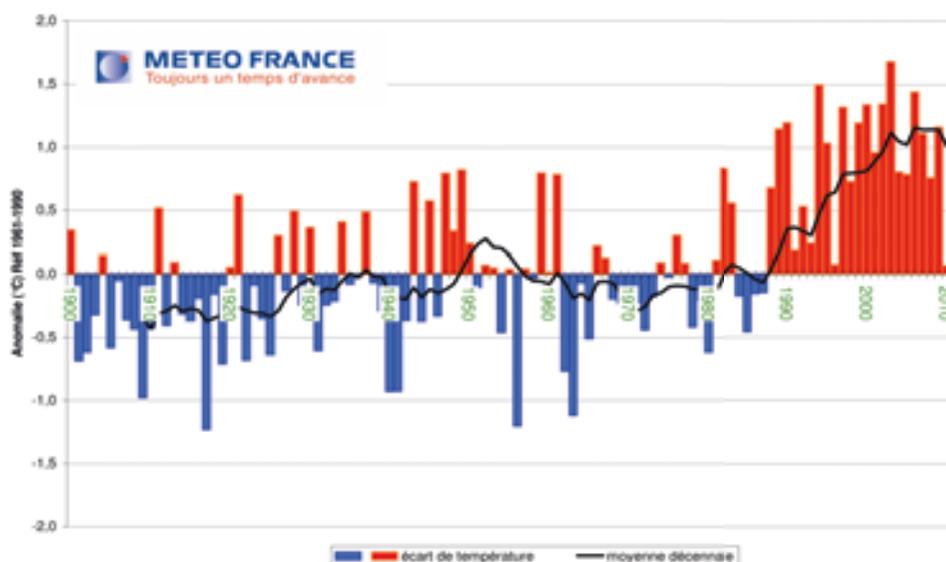
Across the whole of France the temperature, precipitation and hours of sunshine in 2012 were close to normal. Rainfall across the whole country conformed to average values but it was marked by considerable regional disparities. An exceptional cold spell affected the whole country at the start of February.

After a dull winter France experienced a particularly turbulent, cold and sunless spring right through till July in 2013. This was the coldest spring since 1987 and one of the wettest since 1959. Throughout the season across the country precipitation, generally more frequent than usual, was also 30% more than usual. Spring sunshine was less than usual across the whole of France and to a considerable extent over a large part of the north-east where the deficiency was often over 30%.

The climate severity index, used in energy consumption calculations in order to extract the effect of climate, was particularly high in 2010 (with 1.13, a value unequalled since 1985, thus characterising a very cold year) and particularly low in 2011 (0.81 i.e. the lowest value for over 40 years). In 2012 the climate severity index was 0.97. These very great differences had a significant impact on national greenhouse gas emissions in view of the resulting variations in energy consumption.

The annual temperature differences compared with the average temperatures recorded over the period 1961-1991 is shown on the figure below. Detailed results on observed climatic changes and on the expected impacts of climate change are presented in chapter VI.

**Figure 6: annual temperature in France since 1900**



Source: Météo-France

## E. Economy

After a historic recession in the eurozone in 2009 (with GDP falling by 4.3%), activity recovered in 2010 without returning to its 2008 level however. Despite a growth of GDP (+1.5% compared with +1.9% in 2010), 2011 was marked by a very difficult economic and financial environment. The financial and economic crisis in the eurozone turned into a sovereign debt crisis with serious consequences in terms of confidence. From the middle of 2011 the European economies have suffered a hardening of credit conditions resulting from financial tensions in several countries and intensification of budgetary consolidation measures implemented to restore the credibility of Member States. In 2012 the activity contracted by -0.5% in the eurozone.

France did not escape the serious deterioration of the economic situation in the Euro zone in 2012 and

as a result activity stagnated. GDP was stable, after growing by 2.0% in 2011 and 1.7% in 2010. The net activity slowdown which is shown as an annual average in fact dates from the spring of 2011: after a sharp increase at the beginning of 2011 activity has since levelled out. The stability of GDP covers a net decline in the activity of French industry (-2.2% for production after +2.0%) and a slight increase in that of goods and services (+0.3% for production after +2.8%).

In 2012 household consumption fell by 0.4% after an increase of 0.5% in 2011. Investment also declined by 1.2% after a 2.9% increase in 2011. Consumer prices rose +2.0% in 2012, almost the same as in 2011 (+2.1%). These averages mask the marked profile of inflation, which continually turned down over the course of the year, although it had significantly increased in 2011.

The public deficit fell to 4.8% of GDP, after 5.3% in 2011: it is falling thanks to budgetary consolidation measures taking effect in 2012 in spite of the spontaneous widening of the public deficit caused by the deterioration of the economic situation. Thus, mandatory levies increase more than spending. The burden of the public debt as a share of GDP increased to 90.2% at the end of 2012 compared with 86.0% of GDP at the end of 2011 and 82.3% at the end of 2010. The rate of mandatory deductions was 45.0% of GDP in 2012, up by 1.2 points compared with 2011.

In terms of external trade the trade deficit on goods and services fell to 45 billion Euros, i.e. 2.2% of GDP, after 59 billion Euros in 2011, i.e. 3.0% of GDP. Exports increased by 2.4% in volume in 2012, after 5.4% in 2011 and +9.6% in 2010. Imports which had increased by 8.9% in 2010 and 4.9% in 2011, slowed and fell by 1.1% in 2012 due to low domestic demand.

In the first quarter of 2013 GDP fell again by volume: - 0.2% after - 0.2% in the 4th quarter of 2012. Household consumer spending was also stable at the start of 2013 (- 0.1% after 0.0%). The foreign trade balance contributed negatively to the growth of GDP (- 0.2%) with imports almost stable (+ 0.1% after - 1.3%) and exports falling (- 0.5%).

## E.1 Transport

At the end of 2011 the French road network measured over 1,050,000 kilometres (including 11,400 km of motorway) i.e. about 190 km per every 100 km<sup>2</sup>. The rail network totalled 30,936 km, i.e. 5.7 km for every 100 km<sup>2</sup>, with about 2,000 km of high speed line. The used waterway network represents about 5,000 km

### Freight

The inland transport of goods, all forms of transport combined, was 342 billion tonne-kilometres in 2012. This level is 15.3% below the maximum extent reached in 2007. After a serious decline in 2009 (-13.5%) inland transport of goods recovered in 2010 and 2011 (+3.9% and +2.4%) but fell again in 2012 (-4.4%). This reduction occurred after a period of considerable growth (+ 59.5% between 1990 and 2007) and the 2012 level remains 35.1% above that of 1990.

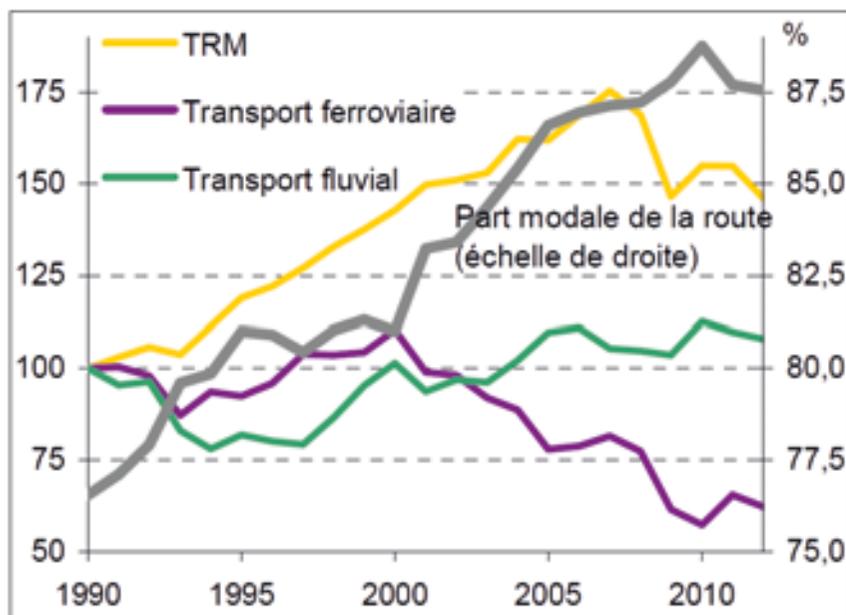
The various modes of transport have experienced very different changes. Road haulage largely predominates with an 88.3% modal share in 2012 compared with 9.4% for rail transport and 2.3% for river transport (these shares were 76.5%, 20.6% and 2.8% respectively in 1990).

**Table 3: inland transport of goods (in billion tonne-kilometres)**

	1990	2000	2005	2007	2008	2009	2010	2011	2012
<b>Road</b>	19.4	28.3	32.6	35.4	34.1	29.7	31.2	31.6	30.2
<b>Railways</b>	5.2	5.8	4.1	4.3	4.0	3.2	3.0	3.4	3.2
<b>Inland waterways</b>	0.7	0.7	0.8	0.8	0.8	0.7	0.8	0.8	0.8
<b>Total</b>	25.3	34.7	37.5	40.4	38.9	33.6	35.0	35.8	34.2

Source: SOeS, Transport counts

**Figure 7: changes in inland transport by mode (yellow line for road, purple line for railways and green line for inland waterways) and road transport modal share (on the right axis)**



Source: SOeS, transport counts (2012 counts, initial results p. 21)

### Passenger Transport

In 2012 total passenger transport, all modes combined, was 984.3 billion passenger-kilometres, i.e. an increase of 0.3% compared with 2011. After 2007 there was a slight drop in traffic (- 0.3%) in 2008 marked by a reduction in the use of private cars (- 1.5%) and a 6.4% increase in public transport use other than air travel (bus, coach, tram, underground and railways). Between 2008 and 2012 car traffic increased by 1.7%, overtaking its previous peak in 2007, and public transport increased by 4.5%.

After a period of considerable growth up to the start of the 2000s the increase in car traffic has been more moderate. Rail passenger transport has increased significantly since the mid 1990s thanks

to the development of high speed lines and the transfer of regional transport management to the regions. Private cars are still the dominant form of travel, with an 84.6% modal share in 2012 compared with 13.8% for public transport other than air and 1.7% for inland air travel (these shares were 83.0%, 15.4% and 1.5% respectively in 1990).

1.9 million vehicles were registered in 2012. At 72.4% the proportion of diesel cars among new registrations continues to increase. Electric and hybrid vehicle ownership is increasing, reaching 1.8 % of registrations (compared with 0.8% in 2011). Average CO<sub>2</sub> emissions per km from new cars continues to fall (down 3.6 g/km, or - 2.9%), reaching 124.1 g/km in 2012.

**Table 4: inland passenger transport (in billion passenger-kilometres)**

	1990	2000	2005	2007	2008	2009	2010	2011	2012
Passenger cars	61.7	75.4	80.1	81.2	80.0	80.3	81.1	81.3	81.4
Buses, coaches	4.1	4.2	4.2	4.5	4.8	4.9	5.0	5.1	5.2
Railways	7.4	8.1	9.0	9.5	10.1	10.0	10.1	10.4	10.4
Air transport	1.1	1.5	1.3	1.3	1.3	1.3	1.3	1.3	1.4
<b>Total</b>	<b>74.3</b>	<b>89.2</b>	<b>94.6</b>	<b>96.6</b>	<b>96.3</b>	<b>96.5</b>	<b>97.4</b>	<b>98.1</b>	<b>98.4</b>

Source: SOeS, Transport counts

In 2012, the number of vehicles on the road was 38.2 million, of which 31.6 million were private cars, 5.9 million lightweight commercial vehicles and 0.6 million heavy vehicles (HGVs, coaches and buses). After an average increase of 1.8% per annum between 1990 and 2000 and 1.3% between 2000 and 2008, the increase has slowed down (+ 0.7% per annum, on average between 2008 and 2012). There was a very considerable increase in the share of diesel vehicles among light commercial vehicles, reaching 60.6% in 2012, thus continuing a long term trend.

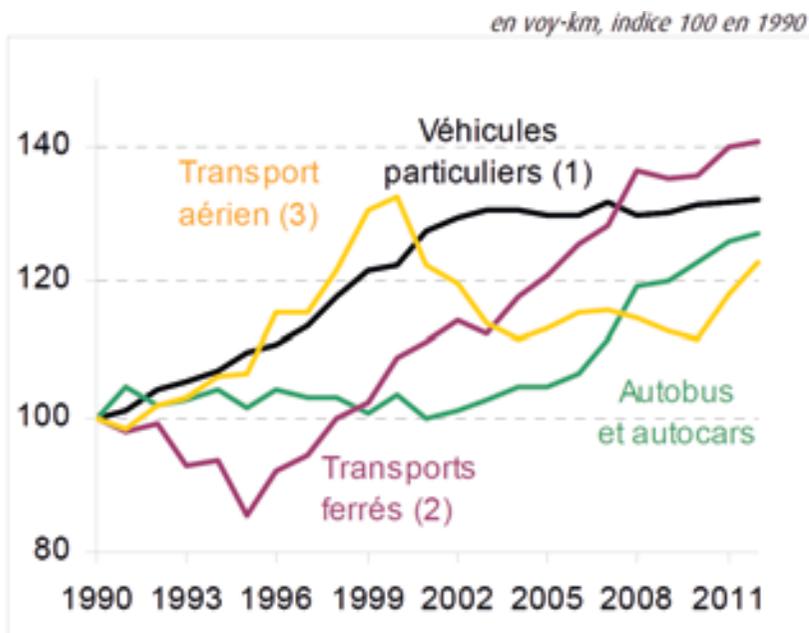
The energy consumption of transport traction was 51.0 million Toe (a figure which includes fuel deliveries for international air and sea fuel bunkers). This level is 0.4% below that of 2008. The share of the main sectors is as follows: 47.0% for private transport (private cars and motorcycles), 30.3% for

road haulage, 13.2% for air transport, 5.1% for sea transport and 1.6% for rail transport.

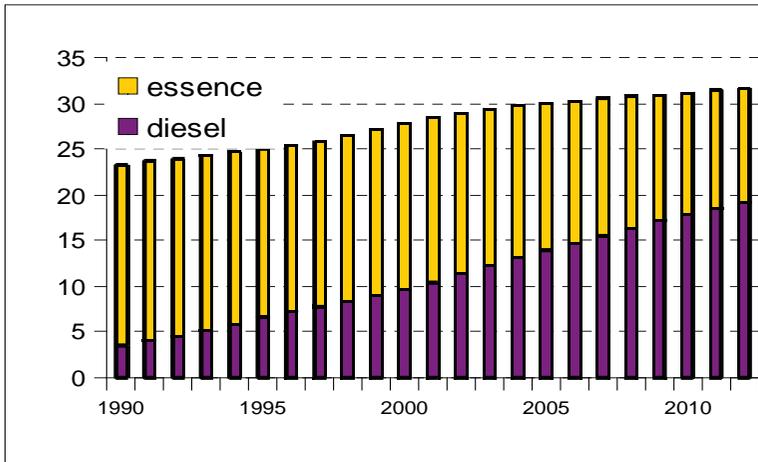
Fossil fuels remain dominant with over 90% of the sector's total consumption. Electricity accounts for 1.6%. The effective share of bio-fuels in petrol and diesel fell slightly in 2011.

Unit consumption by vehicles in 2011 was 6.8 litres/100 km. The recent increase in the number of vehicles with alternative forms of engine power (electric, hybrid, etc.) is not yet sufficient to have a significant effect on average consumption and the total car fleet.

**Figure 8: change in inland passenger transport by mode (black line for passenger cars, yellow line for air transport, purple line for rail transport, yellow line for air transport and green line for buses and coaches)**



Source: SOeS, transport counts (2012 counts, initial results p. 21)



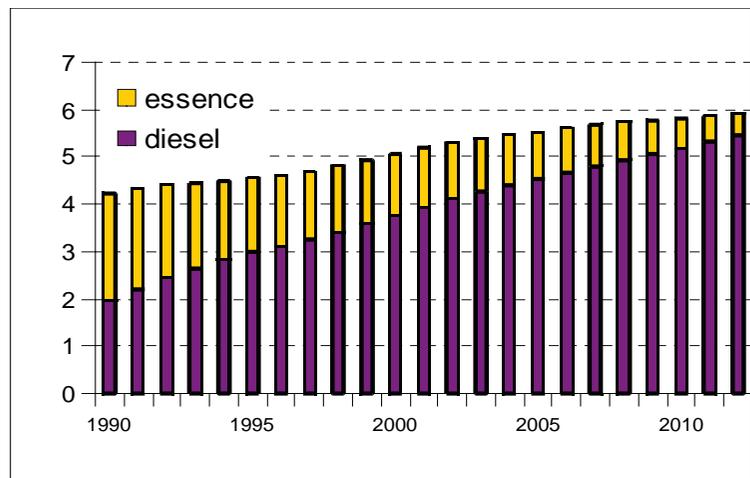
**Figure 9: number of private cars and lightweight commercial vehicles on the road according to ownership**

**Figure 9.a: number of private cars on the road (millions of vehicles)**

Source: SOeS, CCTN 2012 initial results (p. 51)

**Figure 9.b: number of lightweight commercial vehicles on the road (millions of vehicles)**

Source: SOeS, CCTN 2012 initial results (p. 51)



**Table 5: unit vehicle consumption (1990-2011)**

	1990	2000	2005	2007	2008	2009	2010	2011
<b>Passenger cars</b>	<b>8.21</b>	<b>7.46</b>	<b>7.07</b>	<b>6.98</b>	<b>6.98</b>	<b>6.95</b>	<b>6.93</b>	<b>6.79</b>
Incl. gasoline powered vehicles	8.68	8.12	7.78	7.72	7.75	7.76	7.82	7.66
Incl. gasoil powered vehicles	6.73	6.74	6.59	6.59	6.60	6.58	6.56	6.45
<b>Light duty vehicles</b>	<b>9.63</b>	<b>9.62</b>	<b>9.28</b>	<b>9.20</b>	<b>9.23</b>	<b>9.30</b>	<b>9.32</b>	<b>9.16</b>
Incl. gasoline powered vehicles	9.39	9.29	8.62	8.33	8.36	8.38	8.44	8.27
Incl. gasoil powered vehicles	9.77	9.67	9.35	9.27	9.29	9.36	9.37	9.20
<b>Heavy vehicles</b>	<b>35.81</b>	<b>36.27</b>	<b>35.72</b>	<b>35.53</b>	<b>34.79</b>	<b>34.66</b>	<b>34.85</b>	<b>34.63</b>
Incl. heavy goods vehicles	36.23	36.62	36.17	35.99	35.26	35.13	35.33	35.11
Incl. buses and coaches	32.00	32.99	32.60	32.65	32.55	32.81	32.99	32.78

Source: SOeS, CCTN

Consumption by cars is falling due to the increased share of diesel powered vehicles (which have low unit consumption), improved technical performance, in spite of the increased use of SP95-E10 fuel (which is cheaper but with a lower heating value) and more economical driving encouraged by the economic crisis.

## **E.2 Construction / Residential / Tertiary**

The final energy consumption of the residential and tertiary sector was 68.5 Mtoe in 2011 (59.2 Mtoe for the residential sector and 18.4 Mtoe for the tertiary sector). It accounted for 44.1% of France's final energy consumption in 2011.

Energy consumption in the residential sector was up by 0.6% in 2011, after correction for climatic variations, following a fall of 1.0% in 2010. That of the tertiary sector is also up by 1.6%, following a fall of 2.5%.

The energy mix of the two sectors is quite different. In the residential sector renewable energy accounts for 17% of final energy consumption, mainly wood, but in the tertiary sector it is only 4%. While the proportion of gas is slightly more than 30% in each of the two sectors, that of electricity is greater in tertiary sector consumption, particularly due to its intensive use for office equipment and air-conditioning.

### **Residential**

On 1st July 2011 there were 33.8 million homes in Metropolitan France and the Overseas Departments. This is an increase of 345,000 units compared with the previous year (i.e. + 1.0%). New builds contribute 371,000 and demolition, merging, destruction and changes of use caused a loss of 26,000. The housing stock has grown at a very regular rate over the last twenty years (average increase of 1.1% per year). In 2011 growth was higher in the rural municipalities (+ 1.3% in 2011) while it remains low in the Paris conurbation (+ 0.5% in 2011).

Over 28 million homes, 84% of the housing stock, are occupied by households for most of the year (main residences), the rest are made up of second homes (9% of the housing stock) and empty properties (7%). The proportion of main residences has increased slightly since 1985 (+ 1.1 points), to the detriment of empty properties and second homes (- 0.6 and - 0.5 points respectively over the whole of this period).

Individual houses make up the majority of homes (56.5%). After increasing between 1999 and 2008 their share fell very slightly, linked to a greater decline in new construction of individual houses from 2008 to 2010. Homeowners who are not first time buyers (up by 2.5% on average since 2001) alone occupy half of individual homes and 18% of collective housing.

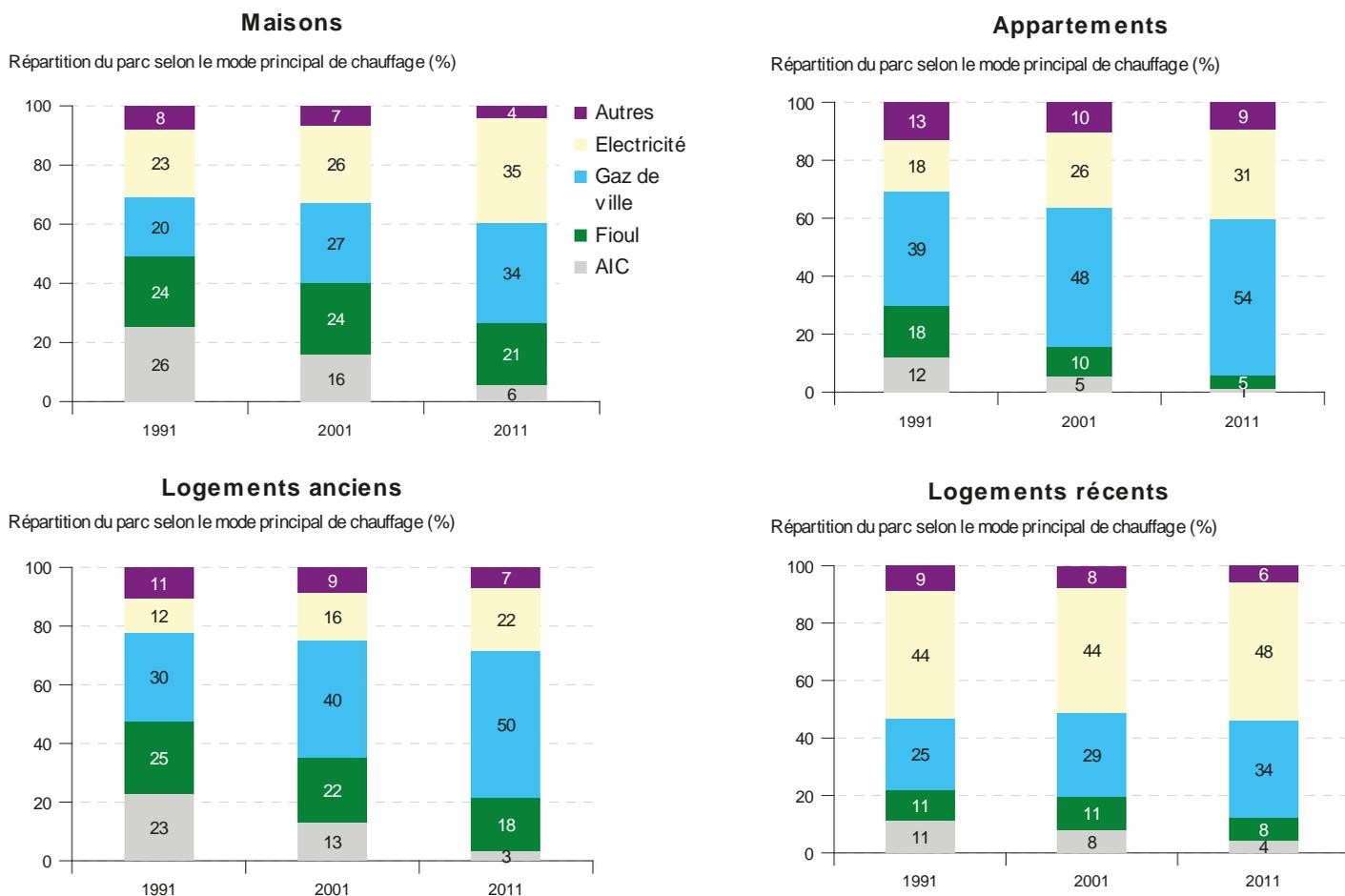
The ageing of the population combined with elderly people remaining in their own homes to a more advanced age, and the crumbling of traditional modes of living together, are bringing about a reduction of the average size of households and stimulating the demand for housing. The number of main residences is tending to grow at a faster rate than the number of people living in households. Correlatively the number of people per household, which was 2.36 in 2011, continues to decline. The living conditions of people living in this housing has improved. Between 1999 and 2011 main residences became larger, from 81.1 m<sup>2</sup> to 85.2 m<sup>2</sup> on average. The average area per person has increased from 32 m<sup>2</sup> to 36 m<sup>2</sup>. Over the same period the average number of rooms per person has increased from 1.43 to 1.56. At the same time comfort has improved: only 1.5% of homes in 2006 were without hot water or bathrooms compared with 15% in 1984.

Taking climatic variations into account energy consumption in kWh per m<sup>2</sup> fell significantly in 2011 (- 1.7%). Since 2003 this consumption has declined by an average of - 1.9% each year, after - 0.5% from 1984 to 2002. This progress is the result of changes in household behaviour, particularly due to the surge in energy prices, but also to work on the existing housing stock to control energy (insulation, more economical equipment) and the successive implementation of thermal regulations in new builds. Over the same period specific energy consumption (lighting, household appliances, etc.) in kWh per m<sup>2</sup> increased by 1.5 between 1984 and 2011 to 30 kWh per m<sup>2</sup> in 2011. This change is partly explained by the increased use of domestic appliances, hi-fi and office appliances.

The share of energy expenditure in all current housing expenses has declined considerably over the last twenty years (- 7 points). In the long term this downward trend has been encouraged by the moderate growth in energy prices over the period 1987 to 2007. It is also due to a small increase in volumes as the result of efforts to save energy (thermal regulation, tax credits in old properties, progressive disappearance of collective boilers, spread of electricity, etc.). In the last 20 years the

equipment in heating appliances has changed a great deal to adapt in particular to changes in the prices of different forms of energy. Policies aimed at controlling energy consumption in homes and reducing its impact on the environment have supported or provided an impetus for these changes. Between 1991 and 2011 improvements in housing comfort were the result of the widespread use of central or electrical heating: in 2011 only 1 million homes were equipped with separate heating appliances, compared with 4.3 million in 1991. Equipment using electricity or gas now accounts for 76% of the housing stock, replacing less comfortable and more polluting forms of heating. Private central heating (more compliant with thermal regulations as it controls consumption) has particularly increased: between 1991 and 2011 its installation rate increased from 75% to 94% in houses and from 42% to 59% in flats. Collective central heating has slowly declined: it was still in 40% of flats in 2011 compared with 46% in 1991. In 2011 coal had almost disappeared. The share of fuel oil has also fallen since 1991, to 14%. This decrease is largely in flats, where the market share of fuel oil fell from 21% in 1991 to 6% in 2011 in old properties and from 8% to 2% in flats built since 1975. On the other hand, the proportion of houses heated with fuel oil has remained almost constant over this period, close to 29% for housing built before 1975 and 14% for those built after 1975.

**Figure 10: distribution of the housing stock according to main form of heating (from left to right and from up to down : houses, flats, homes built before 1975 and homes built after 1975 – grey boxes for individual heating appliances, green for fuel oil, light blue for gas, off white for electricity and purple for others)**



Source: Ceren

### Tertiary Sector

The heated area was 922.3 million m<sup>2</sup> in 2010, (compared with 912.4 million m<sup>2</sup> in 2009) consisting of 45.9% with gas, 25.5% with electricity and 18.6% with fuel oil. The “retail”, “office” and “education” sectors alone account for 64% of all heated areas.

In 2010, of the 11,315,000 m<sup>2</sup> of new areas, 4,310,000 m<sup>2</sup> had air-conditioning and 731,000 m<sup>2</sup> were cooled. In 2010, the amount of air-conditioning increased slightly (38% compared with 37% in 2009 and 39% in 2008), but the combined share of air-conditioned and cooled areas remained stable (44%). 52% of offices and 49% of authorised shops were air-conditioned in 2010. These two sectors alone therefore account for 76% of the air-conditioned area.

## E.3 Energy

### Primary and final energy consumption

Primary energy consumption adjusted by climate variations fell by 2.3% in 2012. It therefore fell below the 260 Mtep mark, i.e. below the 2009 level, the year in which the economic crisis was particularly acute. This is therefore a long way from the very high levels of over 270 Mtoe per year attained between 2002 and 2008.

All consumption has been affected by this decrease, but in particular primary energy consumption by the energy sector (- 5%) under the combined effect of lower levels of nuclear production in 2012 and the decline in refining activity. The slow growth of the French economy and in particular the industrial recession has also resulted in an escalation in the decline of non-energy final consumption<sup>4</sup>. The apparent stability of final energy consumption, which has fluctuated around 155 Mtoe over the last four years, masked contrasting changes. A further indication of the crisis has been the steep decline in transport and industry.

In 2012 oil consumption fell by comparison with 2011 by almost 5%: with less than 79 Mtoe. Its

primary consumption reached its lowest level since energy reports began in 1970. Consumption of natural gas also fell significantly (- 4%) due to less use, relatively speaking, in natural gas power stations. On the other hand, the movement of international stock markets, favourable to coal, explains the jump of more than 10% in coal consumption for production of secondary electricity. Lastly, the return to more normal temperatures in 2012, prompting a rise in wood consumption for energy, on the one hand, and the increasing popularity of recent technological sectors (biogas, heat pumps, solar power), on the other hand, explain the net upturn in thermal renewable energies and waste recycling which have set a new primary consumption record at over 17 Mtoe.

Primary consumption increased by an average of +1.5% per year over course of the 1990s, but then reached a plateau. Recent changes have been more uneven due to the 2009 crisis and the recovery which followed. It is therefore difficult to confirm whether this is the start of a new underlying trend.

<sup>4</sup> Which for example includes naphtha for plastics, bitumen for roads, natural gas for fertiliser production, etc.

**Table 6: consumption of primary energy by type of energy source**

Data corrected by climatic variations in Mtoe

	1973	1990	2000	2005	2007	2008	2009	2010	2011	2012
Primary electricity *	0.8	8.3	10.9	11.7	11.6	11.7	11.1	11.5	11.7	11.4
Oil	12.1	8.8	9.5	9.2	9.0	8.8	8.3	8.1	8.3	7.9
Gas	1.3	2.6	3.8	4.1	4.1	4.1	3.9	4.0	4.0	3.8
Renewable and waste	0.9	1.1	1.3	1.3	1.4	1.5	1.6	1.6	1.6	1.7
Coal	2.8	1.9	1.4	1.4	1.3	1.2	1.1	1.1	1.0	1.1
<b>Total</b>	<b>18.0</b>	<b>22.8</b>	<b>26.9</b>	<b>27.7</b>	<b>27.4</b>	<b>27.4</b>	<b>25.9</b>	<b>26.3</b>	<b>26.5</b>	<b>25.9</b>

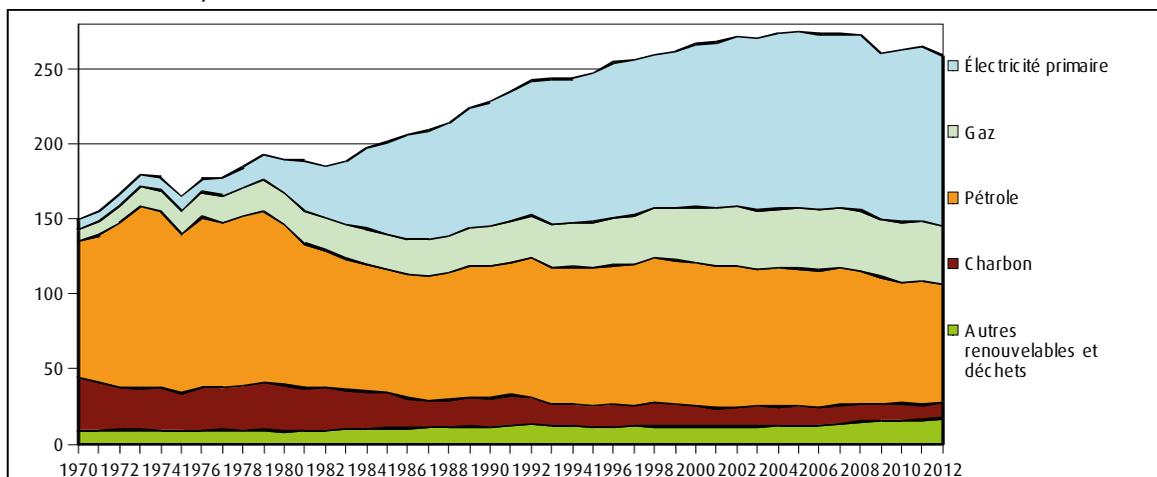
\*Nuclear, HEP, wind, solar

\*\*Thermal renewable and waste energies

Source: SOeS, energy reports

**Figure 11: change in primary energy consumption**

Data corrected by climatic variations in Mtoe



Source: SOeS calculations, according to sources by energy (from top to bottom: primary electricity, gas, oil, coal, other renewables and waste)

### Primary energy production

Final energy consumption, all uses combined, fell slightly in 2012. It has fluctuated between 166 and 167 Mtep over the last three years, a level markedly less than the 175 Mtep of the first half of

the first decade of this century. At just 12 Mtoe the reduction was even greater for non-energy uses (especially oil in the petrochemical industry) than for energy uses, which dwindled to a little under 155 Mtoe.

**Table 7: final energy consumption by type of energy**

Data corrected by climatic variations in Mtoe

	1973	1990	2010	2011	2012
Oil	85.4	70.8	65.3	66.2	64.6
Electricity	13.0	25.9	38.1	37.0	37.6
Gas	8.7	23.3	32.4	32.6	32.0
Renewables	8.9	10.5	13.4	14.0	14.9
Coal	17.7	10.2	5.7	5.4	5.2
Total for energy use	133.6	140.7	154.9	155.2	154.4
Total for non-energy use	10.9	12.4	12.2	12.4	12.0
Total	144.6	153.1	167.1	167.6	166.4

Source: SOes calculations, according to sources by energy

National primary energy production fell dramatically in 2012 to a little more than 136 Mtoe, i.e. a drop of just over 1% by comparison with the record set in 2011. This is almost entirely attributable to nuclear electricity which fell by 3.8%, i.e. over 4 Mtoe, due to fewer power stations being available. Oil production in France was almost halved in one year, accounting for no more than 1 Mtoe of primary energy production. Other forms of national fossil fuel production (natural gas, coal), already completely marginal, have continued their decline.

On the other hand the renewable sectors regained strength in 2012 after a very different year in 2011. After reaching its lowest ever level in 2011 water power production (including pumping) increased by 25% in 2012 due to the drought of the previous two years coming to an end. Facilities continue to increase, production of wind power, solar power and energy from renewable sources and energy recovery from waste all increased in 2012. In total, all renewable sectors produced additional energy of nearly 4 Mtoe compared with 2011.

**Table 8: primary energy production**

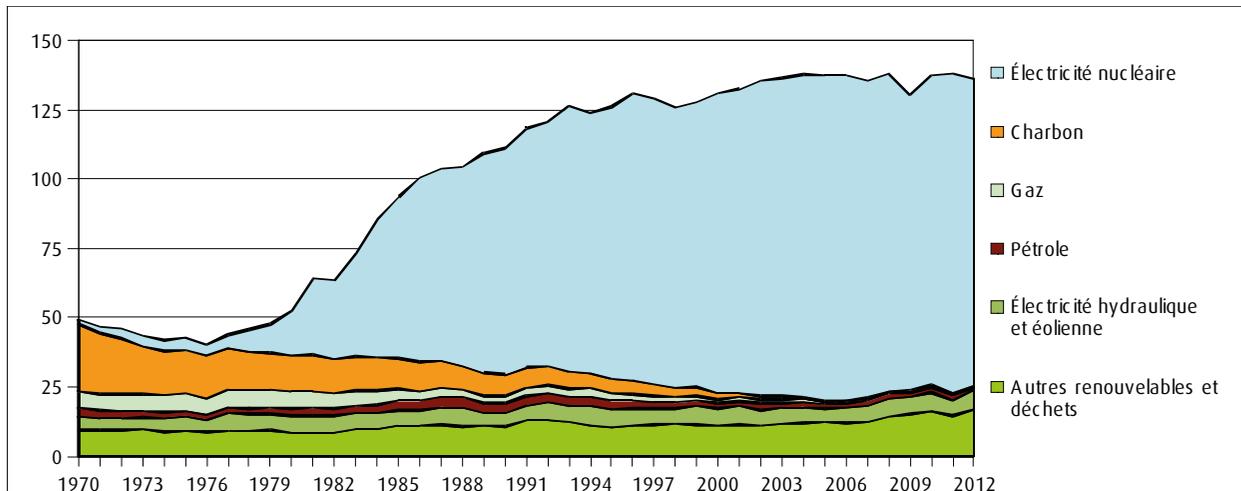
In Mtoe, actual data, not corrected for climate variations

	1973	1990	2007	2008	2009	2010	2011	2012
Électricité primaire *	8,0	86,8	120,5	120,9	112,8	118,4	120,8	117,9
Pétrole	2,2	3,5	1,1	1,1	1,0	1,9	2,0	1,1
Gaz	6,3	2,5	0,9	0,8	0,8	0,6	0,5	0,4
EnRt et déchets **	9,8	10,7	13,0	14,8	15,6	16,4	14,7	16,7
Charbon	17,3	7,7	0,2	0,1	0,1	0,1	0,1	0,1
<b>Total production primaire</b>	<b>43,5</b>	<b>111,2</b>	<b>135,6</b>	<b>137,7</b>	<b>130,2</b>	<b>137,4</b>	<b>138,0</b>	<b>136,3</b>

Source: SOes calculations, according to sources by energy

**Figure 12: primary energy production**

In Mtoe, actual data, not corrected for climate variations (from top to bottom : nuclear electricity, coal, gas, oil, hydro-electric and wind power, other renewables and waste)



Source: SOes calculations, according to sources by energy

## E.4 Industry

Of the major market sectors, manufacturing industry experienced the greatest change. Its production fell by nearly 12% in volume compared with 2008. Within the manufacturing industry, the car industry was most affected. Its production fell by nearly 24% by volume. The year 2010 was a year of moderate recovery with a 4.5% increase in manufacturing production which continued at a slower pace in 2011 (+ 3.2%). After a significant increase in the first quarter of 2011 (+ 3.1%) it stopped growing, affected by the end of the scrap bonus scheme in the car sector and by the deterioration of the global economic situation from the spring of 2011. Demand for manufacturing products lost its momentum, particularly as a result of the slowdown in household consumption of manufactured products. The same thing happened with business investment and exports.

Following a net downturn in 2008 and 2009 (- 4.3% followed by - 8.5%) added value in industry increased by 3.9% in 2010. In manufacturing, added value increased by 3.6%. Apart from transport equipment, the "other industrial sectors" (textiles, wood, pharmaceuticals and even metallurgy), which account for almost half of industry, have also started to increase again (+ 4.3% after - 7.5%). In 2011 the added value in industry only increased by 0.5% in volume. The decline in added value in the transport equipment production sector (- 15.6 % after + 19.4 % in 2010) explains nearly all of this contraction in industrial activity. On the other hand activity has remained fairly well oriented in domestic durable goods (production of computer products, electrical appliances or machines), the added value of which increased by 6.4%, and in the "other industrial sectors" (textiles, wood, pharmaceuticals and even metallurgy), the added value of which has increased by 2.6%.

**Table 9: main aggregates of industry in 2011**

Main aggregates of industry in 2011 Sector (NAF Rev.2)	Production in value in billion Euros	% change by volume 2010/2011				
		Production	Added value	Exports <sup>1</sup>	Imports <sup>1</sup>	Household consumption expenditure
Extr., energ., water, waste mgmnt. & depol.	148	- 3.9	- 0.6	21	1.2	- 9.0
incl. prod. & distr. elec. gas vap. & air con.	105.8	- 5.9	- 1.5	30.7	- 56.3	- 12.0
water, waste & depollution management	36.3	1.5	1.4	14.1	19	- 1.3
Prod. elec. equip., electr., IT. & machines	91.2	5.1	6.4	7.8	8.7	6.8
incl. manuf. computer prods., electronics & opt.	22.8	5.7	9.9	9	5.9	9.1
Manufacture of transport equipment	127	5.6	- 15.6	0.6	6.9	0.2
Manufacture of other industrial products	361.7	2.8	2.6	4.1	5.6	1
incl. textiles, clothing, leather and shoes	16.6	- 2.3	- 1.2	7.5	3.4	- 1.4
Chemical industry	66.1	4.8	- 11.3	3.2	6.3	5
pharmaceutical industry	25.3	- 1.6	1.9	1.4	5.4	2.9
metallurgy & manuf. metal prods. except machines	98.6	2.8	9.4	6.2	8.3	0.3
Total	727.9	2.3	1.1	4.5	6.3	0.5

<sup>1</sup> Exports valued FAB (Free on Board) and imports valued CIF (Cost, Insurance and Freight) per product.

Source: Insee, French economic tables, 2013 edition

The trade balance deficit on domestic durable products (21.2 billion Euros) and the “other industrial products” (26.6 billion Euros) continued to deteriorate in 2011. However the balance of agrifood products improved again in 2011 with a surplus of 6.5 billion Euros. Finally, the balance of transport equipment remained largely in surplus (+ 12.3 billion Euros) but fell by 4.5 billion Euros compared with 2010.

After a serious decline in 2009 and 2010 the employment downturn certainly eased in 2011 in the industrial sectors: job losses were limited to 19,000 full-time equivalent (- 0.6%) compared with 107,000 in 2010. Coking and refining activities, in which the number of jobs have a marginal impact on the economy, and the “other industrial sectors” (textiles, wood, pharmaceuticals, metallurgy), which account for over half of industrial jobs, have an even greater impact on the increase of jobs in industry.

**Table 10: domestic employment in the manufacturing industry**

	Average annual % change						Employees in 2011	
	2006 (r)	2007 (r)	2008 (r)	2009 (r)	2010 (r)	2011	in thousands	in % of total jobs
Production of foodstuffs, drinks and tobacco based products	0.9	- 0.6	- 0.6	- 2.0	- 0.6	- 0.5	581.9	2.3
Coking and refining	- 0.6	- 0.9	- 1.0	- 8.4	- 2.1	- 4.2	7.1	0
Manuf. elect. equipment, electronics, IT manuf. machines	- 1.7	- 0.4	- 0.5	- 9.9	- 5.1	- 1.6	366.1	1.4
Manufacture of transport equipment	- 2.2	- 2.1	- 2.6	- 6.1	- 5.1	- 0.0	251.1	1
Manufacture of other industrial sectors	- 2.4	- 1.5	- 1.6	- 4.7	- 4.4	- 1.0	1579.9	6.2

Interpretation: in 2011 jobs in the coking and refining sectors fell by 4.2% to 7,100 full-time equivalent jobs  
Source: Insee, French economic tables, 2013 edition

## E.5 Agriculture and forestry

### Agriculture

The agriculture and food production sector accounted for about 3.2% of the national GDP (1.6% and 1.6% respectively) in 2011 and 5.6% of total jobs in 2011 (3.3% and 2.3% respectively). Europe's leading agricultural producer, France has the second highest food industry turnover in Europe<sup>5</sup>.

Farming occupied 29.2 million of the 55 million hectares of land in Metropolitan France and 131,800 hectares of the 8.5 million hectares in the Overseas Departments was in agricultural use in 2010. There are about 515,000 farms distributed across the entire territory.

The total cultivated area has steadily decreased since 1950. This reduction has been to the benefit of wooded areas and uncultivated land which have increased by an average of 75 and 51 thousand hectares per year respectively since 1950.

The breakdown of agricultural land between arable land (63%), areas always under grass (33%) and permanent cultivation (4%) remains fairly stable.

**Table 11: change in the area of usable agricultural land (in million hectares)**

	1990	2010
Area under agriculture	30.6	29.1
- arable land	17.8	18.3
- areas permanently under grass	11.4	9.7
- vines, orchards, others	1.4	1.1
- uncultivated agricultural land	2.8	2.6
Poplar groves, woods and forests	15.0	15.6
Non agricultural land	6.5	7.6
Metropolitan territory	54.9	54.9

Source: Agreste France – 2012 Guide

<sup>5</sup> Agreste agricultural statistics guide, December 2012

In 50 years French agriculture, like its European neighbours, has experienced unprecedented modernisation and productivity gains. Now, the agricultural sector also has to respond to the new challenges of protecting the environment and natural resources and combating climate change. The Agriculture and Ecology Plan for France, as part of "Produisons autrement" (Let's produce differently) and the implementation of the Common Agricultural Policy has helped to encourage more sustainable agriculture that reconciles economic performance and ecology.

Between 1990 and 2010: the number of French livestock decreased: only goat and pig production and the equid population have increased.

**Table 12: changes in livestock (in billion heads)**

	1990	2010
Cattle	21.4	19.4
- including cows	9.8	7.8
Pigs	12.5	13.9
Sheep	11.1	7.5
Goats	1.2	1.4
Equids	0.3	0.5
Poultry	260.5	256.3

Source: Agreste- Food production, Occasional paper n°26 2012

a better use of mineral fertilisers. Since the early 90s the amounts of mineral nitrogen used has increased more slowly than the heaviest fertiliser consuming products (cereals and oilseed rape). In addition, practices of adjusting amounts during cultivation and staggering amounts have improved.

National nitrogen delivery is estimated at 2.01 million tons (value in tons of nitrogen) for the year 2011/2012 according to UNIFA (Union of Fertilisation Industries) data. The Nitrates Directives report 2008-2011 gives the following details:

All areas combined, a comparison of the two years 2005-2006 and 2010-2011 shows, as in the report of the preceding year, a downward trend in the total amounts of mineral nitrogen applied, especially for spring barley (-12%) and soft wheat (- 5%) which over the same period saw a decline in yield. Amounts are also falling for silage maize (- 7% ), for which yields are stable. Average amounts of mineral nitrogen on sunflowers, beetroot, grain maize, hard wheat and winter barley remain stable and yields appear stable or on the increase apart from spring barley which shows a decline of 16%. The continued practice of staggering applications which aims to apply nitrogen to match the needs of the plant as near as possible, is the same in 2010-2011 as in 2006.

More frequent use of tools to help control nitrogen fertilisation of soft wheat enabling the amount of nitrogen applied to be adjusted during the year in order to match the needs of the plant more closely (a quarter of areas under spring barley and soft wheat and more than a third for hard wheat).

### Forestry

France is the second most forested country of the 28 EU Member States by area (Sweden 28 Mha and Finland 23 Mha) with 10% of the European Union's forests. Forests occupy nearly 23.8 million hectares: 15.5 million hectares in Metropolitan France and 8.3 million hectares in the Overseas Departments (Guadeloupe, Guyana, Martinique, Réunion and Mayotte). Guyana is mainly forest, with an afforestation rate of 95%, and represents almost the entire forested area of the Overseas Departments.

Broadleaved populations occupy 62% of the forested area of Metropolitan France, conifers 21% and the remaining 17% being mixed populations. The forestry sector directly and indirectly employs about 400,000 people in rural areas.

The forested area of Metropolitan France has increased significantly since the second half of the 19th century. It is estimated that the area of France under woodland was between 8.9 and 9.5 million hectares in 1830. Woodland has increased by 7 million hectares since 1900. Between 1980 and

2000 woodland increased by about 68,000 hectares per year and has slowed considerably since. This extension was principally achieved through natural colonisation of land not under agricultural use.

Private forest in Metropolitan France accounts for 75% of the total area and is very fragmented. The remaining 25% is divided between state-owned forests (about 10%) and forests owned by territorial collectivities (15%). The forests of the Overseas Departments are mostly state-owned.

The productivity of French forests has increased considerably over the last ten years, with an annual increase of about 85Mm<sup>6</sup>. Average annual removal over the period 2005-2010 is estimated, apart from windthrow linked to the 2009 Cyclone Klaus, at 40.4 Mm<sup>3</sup>, i.e. a removal rate of close to 50%. This removal includes the commercial and self-consumed harvest from forests as well as operating losses but does not include pulpwood. Altogether the total harvest was estimated at 54.1 Mm<sup>3</sup><sup>7</sup> in 2008, before the storm.

The French forest sink was 57 Mt eq. CO<sub>2</sub><sup>8</sup> in 2011, i.e one of the largest in the European Union.

### E.6 Waste

355 million tons of waste was produced on French territory in 2010, i.e. 10 million tons more than in 2008. With a ratio of 5.5 tons per head of population France is above the EU27 average, which is 5.0 tons per head of population.

Almost 70% of this is mineral waste, mainly from the construction sector. 3% is hazardous waste.

The remainder, 92.7 million tons, is non-mineral non-hazardous waste. 26.4 million tons is household waste. The tertiary sector (22.4 million tons) with

<sup>6</sup> Volume of main stem measured in the national forest inventory, i.e. comprising the volume of the main stem up to 7 cm in diameter. Everything beyond the 7cm mark is considered pulpwood.

<sup>7</sup> Volume in roundwood over bark - source: Annual branch survey and Housing survey

<sup>8</sup> France's submission in respect of the UNFCCC, calculation of article 3.4 of the Kyoto protocol - April 2013

its numerous service activities is responsible for disposing of numerous end of life products (from end-of-life vehicles to electronic waste, etc.) Industrial production (17.2 million tons) has fallen by one million tons in two years. The construction sectors with 14.3 million tons and waste, water and sewage treatment, with 11.5 million tons are the largest contributors.

At 11.5 million tons in 2010, the production of hazardous waste has slightly increased over the last four years. Industrial activity has nevertheless experienced a downward trend in its production of hazardous waste, especially in metallurgy.

The quantities of waste produced and treated in 2008 and 2010 are shown in the table below.

All waste taken together, 64% of waste was recycled in 2010 (incineration with energy recovery and recycling), i.e. equivalent to the 2008 level. The recycling rate is 60% of treated waste including back-filling (quarry filling) of mineral waste, and 47% otherwise. Between 2008 and 2010 sorting and composting increased considerably with 2 million additional tons. The table below shows the percentages treated in each sector in 2010 by type of waste.

**Table 13: amount of waste produced in 2008 and 2010 in France by type of waste**

	Waste production (in million tons)		Waste treatment (in million tons)	
	2008	2010	2008	2010
Mineral waste	245.0	250.8	241.4	248.3
Non-mineral, non-hazardous waste	89.1	92.7	74.4	79.1
Hazardous waste	10.9	11.5	6.9	8.5
Total	345.0	355.1	322.7	335.9

Source: CGDD/SOeS (Figures and statistics n°385 - January 2013)

**Table 14: waste treatment by sector (in 2010)**

	Incineration with energy recovery	Incineration without energy recovery	Recycling	Storage	Spreading
Mineral waste	0%	0%	65.4%	33.6%	0%
Non-mineral, non-hazardous waste	16.7%	8.2%	44.1%	30.2%	0.8%
Hazardous waste	12.9%	15.3%	40.0%	31.8%	0%
Total	4.3%	2.3%	59.7%	33.5%	0.2%

Source: from CGDD/SOeS (Figures and statistics n°385 - January 2013)

36.6% of household waste is recycled, 14.8% is incinerated with energy recovery and 40.8% is removed through storage or incineration facilities without energy recovery, the rest is spread or composted<sup>9</sup>.

<sup>9</sup> MEDDE/SOeS, last waste statistics regulations, 2012



## CHAPTER 3

## 3

# Information on the GHG emissions inventory including information on the French national inventory system and national registry

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## A. Change in French GHG emissions

In the context of the United Nations Framework Convention on Climate Change, the French emissions framework includes emissions from the French Overseas Departments, Overseas Collectivities and New Caledonia. In 2011 French GHG emissions in the Convention framework were estimated at 491.7 Mt CO<sub>2</sub> eq. The emissions of the Overseas Collectivities and New Caledonia were 6 million tons, i.e. 1.2% of the emissions of mainland France.

On the other hand, the French GHG emissions framework under the Kyoto Protocol includes Metropolitan France and the Overseas Departments apart from Mayotte. Also excluded from the Kyoto framework are the Overseas Collectivities and New Caledonia. The reference emission levels of French commitments under the Kyoto Protocol have been set at 563.9 Mt CO<sub>2</sub> eq. In 2011 French emissions in Kyoto Protocol framework were **485.5 Mt CO<sub>2</sub> eq.**

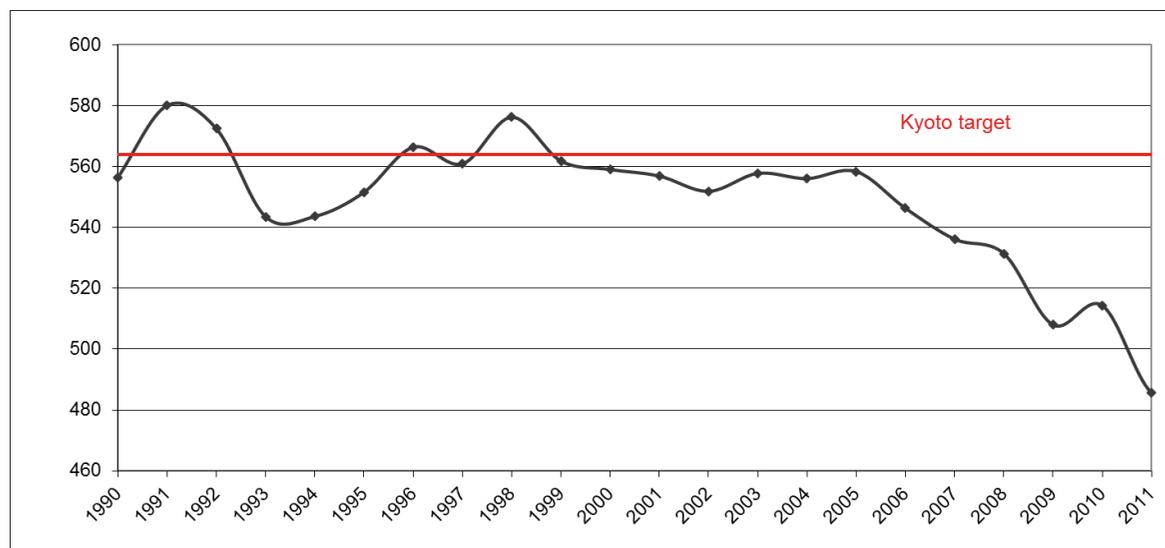
**Between 1990 and 2011 greenhouse gas<sup>1</sup> emissions fell by 13.9%** (cf. figure 13). In tons per capita this is a reduction of 26% between 1990 and 2011 (9.6 t CO<sub>2</sub> eq./capita in 1990 and 7.5 t CO<sub>2</sub> eq. /capita in 2011), the population having increased by 12 % since 1990.

On the basis of an estimate for 2012<sup>2</sup> the GHG emissions reduction in relation to the Kyoto target was 50 Mt CO<sub>2</sub> eq. per year over the period 2008-2012 (average difference between recorded emissions and the Kyoto target).

This reduction is largely explained by the improvement of industrial processes and policies enabling the upward trend linked to population increase to be overtaken.

Since 2007 France has sent the United Nations the results of the inventory each year in accordance with these two geographical frameworks<sup>3</sup>.

**Figure 13: Trend of GHG emissions between 1990 and 2011 in Mt CO<sub>2</sub> eq**



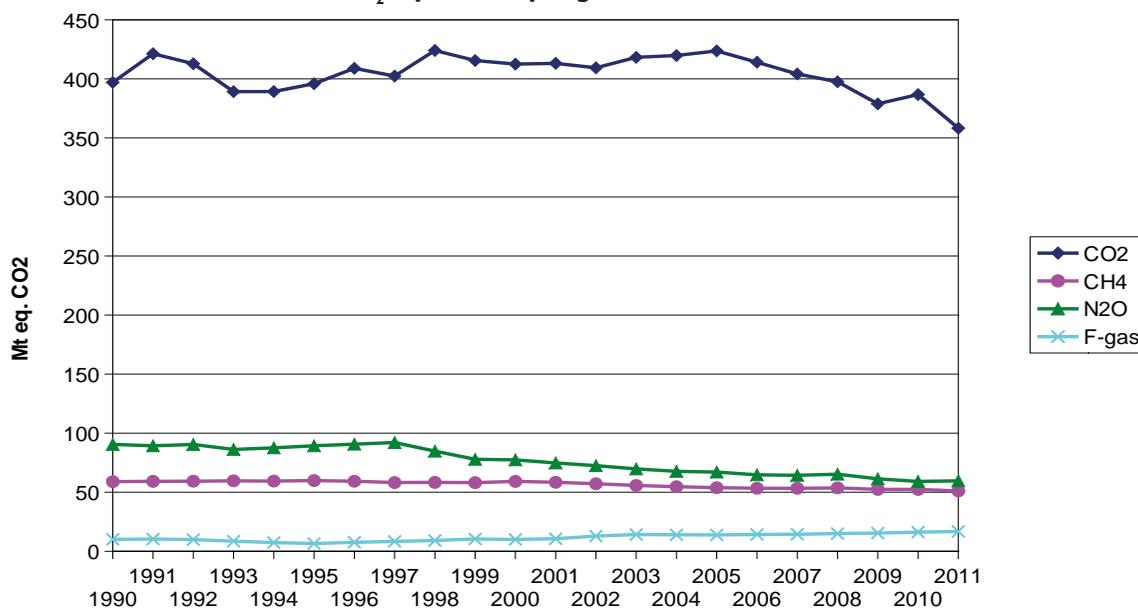
Source: 2013 Submission, French National Programme on Tackling Climate change format to the Kyoto framework, CITEPA / MEDDE

<sup>1</sup> In the Kyoto framework

<sup>2</sup> CITEPA/MEDDE Estimate, Secten report, May 2013

<sup>3</sup> The CRF 10 tables are quoted in Appendix 1 for the Kyoto framework.

**Figure 14: change in France's GHG emissions (Metropolitan France and Overseas Departments) between 1990 and 2012 in Mt CO<sub>2</sub> equivalent per gas.**



Source: PNLCC (French national programme on tackling climate change), Kyoto framework, CITEPA/MEDDE, UNFCCC submission April 2013

The graph, which shows change in GDP versus change in emissions per unit of GDP (see chapter 1), highlights the increasing separation between GHG emissions and the growth of GDP in France. The French economy is therefore becoming more carbon-friendly despite the economic crisis.

In 2011 CO<sub>2</sub> emissions were 358.2 Mt CO<sub>2</sub> eq., i.e. 74 % of French GHG emissions. Emissions of gases other than CO<sub>2</sub> accounted for 127.5 Mt CO<sub>2</sub> eq., i.e. 26 % of France's GHG emissions (Metropolitan France and Overseas Departments). In 2011 methane emissions were 51.2 Mt CO<sub>2</sub> eq. and accounted for 10.5 % of French GHG emissions. N<sub>2</sub>O emissions were 59.6 Mt. CO<sub>2</sub> eq. and accounted for 12.2 % of French GHG emissions. F-gas emissions were 16.7 Mt CO<sub>2</sub> eq. and accounted for 3.3 % of France's total GHG emissions.

CO<sub>2</sub> emissions fell by 9.8% between 1990 and 2011. Between 1990 and 2007 CO<sub>2</sub> emissions remained stable and then fell sharply with the crisis. This decrease continued after 2008, indicating a new phase of decrease linked to policies and measures put in place. Emissions projections (see chapter

V) show existing policies together with additional policies having a marked impact on CO<sub>2</sub> compared with a without measure scenario for the years 2015 and 2020.

Between 1990 and 2011 N<sub>2</sub>O and CH<sub>4</sub> emissions fell by 30 % and 17 % respectively. These reductions are explained in particular by the implementation of policies and measures: recovery of methane from landfill, reduction in the quantity of inputs to agricultural soils, implementation of reduction processes in industry (see chapter IV). The projections show these trends continuing up to 2020 (see chapter V).

Emissions of f-gases went up 66% between 1990 and 2011 despite the implementation of European directives (European regulations no. 2037/2000 and 842/2006, Directive 2006/40/EC), supplemented in 2011 by Decree 2011-396 which specifies the regulatory provisions for use other than in refrigeration and air-conditioning. New f-gas regulations are in the process of being adopted at European level. This should strengthen legislation on the maintenance, filling and end of life stages of equipment.

**Table 15: France's GHG emissions in 2011, CRF (Common Reporting Format) table "summary 2"**

GREENHOUSE GAS SOURCE AND	CO <sub>2</sub> <sup>(1)</sup>	CH <sub>4</sub>	N <sub>2</sub> O	HFCs <sup>(2)</sup>	PFCs <sup>(2)</sup>	SF <sub>6</sub> <sup>(2)</sup>	Total
SINK CATEGORIES							
CO <sub>2</sub> equivalent (Gg)							
Total (Net Emissions) <sup>(1)</sup>	310,347.81	52,720.78	61,070.33	15,801.54	429.46	546.09	440,916.01
Energy	337,639.68	2,693.36	4,062.87				344,395.91
Fuel Combustion (Sectoral Approach)	334,714.95	1,549.89	4,043.89				340,308.74
Energy Industries	52,300.37	50.91	610.04				52,961.32
Manufacturing Industries and Construction	64,448.28	161.40	791.25				65,400.93
Transport	130,457.07	190.36	1,397.95				132,045.38
Other Sectors	87,509.24	1,147.22	1,244.66				89,901.12
Other	NO <sup>(5)</sup>	NO <sup>(5)</sup>	NO <sup>(5)</sup>				NO <sup>(5)</sup>
Fugitive Emissions from Fuels	2,924.73	1,143.47	18.97				4,087.18
Solid Fuels	NA <sup>(6)</sup> , NO <sup>(5)</sup>	44.39	NA <sup>(6)</sup> , NO <sup>(5)</sup>				44.39
Oil and Natural Gas	2,924.73	1,099.08	18.97				4,042.78
Industrial Processes	18,016.11	52.97	1,244.35	15,801.54	429.46	546.09	36,090.52
Mineral Products	12,248.93	NA	NA				12,248.93
Chemical Industry	1,954.60	51.45	1,244.35	NA <sup>(6)</sup>	NA <sup>(6)</sup>	NA <sup>(6)</sup>	3,250.40
Metal Production	3,812.57	1.52	NA <sup>(6)</sup>	NA <sup>(6)</sup>	85.96	204.89	4,104.95
Other Production	NA <sup>(6)</sup>						NA <sup>(6)</sup>
Production of Halocarbons and SF <sub>6</sub>				99.90	3.41	NA <sup>(6)</sup> , NO <sup>(5)</sup>	103.31
Consumption of Halocarbons and SF <sub>6</sub> <sup>(2)</sup>				15,701.64	340.09	341.19	16,382.92
Other	NO <sup>(5)</sup>	NO <sup>(5)</sup>	NO <sup>(5)</sup>	NA <sup>(6)</sup> , NO <sup>(5)</sup>	NO <sup>(5)</sup>	NO <sup>(5)</sup>	NA <sup>(6)</sup> , NO <sup>(5)</sup>
Solvent and Other Product Use	1,032.93		87.45				1,120.38
Agriculture		38,183.09	52,967.60				91,150.69
Enteric Fermentation		28,133.19					28,133.19
Manure Management		9,914.47	4,696.77				14,611.24
Rice Cultivation		112.50					112.50
Agricultural Soils <sup>(3)</sup>		NA <sup>(6)</sup>	48,261.98				48,261.98
Prescribed Burning of Savannas		NO <sup>(5)</sup>	NO <sup>(5)</sup>				NO <sup>(5)</sup>
Field Burning of Agricultural Residues		22.93	8.85				31.78
Other		NO <sup>(5)</sup>	NO <sup>(5)</sup>				NO <sup>(5)</sup>
Land Use, Land-Use Change and Forestry <sup>(1)</sup>	-47,709.69	1,635.79	1,447.23				-44,626.68
Forest Land	-65,636.96	555.72	61.78				-65,019.46
Cropland	15,067.26	133.34	1,367.31				16,567.91
Grassland	-7,617.89	125.82	12.77				-7,479.30
Wetlands	-3,522.29	7.03	0.71				-3,514.54
Settlements	14,228.99	56.44	4.51				14,289.94
Other Land	127.42	1.43	0.15				129.00
Other	-356.23	756.00	NA <sup>(6)</sup> , NO <sup>(5)</sup>				399.77
Waste	1,368.78	10,155.58	1,260.83				12,785.18
Solid Waste Disposal on Land	NA <sup>(6)</sup> , NO <sup>(5)</sup>	8,749.29					8,749.29
Waste-water Handling		1,209.63	766.84				1,976.48
Waste Incineration	1,368.78	23.03	66.81				1,458.62
Other	NA <sup>(6)</sup>	173.62	427.18				600.80
Other (as specified in Summary 1.A)	NO <sup>(5)</sup>	NO <sup>(5)</sup>	NO <sup>(5)</sup>	NO <sup>(5)</sup>	NO <sup>(5)</sup>	NO <sup>(5)</sup>	NO <sup>(5)</sup>
Memo Items; <sup>(4)</sup>							
International Bunkers	25,144.07	4.75	227.06				25,375.89
Aviation	16,714.17	1.92	168.84				16,884.93
Marine	8,429.90	2.84	58.22				8,490.96
Multilateral Operations	1.13	NE <sup>(7)</sup>	NE <sup>(7)</sup>				1.13
CO <sub>2</sub> Emissions from Biomass	53,665.64						53,665.64
Total CO <sub>2</sub> Equivalent Emissions without Land Use, Land-Use Change and Forestry							485,542.69
Total CO <sub>2</sub> Equivalent Emissions with Land Use, Land-Use Change and Forestry							440,916.01

<sup>(1)</sup> For CO<sub>2</sub> from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+). <sup>(2)</sup> Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included. <sup>(3)</sup> Parties which previously reported CO<sub>2</sub> from soils in the Agriculture sector should note this in the NIR. <sup>(4)</sup> See footnote 8 to table Summary 1.A. <sup>(5)</sup> NO: not observable. <sup>(6)</sup> NA: not available. <sup>(7)</sup> NE: not estimated.

Source: CRF table of the French inventory under the Kyoto framework, April 2013

## B. Summary of items in the French GHG emissions inventory, Kyoto framework

The sectors of activity chosen to present the emissions inventory analysis per sector are those defined by France in the context of the PNLCC (French national programme on tackling climate change) format (CITEPA, OMINEA Report, 2013).

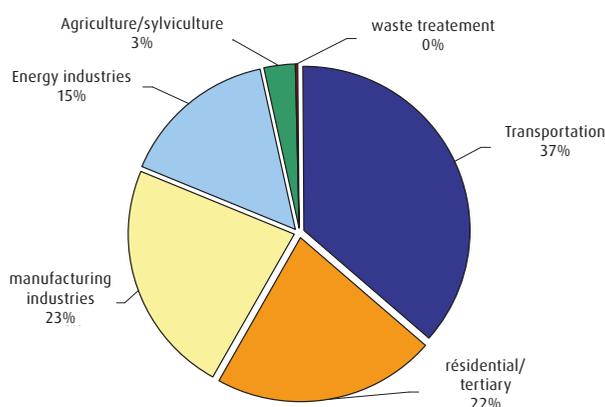
This format is based on the CRF (Common Reporting Format) format with the particular feature compared with the international CRF format that emissions related to f-gas consumption are distributed within each consumer sector (transport, residential, etc.) and not grouped together in the same category (CRF 2F). GHG emission results tables in CRF format for the Convention framework are given in Appendix II.

### B.1 Distribution of carbon dioxide (CO<sub>2</sub>) emissions by sector

In 2011 CO<sub>2</sub> emissions were 358.2 Mt CO<sub>2</sub> eq., i.e. 74 % of French GHG emissions.

The transport sector was the biggest CO<sub>2</sub> emitter with a 37 % share of CO<sub>2</sub> emissions. The second and third largest emitters of CO<sub>2</sub> were manufacturing industry with a 23 % share and the residential/tertiary sector with a 21 % share. These proportions have barely changed since the 5th national communication.

**Figure 15: distribution of CO<sub>2</sub> emissions by sector in 2011**



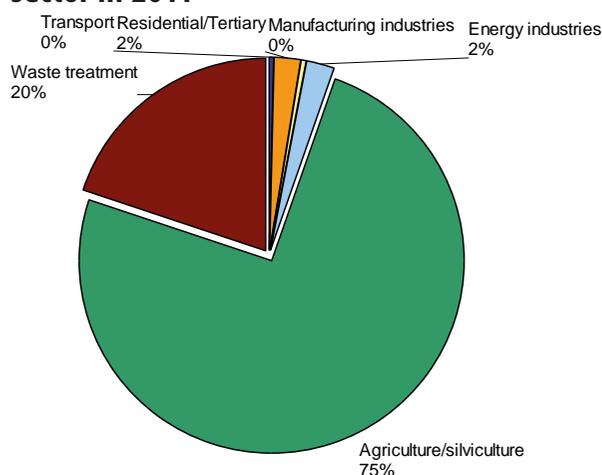
Source: CITEPA/MEDDE inventory, April 2013 submission, Kyoto framework, PNLCC for

### B.2 Distribution of methane (CH<sub>4</sub>) emissions by sector

In 2011 methane emissions were 51.1 Mt CO<sub>2</sub> eq. and accounted for 10.5 % of French GHG emissions.

The agricultural sector contributed 76 % of methane emissions. The main source of these emissions was from enteric fermentation and animal excrement management. The second largest emitter of methane was waste treatment (mainly anaerobic fermentation on rubbish dumps). The agricultural sector's share has fallen by several per cent since the 5th national communication (76%, compared with 80% in 2007).

**Figure 16: distribution of CH<sub>4</sub> emissions by sector in 2011**



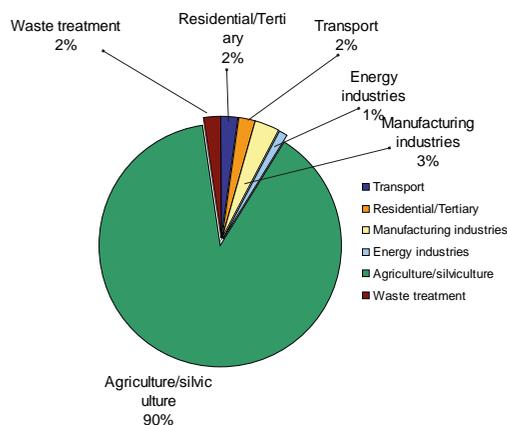
Source: CITEPA/MEDDE inventory, April 2013 submission, Kyoto framework, PNLCC format

### B.3 Distribution of Nitrous Oxide (N<sub>2</sub>O) emissions by sector

In 2013 N<sub>2</sub>O emissions were 59.6 Mt CO<sub>2</sub> eq. and accounted for 12.2 % of French GHG emissions.

Agriculture was also the greatest emitter of N<sub>2</sub>O with an estimated 90% share of France's total emissions. Emissions were linked to manure spreading and enteric fermentation in animals. Agriculture's share has increased since the fifth national communication (90%, compared with 84% in 2007). On the other hand, industry's share has significantly decreased since the last national communication (2 %, compared with 10 % in 2007).

Figure 17: distribution of N<sub>2</sub>O emissions by sector in 2011



Source: CITEPA/MEDDE inventory, April 2013 submission, Kyoto framework, PNLCC format

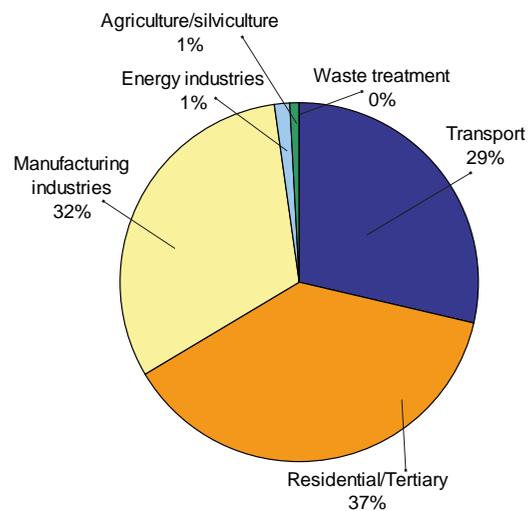
### B.4 Distribution of f-gas emissions (PFC, HFC and SF<sub>6</sub>) by sector

In 2011 emissions were 16.7 Mt CO<sub>2</sub> eq. and accounted for 3.3 % of France's total GHG emissions.

37% of F-gas emissions came from the residential/tertiary sector (air-conditioning and commercial and domestic refrigeration systems), 29% from the transport sector (air-conditioning) and

32% from the manufacturing sector. Emissions from manufacturing were particularly linked to production of magnesium and manufacture of high voltage switch gear. The proportions from the various sectors have remained stable in relation to the fifth national communication.

Figure 18: distribution of f-gas emissions in 2011



Source: CITEPA/MEDDE inventory, 2013 April submission, Kyoto framework, PNLCC format

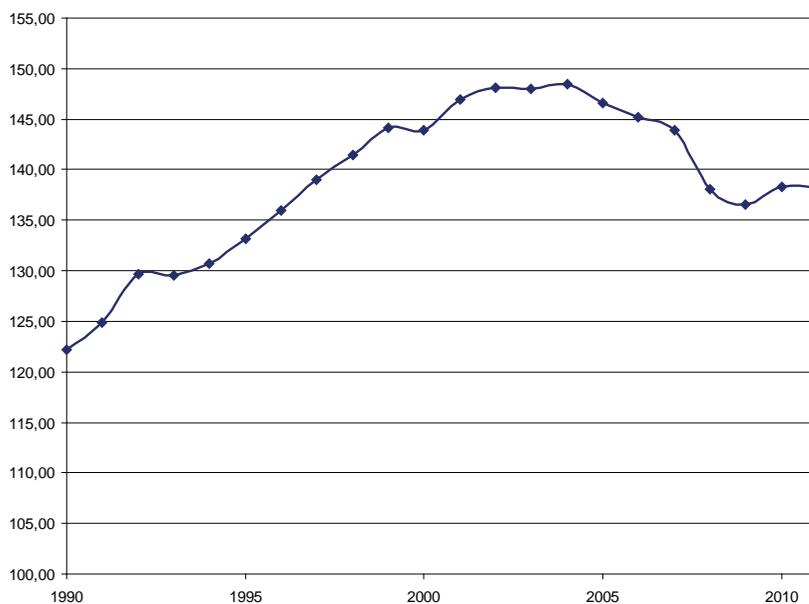
## B.5 Analysis of total GHG emissions by sector of activity

The transport sector (CRF 1A3)

Transport is France's main GHG emitter. It accounted for 28.1 % of national emissions (138.3 Mt CO<sub>2</sub> eq.)

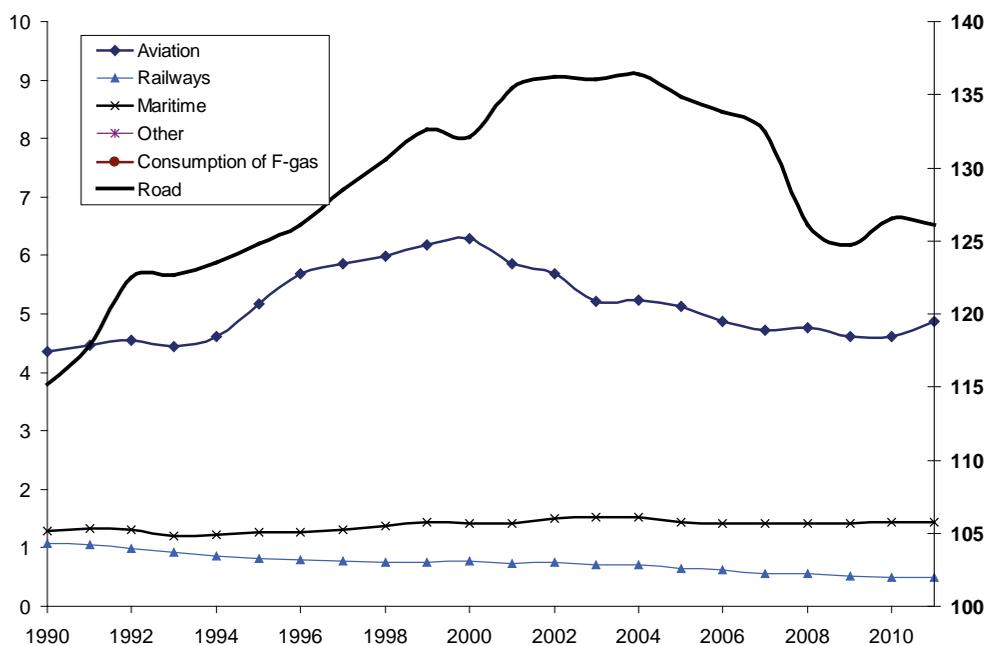
in 2011, with a significant increase between 1990 and 2001 (+ 22 %) and then a slight decrease since 2004.

**Figure 19: change in emissions from the transport sector (CRF 1A3) between 1990 and 2011 in Mt CO<sub>2</sub> eq**



Source: France's UNFCCC inventory under the convention framework, April 2013 submission - CITEPA/MEDDE

**Figure 20: change in emissions from the transport sector between 1990 and 2011 by sector; main axis: emissions from sea, rail and other forms of transport and emissions linked to f-gas consumption and secondary axis: emissions from the road sector**



Source: France's UNFCCC inventory under the convention framework, 2013 submission - CITEPA/MEDDE

In the national inventory in UNFCCC format the results of sea and air transport do not include international links.

The biggest emitter is the road transport sector, in which emissions have begun to decrease since 2004.

For road transport the distribution of GHG emissions by vehicle type in 2011 is as follows:

- Cars: 57 %
- Light utility vehicles: 18 %
- Heavy Goods Vehicles: 21 %
- Buses and coaches: 3 %
- Two and three-wheeled motorbikes 1 %

Cars are therefore responsible for more than half the sector's emissions, and 3/4 of these emissions are for trips of less than 100 km. The contribution of heavy goods vehicles to the sector's emissions

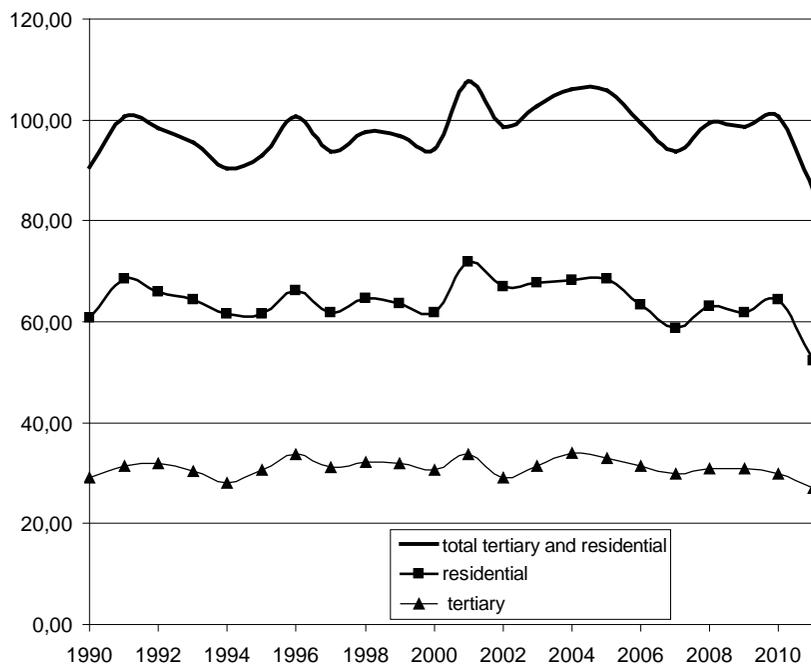
is less than half that of cars. It has remained stable since the 5th national communication.

The increased use of bio-fuels (about 1% of total fuels to about 6% in 2011) in road transport and the increase in diesel-powered vehicles combined with supporting measures such as the promotion of eco-driving are partly responsible for this decrease. The other factors are policies, such as the bonus-malus system and the scrappage scheme available since 2008, implemented on the average consumption of new cars.

### The residential/tertiary sector (CRF 1A4a and 1A4b)

Emissions from the residential sector and tertiary buildings accounted for 17.5% of France's GHG emissions in 2011. 60.8 % of emissions were attributed to the residential sector and 38.2 % to the tertiary sector. They were made up of 90 % CO<sub>2</sub>.

**Figure 21: change of emissions linked to the residential/tertiary sector in million tons of CO<sub>2</sub> equivalent (categories CRF 1A4a and 1A4b)**



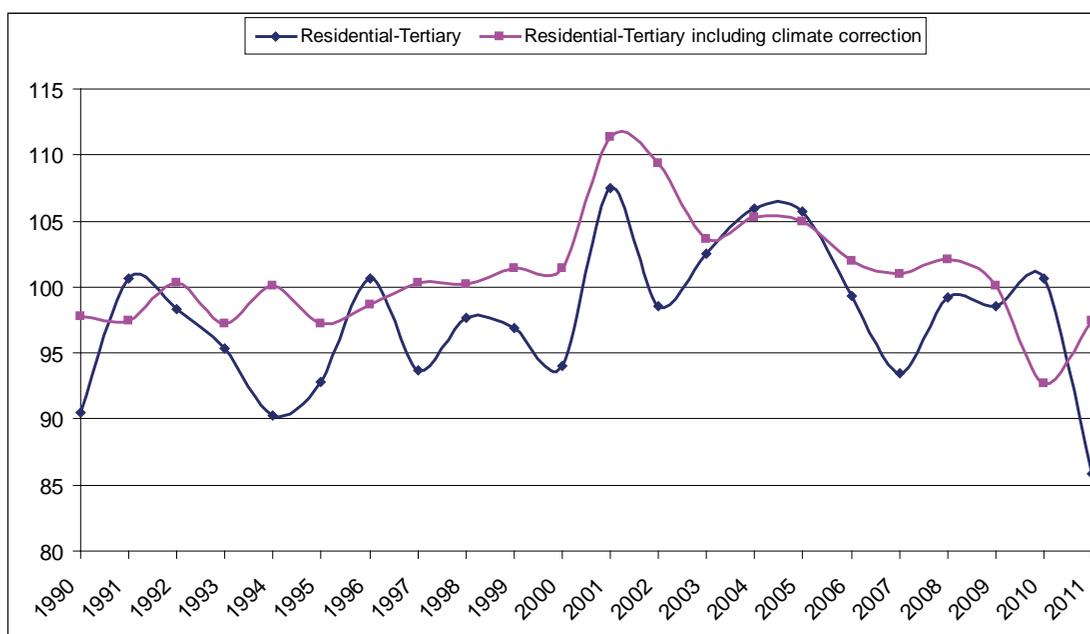
Source: France's UNFCCC inventory under the convention framework, April 2013 submission - CITEPA/MEDDE

Since 1990 the policies and measures in place, and in particular the thermal regulations on new buildings, have stabilised emissions from the residential/tertiary sector, compensating for the rise in emissions linked to the increase in the number of homes (cf. chapter II) up to 2008.

The residential sector's share has fallen since 2008, due in large part to energy savings made by households following rising prices of fossil fuels and also due to policies carried out in the building sector. The improved energy efficiency of the existing housing stock was facilitated by support measures such as the CIDD (sustainable development tax credit) and éco-PTZ (zero-rate eco-loan), which are regularly reviewed in order to target the most

effective measures, and the new thermal standards for new builds have enabled existing systems to be progressively replaced with lower-carbon energy systems. Coal has almost disappeared from the sector and fuel oil has significantly decreased in favour of gas and electricity. 2011 was a special case as its average temperature was 1.5 °C above normal. Figure 22 shows the emissions recorded since 1990 and emissions corrected for the effect of climate (calculation of consumption by MEDDE / SOeS and calculation of emissions by CITEPA). It can be seen that in 2011 the effect of climate on emissions from the residential and tertiary sector was considerable and can largely explain the decrease observed.

**Figure 22: emissions from the residential and tertiary sector corrected and not corrected for climate in Mt CO<sub>2</sub> eq.**



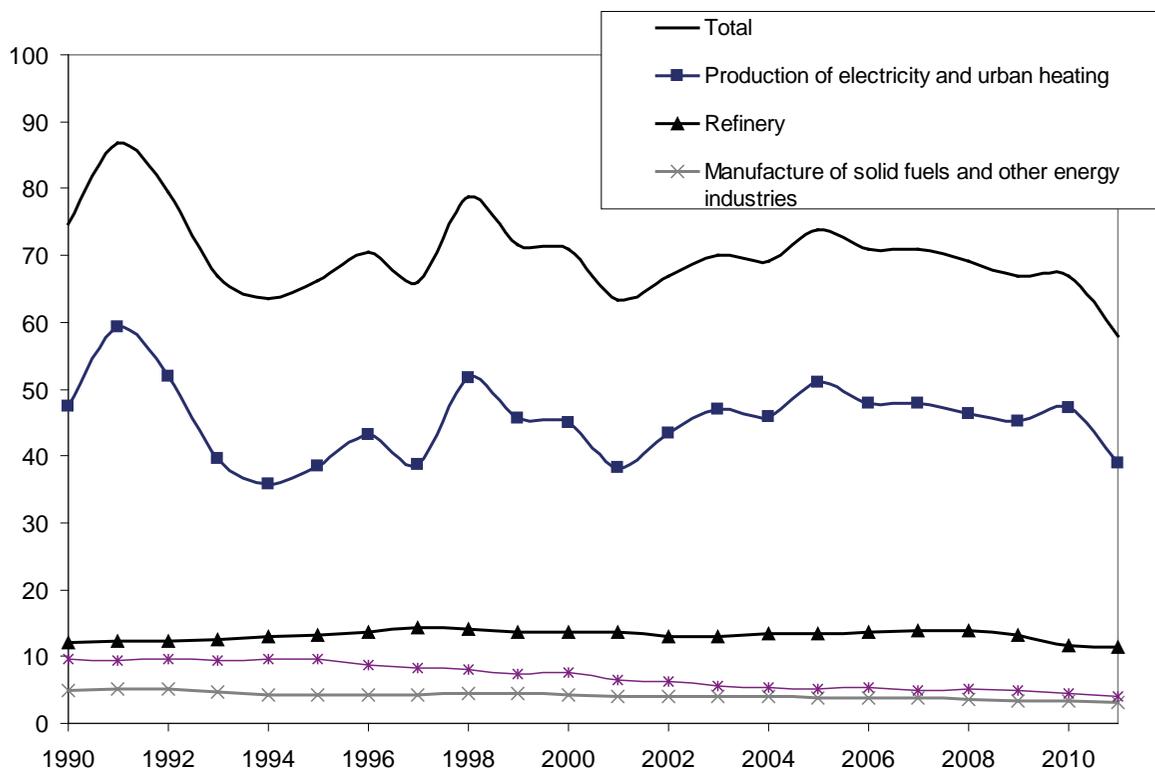
Source: France's UNFCCC inventory under the convention framework, April 2013 submission - CITEPA/MEDDE and CITEPA calculation

### The energy industry sector (CRF 1A1 and 1B)

Emissions from the energy production sector (electricity generation, urban heating, oil refining) were 58.0 Mt CO<sub>2</sub> eq. in 2011, i.e. 11.8 % of France's total emissions. Between 1990 and 2011 emissions linked to energy production fell by 16.7%. However, this figure is marked by a significant decrease between 2010 and 2011 due to the mild temperatures of 2011, which led to a lower demand for energy in that year, and also, by considerable availability of the nuclear estate and increased use of hydro-electricity after two years of drought.

Emissions from this sector were quite low compared with other countries. This is partly explained by the share of nuclear power and also the use of hydro-electric power. It should also be noted that increased demand (population increase) is compensated for by the policies put in place (see chapter IV).

**Figure 23: change in emissions linked to energy (categories CRF 1A1 and 1B)  
(in million tons of CO<sub>2</sub> equivalent)**

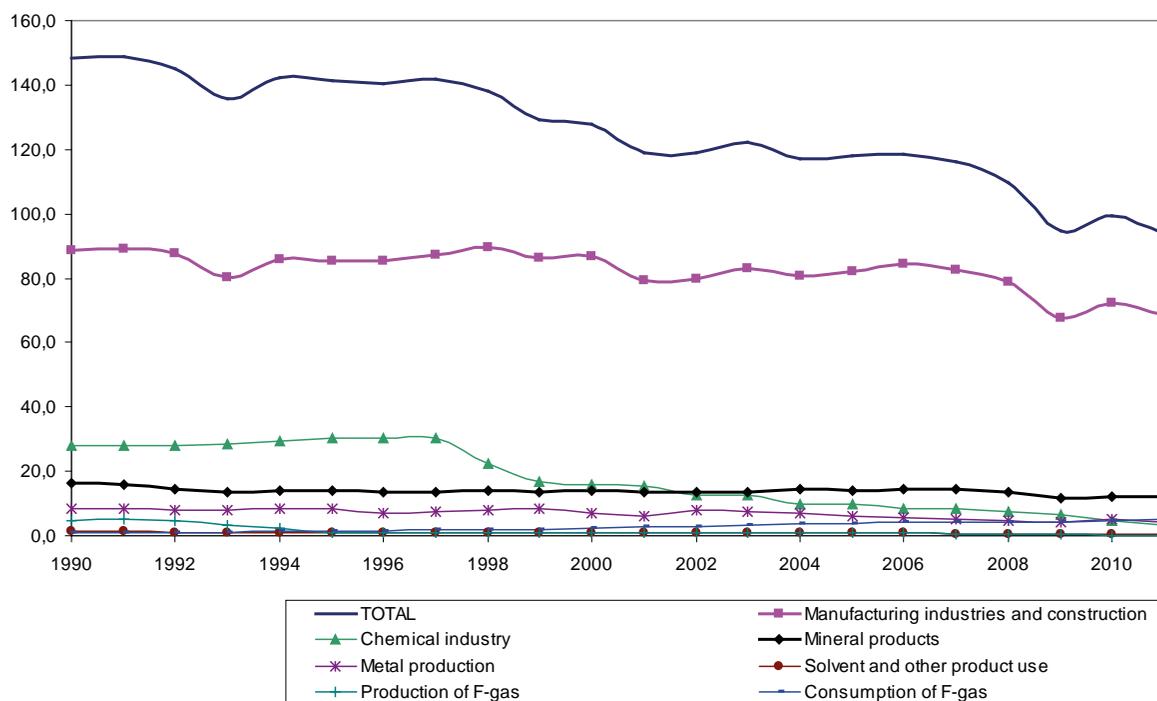


Source: Frances UNFCCC inventory under the convention framework, April 2013 submission - CITEPA/MEDDE

## The manufacturing sector (CRF 1A2, 2)

The industry sector accounted for 19.1% of France's total GHG emissions in 2011, i.e. 93.9 Mt CO<sub>2</sub> eq.

**Figure 24: change in emissions linked to industry (categories CRF 1A2,2) in million tons of CO<sub>2</sub>**



Source: France's UNFCCC inventory under the convention framework, April 2013 submission - CITEPA/MEDDE

Emissions from the manufacturing and construction sectors of industry have fallen since 1990 with a significant decrease between 1997 and 2002 and between 2007 and 2009. While manufacturing production's share in French added value fell from 18 % to 10 % by volume between 1990 and 2010, it increased by about a third between 1990 and 2007 (Insee, national counts), before decreasing by 12 % in two years and then stabilising. While the decline in emissions would not have been so great without the contraction in industrial activity in

certain sub-sectors (mineral production, etc.) and its stabilisation in others, the main explanation lies in the progressive modification of certain processes, notably in the chemicals industry (implementation of smoke treatment systems which capture nitrous vapour at factories that make adipic acid, nitric acid and glyoxylic acid). In particular, emissions of nitrous oxide from the chemicals industry have fallen by a further 23 Mt CO<sub>2</sub> equivalent since 1990 (a 20-fold decrease).

### The agricultural sector (CRF 1A4c and 4)

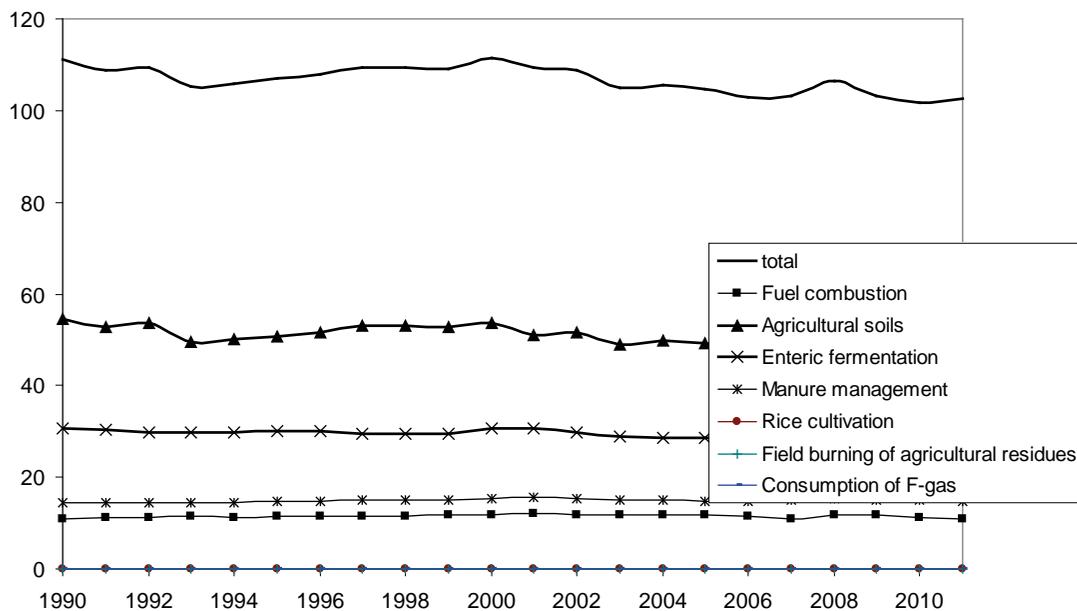
Agriculture and forestry are forms of land use in which human activity can lead to emissions or absorptions of GHGs.

GHG emissions from agriculture in 2011 were 102.6 Mt CO<sub>2</sub> equivalent (except carbon sinks), i.e. 20.9 % of French emissions. They came from the activities (cultivation, livestock farming) of about 514,800 farms in 2010<sup>4</sup>.

The continued decline in GHG emissions of agricultural origin since 1990 has been due to a

reduction in the use of nitrogen fertiliser, a decrease in the number of cattle and a drop in energy consumption. Between 1990 and 2011 emissions from the agriculture sector fell by 7.6%. It should be noted however that nitrogen fertilisation on which N<sub>2</sub>O emissions from agricultural soil directly depend varies from year to year depending on prices and weather conditions despite a downward trend prompted by policies and measures to reduce nitrogen emissions in the agricultural sector (see chapter IV).

**Figure 25: change in emissions linked to agriculture (categories CRF 1A4c and 4) (in million tons of CO<sub>2</sub> equivalent)**



Source: France's UNFCCC inventory under the convention framework, April 2013 submission - CITEPA/MEDDE

### The waste treatment sector (CRF 6)

Emissions linked to waste management were 12.9 Mt CO<sub>2</sub> equivalent in 2011, i.e. about 2.6 % of France's total GHG emissions. They have fallen by 1.8% since 1990.

Diffuse methane emissions from Non hazardous Waste Storage Facilities (ISDND in French)

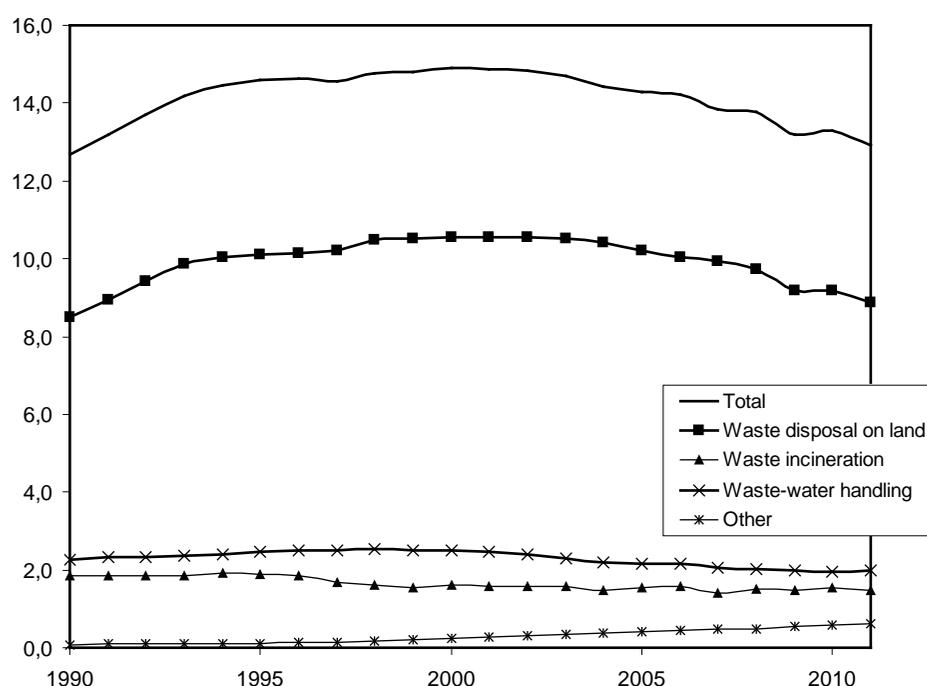
<sup>4</sup> Agricultural survey 2010

accounted for the majority of emissions (69%) from the waste treatment sector in 2011. This figure is an over-estimation of actual emissions however, as it only takes partial account of the fact that more and more ISDND are being equipped with systems to recover biogas produced during the anaerobic fermentation process. In fact, for facilities for which no information was available on volumes of biogas collected a conservative hypothesis

was used, taking into account the total of biogas produced, and therefore methane diffused into the atmosphere<sup>5</sup>.

The change of emissions is a reflection of the policies put in place which act, first of all, on the prevention of waste at source and on emissions associated with "Dumping in landfills" (see chapter IV).

**Figure 26: change in emissions due to the waste treatment sector (categories CRF 6)**



Source: France's UNFCCC inventory under the convention framework, April 2013 submission - CITEPA/MEDDE

### The land use, land-use change and forestry sector (CRF 5)

Forestry contributes to the fight against climate change due to its atmospheric carbon sequestration capacity. It stores an average of 75 tons of carbon per hectare in trees (biomass above and below ground). Forests (the spread of forests, forest harvests and land-use change) represent a very large carbon dioxide sink (-56.5 Mt CO<sub>2</sub> in 2011 according to the 2011 GHG inventory in the Kyoto format, article 3.4), a steady increase since 1990.

Increased carbon sequestration in managed forests in Metropolitan France is mainly the result of a very low level of operation of the forestry resource, about half of its natural increase, together with the relative immaturity of this forest.

<sup>5</sup> An amending provision of the Order of 31st January 2008 on the annual declaration of pollutant emissions was published on 26th December 2012. From 1st January 2013 GERE declarations (emissions for the year n-1) by ISDND operators will be used to obtain information on the amounts of methane produced, burnt off and recovered, and thus enable their diffuse methane emissions to be calculated.

## C. French national inventory system (Article 5.1 of the Kyoto Protocol)

### (a) Name and address of the person in charge of the national inventory system appointed by the Party

In accordance with Article 5.1 of the Kyoto Protocol France has created a national inventory system: SNIEBA (National system for air emissions inventories and audits), defined by an inter-ministerial decree dated 24 August 2011.

The Ministry of Ecology, Sustainable Development and Energy (MEDDE) is responsible for its operation. Mrs Frédérique Millard of the General Directorate of Energy and Climate of MEDDE is responsible for the French national inventory of greenhouse gas emissions, frederique.millard@developpement-durable.gouv.fr.

### (b) Division of roles and responsibilities within the national inventory system

MEDDE defines and distributes the responsibilities allocated to the various bodies involved. They are distributed as follows:

- Project management of inventory compilation and coordination of the whole system is carried out by the General Directorate of Energy and Climate of MEDDE;
- Other departments, ministries (the General Committee on Sustainable Development of MEDDE, the Ministry of Agriculture, Food and Forestry (MAAF), the Ministry of the Economy, Finance and Industry (MINEFI)) and research bodies (INRA, ARMINES, IGN) contribute to the emissions inventories by providing data and statistics used to compile the inventories or giving methodological support.
- MEDDE has entrusted the compilation of emissions inventories, in respect of methods and preparation of their changes, data collection and processing, archiving, writing reports and various supporting material, quality

control and quality management, to CITEPA (Interprofessional Technical Centre for Studies on Air Pollution).

- MEDDE provides CITEPA with all the information at its disposal under existing regulations, such as annual declarations of pollutant waste from Classified Facilities, as well as the results of various studies providing more knowledge on emissions, which it initiated within its own departments and those of other public bodies such as INERIS. In addition, in the SNIEBA Order of 24th August 2011 MEDDE has drawn up a list of statistics and data from public bodies or those with a public service agenda, used for emission inventories (cf. table 16 below, appendix II of the SNIEBA Order).

MEDDE holds meetings of the Emissions Inventory Consultation and Information Group (GCIIE) three times a year. This group is made up of representatives of the above-mentioned ministries and bodies and representatives of the Ministry for Research, the Environment and Energy Management Agency (ADEME) and the French National Institute for Environmental Technology and Hazards (INERIS). The GCIIE's remit is to give advice on:

- Results of estimates produced from the inventories,
- Changes made to estimation methodologies,
- An action plan for improving inventories for future dates.

MEDDE deals with the distribution of the emission inventories. It distributes the GHG emissions inventory to the United Nations Framework Convention on Climate Change (UNFCCC) and in particular, in relation to the Kyoto Protocol, to the Convention Secretariat.

At MEDDE's request CITEPA distributes all the inventories it produces by, among other things, providing free public access to inventory reports via the web address <http://www.citepa.org/fr/>.

Table 16: list of statistics and data used for the emissions inventories (SNIEBA Order)

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## ANNEXE II

LISTE INDICATIVE DES STATISTIQUES ET DONNÉES ÉMANANT D'ORGANISMES PUBLICS  
OU AYANT UNE MISSION DE SERVICE PUBLIC UTILISÉES POUR LES INVENTAIRES D'ÉMISSION

SECTEUR	TYPE DE DONNÉES	ORGANISME ÉMETTEUR des données
Energie	Bilan de l'énergie. Consommation d'énergie en France. Consommation et ventilation des produits pétroliers à usage non énergétique. Consommations d'énergie dans l'industrie. Consommations d'énergie dans le résidentiel et le tertiaire. Consommations d'énergies renouvelables dans l'industrie et le résidentiel/tertiaire. Bilan de la pétrochimie.	Ministère chargé de l'industrie
	Déclarations annuelles des rejets polluants de certaines installations classées.	Ministère chargé de l'écologie
	Consommations d'énergie dans les industries agricoles et alimentaires (IAA).	Ministère chargé de l'agriculture et de la pêche
	Comptes des transports de la nation. Statistiques du transport maritime. Statistiques du transport aérien.	Ministère chargé des transports
Procédés industriels	Déclarations annuelles des rejets polluants de certaines installations classées.	Ministère chargé de l'écologie
	Production des IAA. Enquêtes de branches.	Ministère chargé de l'agriculture et de la pêche
	Statistiques industrielles.	INSEE
	Inventaires de fluides frigorigènes.	ADEME
Utilisation de solvants et autres produits	Déclarations annuelles des rejets polluants de certaines installations classées.	Ministère chargé de l'écologie
	Production, imports et exports, consommation de peinture/encre/colle.	INSEE et ministère chargé du commerce extérieur
Agriculture	Statistiques agricoles. Caractérisation des modes d'élevage (mode de gestion des déjections, bâtiments). Caractérisation des pratiques culturales. Facteurs d'émission.	Ministère chargé de l'agriculture et de la pêche INRA
UTCF (utilisation des terres, changement d'affectation des terres et foresterie)	Statistiques forestières. Utilisation du territoire. Récolte de bois et production de sciages.	Ministère chargé de l'agriculture et de la pêche
	Accroissement et stocks forestiers en métropole.	IFN
	Température/rayonnement solaire global.	Réseau RenEcofor/ONF
Déchets	Inventaire des installations de traitement des déchets ménagers et assimilés. Statistiques déchets de soins à risques. Statistiques déchets industriels.	ADEME et ministère en charge de l'écologie
	Déclarations de rejets polluants. Surveillance dioxines/métaux lourds des usines d'incinération.	Ministère chargé de l'écologie
Tous secteurs	Tout ou partie des éléments ci-dessus selon les secteurs, pour les inventaires territoriaux.	Voir ci-dessus, et AASQA, CITEPA, services des collectivités

In the interests of consistency, quality and efficiency, the large number of requirements involved in the compilation of inventories of emissions of pollutants into the atmosphere, often relating to similar substances and sources, justifies using the principle of uniqueness of the inventory system. This strategy is in line with the recommendations of the international authorities of the European Commission and the United Nations. The French organisation complies with the principles of national systems specified in article 5.1 of the Kyoto Protocol (decision CMP.1 annexed to decision 20/CP.7 of the UNFCCC).

### **(c) Collection procedures, choice of emission factors and emissions calculations**

Emissions inventories are carried out in accordance with UNFCCC recommendations (guidelines FCCC/SBSTA/2006/9) and based on the CORINAIR methodology.

In accordance with article 10 a. and f. of the Kyoto Protocol, France has undertaken various programmes to improve emissions factors or activity data relating to the national emissions inventory. These programmes are monitored by the GCIIE (Emissions Inventory Consultation and Information Group) as part of the SNIIEBA (Order of 24th August 2011 on the national system for air emissions inventories and audits). The main improvements to the national inventory, in recent years, are shown below.

#### **a) Energy/industry sectors**

- Implementation of an integrated system of declarations to the national emissions registry (GEREP) in 2005, enabling responses to be made to the different requirements in terms of registering emissions (EU ETS, E-PRTR) and requirements relating to the various emissions inventories. This programme improved national inventories by increasing the number of industrial sites individually taken into account and improved consistency between the national GHG inventory and data on the EU ETS registry.
- Exchange programme with the SOeS (the Ministry of Ecology's Statistics and Observation

Service) to refine certain points concerning energy consumption when using the national energy audit in the national emissions inventory.

- Work on the completeness of the national inventory (e.g. emissions linked to the industrial process of ferro-alloy production).
- Work to improve the f-gas emissions inventory in certain sectors in collaboration with the industrial federations, the Ecole des Mines in Paris and the Ministry of Ecology.
- Work on improving emission factors for the steel sector with the federation and annual GERP declarations.
- Etc.

#### **b) Transport sectors**

- Working group as part of the CCTN (National Transport Audit) to monitor and ensure appropriateness of national transport statistics (traffic data and consumption) for the national emissions inventories.
- French implementation programme for the European COPERT IV methodology (with its various successive versions) (improvements to road transport sector EFs for N20, CH4, NOx, etc.).
- DGAC (Directorate General of Civil Aviation) working group on aircraft emission evaluations, enabling emissions calculations for aviation to be improved periodically (e.g. refinement of aircraft engine distribution, taking APUs into account, etc.).
- Bottom-up work in 2010 for updating the distribution of fuel consumption between national and international maritime transport.
- Etc.

#### **c) Agriculture sector**

- Since 2010 a specific agriculture working group (with INRA, the technical institutes, the Ministry of Agriculture, etc.) as part of the GCIIE has met regularly to monitor and help to improve methodologies for the agriculture sector.
- In the last 3 years building survey data has been used to refine livestock farming emissions.
- Recently, the "MONDFERENT" ("Methane emissions from cattle in France", INRA) project has refined calculations of enteric fermentation

and cattle excrement management for the national inventory. This project was followed by the "MONDFERENT 2" project dedicated to excrement from small ruminants and sheep.

- Recently, following the 2010 Agriculture Census, the 1990 to 2011 statistics series on areas and annual production were updated in the March 2013 edition of the national inventory.
- Etc.

#### d) LULUCF sector

- Contributions of the French Land Use, Land-use Change and Forestry (LULUCF) working group with the GCIIE. This is manifested by taking into account growth parameters, sampling and stocks in soils on a regional basis, by improved land monitoring in Metropolitan France and the Overseas Departments and better knowledge about carbon stocks in the Overseas Departments.
- Since the April 2012 inventory, updating of statistical data on forest growth and mortality taken into account, particularly after reworking of the system of forest data collection in the field by the National Forestry Inventory which has merged with the IGN.
- Since the April 2012 inventory, inclusion of an additional item of statistical data for estimating forest harvest: "direct" measurement of forest removals. Thanks to this new information the impact of GHG inventory calculation hypotheses (volume of wood energy, source of wood energy, etc.) can be limited.
- Since the March 2012 inventory, stock value on artificial areas and wet lands taken into account, which was not the case in previous inventories. With this modification carbon flows from the soil reservoir can be taken into account, especially on artificial land surfaces, which has a significant impact in terms of emissions.
- April 2013 inventory, review of the CO<sub>2</sub> emission factor of scum from sugar refineries used in calcareous enrichment of agricultural soils
- Etc.

#### e) Waste sector

- Regular collaboration with ADEME and FNADE to improve emission factors and activity data for the waste sector.
- With the March 2013 edition of the national GHG inventory and after the ISDND survey, the collection of biogas generated and its combustion by flaring or recovery facilities are taken into account for the calculation of CH<sub>4</sub> emissions from waste.
- Improved estimates of emissions from industrial waste incineration, in terms of site identification (use of GEREPE declarations), especially for in-situ incineration. Identification of the impact of the use of alternative fuel.
- Extent and temporary resolution, periodicity
- As part of the UNFCCC, inventories are drawn up on the basis of a calendar year.

#### (d) Results of the analysis of key categories:

A key category is an emission category which, combined with other categories, contributes to 95% of France's GHG emissions. According to GIEC recommendations, an analysis of key sources is carried out. It is carried out as a whole on the basis of contributions in CO<sub>2</sub> equivalent of the different sources according to CRF categories for the six GHGs. According to GIEC recommendations this analysis is carried out by type of fuel for combustion plants. It also includes activities linked to LULUCF in order to meet UNFCCC recommendations. For 2011, reported in April 2013, CO<sub>2</sub> from road transport was in first place in the classification with a contribution of 20.7%. In view of the size of emissions from LULUCF, CO<sub>2</sub> from the "forests remaining forests" category manifesting, among other things, the spread of forests and forest harvest was in second place at 9.7%. CO<sub>2</sub> from natural gas in the residential sector was in 3rd place with a contribution of 5.4%. CH<sub>4</sub> from enteric fermentation in livestock was in 4th place with a contribution equal to 4.7 %. N<sub>2</sub>O direct from agricultural soils occupied 5th place with a contribution of 3.6 %, etc.

Detailed results are given in the appendix.

*Emission quantification methodology:*

The methodological approaches used are taken from the CORINAIR methodology which has been developed since the mid-80s (Cf. French NIR, 2013 submission, OMINEA, CITEPA report, May 2013) and follow GIEC guidelines for 1996, 2000, 2003 and UNFCCC guidelines.

**(e) Description of backward extrapolation of a methodological modification to previous inventories**

Each year a number of revisions are made to the inventory results. They are of two kinds, firstly, methodological and secondly, statistical. These modifications meet United Nations requirements and comprise a continuous improvement process that reduces uncertainties and makes the inventories more reliable.

The main justifications behind the annual revisions are:

- Retrospective statistical updates;
- Statistical breaks: once a statistic ceases to be distributed an alternative method is developed;
- Consecutive methodological improvements:
  - To decisions taken by the National Emissions Inventories Consultation and Information Group led by the Ministry for Ecology,
  - To comments made during official reviews of the French inventory by the United Nations and the European Commission,
  - To the availability of new information;
  - To corrections of errors and anomalies;
  - To the consideration of a new emission source.

After each submission of the inventory, the continuous improvement programme is revised by dealing with the key categories as a priority.

Modifications made are applied retrospectively to the whole historic series of emissions since 1990, the reference year of inventories under the UNFCCC.

Impact of modifications on the change in emissions  
In order to assess the impact of methodological changes made to the inventory, every year the body in charge of the inventory compares the

results of year n-3 obtained with the methodology of the year n-1 and with that of year n.

Modifications to methods between the 2011 submission and the 2010 submission show a difference of - 7.1 % in the change in total GHG emissions between 1990 and 2010. Discrepancies for this period, by gas and/or by sector, show that the new methodology results in a reduction of CH<sub>4</sub> emissions (-16%) linked to the implementation of the new methodology on landfills, an increase in SF<sub>6</sub> emissions (+18%) and a drop in HFC emissions (-10%).

**(f) Description of the quality assurance and quality control procedure***Quality management*

The national emissions inventory system was established by integrating the usual criteria applicable to Quality Management Systems (QMS). CITEPA implemented a system based on the ISO 9001 standard, version 2000. This provision was confirmed by the awarding an AFAQ certificate. The QMS covers the compilation of national emissions inventories by means of several specific processes (see CITEPA Quality Manual).

In this respect, several processes relating to quality control and quality assurance of inventories are included in the various processes and procedures put in place, corresponding to the various phases and actions on the following points:

- General review, resource management, planning and monitoring functions and participation in external work appropriate to emissions inventories.
- Choice, implementation and development of methodologies as well as selection of information sources and data collection. The method selection processes are clearly established particularly in relation to reference frameworks and relevant permanent characteristics expected from data sources.
- Development of calculation procedures, particularly emissions calculation models, databases and reports.
- Pursuit of adequate traceability and transparency.

- Implementation of controls relating to important stages and risks of processes and procedures, i.e. multiple internal checks on input data and databases or reports, data archiving, change monitoring (error corrections or improvements), non conformities.
- Validation and approval of inventory results.
- Validation and approval of reports and other information material by MEDDE.
- Systematic archiving of the necessary elements to ensure traceability.
- Dissemination of corresponding information and products.
- Permanent improvement to the quality of estimates by developing procedures to prevent any systematic errors, reduce associated uncertainties, cover emitted substances and sources of emissions more completely, etc. aimed at meeting quality objectives. A plan of actions is defined and regularly updated. It includes required and possible improvements taking into account GCIE recommendations.
- Evaluation of the implementation of quality control and quality assurance provisions, especially quality objectives and the quality plan.

#### *Quality objectives*

The overall objective of the quality assurance and quality control plan concerns the compilation of national emissions and sinks inventories in accordance with the requirements set out in the various national and international frameworks covered by the SNIEBA. Requirements aimed at meeting the following criteria:

- Exhaustiveness: all sources falling within the framework defined by the inventory or inventories must be taken into account.
- Consistency: the series must be homogeneous year on year.
- Accuracy / uncertainty.
- Transparency: the methods and data used must be clearly explained in order to be assessed as part of validation and verification. Consequently, data transparency is essential.
- Comparability.
- Confidentiality: the data disclosed in the inventories must comply with any confidentiality

rules that may be specified.

- Timeliness: the system for drawing up inventories must be such that it allows them to be produced within the required time scale.

#### *Quality control*

With regard to the compilation of inventories almost all the general arrangements (Tier 1) described in the GIEC Good Practice Guide are applicable. Specific arrangements for certain categories of sources (Tier 2) are implemented on a case by case basis largely in the "industry" and "transport" sectors.

#### *Quality assurance*

This is provided by several arrangements aimed at submitting inventories for review and gathering comments and assessments from the appropriate public sector experts. More particularly, the following actions, some of which are included in the inventory system and consequently in the QMS, have come into effect:

- Comments from members of the Emissions Inventory Coordination and Information Group which also have their own data for cross-checking methodological elements,
- Assessments by the local authorities (DREAL) in relation to individual activity and/or pollutant emission data declared annually via the National Registry of European Quotas.
- Quality assurance implemented by the statistics entities responsible for drawing up certain data in the context of agreements obtained by the Administration (energy audit, production, etc.).
- Reviews carried out by the Secretariat of the United Nations Framework Convention on Climate Change; these reviews give rise to reports which enable improvements to be introduced.
- The revisions carried out on the various frameworks (EEC-UN / LRTAP, EC/Community Mechanism for Monitoring Greenhouse Gas Emissions, etc.) are in effect analysed by experts who each participate, in relation to the other frameworks, in the quality assurance of emissions inventories.
- Selective examinations carried out by various people with access to the inventory reports available to the public or following comments

made by third parties.

- Bi- and multi-lateral discussions and actions carried out with foreign experts and bodies responsible for compiling national inventories.

#### **(g) Description of the official inventory validation procedure**

In accordance with the responsibilities described above, the GCIE validates methodological changes to the submission of the national inventory report for the year n+2 in September of the year n+1. It then validates the inventory results in December of the year n+1.

## **D. National registry**

The Caisse des Dépôts is a public group and long term investor in the general interests of the country and its economic development. Under Decree n° 2004-1412 the Caisse des Dépôts was given responsibility for administering the French national registry and developing information systems designed to use the registry, and ensuring their security.

Since migration to the European Union registry in June 2012, the European Commission is now responsible for supplying, maintaining and securing the national registry information system for the commitments of European Member States as Parties to the Kyoto Protocol (KP registry) and as participants in the European Union Emissions Trading System (EU-ETS Registry) run by the European Commission.

Decree n° 2004-1412 of 23rd December 2004 was amended by Decree 2012-343 of 3rd December 2012 to integrate changes in European Directives, in particular the replacement of national registries by a single system developed by the Commission. It also confirmed the public service concession awarded to the Caisse des Dépôts for the period 2013-2020.

Directive 2009/29/EC adopted in 2009, provided for the centralised operation of the Greenhouse Gas

Emission Allowance Trading Scheme (EU ETS) in a single EU registry administered by the European Commission, including the aviation sector. Moreover, in view of the increasingly effective management of their respective national registries the EU Member States which are also Parties to the Kyoto Protocol (KP) as well as Iceland, Liechtenstein and Norway decided to administer their registries on a consolidated basis in accordance with the decisions applicable to the implementation of the Parties' registers, in particular decisions 13/CMP.1 and 24/CP.8.

In 2012 the EU Registry was thus the subject of a major adjustment in order to comply with the requirements of European regulations 920/2010 and 1193/2011 and also meet Member States' obligations as Parties to the Kyoto Protocol, requiring them to administer national registries. The single platform that ensures that national registries are kept in a consolidated manner (including that of the EU) is called the Consolidé de Registres Européens (Consolidated System of European Registries – CSEUR). It was developed in parallel with the new EU registry on the basis of the following models:

- Each party remains responsible for its designated organisation both as administrator of the registry, charged with keeping its national registry and meeting all its obligations, and as a Party to the KP;
- The unique serial number of each Kyoto unit issued in the EU Registry by one of the constituent Parties contains the origin identifier of the said Party;
- Each Party keeps its own series of national accounts in accordance with paragraph 21 of the appendix to decision 15/CMP.1. Any account opened in a national registry keeps a unique identification number composed of the Party's origin identifier followed by a unique serial number pertaining to the Party where the account is open;
- Kyoto transactions continue to be transmitted to the UNFCCC's Independent Transaction Log (ITL). The ITL remains responsible for verifying the accuracy and validity of these transactions.
- The transactions log and the registries continue

to reconcile their data in order to ensure their consistency and to facilitate automated checks by the ITL;

- The provisions of Decision 13/CMP.1, annex, paragraphs 44 and 48 on the publication of non-confidential information are incumbent upon each Party individually;
- All the registries are hosted on a single computer platform sharing the same infrastructure technologies. The chosen architecture implements arrangements that ensure that the national registries can be uniquely identified, protected and differentiated from one another, in particular:
  - Concerning data exchange, each national registry is directly connected to the ITL via a separate secure data link based on a consolidated communication channel (Virtual Private Network);
  - The ITL remains responsible for the authentication of national registries and ensures the exhaustiveness and finalisation of records of all transactions involving Kyoto units and other administrative processes such that these transactions cannot be challenged or cancelled;
  - Concerning data storage the consolidated platform continues to ensure the confidentiality and protection of data against any unauthorised manipulation;
  - The data storage architecture moreover guarantees that data relating to the national registry is differentiated and identified uniquely in relation to data concerning other consolidated national registries;
  - In addition, each national registry retains a separate point of entry (URL) and must specifically apply the authorisation and configuration rules.
- After the CSEUR platform was brought into production the 28 national registries concerned were re-certified on 1st June 2012 and migrated to their new registries on 20th June 2012. On start-up all data relating to transactions and accounts was transferred to the CSEUR platform. Individual connections to and from the ITL were re-established for each Party.
- The following changes were made to France's national registry in 2012 following migration to the CSEUR platform:

Section	Description
15/CMP.1 Annex II.E Paragraph 32.(a) Changes of name or contact	The Administrator of the French Registry is Mr Yves ANDRE since 1st March 2011: + 33 1 58 50 11 87 <a href="mailto:yves.andre@caissedesdepots.fr">yves.andre@caissedesdepots.fr</a>
15/CMP.1 Annex II.E Paragraph 32.(b) Changes to the cooperation agreement	<p>The EU Member States which are also Parties to the Kyoto Protocol together with Iceland, Liechtenstein and Norway decided to administer their registries on a consolidated basis. The Consolidated European Registries System was certified on 1st June 2012 and put into production on 20th June 2012.</p> <p>A full description of the single registry was submitted to the ITL in the general and specific documentation in view of start-up of the EU national registry and consolidated national registries. This description among other things includes the following points:</p> <ul style="list-style-type: none"> <li>- <b>Start-up questionnaire</b></li> <li>- <b>Access monitoring and management</b></li> <li>- <b>Change management procedure</b></li> <li>- <b>Disaster recovery</b></li> <li>- <b>Manual intervention</b></li> <li>- <b>Operational plan</b></li> <li>- <b>Roles and responsibilities</b></li> <li>- <b>Security plan</b></li> <li>- <b>Validation deadlines</b></li> <li>- <b>Update management</b></li> </ul> <p>A new centralised support service was set up for national registry administrators of this consolidated system. This support service acts as 2nd line local support supplied by the Parties. It also plays a key role in communications with the ITL Service Desk, particularly in relation to connectivity or reconciliation problems.</p>
15/CMP.1 Annex II.E Paragraph 32.(c) Changes to the structure or capacity of the national registry database	<p>Up to 19th June 2012 no change of structure since the last submission. Data was stored on disks in RAID 5 with 50 GB capacity. Used on this basis: 3 GB for the databases and 20 GB for local backups. It was possible to extend the storage but this involved stopping the service.</p> <p>In 2012 the EU Registry was the subject of a major overhaul in order to comply with the requirements of European regulations 920/2010 and 1193/2011 and also to meet Member States' obligations as Parties to the Kyoto Protocol, requiring them to administer national registries.</p> <p>A full description of the single registry was submitted to the ITL in the general and specific documentation in view of start-up of the EU national registry and consolidated national registries.</p> <p>During certification the consolidated registry was, among things, subjected to various tests (connectivity, reliability, identification and interoperability) to test its conformity with the Data Exchange Standard (DES). All the tests were successfully carried out and led to the awarding of certification on 1st June 2012.</p>

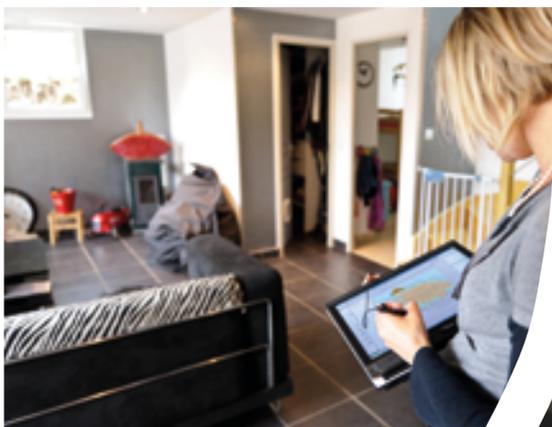
Section	Description
<p>15/CMP.1 Annex II.E Paragraph 32.(d) Changes concerning conformity with technical standards</p>	<p>All the changes made for the purpose of setting up the Consolidated European Registries resulted in changes to registry software and required new conformity tests.</p> <p>A full description of the single registry was submitted to the ITL in the general and specific documentation in view of start-up of the EU national registry and consolidated national registries.</p> <p>During certification the consolidated registry was, among other things, subjected to various tests (connectivity, reliability, identification and interoperability) to test its conformity with the Data Exchange Standard (DES). All the tests were successfully carried out and led to the awarding of certification on 1st June 2012.</p>
<p>15/CMP.1 Annex II.E Paragraph 32.(e) Change in discrepancy handling procedures</p>	<p>All changes made for the purpose of setting up the Consolidated European Registries resulted in changes to discrepancy handling procedures, as indicated in the updated service manual and operational plan submitted to the ITL.</p> <p>A full description of the single registry was submitted to the ITL in the general and specific documentation in view of start-up of the EU national registry and consolidated national registries.</p>
<p>15/CMP.1 Annex II.E Paragraph 32.(f) Changes relating to security</p>	<p>All the changes made for the purpose of setting up the Consolidated European Registries led to changes in relation to security, as described in the security plan submitted to the ITL.</p> <p>A full description of the single registry was submitted to the ITL in the general and specific documentation in view of start-up of the EU national registry and consolidated national registries.</p>
<p>15/CMP.1 Annex II.E Paragraph 32.(g) Changes to information sites available to the public</p>	<p>The new information sites for the French Registry can be viewed at the following address:  <a href="http://www.seringas.caisseledesdepots.fr">http://www.seringas.caisseledesdepots.fr</a>  Public reports (SEF/SAIR) are available at the following address:  <a href="http://www.seringas.caisseledesdepots.fr/-rapports-publics-.html">http://www.seringas.caisseledesdepots.fr/-rapports-publics-.html</a></p>
<p>15/CMP.1 Annex II.E Paragraph 32.(h) Change of website address for the registry</p>	<p>The new website address of the French Registry is:  <a href="https://ets-registry.webgate.ec.europa.eu/euregistry/FR/index.xhtml">https://ets-registry.webgate.ec.europa.eu/euregistry/FR/index.xhtml</a></p>
<p>15/CMP.1 Annex II.E Paragraph 32.(i) Changes concerning data integrity measures</p>	<p>All the changes made for the purpose of setting up the Consolidated European Registries led to changes in relation to data integrity measures, as described in the security plan submitted to the ITL.</p> <p>A full description of the single registry was submitted to the ITL in the general and specific documentation in view of start-up of the EU national registry and consolidated national registries.</p>

Section	Description
<p>15/CMP.1 Annex II.E Paragraph 32.(j) Changes after conclusive tests</p>	<p>A new version of the software (V4) was released on 2nd October 2012 , comprising functionalities to enable:</p> <ul style="list-style-type: none"> <li>- Phase 3 quotas and aviation quotas to be made open for bidding</li> <li>- A new type of EU ETS account to be opened (negotiation account),</li> <li>- Lists of trusted accounts to be set up.</li> </ul> <p>Lists of trusted accounts will complete all the security measures available in the single Registry. This measure prevents any transfer from a deposit account to an account not appearing on the trusted list associated with the issuance account.</p>
<p>Recommendations of the previous annual report</p>	<p>After its last SIAR assessment the team of experts in charge of the review (Expert Review Team) indicated:</p> <ol style="list-style-type: none"> <li>1) In its SIAR evaluation report (part 1) of 13th July 2012 “that a clear confidentiality declaration was added to the public page of the Party’s website. The declaration referred to current EU regulations”.</li> <li>2) In its SIAR evaluation report (part 2) of 30th July 2012 “that the Party has solved all technical problems previously raised in relation to the dissemination of information to the public and that no further recommendation was needed. ”</li> </ol>

# Policies and measures

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In accordance with UNFCCC guidelines the policies and measures implemented by France are classified according to two categories:

Existing measures, which refer to policies implemented before 1 January 2012 Additional measures which refer to measures decided after 1 January 2012 and sectoral objectives which have entered French Law.

Results of scenarios including one or other category of measures are presented in chapter V. Individual evaluations of existing or additional measures are presented in this chapter.

## A. The policy making process

### A.1 Institutional foundations

Coordination and organisation of domestic policies on tackling climate change is a responsibility of the General Directorate for Energy and Climate (DGEC) of the Ministry in charge of Sustainable Development - MEDDE - (see also chapter 1). Regarding adaptation, the French National Observatory for the Effects of Global Warming (ONERC), set up by the French Parliament on 21 February 2001, is tasked with collecting and disseminating information on global warming and extreme weather phenomena. It is attached to the General Directorate for Energy and Climate. Policy and measures monitoring committees organised by the department for tackling the greenhouse effect have met periodically since November 2009.

Policies which contribute to climate change adaptation and mitigation and require public spending are covered by the cross-sector "Climate" policy document (DPT), which the Ministry of Ecology, Sustainable Development and Energy presents to Parliament each year as an appendix to the Finance Bill. This document contains:

- 1) A presentation of cross-sector policies and the overall strategy for improving performance and a presentation of selected performance indicators and objectives by key strategic area and their associated values;
- 2) A detailed presentation of the French government's financial investment contribution to the national climate policy for the coming

- year, the current year and the previous year;
- 3) A list of programmes which contribute to the cross-sector policy and a detailed presentation of the way in which they participate in its implementation.

### A.2 The foundations of French climate policy

Stated in action plans since 1995 and then defined within an integrated approach in the French National Programme for Combating Climate Change (2000), French climate policy is based on two pillars: mitigation (reduction of GHG emissions) and adaptation. It is part of the French National Sustainable Development Strategy published in June 2003, the last update of which was adopted in July 2010.

Climate policy is presented in the "Climate Plan", which is the French action plan for complying with its European (Climate and Energy Package) and international (Kyoto Protocol) commitments. The Climate Plan has been revised at two year intervals in accordance with article 2 of the French framework law setting the directions to be followed by the energy policy of 13 July 2005. In the same law, France set itself the target of a four-fold cut in emissions by 2050 (article 2 of the Law of 13 July 2005, reaffirmed in the law of 3 August 2009). The policy on combating climate change was revised in 2007 as part of the "Grenelle Environment Round Table". At the end of these discussions new laws relating to climate, in particular, were adopted:

- Framework Law no. 2009-967 of 3 August 2009 on implementation of the Grenelle Environment Round Table;
- Law no. 2010-788 of 12 July 2010 on the national commitment in favour of the environment.

In order to take the environmental dialogue to the same level as the social dialogue and to enable France to achieve an energy and ecological transition, the first environmental conference was organised in 2012. These conferences will take place every year.

The first of these environmental conferences

led to the launch of a great national debate on the energy transition. Discussions across France during the first half of 2013 contributed to this public debate, revealing a shared awareness of investments needed today in order to change the French energy mix over the course of the next few decades, in line with French international commitments, particularly those of the second period of commitment to the Kyoto protocol (see chapter II) and to identify the measures to be implemented to develop renewable energies and to make the best use of available energy by optimising consumption. An energy transition Bill will result from the conclusions of this debate.

In the **energy sector**, the main measures defined in the 2004-2012 Climate Plan and its 2006, 2009 and 2011 updates are:

- The European Union Emissions Trading Scheme;
- Implementation of a system of energy saving certificates;
- Support for renewable electrical energy through feed-in tariffs;
- Implementation of a fonds chaleur (heat fund) to support development of renewable thermal energies.

In **industry**, the main measures are:

- The European Union Emissions Trading System;
- Energy audits;
- F-gas regulations.

In **transport**, the main measures are:

- The development of biofuels through incorporation targets (7% in 2010) and incentive measures;
- CO<sub>2</sub> emissions and consumption labels for new vehicles (private cars, light utility vehicles);
- Bonus-malus scheme for purchases of new vehicles;
- Introduction of an eco-tax for heavy goods vehicles;
- Implementation of a requirement for transport service providers to give information of the amounts of CO<sub>2</sub> emissions resulting from their services;
- Development of public transport with dedicated lanes and intermodal inter-urban transport,

particularly through calls for projects

In the **building** sector, the main measures are:

- The new thermal regulation RT 2012;
- Energy performance labels for new buildings (high-energy performance HPE and very high-energy performance THPE) for new buildings;
- Tax credit for cost of equipping main residences with energy-saving and sustainable development appliances;
- Low-interest loans to encourage the retrofitting of social housing (éco-PLS - social housing eco-loans) and extensive retrofitting of the housing stock (éco-PTZ - zero rate eco-loan).

In **agriculture**, the main measures are:

- The second pillar of the Common Agricultural Policy and the Nitrate Directive
- The "Serre-énergie" (Greenhouse - Energy) plan or measures such as the tractor adjustment campaign which aim to reduce energy consumption on farms;
- Implementation of a programme to recover agricultural biogas.

### **A.3 Implementation of EU policies**

The climate and energy package tackles energy and climate issues using an integrated approach and is based on three pillars: increased production of renewable energies to achieve a level of 20% of total energy consumption, a 20% reduction in European energy consumption compared with the trend and a 20% cut in the European Union's greenhouse gas emissions compared with 1990. The greenhouse gas emissions reduction target was the subject of a standardised treatment integrated at the EU scale for the largest emitters through the European Union Emissions Trading Scheme (EU ETS, in which allocations are reduced by 21% between 2005 and 2020), and a burden sharing between Member States of reductions of more diffuse emissions (transport, construction, agriculture, waste, and smaller industrial plants, etc.). In this respect France is committed to a target which supposes a reduction of its emissions from activities not covered by the ETS by 14% between 2005 and 2020.

Implementation of EU provisions contributes to the achievement of these European targets, with among other things:

- The review of the EU ETS directive which has permitted quota allocation methods to be standardised within the EU and has reinforced the targets of the previous directive;
- The Directive on the promotion of the use of energy from renewable sources which sets a target of 20% of final energy consumption being of renewable origin by 2020 for the EU, 23% of which is for France;
- The 2012 Energy Efficiency Directive which supplements the Energy Services Directive of 2006. It establishes a common framework of measures for promoting energy efficiency within the European Union to ensure the objective of increasing energy efficiency by 20% between now and 2020 is achieved. In this respect, France is required to send updates of its National Action Plan for Energy Efficiency (PNAEE). This plan notes energy efficiency actions undertaken enabling the indicative energy savings target of 9% to be reached by 2016 and 20% by 2020;
- Regulation on CO<sub>2</sub> from vehicles for which the target is to reduce average specific emissions from new vehicles
- The Energy Performance of Buildings Directive (EPBD) which allows the energy consumption of new and existing buildings to be reduced through thermal regulations, energy performance assessments and inspections of boilers and air conditioning systems;
- Implementation of the Ecodesign Directive which enables requirements to be set in terms of the ecodesign of energy consuming products (light bulbs, electrical appliances, etc.);
- The directive on the quality of biofuels, which introduces a target of reducing GHG emissions per quantity of energy produced by 10% between 2010 and 2020, is currently under review to take account of the re-evaluation of the importance of indirect land-use changes brought about by this policy.

#### A.4 Assessment of the impact of policies and measures

In addition to the overall assessment of WEM and WAM scenarios (see chapter V), and in order to improve the quantification of the policies and measures that France has to publish as part of its EU and international commitments, MEDDE has developed a tool for evaluating the impact in terms of emissions in comparison with a reference scenario by changing the technical input data (e.g. change in road traffic, housing stock, building insulation) according to the planned measures. This tool (known as SceGES for Scénarisation des Emissions de GES or GHG emissions scenario writing) was developed with the Ecole des Mines in Paris, CITEPA (Interprofessional Technical Centre for Studies on Air Pollution), Energies Demain and Solagro engineering and design firms and INRA (French National Institute for Agricultural Research). SceGES is a climate and energy assessment tool which is based on a bottom-up approach. Emissions calculations are therefore based on fine activity data from a sectoral point of view. For each measure considered, this tool enables energy savings and greenhouse gas emissions reductions to be quantified<sup>1</sup> in relation to a reference scenario, once the physical input parameter changes caused by the measures have been evaluated.

The reference scenario comes from the scenario development work presented in chapter V. For SceGES purposes the scenario is extended until 2035.

The main characteristics of the SceGES tool are as follows:

- SceGES deals with direct emissions of the six greenhouse effect gases of the Kyoto protocol. It is in line with the official national inventory in the Kyoto geographical framework for the period 2005 to 2010 and a trend scenario up to 2035;
- SceGES covers the main sectors of greenhouse gas emissions activities considered in the National inventory: buildings (residential and tertiary), transport (road, air, water and rail),

<sup>1</sup> Including non-energy greenhouse gas emissions (agriculture, refrigeration fluids,...)

electricity generation, manufacturing industry, refineries (oil products), biofuel production, urban heating, waste treatment (landfill, sewage treatment and incineration), agriculture (crops and livestock) and domestic and industrial use of refrigeration fluids;

- Emissions calculations are based on a technically detailed description for the majority of sectors of activity (description of the housing stock according to year of construction, description of the vehicle fleet according to capacity, vehicle age, rate of car ownership, description of livestock in agriculture, description of built-up areas accommodating tertiary activities by sector, etc.).

The parameters (description of the stock, volume or energy intensity of a given activity) constituting each of these trends can be adjusted by the user who can create his own scenario by changing their evolution over time. Results of the calculation are then given by deviation from the “trend” curve in tons of CO<sub>2</sub> equivalent with annual time steps.

Each GHG emitting sector of activity is dealt with in the form of a module. Some modules function independently (e.g.: refrigerant module – f-gases) whereas others interact with each other (e.g.: construction and electricity production/demand modules).

Each module starts with an official emissions trend going from the base year 2005 to the year 2035: DGEC 2010 scenario for the transport, construction, electricity production and demand sectors, Ecole des Mines de Paris scenario for the f-gas sector, INRA scenario for the agriculture module.

By changing trend scenario parameters (description of the stock, volume or energy intensity of a given activity) a new scenario can be created. Results of the calculation are then given by deviation from the trend curve in tons of CO<sub>2</sub> equivalent per year.

Measures evaluated with the SceGES tool up to the present time are listed in table 17. Note that while this approach cannot substitute for an overall assessment of changes in GHG emissions,

particularly due to the non-additionality of some measures, it nonetheless represents an improvement in the assessment of each of the measures proposed for the public decision-maker.

**Table 17: Measures evaluated with the help of SceGES (inventory, July 2013)**

Sector	Measures evaluated
Energy	Renewable energy development objectives (multi-annual investment programming: wind, hydroelectric, biomass and photovoltaic solar power); Ban on incandescent light bulbs (implementation of the “Ecodesign Directive”); Turning off illuminated shop signs during the night (Decree 2012-118 of 30 January 2012).
Construction	Thermal regulations (RT2005, RT2012); Eco-prêt à taux zéro; Crédit d’impôt développement durable.
Transport	Fiscal measures aimed at changing new vehicle purchase behaviour (bonus-malus, scrappage scheme); National biofuels incorporation target (POPE Law and Agriculture Framework Law) Eco-tax for heavy goods vehicles French national plan for the development of electric and hybrid vehicles
Agriculture	Doubling of areas under leguminous plants by 2020 (Objective of the Land Objectives Plan 2009); Abolition of set-aside payments by 2020 (CAP Health Check 2008).
Waste treatment	Reduction of household waste production and increased recycling (article 46 of Framework Law 2009-967 of 3 August 2009 on the implementation of the Grenelle Environment Round Table).
Refrigeration fluids	Ban on the use of HFCs with high PRG in car air-conditioning (Directive 2006/40/EC).

## B. Regional or domestic legislative and/or administrative programmes put in place to meet the requirements of the Kyoto protocol

The public authorities have introduced a number of measures aimed at integrating sustainable development criteria and energy efficiency criteria into public procurement. Public purchases account for about 10% of GDP and help to give prospects to market participants, particularly through the volume of orders and the direction given by public policies. The Public Procurement Code has been adjusted continually since 2004 and now allows sustainable public procurement procedures to be developed. An economic observatory of public procurement was created by the Order of 10 November 2005. Its general secretariat is provided by the legal affairs section of the Ministry of Economy. It brings together all public procurement stakeholders: professional organisations, those in charge of implementing economic policies and buyers' representatives.

The Ministry for Economy and Finance provides information for public officers to promote environmentally responsible public procurement. Specific sectoral guides are updated each year (for example, publication in July 2012 of the guide to public procurement of road transport vehicles).

A network of senior sustainable development officers (HFDD) was set up in 2003 within each ministry in order to promote the mobilisation of services. They are responsible for ensuring compliance with commitments concerning coordination of the implementation of sustainable development action plans within each authority. More broadly, combating climate change and controlling energy demand are the subject of specialised training courses on issues such as procurement, energy,

HQE standardisation, land management, urban mobility plans, etc. In particular they are organised and provided by the Institut de FORMation de l'Environnement (IFORE) (Institute of Environmental Education), the Institut de la Gestion Publique et du Développement Economique (IGPDE) (Institute of Public Management and Economic Development) and the Centre National de la Fonction Publique Territoriale (CNFPT) (National Centre of Local Government Civil Service).

Since 2008 an "Exemplary State" circular has specified the national objectives in terms of exemplary environmental behaviour.

### Third report of the Exemplary State system (in the course of publication)

In the construction and energy sector, due to voluntary action by authorities which have implemented the necessary means, the target objectives of the circular of 3 December 2008 were reached and overachieved. Average energy consumption per officer fell by 12% (by value, after correction of the inflation) between 2009 and 2011.

Some authorities have gone beyond the assessed actions by developing ministerial strategies on energy expenditure and recommending the use of energy saving certificates to promote lower energy actions.

In the transport and travel sector, since 2010 the authorities have made sufficient progress on greenhouse gas emissions from bought or rented private cars to exceed the targets set by the circular of 3 December 2008. Results were improved still further in 2011: 91% of bought or rented vehicles emitted less than the stipulated emission threshold (120 g of CO<sub>2</sub>/km in 2011) even though it had been lowered by comparison with 2010 (it was 130 g of CO<sub>2</sub>/km).

In addition, nearly half (45%) of the French government's professional drivers were trained in eco-driving in 2011 and therefore drive in a way that saves more energy and produces lower greenhouse gas emissions. At the same time, all authorities have a system to monitor air miles travelled, the first stage towards rationalisation

of air travel. Video-conferencing is currently being deployed: all authorities have rooms fitted with video-conferencing systems, ranging up to several hundred in ministries with a large number of decentralised services (interior, justice). All these measures help to reduce greenhouse gas emissions, cut economic costs and improve staff well-being.

The Exemplary State measure has been reinforced particularly in relation to everyday purchases and the State's environmental compliance and social responsibility measures, as an employer and economic operator. All public bodies employing over 250 people and all territorial collectivities of more than 50,000 people have had to report their GHG emissions before 31 December 2012.

### **B.1** Legislative arrangements implemented at regional level

As public order givers, territorial collectivities together with the State play a major role in respect of their assets (buildings,...), direct activities and more broadly through effects of their actions on the whole economic and social fabric. Measures concerning territorial collectivities or measures in which territorial collectivities are involved relate to all sectors (transport, construction, agriculture, forestry and energy).

#### **The regional planning dynamic**

Regional collectivities and the State work together to prepare regional climate, air and energy plans. Two thirds of these regional planning documents have already been adopted. Only one, which is still in preparation, has not yet been submitted to public enquiry. These plans have been the subject of considerable mobilisation of stakeholders and civil society through synergy with the national debate on the energy transfer carried out in the spring of 2013. These plans ensure the consistency of regional targets for mitigating climate change, improving air quality, developing renewable energies and adaptation to climate change, on the basis of a guide prepared by the State.

Regional, departmental, urban and large inter-municipality collectivities are implementing

regional climate and energy plans (plans climat énergie territoriaux – PCET). At the same time, they are also setting up observation structures in the climate and energy sector and developing actions to raise awareness and support local stakeholders in their territory. In spring 2013, 374 PCET were initiated, of which 140 have been adopted and entered the implementation phase. Some of these measures were initiated by collectivities of less than 50,000 people, for which the measure is voluntary. ADEME has taken the organisation of this measure to the national level, with the preparation of a guide, feedback, development of networks of elected representatives and the introduction of labels promoting the actions of collectivities. Each PCET is based on a territorial emissions report and describes the practical mitigation and adaptation measures planned by the collectivity.

#### **Funding projects**

In the context of contracts between the State and the regions (project contracts for the period 2007-2013), ecology and sustainable development have benefited from a State budget of €2.11 billion for seven years, i.e. over €300 million a year. This includes such issues as natural hazards, preservation of biodiversity, energy-saving and promotion of renewable energies.

Of these commitments, the State has given particular priority to supporting regional climate plans with funding of up to €76 million per year for regional energy projects. This contractual arrangement specified the principle of carbon neutrality for the investments funded. To assess and monitor this carbon neutrality, the State implemented a tool called NECATER in 2007, managed by the Délégation à l'Aménagement du Territoire et à l'Attractivité Régionale (DATAR) (Delegation for territorial development and regional attractiveness).

In addition to contracted funding, territorial collectivities have also been able to promote their projects as part of the Energy Saving Certificates (ESC) schemes set up by the Energy Policy Framework and Orientation Law (POPE Law) of 13 July 2005 (cf. section on the energy sector). This

provision, which is targeted at essential energy suppliers, enables public collectivities carrying out energy-saving projects within the framework of their powers to obtain ESCs which they can sell and use to finance part of their projects. Municipalities also benefit from purchase prices on electricity generated from renewable sources (cf. Section on the energy sector).

## B.2 Description of publicity centred on these projects

Civil society representatives are systematically involved in preparing and monitoring the implementation of SCRAEs (Regional Climate, Air and Energy Plans) and PCETs (Regional Climate and Energy Plans), well beyond mandatory consultations alone. These planning documents schedule projects to raise public awareness in their territory. ADEME organises a documented and widely consulted PCET resource centre (<http://www.pcet-ademe.fr/>) and distributes a large number of educational tools aimed at the general public and businesses.

## B.3 Description of legislative arrangements put in place to coordinate participation in the mechanisms under article 6, 12 and 17 of the Kyoto Protocol

A major decision was taken at the end of 2008 which helps to improve management of the French climate policy, in its “carbon markets” component. It consists in the creation of a **carbon markets bureau within the General Directorate of Energy and Climate (DGEC) of MEDDE, by the Order of 16 December 2008.**

The purpose of this unit is “[to] develop and propose a strategy for managing the State’s carbon assets and intervene in carbon markets if it needs to buy or sell emission rights or quotas”. It also aims to improve the consistency of administrative action by grouping the State’s main allocations in the carbon markets sector: reform of the operation of the EU emissions trading scheme, defining the French position on the interconnection of carbon markets in the post-Kyoto framework,

management of the approvals procedure for project mechanisms (Clean Development Mechanisms and Joint Implementation Mechanisms, especially in its “Domestic” component).

By ratification of the Kyoto Protocol and later agreements implementing the Protocol (particularly those signed in Marrakech in 2001), France decided to give its support to the implementation and development of innovative financing instruments which constitute the Protocol project mechanisms.

The CDM (clean development mechanism – article 12 of the Kyoto Protocol) enables countries not listed in annex 1 to the Convention (or annex B of the Kyoto Protocol) to be included in GHG emissions reductions, through incentives and partnerships, while reducing compliance costs for businesses and countries with legally binding targets.

The JI (joint implementation – article 6 of the Kyoto Protocol) enables the countries in annex one of the Convention to effectively use their own GHG emissions reduction sources by encouraging the emergence of projects through the issue of carbon credits.

By means of Decree n° 2006-622 of 29 May 2006, the Order of 2 March 2007<sup>2</sup> and the Order of 27 December 2012<sup>3</sup>, France has put the necessary legal framework and other procedures in place for implementing CDM and JI projects, including those on national territory (“Domestic Projects”).

On the institutional level, the Inter-ministerial Mission on the Greenhouse Effect (MIES) was until July 2008 responsible for coordinating implementation of the project approvals procedure on behalf of the French government. Following Decree n° 2008-680 of 9 July 2008, which brought MIES to an end, this mission was devolved to the DGEC’s “carbon markets” unit, which now fulfils

<sup>2</sup> [http://www.legifrance.gouv.fr/jopdf/common/jo\\_pdf.jsp?numJ0=0&dateJ0=20060530&numTexte=58&pageDebut=08089&pageFin=08091;](http://www.legifrance.gouv.fr/jopdf/common/jo_pdf.jsp?numJ0=0&dateJ0=20060530&numTexte=58&pageDebut=08089&pageFin=08091;)  
[http://www.legifrance.gouv.fr/jopdf/common/jo\\_pdf.jsp?numJ0=0&dateJ0=20070307&numTexte=61&pageDebut=04386&pageFin=04389](http://www.legifrance.gouv.fr/jopdf/common/jo_pdf.jsp?numJ0=0&dateJ0=20070307&numTexte=61&pageDebut=04386&pageFin=04389)

<sup>3</sup> <http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000026864354&dateTexte=&categorieLien=id>

the functions of the Designated National Authority (DNA) for the CDM and the Designated Focal Point (DFP) for the JI.

The Ministry of Ecology informs the project proposers of the authority's decision, which takes the form of a Letter of Approval (LoA), within one month of receipt of the full dossier for projects carried out outside the national territory and two months for projects which take place in France ("domestic projects" see next paragraph).

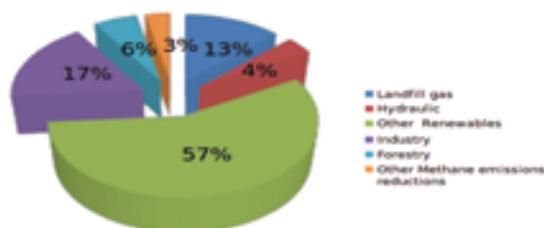
A practical guide was written and distributed in November 2008<sup>4</sup> under the aegis of the Ministry of Ecology, the Ministry of the Economy and the French Global Environment Facility (FFEM) to give project proposers a better understanding of the Protocol's flexibility mechanisms and help their appropriation of the underlying legal and institutional mechanism.

### France in the CDM

Since 2005 France has issued 182 LoAs and 102 letters of authorisation to participate in CDM projects.

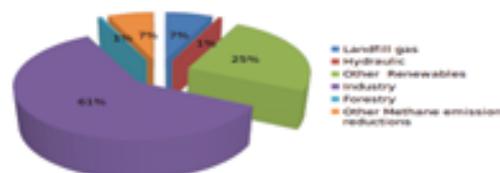
The distribution of projects shows the dominance of industrial activities by percentage of credits generated (61%), while renewable energies have been promoted in most projects (57% of the total number of projects).

**Figure 27: Portfolio of CDM projects on 1 July 2013 by category (in % of total number of projects)**



<sup>4</sup> "Carrying out a CDM or JI GHG emissions reduction project: what opportunities are there? How do you move to action?"

**Figure 28: Distribution of credits according to type of CDM project on 1 July 2013 (in % of total credits generated)**



### France and Joint Implementation

In the context of the JI the French government has approved 33 projects.

Nearly half of these are renewable energy projects. It is the industrial projects, however, that have generated the largest amount of emissions reductions (49% of GHGs reduced by JI projects approved by France).

As well as issuing Letters of Approval and letters of authorisation for projects implemented in the other Annex 1 countries, France decided to take advantage of the JI as an innovative financing tool for promoting low-cost reduction projects in sectors considered as "diffuse", i.e. not covered by the EU GHG Emissions Trading Scheme.

The creation of this "domestic projects" system was officially announced by the French Government on 2 December 2006 on the basis of a discussion paper produced at the end of 2005 by the Caisse des dépôts et consignations (French Deposits and Consignments Office). The system was optimised by a new order of 26 October 2012<sup>5</sup>.

Domestic projects aim to give carbon credits (emission reduction units) as remuneration to businesses and households which make a commitment, on French territory, to reducing their GHG emissions by more than that required by current standards, in sectors such as transport,

<sup>5</sup> <http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000026705395>

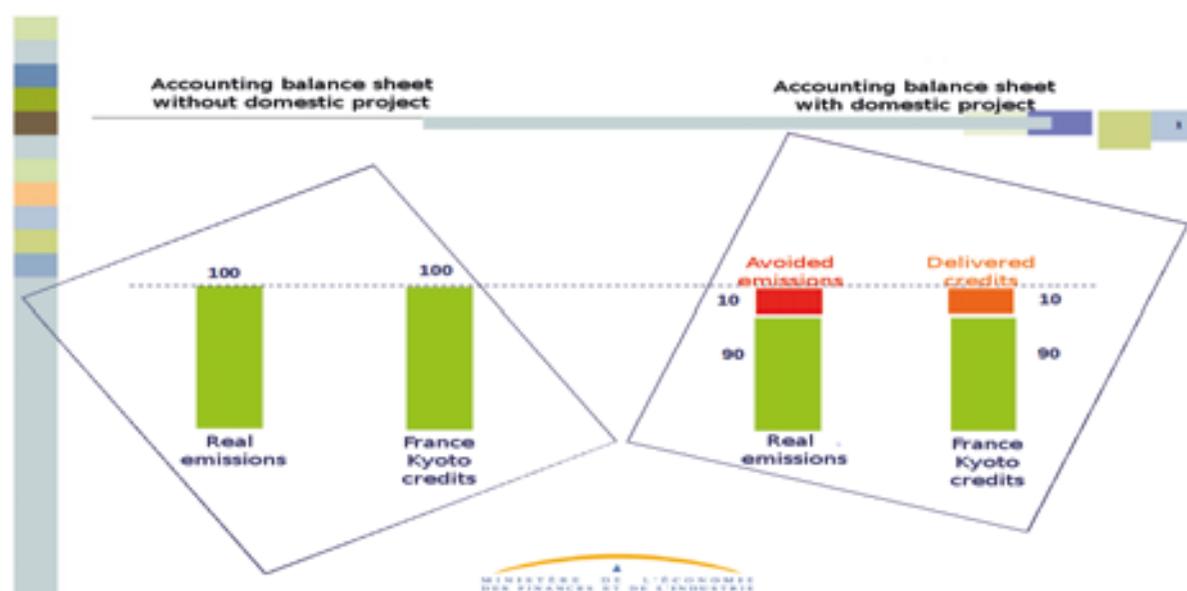
construction, agriculture etc. This mechanism also enables the carbon price signal to be expanded and spread beyond industrial and energy activities subject to quota.

In this respect, the French State relinquishes part of its carbon assets (AAUs, converted into ERUs) to project proposers in exchange for the emissions reductions obtained through the project. It must therefore ensure above all else that the project: Leads to emission reductions that are properly accounted for in the national GHG inventory. Meets the additionality criteria: some proposed projects would have taken place anyway, irrespective of the additional incentive provided by the carbon credits, either because emissions reductions are directly or indirectly dictated by the applicable regulations (e.g.: energy performance standards on certain products), or because public aid in the broad sense (direct subsidies, tax credits, renewable energy purchase prices) already help to make the project profitable, without the need to add a new financial incentive in the form of CO<sub>2</sub> credits. In fact, the State is not supposed to issue carbon credits for projects that would have taken place anyway. Carbon credits should only remunerate the part of the outlay which takes the project beyond the trend.

As the State uses its own carbon assets to remunerate project proposers, the final balance of the transaction is in theory neutral from the point of view of French Kyoto commitments, as France's emission rights are supposed to decrease in accordance with CO<sub>2</sub> emissions saved as a result of the projects, while improving the cost-efficiency of the national climate policy. Figure 29 shows an example of the balance sheet for a domestic project corresponding to 10 French AAUs.

Considering that any method built to evaluate the additionality of domestic projects comprises uncertainties and thus may not always fully distinguish really "additional" projects from naturally profitable projects and/or projects coming within the framework of the regulations. In order to protect itself from the economic risk generated by this uncertainty (imbalance of France's GHG balance), without in any way reducing the economic benefit of domestic projects, the French State decided to remit an amount of ERUs for each project equivalent to 90% of emission reductions actually obtained (article 15.11 of the order of 2 March 2007).

**Figure 29: Balance sheet of French emissions before and after a domestic project**



Source: DGTPE (Ministry of the Economy)/DGEC (Ministry of Ecology).

The approval procedure has been simplified in recent years to allow new methodologies, if they did not already exist, and projects to be submitted jointly in future. The Designated Focal Point assesses the two documents, studies them, examines them and then gives its approval to the project which demonstrates its benefit, seriousness and additionality and enables the resultant reductions of emissions to be actually verified.

In practical terms the tool has helped France to identify new reduction options unrecognised by the authorities, including some in sectors characterised by diffuse emissions.

20 domestic CDM projects on French territory were approved by the Ministry for Ecology up to 31/12/2012. These projects have resulted in a saving of 9.4 million tons CO<sub>2</sub> equivalent, i.e. over 8.5

Million ERUs issued<sup>6</sup> between 2007 and 2012 for €60 million of investment. This system places France in the top three host countries in the European Union (after Poland and Romania).

Of all of these twenty projects, thirteen have ceased to be eligible since 2013 as they have come within the scope of the provisions of phase III of the EU ETS Directive. Seven of the projects already in existence and approved still meet the criteria laid down by the international community and by France and are therefore justified in seeking an extension.

#### **B.4 Biodiversity and implementation of policies and measures under articles 3.3 and 3.4 of the Kyoto Protocol**

Preservation of biodiversity in the day to day management of public forests is the subject of a variety of arrangements. In 2004 France defined a national biodiversity strategy with a number of action plans including one for forestry approved in September 2006. In 2006 the National Forestry

Office (ONF) adopted its environmental policy in which biodiversity constitutes one of four key strategies. This direction was confirmed by the State-ONF contract for the period 2007-2011.

The Framework Law 2009-967 of 3 August 2009 on the implementation of the Grenelle Environment Round Table (articles 29 and 20) supplements regulatory provisions defining the national forestry policy. It specifies that "ordinary and remarkable forest biodiversity must be preserved and valued as part of more dynamic management of the timber sector and with a view to combating climate change" and that the French State is committed among other things "to supporting EU and international forestry and biodiversity plans as one of the pillars of the international framework on tackling climate change."

In 2009 ONF published a circular specifying arrangements for implementing biodiversity preservation in the everyday multi-purpose management of public forests.

<sup>6</sup> The State only issues 90% of reductions achieved in the form of credit

## C. Policies and measures and their impacts

### C.1 Cross-sector policies and measures

Some policies and measures have an impact on several sectors. In the interests of the readability of this document a “reference sector” has been allocated to each of these measures (for example, industry for the EU ETS directive). This simply means

that these measures are described in the section devoted to the description of policies and measures in their “reference” sector. However, when it has been possible to assess the impact of these measures in terms of GHG emission reductions, this impact has been distributed between the various sectors concerned.

Table 18 summarises cross-sector policies and measures by specifying all the sectors affected and each of their “reference” sectors.

**Table 18: Allocation of cross-sector policies and measures**

	Sectors affected							Description in the sector (“reference” sector)
	Agriculture	Residential/tertiary	Waste	Energy	Forestry	Industry	Transport	
Biofuel development	X						X	Transport
Fuel wood development		X		X	X	X		Forestry
Development of timber products		X			X			Forestry
All measures enabling the energy performance of buildings to be improved (thermal regulation, tax credit, zero rate Eco-loan)		X		X				Residential / Tertiary
Energy saving certificates (ESC)		X		X			X	Energy
Measures to promote geothermal, solar thermal and photovoltaic energy, and heat pumps		X		X				Energy
Renewable heat fund (Fond Chaleur)	X	X		X	X	X		Energy
EU ETS Directive				X		X		Industry

## C.2 Transport

The Framework Law n° 2009-967 of 3 August 2009 on the implementation of the Grenelle Environment Round Table (law n° 2009-967 of 3 August 2009) set the ambitious target of reducing greenhouse gas emissions from transport to their 1990 level by 2020 (article 10). The policies implemented to achieve this target are based on several key areas covering support for the forms of transport generating the lowest emissions (particularly by developing public transport and improving transport infrastructure networks) and improving the efficiency of modes of transport used.

### Support for the modal shift

A first strand of actions consists of promoting a modal shift to the forms of transport that emit the lowest amounts of CO<sub>2</sub> by, among other things, improving the range of transport services and infrastructures available as alternatives to roads. In terms of infrastructure, in 2011 the French government published a National Transport Infrastructure Plan (SNIT) specifying State directions for the maintenance, modernisation and development of networks under its power and aid to territorial collectivities for developing their own networks. This policy is in the process of being re-orientated around three investment priorities:

- Improving existing services and networks;
- Removing bottlenecks that prevent optimal use of the rail network and pursuing national network coverage;
- Supporting public transport.

For rail freight transport these provisions supplement the national commitment on rail freight launched in 2009, aimed at revitalising rail freight on the basis of eight key areas:

- Creating a freight-oriented network, i.e. on which freight is given priority;
- Creating a network of regular rolling highways (two lines are currently in service: the Perpignan-Bettembourg line and the Alpine rolling highway);
- Assisting the development of combined transport;
- Developing local rail operators;
- Developing high-speed rail freight between

airports, using high-speed lines outside rush hours;

- Removing bottlenecks;
- Modernising slot management and improving service to and from large sea ports.

For passenger transport, article 13 of Law n° 2009-967 of 3 August 2009 provides for a dedicated-lane public transport development programme extending 1,800 kilometres beyond the Ile-de-France (compared with 329 km in 2008). The first call for projects was launched as part of the sustainable towns programme. It was aimed at collectivities in which public works were scheduled to start before the end of 2011. The French State has committed up to €810 million to co-finance 52 projects carried out by 37 collectivities for a total of more than 400 km of new lines. Apart from a few abandoned (Saint-Etienne and Mulhouse) or postponed projects (Lens and Rennes), all finance agreements with the Agence de financement des infrastructures de France (AFITF) (French infrastructure financing agency) were approved and operations carried out before the end of 2011. A second call for projects, launched in 2010, the results of which were published on 9 February 2011, resulted in the selection of 78 projects representing 622 km of lines in 54 large urban areas. A third call for projects, representing State investment of €450 million, was launched in May 2013.

A second set of actions concerns the introduction of a price signal in freight transport charges by the installation of an **HGV eco-tax**. On 1 January 2014 an eco-tax was to come into force for HGVs over 3.5 tons using the national private road network. This tax was designed with the aim of taking account of the cost of using the national state-owned road network in mainland France and highways of territorial collectivities likely to encounter a transfer of traffic. The rate is between €0.025 and €0.20 per kilometre, depending on the number of axles, gross vehicle weight (GVW) and EURO emission class of the vehicle, with a 30% allowance for outlying regions, such as Brittany. To encourage better distribution of transport across the network some departmental or municipal routes will also be affected by the charge. Hauliers may pass this

tax onto the beneficiary of the goods transport (the order provider) and therefore to the consumer (the end customer). The purpose of this eco-tax is to fund transport infrastructure projects. Profit from the tax, estimated at €800-€880 million in a full year, is allocated to AFITF (*Agence de financement des infrastructures de transport de France* - French transport infrastructure Finance agency). The State will give a proportion of the profit from this tax back to the territorial collectivities for use on the road network which they own

- → Implementation of the HGV eco-tax will enable 0.26 to 0.6 Mt CO<sub>2</sub>e<sup>7</sup> to be saved each year.

A third key action area of the policy for support of the modal shift consists of improving information for users of transport services. As of 1 October 2013, passenger and goods transport or removal service providers must supply information on the quantities of CO<sub>2</sub> produced by their service (see section on the business sector).

### Reduction of emissions from private vehicles

The European Union has set a unit CO<sub>2</sub> emissions reduction target for new cars with a first stage of reduction to 130 g CO<sub>2</sub>/km progressively applicable between 2012 and 2015 (65 % of the fleet in 2012, 74 % in 2013, 80 % in 2014 and 100 % in 2015) and a target value of 95 g CO<sub>2</sub>/km in 2020. Average specific emission values were allocated to each car manufacturer according to a utility criterion: average quantity of vehicles sold on the European market. Financial penalties have been provided since 2012 for manufacturers that exceed the specific values set for them. At national level, France set itself the target of reducing average carbon dioxide emissions for the entire fleet of cars in circulation from 176 g of carbon dioxide per kilometre to 120 g of carbon dioxide per kilometre in 2020. These targets will be achieved by implementing the European regulation

on car emissions, which provides penalties for manufacturers that do not meet their obligations and through provisions aimed at encouraging people to buy the lowest carbon vehicles, including the bonus-malus system for cars.

*The car bonus-malus scheme:* implemented in France since January 2008, encourages the purchase of vehicles with the lowest CO<sub>2</sub> emissions. A purchase bonus is paid to people who buy vehicles that emit less than 105g CO<sub>2</sub>/km (threshold valid on 1 January 2013). Conversely, a purchase tax ("malus") applies to cars that emit over 135 g CO<sub>2</sub>/km. Amounts and thresholds are reviewed periodically in order to improve the performance of the system. Following the Council of Ministers of 25 July 2012 and in order to support the purchase of zero-emissions or low pollution vehicles, the French government decided to reinforce the bonus to which they give entitlement with effect from 1 August 2012. The bonus ceiling for electric vehicles was raised from €5,000 to €7,000 in 2012, up to a limit of 30 % of the total cost of the vehicle including tax. The ceiling for hybrid vehicles was doubled to €4,000, up to a limit of 10 % of the total cost of the vehicle including tax, with a minimum subsidy of €2,000. This bonus is also open to company vehicles and vehicles belonging to government departments. In addition bonuses for low pollutant thermal vehicles were increased from €100 to €200 and from €400 to €550. In addition, the bonus is reinforced by an additional subsidy (superbonus) of €200 when the purchase of a vehicle attracting a bonus is accompanied by the destruction of a vehicle over 15 years old. Subsidies for buying an LPG vehicle (liquid petroleum gas) or converting a vehicle to LPG were discontinued in 2011. Henceforth, subsidies for buying this type of vehicle are subject to the same conditions as subsidies for buying a zero-emissions vehicle running on petrol or diesel. The bonus-malus scheme has had a significant effect on sales of new vehicles in France: average emissions from new vehicles fell to 127 g CO<sub>2</sub>/km in 2011 (compared with 149.3 in 2007, before the introduction of the scheme). Over the first ten months of 2012, although the overall market shrank by 13.6 % compared with the same period in 2011, each of the tranches eligible for the bonus

<sup>7</sup> *SceGES Assessment French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 140*  
[http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_.pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013_.pdf)

saw its new vehicle registrations increase strongly (+75 %) whilst those subject to the “malus” saw their registrations fall (-28 %).

L'étiquette CO<sub>2</sub> des véhicules particuliers (CO<sub>2</sub> label for private cars) for sale was made mandatory by decree with effect from 10th of May 2006 for new vehicles. Its aim was to raise the awareness of vehicle buyers and also to enable fiscal measures linked to CO<sub>2</sub> emissions to be implemented (cf. chapter IX)

Since 2006 the amount of the *taxe annuelle sur les véhicules de société* (annual tax on company cars) has been set according to the vehicle's level of greenhouse gas emissions and not according to its tax rating. Companies are liable to this tax on account of the vehicles they use in France regardless of which State they were registered in, or vehicles they own, which are registered in France, when these vehicles are registered in the private car category. Company car tax scales were made harsher for the most polluting vehicles for the tax period 1 October 2011 to 30 September 2012. With regard to the scale relating to the level of carbon dioxide emissions, the vehicles targeted by this tariff increase are those which emit more than 120 g CO<sub>2</sub>/km. Vehicles which emit up to 50 g CO<sub>2</sub>/km are now exempt from the tax (condition currently met only by electric vehicles). The scale relating to the tax rating of vehicles has also been changed, each tranche being reduced by one horsepower (HP). The applicable tariff is set on a scale from €2 per g CO<sub>2</sub> per kilometre for vehicles whose emissions are between 50 and 100 g CO<sub>2</sub>/km to €27 per g CO<sub>2</sub> per kilometre for vehicles emitting over 250 g CO<sub>2</sub>/km.

- → The aggregated impact of all measures aimed at cutting emissions from private cars was estimated at -9 Mt CO<sub>2</sub> eq. in 2020<sup>8</sup>.

In addition, a government plan for development of rechargeable electric and hybrid vehicles was launched in October 2009. The aim is to have 2

million vehicles of this type on the road by 2020. In practical terms, the plan will be deployed in the various electric vehicle sectors (batteries, recharging facilities, research, industrial production):

- In April 2010 a group of large corporations, associations of collectivities and State representatives signed an agreement to form an order providing group; Goals of establishing a network of 900,000 private recharging points and 75,000 public recharging points by 2015 and increased to 4 million private recharging points and 400,000 public recharging points by 2020 have been set.

On 3 October 2012, with a view to speeding up the deployment of recharging facilities the ministers in charge of Industrial Renewal, Energy and Transport announced the launch of the Hirtzman Mission, which is part of the car plan. Large-scale charging terminal deployment projects in urban areas of more than 200,000 people, or regional projects, will now be eligible for funds from the Programme des Investissements d'Avenir (Investment for the Future Programme), as will deployment of charging terminals on motorways, in car parks and supermarkets for a limited period

A total budget of €50 million in subsidies has been allocated to operations supported under these programmes:

- Subsidy of 50% of the cost of investment in the case of charging facilities installed on state-owned public highways with normal or high power charge;
- A subsidy of 30% of the investment cost in the case of rapid charge facilities installed on the public highway or in service stations open to the public

ADEME's call for expressions of interest was open from 27 April 2011 to 16 December 2013.

In addition, the GIREVE Group (*Groupement pour l'Itinérance des Recharges Electriques de Véhicules* - Group for Roaming Services for Electric Vehicle Charging) combining ErDF, Caisse des Dépôts, PSA and Renault signed a framework agreement on 3 October 2012 aimed at standardising the

<sup>8</sup> SceGES Assessment. *id.* pages 143-144

geographical directory of charging sites and geographical location of terminals.

- → Implementation of this plan will enable 1.9 to 2.1 Mt CO<sub>2</sub>e to be saved depending on vehicle charging scenarios<sup>9</sup>.

### Biofuel development

The French Customs Code defines the biofuel incorporation targets: 70% by energy value in 2010. France transposed Directive 2009/28/EC, which sets the target of 10% of renewable energy in transport in 2020, and stated these objectives in the national action plan on renewable energies, specifying the volumes of biofuels (first and second generation) to be incorporated in the energy sector by 2020 in order to comply with European objectives on renewable energy development in the transport sector

The ecological transition roadmap resulting from the environmental conference held on 14 and 15 September 2012 stated that the French government asked its European and international partners for a pause in the development of first-generation biofuels. In France, their incorporation rate will be limited to 7 % (net calorific value) and the EU targets will be achieved using second-generation biofuels. Work is currently in progress in the EU on the indirect impact of the development of biofuel sectors on land use.

In order to achieve these objectives the French government has undertaken voluntary action to encourage the production of biofuel and its release onto the market:

- The General Tax on Pollution-generating Activities (TGAP): The French Finance Law for 2005 introduced a fuel tax system aimed at encouraging the incorporation of biofuels: a tax on the release of petrol and diesel for consumption was brought in, based on the sale price before VAT. Its rate is in line with

<sup>9</sup> *ScéGES Assessment French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 143*  
[http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_.pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013_.pdf)

national biofuel incorporation objectives and it is reduced in accordance with the share of biofuels placed on the market as a percentage of energy content;

- Tax exemption: a partial tax exemption from the Domestic Tax on Consumption (TIC) has helped to reduce the extra cost of producing biofuels compared with fossil fuels. The amount is laid down in the Finance Law Only biofuels derived from approved units benefit from this tax exemption, up to a limit of the quantities laid down at the time of the relief.

The Finance Law for 2011 extended this provision, with constant exemption levels between 2011 and 2013, but less than the amounts of exemptions of 2010. The tax exemption on biofuels will be progressively decreased from 2014 until discontinuation at the end of 2015, as stated in the ecological transition roadmap.

The Finance Law for 2010 allows for double counting of biofuels from waste and residue, in accordance with the Renewable Energies Directive. The products benefiting from this measure are listed in the Ministerial Decree of 17 January 2012.

- → Impact: – 6.3 Mt CO<sub>2</sub>e in 2009 for all bioethanol and biodiesel sectors<sup>10</sup>.

Other fuel-related measures have been taken:

- creation of new fuels: in the petrol sector, SP95-E10 has been authorised for sale on French territory since 1 April 2009. It may contain up to 10% of ethanol or equivalent by volume. SP95-E10 is sold in parallel with traditional unleaded high-octane petrol, which has an ethanol content of less than 5% by volume;
- Since 1 January 2011 the new fuel known as “non-road diesel” intended in particular for non-road mobile equipment and farm tractors, may contain up to 7% of methacrylic esters of fatty acids by volume;
- Authorisation of fuels with higher content: super ethanol E85 is intended for flexible fuel

<sup>10</sup> *MEDDE/CGDD, Volume 2, Transport in 2010: 48th report of the National Transport Auditors.*

vehicles (also called “flex fuel”). It is composed of at least 65% ethanol and at least 15% high-octane petrol. Since its launch at the end of 2006 super ethanol has benefited from an advantageous tax exemption, which means consumers are currently offered a pump price of about €0.85/l. The development of this fuel remains well below initial targets.

### Regulations on emissions from air conditioning

In addition to general measures implemented by France to limit emissions of refrigeration gases into the atmosphere<sup>11</sup> (cf. section on the industry sector) in accordance with European Regulation n° 842/2006, Directive 2006/40/EC of 17 May 2006 introduced specific provisions on air-conditioning systems in motor vehicles: progressively banning the use of gas with a Global Warming Potential (GWP) of over 150, and specified measures to limit leaks. Provisions for implementing the Directive are given in regulation 706/2007 of 21 June 2007.

- → This measure enables 0,55 Mt CO<sub>2</sub> eq to be saved by year by 2020<sup>12</sup>. It should be noted that this measure is counted in the industry sector, in accordance with the reporting format on emissions (CRF).

### Air transport

Development of the Single European sky, initiated by European regulations of 2004 and consolidated by the second package of regulations (EC regulation no. 1070/2009), enabled the launch of an ambitious programme to restructure aviation navigation services and improve air traffic management in Europe. The SESAR programme, technical section of the Single European Sky, aims at developing a reliable and efficient new generation of the European air traffic management system for the next 30 years and respond to the challenges of sustainable development. The target is to reduce

CO<sub>2</sub> emissions by 6 to 12% through fuel savings by, among other things, reducing distances travelled and waiting and taxiing times.

### Voluntary measures

- “Hauliers commit to a CO<sub>2</sub> objective”: this measure was initiated in December 2008 for road haulage companies using heavy goods vehicles of 3.5 t and over. After two extensions, the measure is now also aimed at the passenger road transport sector (urban and inter urban), and light goods vehicles. The measure offers a methodological framework to haulage companies wishing to commit, for a period of three years, on the basis of customised practical action plans, to achieving an overall objective of reducing their fuel consumption and greenhouse gas emissions. The actions relate to 4 key areas: vehicle, fuel, driver and organisation of flows. On 1 October 2012, 672 road haulage professionals signed the voluntary charter of commitment to reduction of CO<sub>2</sub> emissions. These hauliers themselves represent over 80,000 vehicles, i.e. nearly 15% of the sector’s total fleet and 25% of CO<sub>2</sub> emissions generated by heavy goods vehicles. The reduction targets agreed on this date correspond to a reduction in the order of 9% of consumption and emissions by volume of equal activity, i.e. a reduction in the order of 550 kt CO<sub>2</sub>e.
- The French National Passenger Transport Federation (FNTV) signed a charter on 14 October 2009 to develop road safety and sustainable development actions. The objective of this charter is to organise a working relationship between the various partners (FNTV, the State, ADEME, etc.) in order to advance environmental and road safety objectives;
- In the aviation sector, an agreement was signed in January 2008 in which all stakeholders of the French aviation sector undertook to carry out practical actions to combat noise pollution, preserve air quality and combat global warming. At the end of four years of the agreement, all the commitments made have been kept or approached.

<sup>11</sup> Articles R 543-75 et seq. of the French Environmental Code

<sup>12</sup> ScEGES assessment, Report to the European Commission (in respect of article 3 of Decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 144 [http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_\\_\\_.pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013___.pdf)

### C.3 Residential / tertiary

#### C.3.1 Existing Measures

Improving energy performance in buildings, particularly existing buildings is essential for reducing GHG emissions. France has already mobilised a range of tools to this end: regulatory tools, financial incentives and information.

#### Regulatory measures

In the case of *new buildings*, Thermal Regulation (RT) 2012<sup>13</sup> has reinforced requirements on the performance of new buildings. It applies to all new buildings for which the planning application was filed after 1 January 2013. These buildings must have an average primary energy consumption of less than 50 kWhPE/m<sup>2</sup>/year. This requirement was implemented in advance, on 28 October 2011, for offices and buildings used for primary and secondary education and childcare facilities. The 50 kWhPE/m<sup>2</sup>/year requirement relates to consumption of heating, cooling, lighting, hot water production and auxiliary systems (pumps and ventilators). Furthermore, this threshold is adjusted according to geographical location, altitude, building use, average surface area of the accommodation and greenhouse gas emissions. On the last point, only buildings using fuel wood and district heating networks that emit the lowest amounts of CO<sub>2</sub> benefit from adjustment of the primary energy consumption threshold, limited to a maximum of 30%. The consumption requirement is also increased by 7.5 kWhPE/m<sup>2</sup>/year for collective housing, for a transitional period ending on 1 January 2015. In addition, to improve the implementation of this new thermal regulation the project owner is required to:

- Issue a document certifying that the thermal regulation had been taken into account and the energy supply feasibility study carried out when the planning application was filed;
- Send the inspection service a certificate of the building's compliance with the thermal regulations when submitting the work completion declaration.

<sup>13</sup> Cf. Decree n° 2010-1269 of 26 October 2010 on thermal characteristics and energy performance of buildings and the Order of 26 October 2010 on thermal characteristics and energy performance of new buildings and new parts of buildings.

- → Implementation of Thermal Regulation 2012 permits 3.55 Mt CO<sub>2</sub>e to be reduced per year in 2020<sup>14</sup>. This assessment only concerns the residential sector and does not take into account savings in the tertiary sector.

The introduction of RT2012 was accompanied by a label system providing for subsidies to be given to project owners who wished to bring forward the construction of new buildings with higher performance than the previous thermal regulations. For this purpose, a label comprising five levels was created, ranging from HPE (high-energy performance, i.e. maximum consumption of -10% compared with the regulations) classification, to BBC classification (low consumption building, corresponding to RT2012 requirements). Achievement of the BBC level opens the way to the possibility of claiming a number of subsidies (exemption from the tax on buildings (TFBP) for territorial collectivities, increase of the zero rate loan, beneficial adjustment of rental investment subsidies as part of the Scellier provision). These measures were discontinued after RT2012 came into force. Two new labels will be added to RT2012 and pave the way for the change to positive energy buildings: the BBC+ and BBC++ labels (-10% and -20% compared with the regulations). They will apply to all planning applications for new buildings (or parts of new buildings) and reinforce the energy performance requirements.

In addition, from 1 January 2008, a technical and economic feasibility study of the various energy supply solutions for the building must be carried out for all buildings over 1000 m<sup>2</sup><sup>15</sup>. This measure is intended to encourage the use of renewable energies and more efficient systems.

<sup>14</sup> Source: *ScéGES assessment French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 132 [http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_...pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013_...pdf)*

<sup>15</sup> cf. Decree 2007-363 of 19 March 2007 on feasibility studies of energy supply, thermal characteristics and energy performance of existing buildings and display of the energy performance assessment of buildings and the order of 18 December 2007 on energy supply feasibility studies for new buildings and new parts of buildings and retrofitting of certain existing buildings in Metropolitan France.

In the case of existing buildings, the Thermal Regulation (RT) is intended to bring about a significant improvement in the energy performance of an existing building when it is retrofitted. The applicable measures, “total RT” and “RT per component” vary according to the extent of the work undertaken. For extensive retrofitting<sup>16</sup> of buildings over 1000 m<sup>2</sup> the total RT defines a total energy performance objective for retrofitted buildings, apart from those built before 1948. For buildings under 1000 m<sup>2</sup> or for buildings over 1000 m<sup>2</sup> subject to minor retrofitting, the RT per component defines a minimal performance for the replaced or installed components. In particular, it concerns insulation, heating, hot water production, cooling and ventilation equipment.

An “haute performance énergétique rénovation” (high energy performance retrofit) label has also been created. It includes two levels for residential buildings: the “high energy performance retrofit, HPE 2009” label for buildings achieving a primary energy consumption of less than 150 kWhPE/m<sup>2</sup>/year and the “low energy consumption retrofit, BBC 2009” for buildings achieving primary energy consumption of less than 80 kWhPE/m<sup>2</sup>/year. This label also includes a label for non-residential buildings.

From 1 January 2013 a certificate that the RT has been taken into account must be provided by one of the following four professionals: an architect, a house energy assessor, a technical inspection office or a certification body if the building is subject to certification. The certification form is part of the works completion and compliance declaration (article R 462-4-2 of the Town Planning Code).

Since 1 January 2008 any building over 1,000 m<sup>2</sup> undergoing extensive retrofitting must, in the same way as a new building, be the subject of an energy supply feasibility study, so as to encourage the project owner to use a renewable energy source or a very efficient system.

The French State subjected a significant proportion of its buildings and those of public establishments to an energy audit between 2009 and 2011. The retrofitting of these buildings will on average cut at least 40% of energy consumption and 50% of greenhouse gas emissions in the State’s buildings estate within 8 years. Achieving this objective will enable it to comply with the obligations of Directive 2012/27/EU on energy efficiency, which provides for the retrofitting of 3% of the area of the State’s buildings each year.

Furthermore, in accordance with Directive 2002/91/EC on the energy performance of buildings, France implemented a requirement that boilers should be subject to annual maintenance. It concerns all boilers (gas, fuel oil, multifuels) with power of between 4 and 400 kW. In addition, to explain the new regulations to the general public, a guide aimed at private individuals, prepared jointly by the Ministry for Sustainable Development and ADEME, was published in December 2009. Sector professionals also worked together to prepare a guide of technical data sheets for professionals in order to ensure the regulations were properly implemented.

Boilers of 400 kW to 20 MW are subject to a minimum energy efficiency<sup>17</sup>. The operator is also required to install appliances:

- To control and measure their efficiency;
- And to assess the quality of combustion.

They are also subject to a mandatory inspection, at least every two years, to ensure they comply with minimum regulatory efficiency and that operators carry out the required inspections and adjustments.

Directive 2009/91/EC also specifies that Member States should carry out periodic inspection of air-conditioning systems of a nominal power of more than 12 kilowatts. In France this obligation was transposed by Decree 349-2010 on 31 March 2010 (no. 349-2010). It defines the main inspection

<sup>16</sup> Retrofitting work costing more than 25% of the building’s regulatory value, except land

<sup>17</sup> Articles R. 224-20 to R. 224-30 of the French Environment Code

stages: documentary inspection, assessment of the system's efficiency, assessment of the system's size compared with requirements on the cooling of the building, provision of the necessary recommendations on proper use of the system in place, possible improvements to the installation, possible benefit of its replacement and other possible solutions. The inspection takes place every five years. It concerns 300,000 installations in France (10% of the installed stock).

### Incentive measures

The Energy Saving Certificates (ESC) measure is intended to promote energy-saving sources, especially in the sectors in which it is the most diffuse, such as the building sector. On 30 September 2012 about 90% of the ESCs issued came from operations carried out in the building sector. Installation of condensation boilers and roof insulation were the most popular operations, alone representing a third of the ESCs issued. Other provisions are specific to the various sectors: private residential, social housing and tertiary.

In the private residential sector a number of incentive measures for private individuals have been implemented in order to encourage improvements to the energy performance of housing. From 1 July 2014 main support measures (CIDD and éco-PTZ) are subject to an eco-conditionality criterion (use of "reconnu Grenelle de l'environnement" (recognised Grenelle Environment Round Table) professionals):

a) **Crédit d'impôt développement durable (CIDD)** (sustainable development tax credit): since 2005, and also under the Framework Law setting the directions of the energy policy, private individuals have been able to benefit from a tax credit for the purchase of the most energy efficient materials or equipment (in existing buildings only) or for generating renewable energy (in new and existing buildings). This provision was extended to owner landlords, i.e. people owning one or more properties and who rented or wish to rent, whether or not they carried out work, and extended to the end of 2015. Since its creation, the list of equipment eligible for the CIDD and the rates it benefits from have been regularly revised. In order to rebalance

public support for extensive retrofits the Initial Finance Law (LFI) for 2012 provided for the CIDD to be adjusted according to the extent of the work, by introducing a rate rebate when a range of building work is carried out ("package of works"). Furthermore, the effectiveness of the fiscal outlay on the CIDD has been improved, particularly by removal of the tax rebate on windows in a detached house when they are not part of a package of work, a new reduction of about 50% of the rate allocated for the installation of photovoltaic panels, the introduction of specific ceilings on photovoltaic panels and solar water heaters (solar energy) and non-renewal of the eligibility of new homes after 2013, the date when the new thermal regulations come into force.

Between 2005 and 2010 (these are the years in which work is carried out, tax deduction takes effect in the following year) 6.2 million homes benefited at least once from the CIDD out of a total of 27 million main residences in Metropolitan France. The total tax credit given over this period was €12 billion for €40 billion of expenses declared by households. In 2010, 1.41 million households benefited from an average tax credit of €1,375 for an average declared amount of €5,880<sup>18</sup>.

■ → The implementation of this measure between 2009 and 2012 will bring about an annual reduction in 2020 of 3.76 M. CO<sub>2</sub>e<sup>19</sup>.

b) An **éco-PTZ (Zero rate eco-loan)**: available since 1 April 2009, it is aimed at private owner occupiers or landlords for funding extensive retrofitting work. It has three options:

- Implementation of a "bouquet de travaux" (package of works);
- Achievement of a minimum "performance

<sup>18</sup> CGDD (2010), Sustainable development tax credit update n° 147, October 2012

<sup>19</sup> Source: SceGES assessment French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 135 [http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_...pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013_...pdf)

“énergie globale” (total energy performance) level in the dwelling;

- Retrofitting a privately-owned waste water treatment system with a system that does not consume energy.

This loan provides up to €30,000 for home energy saving improvements for a period of 10 years. The Initial Finance Law for 2012 implemented the possibility of extending the repayment period to 15 years for very extensive retrofits (carrying out a package of at least three building projects or minimal total performance option). It can be used in conjunction with subsidies from Anah and territorial collectivities, energy saving certificates and the zero rate loan for retrofit acquisition projects.

At the same time, information documents aimed at private individuals and building professionals have been produced in order to improve the technical quality of loan files and make it easier for them to be examined by credit institutions, which claim that this is the main bottleneck in the development of the measure.

Finally, to make it easier to carry out work on jointly owned properties, the Amending Finance Law for 2011 of 28 December 2011 provided for the extension of the éco-PTZ to owner associations. The entry into force of these measures is currently conditional on the appearance of an implementing decree to the law of 22 March 2012, known as the “Warsmaan” Law, on the simplification of the law and relaxation of administrative measures.

Since June 2011, the packages of works eligible for the éco-PTZ and total energy performance requirements have been adapted to the overseas context. The éco-PTZ has provided funding for part of retrofitting work carried out in Guadeloupe, Martinique, Reunion, Guyana and St Martin. The éco-PTZ was intended to contribute to the retrofitting of 200,000 homes over the period 2009-2010 and 400,000 homes per year from 2013. Between 2009 and 2011 on average 65,000 éco-PTZ were issued per year. New measures will be implemented as part of the Housing Investment

Plan in order to improve performance and reinforce use of this measure.

- → The implementation of this measure between 2009 and 2011 will continue to achieve an annual reduction of 0.33 Mt CO<sub>2</sub>e<sup>20</sup> by 2020.

- Building tax exemption: the Amending Finance Law for 2006 introduced the option for local authorities to give an exemption from building tax for five years with an exemption rate of 50 or 100%, for buildings completed before 1 January 1989 for which extensive work eligible for the CIDD has been carried out. This possibility has since been extended to all buildings completed before 31 December 2008.

- Reduced rate VAT for renovation work<sup>21</sup>: improvements, conversions, fitting out and maintenance of buildings completed more than two years earlier (apart from some big equipment) benefit from a reduced VAT rate (5.5% to 7% from 1 January 2012, then 10% from 2014 instead of 19.6%) Although this measure is not specific to energy-saving work it does help to support the energy retrofitting of homes. The law of 13 July 2006 on the national commitment for housing provides for the implementation of a reduced VAT rate of 5.5% on district heating network charges and on the supply of heat produced by networks using more than 50% of renewable energies. These items are not therefore affected by the creation of the reduced rate of 7% on the 1 January 2012 and remain subject to the reduced rate of 5.5%. Retrofitting of social housing will benefit from the reduced VAT rate of 5% on 1 January 2014.

- *Le livret de développement durable* (LDD) (Sustainable Development Account): since 1<sup>st</sup> January 2007, CODEVI (*compte pour le développement industriel* - industrial

<sup>20</sup> *SceGES assessment French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 133*  
[http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_\\_\\_.pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013___.pdf)

<sup>21</sup> *cf. article 279-0 bis of the General Tax Code.*

development account) replaced the LDD, and its use was expanded. It was previously reserved for funding small and medium-sized enterprises and now allows loans to be granted at beneficial rates to fund energy-saving work in homes more than two years old. The work eligible for funding is the same as that eligible for the CIDD. The deposit ceiling was initially €6,000, increased to €12,000 on 1 October 2012.

In addition, various provisions have been put in place to relieve certain hold-ups in the retrofitting of houses or change to responsible uses. In particular, the French Building and Housing Code has been the subject of changes in the rules on decisions concerning work which could previously be very restrictive for joint-ownerships:

- A majority vote by joint owners on whether work in private areas, in their mutual interest, at the expense of the joint owner concerned, should go ahead;
- A majority vote of joint owners on the installation of thermal energy meters or heating costs distributors;
- Compulsory entry of an item on the agenda of the next general meeting of joint owners after an Energy Performance Assessment, or energy audit, in the whole of a building equipped with a collective heating or cooling system, concerning the question of an energy-saving works plan or an energy performance contract;
- Inadequate individualisation of heating charges: since 1970<sup>22</sup>, any building equipped with shared heating must be fitted with a device enabling heating costs to be allocated individually. Decree n° 2012-545 of 23 April 2012<sup>23</sup> amended articles R. 131-2 to R. 131-7 of the French Building and Housing Code in order to make it easier to implement this requirement by redefining the technical problems of installing measuring devices and by reviewing the economic profitability conditions of the measurement. This measure must come into effect before 31 March 2017;
- Imbalance between owner landlords, who bear the cost of work, and tenants, who benefit from the resultant energy savings: in order to promote a “win-win” relationship, Mobilisation Law no. 2009-323 for housing and combating exclusion, voted on 25 March 2009, provides for a financial contribution from the tenant after energy-saving work has been carried out by the owner. The owner can therefore ask the tenant to contribute up to half the cost of the work carried out. This contribution takes the form of a new line on the rent receipt which will last for 15 years. This contribution is only possible, however, if the landlord carries out a package of energy-efficiency work comprising a minimum of two projects or permitting a minimum level of efficiency to be achieved<sup>24</sup>, and has entered into discussion with the tenant;
- The “Habiter Mieux” (Live Better) programme aims to carry out thermal retrofitting for owner occupiers in energy poverty situations (see the paragraph on tackling energy poverty in this chapter and the employers’ top-up contribution to this programme through ESCs in the chapter on energy measures).

In the social housing stock, a target of retrofitting the 800,000 most energy consuming social housing units by 2020 was set by Framework Law no. 2009-967 of 3 August 2009. The achievement of this objective is based on the following measures and also on additional measures aimed at giving more support to social housing.

- Since 2005 low-rent housing (HLM) or public-private property organisations, which arrange for energy-saving work to be carried out in compliance with the applicable thermal regulations, can benefit from tax relief on the buildings tax (TFPB) equal to a quarter of the costs incurred during the year prior to the year in which the tax is payable (cf. POPE Law). This tax relief can be set off against the buildings tax payable on the building where this work was carried out and also on all other buildings belonging to the same social landlord in the

<sup>22</sup> Cf. Law n°74-908 of 29 October 1974 (article 4).

<sup>23</sup> <http://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000025743279&dateTexte=&categorieLien=id>

<sup>24</sup> Cf. Law n°2009-323 and Decrees 2009-1438 and 2009-1439 of 23 November 2009.

same municipality or in other municipalities when they come under the same tax office<sup>25</sup>.

- The social housing eco-loan (éco-PLS) is a subsidised interest rate loan distributed by the Caisse des dépôts et consignations to finance thermal retrofitting of high-energy consuming social housing. It is available to low-rent housing and public-private property organisations and municipalities that own or manage such homes. The exact details of this provision have changed over time (in terms of the thermal efficiency of eligible properties, and rates, set for loans distributed between 2009 and 2011, covered by the Livret A rate thereafter). The social housing eco-loan provision is now extended until the end of 2020 and has the objective of retrofitting 120,000 social homes per year from 2017.
- → In total, 123,000 social housing eco-loans were distributed up to 1 January 2013, permitting an annual saving of 0.29 Mt CO<sub>2</sub>e<sup>26</sup> to be saved each year.

As this had been negotiated during the French presidency of the Council of the European Union, energy-efficiency and renewable energy investments in the housing sector have been eligible for the European Regional Development Fund (ERDF) since 10 June 2009. The amount available for energy retrofit is 4% of the national ERDF budget, which is about €230 million for Metropolitan France and €90 million for the Overseas Departments for the period 2009-2013, with no annual expenditure ceiling. A circular was published on 22 June 2009 to provide managing regional authorities with recommendations on the use of these funds. The purpose of these recommendations is essentially to ensure consistency with current financial provisions for energy-saving work. It is therefore being recommended that the conditions for allocating this subsidy are in line with those giving entitlement to the éco-prêt logement social (social

housing eco-loan). In the Overseas Departments it is recommended that work aimed at improving comfort in summer or using renewable energies may be financed by the ERDF provided they are innovative or are costly enough to justify the need for additional sources of finance. Subsidies must be concentrated on structuring operations combining a significant number of homes and aimed at exemplary energy performance, in order to give visibility to the use of European credits on these measures. From August 2012 regional prefects are authorised to lift the 4% ceiling for each region, provided the 4% rate is not exceeded on the national scale. For the period 2014-2020 the arrangements for using the ERDF have not been completely decided, but the draft submitted by the Commission for the period 2014-2020 provides that at least 80% of the resources would be concentrated in more developed regions and transition regions in the following three areas: supporting the shift towards a low carbon economy in all sectors, strengthening research, technological development and innovation and enhancing the competitiveness of SMEs. More particularly, at least 20% of funds should be devoted to the transition to a low carbon economy.

### Information measures

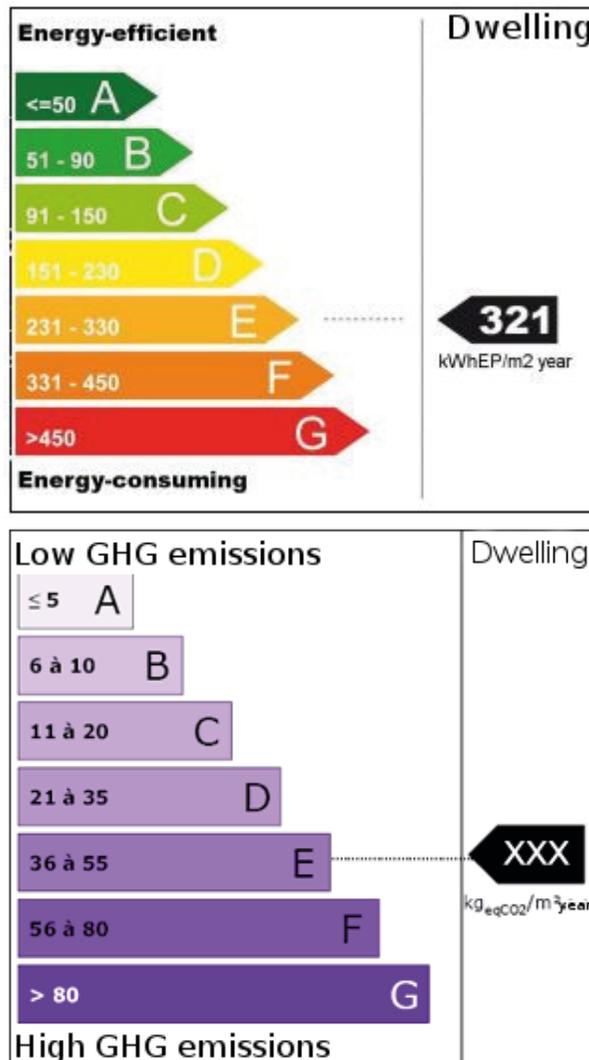
A **diagnostic de performance énergétique (DPE)** (energy performance assessment) was made compulsory when selling a house, or building (residential or tertiary) from 1 November 2006, and renting out a house or flat principally for residential use from 1 July 2007. The energy performance assessment gives information on the energy efficiency of the home or building by assessing its energy consumption and its impact in terms of GHG emissions, with a corresponding classification and energy-saving recommendations. To give owners and occupiers more information on the energy efficiency of their building and the energy savings that can be made, Law no. 2010-788 of 12 July 2010 requires that an energy performance assessment is carried out before 1 January 2017 if heating or cooling is provided by a collective system. Moreover, from 1 January 2013 home energy assessors are required to send the energy performance assessments they have carried out to

<sup>25</sup> Cf. Law 2009-323 of 25 March 2009

<sup>26</sup> SeeGES assessment. French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 135 [http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_...pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013_...pdf)

ADEME so they can be entered into a database. This information will provide us with better information on the energy performance of the building stock.

**Figure 30: Energy labels and information about GHG emissions provided as part of the energy performance assessment**



Jointly owned residential buildings of fifty lots or more, equipped with a collective heating or cooling system, for which the planning application was filed before 1 June 2001, must have an **energy audit** before the end of 2016. This energy audit will make

joint owners aware of energy savings and involve them in the energy retrofitting of their property by suggesting appropriate retrofit scenarios (article L. 134-4-1.2 of the French Building and Housing Code). Decree n° 2012-111 of 27 January 2012 specifies the regulatory details of the audit.

In the case of construction and decoration equipment and products, law 2009-967 of 3 August 2009 provides support for environmental communication from 1 July 2013. Methods of calculating environmental impacts will be defined, particularly in terms of energy consumption and greenhouse gas emissions.

The Espaces Infos Energie (EIE) (Energy Information Centres) are particularly intended to give advice to private individuals (see chapter IX) on how to make their homes more energy efficient. The Espaces Info Energie (EIE) network had 250 centres staffed by 405 energy information consultants at the end of 2011. The direct environmental impact of EIEs in 2011 corresponds to a reduction in GHG emissions of 134'000 t CO<sub>2</sub>e.

**The INIES database** was created in 2009. It is a national database of the environmental and health characteristics of building products and materials.

### Support for research and training

After the first research and testing programme on energy in buildings (PREBAT – 2005-2009), **PREBAT2** was launched in 2010 for the period 2012-2015. It is a national system for coordinating and leading public research on energy in buildings, which relates to actions by the Ministries of Ecology, Energy, Construction, Research and Industry and their agencies ADEME, ANR, Anah, OSEO and ANRU. PREBAT2 serves two purposes: retrofitting the stock to a higher level of energy performance and prefiguring the new buildings of tomorrow.

**The Building - Energy Foundation was created in 2005** by four major stakeholders in the building and energy sector – Arcelor, Edf, GDF Suez and Lafarge. The aim of this foundation is to provide financial support for research operations for a minimum of five years and to finance assessment

of the supported work and its development. It has a budget of €8 million, half of which is provided by the French State.

Concerning demonstrators to be funded by the **“investissements d’avenir”** (Investment for the Future Programme), the steering committee of the Fonds démonstrateurs de recherche sur les nouvelles technologies de l’énergie (New Technologies and Energy Research Demonstration Funds) wrote a road map on buildings and isolated parcels with positive energy and a minimum carbon balance in the autumn of 2010. Two calls for expressions of interest followed, the first organised in 2011 in two phases and the second, closed on 25 September 2012. These calls for expressions of interest are in line with the €1,450 million programme managed by ADEME for funding demonstrators in the renewable energy and green chemistry sector.

### C.3.2 Additional measures

A series of additional measures (part of which is still being defined) will enable us to meet the objectives of reducing primary energy consumption of existing buildings by at least 38% through implementation of the **“Plan d’investissement pour le logement”** (Housing Investment Plan) and general implementation of positive energy buildings in 2020 in the new building stock.

#### Commitments of the Housing Investment Plan

This document, presented by the President of France in March 2013, plans for 500,000 extensive retrofits to be carried out per year from 2015, targeting 50,000 private homes of households facing fuel poverty per year and 120,000 homes in the social housing stock. In the construction sector it has been confirmed that 500,000 new homes need to be built per year in France, including 150,000 social housing units.

#### Additional incentive measures

Implementation of the Housing Investment Plan is based on several measures:

- Introduction of a network of local “one-

stop” renovation desks: as part of the retrofit plan the French government opened new information centres. A network of local advice and information points has been deployed since September 2013 in partnership with collectivities and organisations currently in place (ADEME, ANAH, etc.). In addition, in order to locate and promote measures initiated by collectivities aimed at encouraging energy retrofits in the private housing stock, a call for projects was launched with the collectivities on 30 May 2013.

- Support for the most isolated, impoverished homes by energy retrofit ambassadors: in addition to the local network a system of energy retrofit ambassadors, recruited through the future jobs initiative, will be set up by local collectivities or associations in partnership with Anah. Their mission will be to take proactive measures to detect and identify the most isolated, impoverished households. Deployed across the whole territory they will be able to rely on all stakeholders of the sector (Adil (Departmental Housing Information Office), CCAS (Social Action Community Centre), associations, etc.) to disseminate information. This network of energy retrofit ambassadors should enable the targeted households to have easier access to existing subsidies and retrofit schemes.
- Implementation of a universal allowance for the middle classes: households whose annual income is less than €35,000 (for a couple) will be allocated a subsidy of €1,350. It will be available for two years and will finance energy retrofits in the private housing stock.
- Optimisation of the CIDD and the éco-PTZ;
- Support for energy retrofits in social housing by reinforcing the social housing eco-loan allocated to social landlords, in order to increase the number of refits from 25,000 in 2012 to 90,000 in 2014 and 120,000 by 2017. In this respect it has been recommended that:
  - The eligibility criteria for class D housing is made more flexible;
  - The rate rebate on the social housing eco-loan is increased.
- The energy retrofitting sector is made

professional in order to control its costs and quality. In this respect five measures will make the energy renovation sector into a profession:

- Continuous education for craftsmen (FEEBAT) and study available to others;
- Encouraging skilled workers to improve their qualifications: “reconnu Grenelle de l’environnement” certification will eventually be essential to receive subsidies (eco-conditionality of subsidies from 1 July 2014 for the éco-PTZ and 1 January 2015 for the CIDD);
- Assisting banks to examine éco-PTZ: the small number of éco-PTZ given out is partly explained by the inability of banks to examine the technical section of the finance document. A third-party technical examiner will therefore be given the job of supporting them;
- Supporting professionals in managing their costs: the huge increase in the number of annual retrofits supported by this plan should enable craftsmen to acquire experience that will enable them to lower their costs and help suppliers to benefit from economies of scale, allowing them to reduce their prices, as part of a works package logic. An in-depth and systematic interministerial discussion on future challenges will be set up with the professional organisations of the building sector;
- Modernising the energy performance assessment and making it more reliable.

## C.4 Energy

### C.4.1 Existing Measures

The POPE Law of 2005 introduced the objective of improving final energy intensity: achieving an annual decrease of 2 % in energy intensity from 2015 and an annual decrease of 2.5 % between now and 2030.

#### Energy saving certificates

For this purpose, in particular, the system of energy saving certificates was set up. This provision more particularly targets diffuse sources of energy saving in the residential and tertiary sectors and relies on energy suppliers to promote energy efficiency to their customers.

It is based on a requirement for electricity, gas,

domestic oil, liquefied petroleum and district heating or cooling network suppliers to -promote energy savings. A national target of 54 TWh (i.e. 54 billion kWh) was set for the first period from 1 July 2006 to 30 June 2009. This target was then shared between the various providers which must meet their individual targets by presenting an equivalent amount of energy saving certificates or else pay a penalty of 2 Euro cents per missing kWh. During the second period the provision was extended to suppliers of car fuel. Projects that encouraged innovation, training and information also became eligible. The level of requirements for the second period were 255 TWh<sub>cumac</sub> for all electricity, gas, domestic fuel, liquefied petroleum gas and district heating or cooling network suppliers, and 90 TWh<sub>cumac</sub> for those who release fuel for consumption in cars. The new period started on 1 January 2011 and has lasted 3 years. On 30 November 2012 the volume of final energy saving certificates (ESC) saved was 324.6 TWhcumac<sup>27</sup>. Analysis of the energy savings achieved by the 70 main standardised operations, which represent 95% of ESCs issued at 20 November 2012, indicated that the operations which benefited from ESCs will enable a reduction of 5.0 Mt CO<sub>2</sub>e per year to be achieved by 2020.

- → In view of the additional energy savings that have been permitted by achieving the targets of the second period, the measures that have benefited from the ESCs will enable 6.2 Mt CO<sub>2</sub> eq. to be cut in 2020<sup>28</sup>.

**Implementation of the Ecodesign Directive:** withdrawal of incandescent light bulbs (100 W bulbs in 2009, 75 W in 2010, 60 W in 2011 and the remainder in 2012) has been implemented. The provisions apply more broadly to appliances placed on the market in order to limit consumption caused by standby mode. It applies to all electrical appliances used in the home or office which have to be lower than 1 W (or 2 W according to function) from 2010 and 0.5 W (or 1 W) from 2013. It also

<sup>27</sup> 301.0 TWhcumac as part of standardised operations and 6.1 TWhcumac as part of specific operations.

<sup>28</sup> See assessment carried out in chapter VI.

introduced a reduction of street and office lighting in two stages (2010 and 2012), single digital decoders (their consumption has been limited to 1 W from 2010, then 0.5 W since 2012), and an improvement of the performance of chargers, external power supplies and electrical chargers (before 2010, manufacturers had to come into line with the most energy efficient products on the market and since 2012, they have had to review the design of their products).

- → Impact is estimated at -4.05 Mt CO<sub>2</sub>e in France for the withdrawal of incandescent light bulbs alone in 2020<sup>29</sup>.

### Energy labelling of products

Energy labelling which classifies equipment from A to G according to their energy efficiency already exists for domestic appliances and electric light bulbs. It is a very effective tool for guiding consumer choice and encouraging manufacturers to design energy efficient appliances. Since its creation, this measure was extended to homes (cf. buildings section) and vehicles (cf. transport section) from 2006 and tumble-dryers from 2011.

### Implementation of the EU ETS Directive

Combustion facilities with power of over 20MW and refineries are subject to the EU Emissions Trading Scheme explained in the industry section.

In addition to the emissions trading scheme which is intended to play a structuring role in reducing the carbon content of energy production, special arrangements have been put in place to encourage the development of renewable energies and testing of CO<sub>2</sub> collection and storage technologies.

**Development of renewable energies:** in November 2008 France unveiled its renewable energies development plan. The aim of this programme is to take the share of renewable energies in energy consumption to at least 23% by

<sup>29</sup> SceGES assessment French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 149 [http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_..pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013_..pdf)

2020, by increasing renewable energy production by 20 million tonnes of oil equivalent (Mtoe) per year.

It consists of 50 operational measures, affecting all sectors: bioenergies, wind power, geothermal energy, hydro-electric power, solar power, wave and tidal energy, etc. Its aim is a complete change of scale (doubling production of renewable energies in 12 years): doubling production of wood fuel, increasing geothermal energy by a factor of six, a twelve-fold increase in district heating, and a major change in scale for photovoltaic energy with a 400-fold increase in production.

France uses a wide range of instruments to support renewable energies:

**Implementation of a “renewable heating fund”,** with a budget of €1 billion for the period 2009-2013, enabled heat production from renewable sources such as wood, geothermal energy and solar power to be developed extensively in the tertiary and industry sectors, and heat sources in collective residences to be improved and diversified. It has increased public finance for these energies mainly through annual calls for projects.

- → It will enable 2.7 Mt of CO<sub>2</sub> to be saved each year from 2015<sup>30</sup>.

**Concerning tax, the “sustainable development” tax credit** which helps individuals to buy renewable energy equipment: solar powered water heaters, heat pumps, solar panels, etc., has been extended until 2015. Furthermore, the new incentive tools put in place to support the thermal retrofitting of buildings (éco-PTZ now distributed by the banks, tax exemptions, etc.) will encourage the use of renewable energies.

### Purchase price and regulated requirement

<sup>30</sup> ADEME assessment French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 152 [http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_..pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013_..pdf)

Article 10 of Law n° 2000-108 of 10 February 2000 on the modernisation and development of the public electricity service provides that various installations may benefit from the requirement that EDF or non-nationalised distributors have to buy the electricity they produce. Each renewable sector has therefore been the subject of a specific rate since 2001. New conditions for buying electricity produced from renewable energies were laid down by decrees for the following sectors: hydro-electric (1 March 2007), geothermal (23 July 2010), biomass (27 January 2011), biogas and anaerobic digestion (19 May 2011), wind power (17 November 2008) and photovoltaic energy (4 March 2011).

**Invitations to tender** were launched to support those renewable energy sectors for which the buy-back price was insufficient to encourage the development of renewable energies at a controlled cost for the consumer. This is particularly the case of off-shore wind farms, the costs of which vary considerably from one farm to another, depending, in particular, on geological conditions and distance from the coast.

*Regarding onshore wind power*, firstly, the Ministry in charge of Sustainable Development has confirmed the purchase price and secondly, the regional air and climate schemes include a regional wind power plan in order to define areas suitable for development of wind farms. Wind power projects are subject to planning permission, in order to avoid haphazard encroachment on the land and limit impact on the landscape, heritage and quality of life of local residents, in addition to requirements relating to classified installations (see section on the other impacts IV.C.9).

The plan de programmation des investissements électriques (electricity investment programming plan) provides for a ten-fold increase in the French on-shore wind power estate between 2006 and 2020, with a target of 19,000 MW power installed in 2020. On 1 August 2013 twenty regions had adopted their SRCAE (Regional Climate, Air and Energy Plans) and 4 others their wind power section only, pending adoption of a full SRCAE. Returns on current projects and the content of approved

SRCAEs exceed the target currently specified by the multi-annual investment plan for the on-shore wind power sector with total targets of over 23,000 MW in 19 of the 26 regions.

#### *Off-shore wind farms*

The French renewable energies development plan provides for an acceleration of development of off-shore wind power and wave and tidal energies. It aims to have a total installed capacity of 6,000 MW by 2020, i.e. about 1,200 wind turbines producing 3.5% of French electricity consumption. This programme represents an investment of about €20 billion.

An invitation to tender for the installation of off-shore wind farms with 3000 MW production capacity at five areas identified as suitable at the end of a planning and consultation process was launched in 2011: Le Tréport, Fécamp, Courseulles-sur-Mer, Saint-Brieuc and Saint-Nazaire. The installations must be built progressively from 2015. A new invitation to tender was opened for the creation of off-shore wind farms off Tréport (not allocated at the end of the first call for projects) and Noirmoutier.

Concerning *hydroelectricity*, France's primary source of renewable electricity (12 % of electricity production), the existing fleet has been modernised and optimised (particularly by over-equipping to make water transfer pumping stations) in a sustainable development approach integrating ambitious watercourse quality measures (increasing reserved flows in certain cases, etc.). The objectives of the multi-annual electricity investments programme (PPI) 2009-2020 provide for increased annual production of energy from hydro-electric power by 3 TWh by 2020, which cannot be achieved through improvement of existing structures alone. Increased production will therefore be obtained through the creation of new plants.

## Investment for the Future

The programme des investissements d'avenir (Investment for the Future Programme) launched in 2009 with a total budget of €35 billion should provide funding for profitable assets and research and innovation facilities necessary for the economic development of France.

Five key strategic areas have been identified as "priorities" (higher education and training, research, industrial sectors and SMEs, sustainable development) and should enable France to increase its growth potential.

Of the €35 billion of credits allocated by the Amending Finance Law for 2010 to investments for the future a budget of €3.6 billion was allocated to energy research:

- €1 billion for the "Institutes of Excellence for Low Carbon Energies" programme managed by the French National Research Agency (ANR);
- €1 billion for the "Nucléaire de demain" (Nuclear Tomorrow) programme managed by the French Atomic Energies and Alternative Energies Commission (CEA) and ANDRA;
- €1.125 billion for the renewable energies and green chemistry programme led by ADEME. This budget aims to support technological projects or platforms covering the solar, wind, wave and tidal, geothermal, CO<sub>2</sub> capture and storage, and plant chemistry sectors;
- €165 million for intelligent electrical networks demonstrators run by ADEME. They are intended to support industrial research and testing of intelligent network technologies for electricity distribution and consumption and the integration of renewable energies;
- €950 million for the "Vehicles of the Future" demonstrators (presented in the section on transport) run by ADEME;
- €750 million for the "Town of Tomorrow Programme" managed by the Caisse des dépôts et consignations;
- €210 million for "Circular Economy" demonstrators.

## C.4.2 Additional measures

The extension of the ESC system by means of a third and more ambitious period of commitment in 2014-2016 is the measure with the greatest impact from the road map produced by the national round table for energy efficiency presented on 16 December 2011.

Heat PPI: The WAM scenario posits the hypothesis that the objectives of the various multi-annual investment programmes (PPI) are met. This concerns the electricity PPI detailed above and the heat PPI. In 2012 development of the different renewable energies was as follows:

Standardised gross final consumption	2005	2012	2020 target (WAM)
Wind power (Mtoe)	0.1	1.2	5.0
Geothermal and heat pumps (Mtoe)	0.2	1.5	2.4
Consumption of wood fuel by private individuals (Mtoe)	6.7	7.2	7.4
Other uses of solid and gaseous biomass (production of heat and electricity)	2.6	3.6	10.5
Hydroelectricity (Mtoe)	5.7	5.4	5.5
Photovoltaic solar power (Mtoe)	-	0.4	0.6
Thermal solar power (Mtoe)	0.05	0.13	0.9
Biofuels (Mtoe)	0.4	2.7	3.7
Tidal and hydrokinetic energy (Mtoe)	0.04	0.04	0.1

While the development of some sectors was ahead of target in 2012 (photovoltaic energy in particular) and the targets have also almost been achieved for the other electricity production sectors (80% of the way for wind power), very ambitious targets for development of Renewable Heat have been set, especially in for use of biomass (other than wood fuel by private individuals). If they are to be achieved the Fonds Chaleur Renouvelable (Renewable Heat Fund) must be significantly extended and strengthened.

## C.5 Industry

### C.5.1 Existing and additional measures

#### The Emissions Trading Scheme and its revision

European Directive 2003/87/EC establishing an emissions trading scheme within the European Union (EU ETS Directive) introduced a “cap-and-trade” system for GHG emissions from the main industrial and energy activities of the European Union on 1 January 2005. In France, 988 installations operated by 585 firms were subject to this directive in 2008. The review of the ETS Directive extended its scope, standardised methods of allocating quotas to plants and above all reinforced the GHG reduction targets of the sectors subject to this directive: in Europe their emissions must be reduced by 21% between 2005 and 2020.

The total amount of quotas allocated (including those initially put in the new entrants’ reserve) was 156.51 Mt CO<sub>2</sub> per year for the period 2005-2007 and 133.4 Mt CO<sub>2</sub> per year over the period 2008-2012<sup>31</sup>. In France, emissions from the sectors subject to the EU ETS directive were 131.3 Mt CO<sub>2</sub> in 2005, 127 MtCO<sub>2</sub> in 2006, 126.6 MtCO<sub>2</sub> in 2007, 124.1 Mt CO<sub>2</sub> in 2008, 111.1 MtCO<sub>2</sub> in 2009, 115.7 in 2010 and 104.6 in 2011, i.e. levels below the total amounts of quotas allocated for the corresponding periods.<sup>32</sup>

The review of the EU ETS Directive was adopted by the European Parliament and the Council in December 2008 in the context of the adoption of the Energy and Climate Package. It has enabled:

- Its scope to be extended. The system includes aviation activities from 2012. For the period 2013-2020 (phase 3 of the provision), the system covers new sectors (CO<sub>2</sub> emissions from petrochemical plants, ammonium production, CO<sub>2</sub> and PFC emissions associated with aluminium production, N<sub>2</sub>O emissions from nitric acid production, etc.). In total it covers some 1,200 plants belonging to 650 firms in France.

- Methods of allocating quotas to manufacturers to be standardised with use of frames of reference for all plants;
- A system to address the risk of carbon leakage to be introduced.

### Limiting energy consumption

Important regulatory changes on energy consumption by the manufacturing sector have been introduced since 2008. Directive 2008/1/EC concerning integrated pollution prevention and control of 15 January 2008 requires Member States to ensure that energy is used efficiently in plants pertaining to certain industrial activities (energy industries, metal production and processing, mineral industries, chemical industries, waste management). This requirement was reinforced by Directive 2010/75 concerning industrial emissions (IED) which came into effect in 2012 and which makes the conclusions of the “BREFS” (Best Available Technologies -BAT) compulsory, especially the energy efficiency BREF and conclusions relating to energy in the sector BREFs. In France, article 82 of Law no. 2010-788 of 12 July 2010 on the national commitment for the environment added the rational use of energy (RUE) among the interests protected by legislation for classified installations (CIEP).

### F-gas refrigerants

Concerning f-gas refrigerants, in accordance with European Regulation no. 842/2006, France has implemented a measure aimed at limiting their emission into the atmosphere (articles R.543-75 et seq. of the French Environmental Code). This measure requires sealing controls on refrigeration and air-conditioning<sup>33</sup> equipment with a fluid load of more than 2 kg, recovery of fluids at the end of the product’s life, a minimum level of skill to install, maintain and empty them: only holders of a certificate of ability will be able to carry out these operations and buy refrigerant fluids.

<sup>31</sup> Amounts specified in the national quota allocation plans validated by the Commission

<sup>32</sup> Source: Common International Transaction Log (CITL)

<sup>33</sup> Concerning the other sectors using HFCs, PFCs and SF<sub>6</sub>s a decree is being drafted in order to be able to apply the provisions of Regulation no. 842/2006

- → All these measures will permit an estimated reduction of GHG emissions of 7.17 Mt CO<sub>2</sub>e in 2020<sup>34</sup>.

This regulation was supplemented by Decree 2011-396 which specifies the regulatory provisions on the use of fluorinated greenhouse gases in uses other than refrigeration and air-conditioning. It provides for the implementation of personnel certification systems, specified by Regulation (EC) no. 842/2006 and its implementing regulations. It concerns manufacturers of fire protection systems and fire extinguishers, high-voltage connection equipment or solvents. On 1 December 2012 certification bodies were approved for all these sectors, apart from the solvents sector which concerns a very restricted number of operators. Firms carrying out maintenance and installation operations on fire protection systems (including extinguishers) are also required to be certified. New criminal penalties are associated with it. An annual declaration system for flows of fluorinated greenhouse gases has been instituted, making it possible to assess the efficiency of the recovery sector for these substances.

### Voluntary commitments

In addition, several incentive measures to improve the energy efficiency and reduce the GHG emissions of industrial firms have been put in place: Energy Saving Certificates (see section on the energy sector), rapid paying off and reduction of the tax professionnelle (business rate tax), implementation of a business subsidy system for carrying out energy assessments.

## C.6 Agriculture and forestry

### C.6.1 Existing measures

#### Cutting nitrogen emissions

The national nitrogen surplus of Metropolitan France is 1.1 million tonnes, i.e. 36 kg of nitrogen

per hectare of usable agricultural land. This surplus represents 23% of total nitrogen fertilisation, i.e. 50% of the synthesised mineral nitrogen fertiliser input<sup>35</sup>.

Cutting nitrous oxide (N<sub>2</sub>O) emissions, through better control of nitrogen fertilisation and combating organic nitrogen surpluses, consequently remains a priority issue for the agricultural sector, even though fertiliser deliveries in France have fallen over the last 20 years by more than 10% as have animal-derived organic fertiliser inputs to the soil (-9 %).

Through the spreading of livestock manure, about 280,000 tonnes of mineral nitrogen have been saved per year. Additional savings can be made by optimising the management of digestates from anaerobic digesters.

Nitrate action programmes, compulsory in areas vulnerable to nitrate pollution, aim to balance nitrogen fertilisation with good management of nitrogen fertilisers including animal manure. These programmes aim to reduce the quantities of nitrogen fertilisers spread, optimise the recycling of livestock manure and reduce losses linked to nitrogen fertiliser spreading by the diffusion of improved spreading practices. Before the fifth action programme of the Nitrogen Directive fully comes into effect, at the end of 2013, cover crops have had to be introduced on all plots in vulnerable areas with a period of more than 5 months between harvesting and planting.

Some actions of the “plan végétal environnement” (plant environment plan) (cf. Order of 21 June 2010) also help to reduce nitrogen fertilisation (controlling nitrogen fertilisation through environmental assessments, dissemination of economic practices on inputs, investment in equipment intended to ensure a better distribution of mineral inputs). Over the period 2007-2011 subsidies were awarded to 5,380 files as part of the “réduction des pollutions des eaux par les fertilisants” (reduction of water

<sup>34</sup> Source: ARMINES assessment French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 145 [http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_.pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013_.pdf)

<sup>35</sup> CGDD, March 2012

pollution by fertilisers) issue (in total, €27 million of overall investment). Although not subsidised, expenditure on nitrogen analysis and assessments increased.

Furthermore, various CAP subsidies helped to implement agricultural practices that reduce nitrogen inputs, in particular:

- Decoupling of agricultural subsidies, for optimisation of cultivation practices;
- Subsidy conditionality (maintaining land in good agricultural and environmental condition (GAEC) and in particular, compliance with the measures in the nitrates action plans);
- And the possibility of receiving subsidies to compensate for the cost of implementing agri-environmental measures (AEM), with the following AEMs in particular:
  - Agri-environmental grass premium (PHAE) (economic input management): about 53,000 files in effect in 2011 (undertaken between 2007 and 2011) for an area of 3.6 million hectares;
  - Territorialised agri-environmental measures (territorial AEM) HERBE: keeping areas under grass, limiting nitrogen fertilisation;
  - Territorialised agri-environmental measures (territorial AEM) FERTI: reasoned fertilisation;
  - "Rotational" agri-environmental measure (rotation AEM), concerning diversification of crop rotation to reduce the use of inputs; about 9,000 files in effect in 2011 (undertaken in 2007 or 2010) for an area of 1.2 million ha;
  - Agri-environmental measure for low input forage systems (LIFS): about 1,500 active files in 2011 (undertaken in 2007, 2008, 2009, 2010 and 2011) relating to 70,000 ha.
  - Territorialised agri-environmental measure (territorial AEM) for combating soil erosion (integral inter-row cover for vines) launched in 2009.
- Finally, various policies implemented by the Ministry for Agriculture also helped to reduce nitrogen inputs: the 2010-2013 support plan for protein-rich crops, aimed at developing crops of environmental and agronomic benefit (protein-rich crops belonging to the legume family, which store nitrogen from the air in the soil and

thus reduce the need to add mineral nitrogen to the next crop in the rotation cycle);

- And support for biological agriculture, with a posted target of 20% of the Usable Agricultural Area by 2020;

### Cutting emissions through management of livestock manure

The "plan de modernisation des bâtiments d'élevage" (livestock buildings modernisation plan) provides funding for investments related to management of manure and equipment that cut greenhouse gas emissions (ditch coverage, treatment systems).

Over the period 2007-2011 about 31,000 files including a section on improvement of livestock manure management (5,600 including manure management expenditure) were subsidised resulting in total subsidies of about €630 M.

Anaerobic digestion in agriculture continues to develop, with 90 plants listed in France at the end of 2012. Exemplary anaerobic digesters were subsidised as part of the ADEME "fonds déchets" (waste fund) (€6 million in 2009 and €7 million in 2010), or through various measures such as the "rural centre of excellence" call for projects or local development plans (regions, departments). The buy-back price for electricity from anaerobic digesters was re-assessed in 2011 and a regulatory framework concerning the injection of biomethane (purified biogas) into the natural gas networks was also defined.

- → Development of anaerobic digesters would enable emissions linked to livestock manure to be cut by 0.76 Mt CO<sub>2</sub>e/year in 2020<sup>36</sup> (evaluation based on 800 units of 200 kW electricity).

<sup>36</sup> Source: calcul MAAPMAAF/DLCES. French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 146 [http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_.pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013_.pdf)

### Cutting energy consumption and developing renewable energies in the agriculture sector

A “Plan de Performance Énergétique des exploitations agricoles” (Energy Performance Plan for farms) for 2009-2013 has been implemented: it consists of awareness raising projects and advice on energy saving, production of renewable energies and reduction of GHG emissions.

**A “Serres-Energie” (Greenhouse-Energy) measure** implemented by the Ministry for Agriculture supports the sustainable development of market gardening and horticultural production under glass by encouraging energy saving and development of renewable energies. The system, amended in 2011, is based on four key areas:

- Improving energy efficiency;
- Encouraging energy substitution in favour of the most competitive energy sources;
- Finding ways to save water;
- Reducing the use of plant health products.

This measure also promotes the use of renewable energies by funding investment in boilers powered by renewable energies.

The main support tools are subsidies for investment in horticultural and market gardening greenhouses managed by FranceAgriMer. Some also come from the Plant Environment Plan. The measures managed by FranceAgriMer have a budget of about €5 million per year (€10 million in 2012).

Finally, the livestock buildings modernisation plan, mentioned above, also provides subsidies for additional actions to reduce energy consumption and develop renewable energies.

### EU measures and regulations to promote carbon storage

The **Common Agricultural Policy** includes various measures to promote carbon storage in soils and biomass:

- The agri-environmental grassland incentive and territorialised agri-environmental measures constructed on the basis of grass which enable meadows and pastures to be maintained;

- Installation of topographical elements (hedges, lines of trees, single trees, etc.) on 3% of the usable agricultural land area (dedicated measure) in 2011, and 5% in 2012;
- Autumn and winter soil cover by cover crops (territorialised agri-environmental measures in favour of nitrate-trapping cover crops outside vulnerable areas and good agri-environmental conditions within these areas);
- Promotion of agri-forestry (agri-forestry measures (222), and various territorialised agri-environmental measures aimed at agri-forestry with hedge maintenance), which were favourable to the storage of carbon in the biomass.

In addition, the implementation of sustainability criteria for biofuels helps to prevent the production of raw materials intended for biofuel production on certain carbon-rich soils in certain biodiversity-rich areas within the European Union or in countries that export to the European Union.

### Carbon storage in forests

French forests currently make a net overall positive contribution to climate change mitigation, with emissions (originating in particular from the oxidation of dead wood and felling) lower than sequestration. In 2011 this forest sink was 57 Mt CO<sub>2</sub> in France, corresponding to the absorption of 11.5% of the country's greenhouse gas emissions in 2011. This shows that French forests are not in balance, due in particular to their relative youth. At the same time, the over-representation of populations older than the optimal age of yield makes increased mobilisation possible from a sustainable management perspective.

### The development of timber

Used and produced sustainably, timber requires little energy for its production and enables carbon to be stored temporarily: it already enables about 4 Mt of CO<sub>2</sub> to be stored annually in wood products in France and development of these uses would enable it to increase.

An additional target of mobilising up to 9 Mm<sup>3</sup> of timber per year by 2020 was set by the Forest

Council (December 2007). It was specified in the French national action plan on renewable energies (August 2010).

To achieve this target several measures are provided:

- The **“bâtiments biosourcés” (bio-sourced buildings) label** introduced by Decree no. 2012-518 of 19 April 2012 became operational in 2013 following the publication of the Order of 19 December 2012. It gives visibility to projects that make the effort to make significant use of materials of plant and animal origin (wood, hemp, straw, wool, feathers, etc.).
- **The implementation of the “plan de relance de la compétitivité des scieries”** (sawmill competitiveness revival plan) over the period 2007-2009 was followed by **the creation of the “fonds stratégique bois” (strategic wood fund)** in 2009, extended in 2011 through the modernisation fund supported by the French Government and OSEO (now BPI). Allocated €1.5 million by the French State in 2011 and a further €0.8 million in 2012, this fund is intended to support investment in SMEs of the forestry and wood sector at key moments in their development. The lever effect of public credit enables a minimum of €30 million in loans to be made available to wood processing businesses. After nine months in operation, the measure’s monitoring committee, consisting of State representatives, OSEO and experts, have analysed the first results. On 31 May 2012 44 loan applications had been filed for a potential of €6.7 million, i.e. 89% of the €7.5 million budget;
- The **Xylofutur competitiveness cluster** has promoted the use of timber in construction since 2005;
- The law on the modernisation of agriculture and fishing (July 2010) introduced regional multi-annual forestry development plans, which identify priority projects for wood mobilisation at regional level, taking into account existing markets and the need to preserve biodiversity. They have all been prepared and submitted to the appropriate prefects.
- In 2011 the French State reported to Parliament on forest carbon sinks and the possibilities of

their financial development by the territories, in accordance with article 83 of the law of 12 July 2010 on the national commitment for the environment.

### Development of biomass energy

Wood fuel can be harvested as a by-product of timber, in accordance with the hierarchy of uses. It is therefore beneficial to recover sawmill-related products and some other wood residue in the form of heating.

More generally, development of biomass recovery in the form of energy enables GHG emissions in various sectors to be reduced when substituted for fossil fuels.

Air quality issues raised by the use of wood fuel, in terms of particle pollution and sometimes long periods needed to pay-off the “carbon debt” of the wood fuel sectors, make it essential to give priority to the development of efficient equipment.

Concerning heat production, the plan bois-énergie 2000-2006 (wood fuel plan) implemented by ADEME was extended by the Biomass Energy programme 2007-2010, which expanded to take in other biomass categories (straw, energy crops, etc.). In this respect, 2,800 boiler rooms were installed between 2000 and 2009 (substitution of over 450 ktoe, preventing about 0.7 Mt CO<sub>2</sub>e over the 2000-2006 period).

The Biomass Energy Programme was replaced in 2009 by the Fonds Chaleur (Heat Fund) (cf. energy section). Of the 95 biomass boiler room projects accepted by the “Biomasse, Chaleur, Industrie, Agriculture et Tertiaire” (BCIAT) (Biomass, Heating, Industry, Agriculture and Tertiary) call for projects from 2009 to 2011, 84 are either in the process of being carried out, or already in operation, for a total of about €183 million in subsidies. A further 22 projects selected in 2012 can be added to these figures. Apart from BCIAT, 413 biomass boiler room projects, the vast majority being wood fuel boilers, were subsidised over the 2009-2012 period for a total of €202 million in subsidies and annual production of 321 ktoe.

Furthermore, the *crédit d'impôt développement durable* (CIDD) (sustainable development tax credit), energy saving certificates (ESC) and the *éco-PTZ* (zero rate eco-loan) support the increased use of wood fuel by private individuals while taking into account air quality issues.

Additional mobilisation of wood at territorial level: regional multi-annual forestry development plans were introduced by the law on the modernisation of agriculture and fishing (July 2010) and a national biomass observatory, linked to regional biomass units, was set up, in accordance with law 2010-788 of 12 July 2010 on commitment for the environment.

### C.6.2 Additional measures<sup>37</sup>

#### Anaerobic digestion

In March 2013 an ambitious *Énergie Méthanisation Autonomie Azote* (Anaerobic Digestion and Nitrogen Plan) (EMAA) was unveiled, with a target of 1,000 plants in 2020. This development of anaerobic digestion should also permit emissions linked to animal manure to be reduced by an estimated 0.95 Mt CO<sub>2</sub>e/year by 2020. This policy will not only increase the renewable energies produced in the agricultural sector but also help to reduce nitrogen inputs (manufacture of which generates large quantities of greenhouse gases).

#### Development of the wood sector

An action plan for wood sectors is being prepared by the Ministries in charge of Agriculture, Industrial Renewal and Sustainable Development. It comprises a large number of measures aimed in particular at reinforcing the downstream part of the sector and in particular timber outlets (in compliance with the hierarchy of uses).

<sup>37</sup> The agricultural sections of the "with measures" and "with additional measures" scenarios are identical and do not explicitly take into account the measures stated in this section, as they were not known (with sufficient precision) when the scenarios were being drawn up, apart from the implementation of 800 to 1000 units of agricultural anaerobic digestion, a hypothesis accepted for both scenarios.

#### Negotiation of the CAP 2014-2020:

One aspect of the "greening" of the CAP for the period 2014-2020 is the implementation of the green payments system: 30% of subsidies in the first pillar of the CAP have to be reserved for "green payments", provided the various criteria are met, including the maintenance of a significant area of permanent grassland (criterion favourable to carbon storage) and the maintenance of Ecological Focus Areas.

Furthermore, in the second pillar of the CAP, the AEMs (agri-environmental measures) will be replaced by AECMs (Agri-environmental and Climate Measures): they may henceforth be implemented with the aim of mitigating climate change (cutting emissions or increasing carbon stocks in soil or biomass).

#### National policies in preparation:

It should be noted that the Law on the Future of Agriculture and Forestry (LAAF) entered the consultation process in April 2013. It will aim to revitalise the agriculture and forestry sectors. It will be discussed in parliament in January 2014.

### C.7 Waste

#### Existing and additional measures

##### Prevention of waste production and waste management

The French Environmental Code states that the **prevention of waste production** is a priority for waste management (article L541.1). A target of stabilising waste production by 2008 was therefore set in 2003 (while waste production increased by about 1% per year) and, in 2004, the first waste production prevention plan was published. This plan has been under review and will be published in 2013, in response to the European Waste Framework Directive (2008/98/EC), which requires Member States to draw up waste prevention plans by 12 December 2013 at the latest.

France's waste policy was largely reinforced in 2008 with:

- The transposition of the Waste Framework Directive (Directive 2008/98/EC) into French

law and in particular, article 4, which specifies a waste treatment hierarchy: prevention, preparation with a view to re-use, recycling, other recovery, especially energy recovery and elimination. Order n° 2010-1579 of 17 December 2010 adapts these various provisions of EU law in the waste sector;

- The framework Law no. 2009-967 of 3 August 2009 on implementation of the Grenelle Environment Round Table (article 46) which sets ambitious waste management targets:
  - Reduce annual production of domestic and similar waste per person by 7 % in five years<sup>38</sup>;
  - Increase recycling of material and organic matter by directing 35 % of household and similar waste to these sectors in 2012 and 45 % in 2015<sup>39</sup>;
  - Direct 75% of household packaging waste and non hazardous and non inert business waste (apart from the construction industry, agriculture, agri-food industries and specific activities) to recycling in 2012;
  - Reduce the quantities of non hazardous and non inert incinerated and stored waste by a total of 15%.
- The measures specified by article 46 of law n° 2009-967 of 3 August 2009 will result in a total emissions reduction of 0.4 Mt. CO<sub>2</sub>e in 2020<sup>40</sup>.
- Law n° 2010-788 of 12 July 2010 on the French national commitment to the environment (article 204), which specifies a requirement to sort at source with a view to recovery for the big bio-waste producers.

<sup>38</sup> In 2007 and 2009, production of household and similar waste was 391 and then 374 kg/person/year. Based on stability in 2008 compared with 2007, the target set by the law will reduce waste production by 28 kg per person by 2013, thus falling to 363 kg/person/year.

<sup>39</sup> Category which combines household and similar waste, as well as occasional waste (bulky waste, rubble, green waste, etc.).

<sup>40</sup> Source: SceGES assessment (cf. Chapter VI). French report to the European Commission (in respect of article 3 of decision 280/2004/EC) on the inventory of mitigation policies and measures, March 2013. Page 156  
[http://www.developpement-durable.gouv.fr/IMG/pdf/Fr\\_RMS\\_2013\\_...pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/Fr_RMS_2013_...pdf)

- The plan d'actions sur les déchets 2009-2012<sup>41</sup> (waste action plan) defines the guidelines for implementation of these objectives. Progressive increase of the general tax on pollution-generating activities (cf. below) gives an economic signal by raising the costs of incineration and storage and significantly reinforces the financial commitment of the French State. Credits annually devoted to this policy went up from €57 million of commitment authorisations in 2008 to €107 million in 2009, €172 million in 2010 and €235 million for 2011 (Fonds Chaleur (Heat Funds) + waste credits). These amounts were entrusted to ADEME as part of its public operator mission. They are mainly dedicated to prevention and recycling by supporting local operations (studies, communication and investments) and giving subsidies for research and awareness raising campaigns (including the campaign targeted at the general public, "Réduisons vite nos déchets, ça déborde" (Let's cut waste - the bin is overflowing)).

### Recovery of methane on landfills

When necessary<sup>42</sup>, non hazardous waste storage facilities should be equipped with a definitive methane capture and collection network<sup>43 44</sup> no later than one year after the compartment containing the waste has been filled. This system should enable the biogas to be transported to a recovery plant or, if not, to a destruction facility. This combustion oxidises CH<sub>4</sub> to CO<sub>2</sub> and thus reduces the corresponding greenhouse gas emissions. With the objective of limiting diffuse biogas emissions, France has made provision for a biogas capture requirement, which includes compartments in operation. Furthermore, incentive measures

<sup>41</sup> See also [http://www.developpement-durable.gouv.fr/spip.php?page=article&id\\_article=7315](http://www.developpement-durable.gouv.fr/spip.php?page=article&id_article=7315)

<sup>42</sup> Affects non hazardous waste storage facilities receiving biodegradable waste where considerable quantities of biogas are produced.

<sup>43</sup> Cf. Order of 9 September 1997

<sup>44</sup> Cf. Order of 19 January 2006, amending the Order of 9 September 1997, amended in relation to household and similar waste storage facilities

(purchase prices for electricity produced from biogas - cf. energy section) aimed at improving biogas recovery have been implemented. While combustion or "torching" of biogas already enables CO<sub>2</sub> to form in place of methane which has a higher Global Warming Potential, and thus contribute to the mitigation of GHG emissions this biogas can also be used as an energy source.

Amendment of the **tax exemption on waste storage and incineration facilities**: the general tax on pollution-generating activities (TGAP) was amended in the Finance Law for 2009 to encourage waste prevention and recycling. The reference rate of the general tax on pollution-generating activities (TGAP) applying to household and similar waste received in storage facilities was thus substantially increased and an adjustment according to environmental and energy criteria was introduced. In addition, a TGAP was introduced for waste received at household and similar waste incinerators. The objective of these tax exemption measures is to outbid the cost of these treatment methods in order to limit their use, encourage the prevention of waste production and increase recycling<sup>45</sup>. Additional products linked to these taxes are allocated to ADEME to carry out its missions in respect of the waste policy support plan.

Institution of incentive pricing to finance waste elimination: the household waste collection charge and the household waste collection tax will soon have to include a variable part that can take into account the nature, weight, volume or number of waste collections.

<sup>45</sup> The 2009 Finance Law provides for a four-fold increase in the TGAP rate on waste storage between 2008 and 2015. For NHWSFs not benefiting from any adjustment, TGAP increased from €10.03/T of stored waste to €40/T. In addition, a TGAP was created for incineration of household and similar waste. For incinerators not benefiting from any adjustment, the TGAP was set at €7 /T of incinerated waste in 2009 to reach a rate of €14 /T from 2013. The Finance Law for 2009 and the Amending Finance Law for 2010 introduced numerous adjustments according to the environmental performance of plants. See scales in the appendix to the report: First report on the reform of the TGAP of 2009 and the support policy on household and similar waste [http://www.developpement-durable.gouv.fr/IMG/pdf/RAPPORT\\_AU\\_PARLEMENT\\_-\\_PREMIER\\_BILAN\\_REFORME\\_TGAP\\_DE\\_2009-doc.pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/RAPPORT_AU_PARLEMENT_-_PREMIER_BILAN_REFORME_TGAP_DE_2009-doc.pdf), MEDDE, 2011

Reinforcement of awareness raising projects: particularly through national publicity campaigns on waste: "Faisons vite, ça déborde" (Let's act fast, the bin's overflowing). Credits allocated to ADEME for the waste policy give priority to prevention, with provisions for subsidising collectivities which define local prevention plans and programmes.

## C.8 Businesses

### C.8.1 Existing measures

New environmental requirements, particularly in relation to climate change, have been brought in for businesses.

The law on New Economic Regulations (NRE) of 2001 had already introduced a requirement for businesses quoted on the stock exchange to include information on the social and environmental consequences of their activities in their annual report.

**The duties of businesses in relation to corporate, environmental and social responsibility** were reinforced and extended to new businesses by law n° 2010-788 of 12 July 2010 on the national commitment for the environment. The issue is to permit investors (particularly "investissements socialement responsables" (socially responsible investment) funds) and various stakeholders to be informed about corporate social responsibility policies:

- Article 224 of law n° 2010-788 of 12 July 2010, specified by a decree of 30 January 2012, provides for the requirement for managers of collective investment schemes (OPCVM) to indicate, in documents addressed to subscribers, how they take account of environmental, social and governance criteria in their investment policy;
- Article 225 of the same law, applicable to businesses of more than 500 employees, specifies that the requirement to make information available for groups must include controlled companies and subsidiaries. The information given must enable comparisons to be made and be consistent with the main international frames of reference. In addition, the

information must be verified by an independent third party body. Decree n° 2012-557 of 24 April 2012 specifies implementation details. This requirement takes effect for companies for accounting years started after 1 January 2010 for quoted companies and unquoted companies of more than 5,000 employees. This requirement has been progressively extended to all companies of over 2,000 (500 respectively) employees for accounting years begun in 2013 (2014 respectively). In addition, since 31 December 2012 businesses of over 500 employees are required to draw up an assessment of their greenhouse gas emissions and an action plan for cutting them.

**CO<sub>2</sub> information for transport services.** In order to promote transport with lower CO<sub>2</sub> emissions, since October 2013 operators (passenger or goods transport, removals companies, taxis, couriers, and travel agents) are required to inform their clients about the CO<sub>2</sub> emissions produced by their service. This requirement adopted as part of law n° 2010-788 of 12 July 2010 on the national commitment for the environment is reiterated in the French Transport Code (article L. 1431-3). Decree 2011-1336 of 24 October 2011 defines the principles of a common calculation method for all means of transport (rail or guided, road, inland, maritime, air). It specifies the arrangements for informing the recipient and the schedule for implementing the provisions. The calculation methodology is based on the European standard on the calculation and declaration of energy consumption and greenhouse gas emissions of transport services (standard EN 16 258). This decree proposes a general methodology for calculating the quantity of the different sources of energy consumed by a transport firm according to means of transport used for each section of the journey.

Table 19: Main policies and measures taken into account in the “with existing measures” and “with additional measures” scenarios

Name	Objective	GHG targeted	Instrument	Status	Responsible entity	Estimation of emission reductions in CO <sub>2</sub> e for a given year (Mt CO <sub>2</sub> )					
						1995	2000	2005	2010	2015	2020
<b>Residential/Tertiary WEM</b>											
Thermal Regulation RT 2005 (assessed for the residential sector only)	Set energy performance restrictions for compliance by new buildings. (Regulation reinforced from 2013 by RT2012, taken into account in the WAM scenario)	CO <sub>2</sub> ' (CH <sub>4</sub> , N <sub>2</sub> O)	Regulation	applied	MEDDE/METL				0.41	0.78	1.24
“Total” thermal regulation for existing buildings	Specify a minimum performance for compliance by existing buildings over 1000 m <sup>2</sup> subject to extensive retrofitting	CO <sub>2</sub> (CH <sub>4</sub> , N <sub>2</sub> O)	Regulation	applied	MEDDE/METL						
“Part by part” thermal regulation for existing buildings	For buildings less than 1000 m <sup>2</sup> or for buildings over 1000 m <sup>2</sup> subject to minor retrofitting, the RT per component defines a minimum performance for replaced or installed components	CO <sub>2</sub> , (CH <sub>4</sub> , N <sub>2</sub> O)	Regulation	applied	MEDDE/METL						
Crédit d’impôt développement durable (CIDD)	Encourage energy retrofits Measure studied on the basis of the assumption of it lasting until 2013 in the WEM scenario	CO <sub>2</sub>	Tax exemption	applied	MEDDE/METL/ MINEFI				1.23	3.39	3.76
Eco-Prêt à Taux Zéro (Eco-PTZ)	Encourage energy retrofits Measure studied on the basis of the assumption of it lasting until 2013 in the WEM scenario	CO <sub>2</sub>	Tax exemption	applied	MEDDE/METL/ MINEFI				0.13	0.34	0.33
HPE and THPE labels	From 1 January 2013, two new labels will complement RT 2012 and prepare the way for positive energy buildings. They will apply to all planning applications for new buildings or parts of new buildings and reinforce the energy performance requirements.	CO <sub>2</sub>	Information and economics	applied	MEDDE/METL						
Energy Saving Certificates (ESC)	Mobilise energy saving sources, especially in sectors where it is most diffuse such as the building sector	CO <sub>2</sub>	Economic	applied	MEDDE						
Reduced Value Added Tax (VAT) on certain building renovation work	Encourage energy retrofitting of existing buildings	CO <sub>2</sub>	Tax exemption	applied	MEDDE/METL/ MINEFI						
Social housing retrofit plan	Encourage energy retrofitting of existing buildings	CO <sub>2</sub>	Economic, tax exemption	applied	MEDDE/METL						
Requirement to retrofit tertiary buildings	Encourage purchase and rental of high energy performance buildings	CO <sub>2</sub>	Regulation	applied	MEDDE						
Requirement to maintain boilers		CO <sub>2</sub>	Regulation	applied	MEDDE						
Inspection of air-conditioning systems		CO <sub>2</sub>	Regulation	applied	MEDDE						

Name	Objective	GHG targeted	Instrument	Status	Responsible entity	Estimation of emission reductions in CO <sub>2</sub> e for a given year (Mt CO <sub>2</sub> )				
						1995	2000	2005	2010	2015	2020
<b>WAM</b>										
Target of reducing energy consumption of existing housing by 38% by 2020.		CO <sub>2</sub> -(CH <sub>4</sub> , N <sub>2</sub> O)	Objective							
Reinforcement of Thermal Regulation (assessed for the residential sector only)	Reinforcement of Thermal Regulation - RT 2012	CO <sub>2</sub> (CH <sub>4</sub> , N <sub>2</sub> O)	Regulation	applied (since 01/01/2013)	MEDDE				0.71	3.55
<b>Industry WEM and WAM</b>										
Implementation of the emissions trading scheme - (ETS Directive and its review)		CO <sub>2</sub> (and HFC and N <sub>2</sub> O from 2013)	Economic	applied	European Commission, MEDDE					
Refrigerant gases: sealing checks, recovery of end of life fluids and minimum level of skill required to carry out maintenance operations	Limit emissions of refrigerant gases during maintenance and at end of life	HFC	Regulation	applied	MEDDE			1.28	4.01	7.17
Decree on f-gas use other than refrigeration (decree no. 2011-396)										
ADEME energy assessment	Encourage businesses to improve their energy performance	CO <sub>2</sub>	Information	applied	ADEME					
<b>Agriculture and forestry WEM and WAM</b>										
Reduction of energy consumption for mobile agricultural equipment	Reduce greenhouse gas emissions linked to energy use in the agricultural sector (tractor)	CO <sub>2</sub>	Economics, voluntary agreement	applied	MAAF, MEDDE			0.02	0.07	0.11
Development of anaerobic digestion on farms	Promote methane recovery in the agriculture sector (heating, electricity)	CH <sub>4</sub>	Economics, voluntary agreement, buy-back prices, etc.	applied	MAAF, MEDDE					0.95
Control of nitrogen fertilisation	Reduce nitrogen emissions linked to fertilisation	N <sub>2</sub> O	Economics, regulations	applied	MAAF, MEDDE					
Development of pure vegetable oil incorporation	Reduce greenhouse gas emissions linked to transport in agriculture by incorporation of biofuels	CO <sub>2</sub>	Economics, voluntary agreement	applied	MAAF, MEDDE					
Reduction of energy consumption and development of renewable energies in the permanent agricultural buildings sector	Reduce emissions linked to energy consumption in permanent buildings (greenhouse, stock building)	CO <sub>2</sub>	Economic	applied	MAAF, MEDDE					
Reduction of energy consumption / (environmental certificates, tax credit for energy assessments)	Reduce emissions linked to energy consumption	CO <sub>2</sub>	Economic	applied	MAAF, MEDDE					

Name	Objective	GHG targeted	Instrument	Status	Responsible entity	Estimation of emission reductions in CO <sub>2</sub> e for a given year (Mt CO <sub>2</sub> e)					
						1995	2000	2005	2010	2015	2020
<b>Transport WEM</b>											
Eco-tax for heavy goods vehicles	Tax heavy goods vehicles according to mileage travelled on major roads from October 2013	CO <sub>2</sub>	Tax exemption	applied	MEDDE						
Development of motorways of the sea	Support development of sea transport	CO <sub>2</sub>	Economics, planning	applied	MEDDE						
National commitment for freight	Revitalise rail freight	CO <sub>2</sub>	Economics, planning	applied	MEDDE						
Support for the modal shift	Development of High Speed Railway Lines (HSL) and dedicated-lane public transport (1800 km outside the Ile-de-France by 2020)	CO <sub>2</sub>	Planning	applied	MEDDE						
CO2 regulations for cars	France has set itself the target of cutting average carbon dioxide emissions of all cars on the road from 176 g CO <sub>2</sub> /km to 120 g CO <sub>2</sub> /km in 2020	CO <sub>2</sub>	Objective	applied	MEDDE						
Car bonus-malus	Encourage the purchase of cars with the lowest CO <sub>2</sub> emissions. A purchase bonus (bonus) is paid to buyers of vehicles emitting less than 105 g CO <sub>2</sub> /km. Conversely, a purchase tax ("malus") applies to cars that emit over 135g CO <sub>2</sub> /km.	CO <sub>2</sub>	Economic	applied	MEDDE						
Low carbon vehicles plan	The rechargeable electric and hybrid vehicles development plan provides for 2 million vehicles of this type between now and 2020	CO <sub>2</sub>	Economic	applied	MEDDE					0.4	1.72
Biofuel development	Several measures for ensuring compliance with renewable energy incorporation targets for transport (adjustment of the TGAP, tax exemption (TICPE) for biofuels)	CO <sub>2</sub>	Tax exemption	applied	MEDDE						
Reduction of emissions relating to air-conditioning in cars	Progressive ban on the use of gas with Global Warming Potential (GWP) of more than 150 and measures to limit leakage	CO <sub>2</sub>	Regulation	applied	MEDDE				0.00	0.04	0.55
Inclusion of aviation in the ETS	Reduce air transport emissions	CO <sub>2</sub>	Economic	applied (requirement only applying to flights within the EU in 2012)	MEDDE						

Name	Objective	GHG targeted	Instrument	Status	Responsible entity	Estimation of emission reductions in CO <sub>2</sub> e for a given year (Mt CO <sub>2</sub> e)						
						1995	2000	2005	2010	2015	2020	
All measures aimed at changing behaviour for purchase of new vehicles (car bonus-malus, regulation on CO <sub>2</sub> emissions from private cars, etc.)	Reduce unit consumption of cars	CO <sub>2</sub>	Economics, information	applied	MINEFI, MEDDE				1.7	5	9.2	
<b>WAM</b>												
Target of reducing transport emissions in 2020 to their 1990 level												
Target of taking the non road and non aviation modal share of goods transport to 25% between now and 2022		CO <sub>2</sub>	Objective	applied	MEDDE							
<b>Waste</b>												
<b>WEM and WAM</b>												
	Waste prevention plan											
Methane capture requirement on landfill sites and purchase prices of electricity produced from biogas	Reduce waste production, CH4		Economics, information, MEDDE	applied								
All measures aimed at reducing production of household waste production by 7% in 5 years achieving 45% recycling and optimising energy recovery	Improve collection and recovery of methane from waste	CO <sub>2</sub> , CH4	Economics, regulations	applied	MEDDE							
	Reduce waste recycling and optimise energy recovery	CO <sub>2</sub> , CH4, N2O	Tax regulations, education	planned	MEDDE				0.61	1.64	2.02	

Energy WEM										
Energy Saving Certificates (ESC)	Control energy demand and efficiency	CO <sub>2</sub>	Economic	applied	MEDDE				7.0 <sup>1</sup>	6.2
Ecodesign Directive (only assessed for the section on the progressive ban on incandescent light bulbs)	Establish a framework for setting ecodesign requirements applicable to energy consuming products.	CO <sub>2</sub>	Regulation	applied	MEDDE			1.15	3.56	4.05
Fonds chaleur	Develop renewable heating (continued until 2020 in the context of a constant annual budget scenario)	CO <sub>2</sub>	Economics, planning	applied	MEDDE, ADEME				2.7	6.6
Development of photovoltaic energy (buy-back price)	Develop renewable electricity sources	CO <sub>2</sub>	Economics, planning	applied	MEDDE, ADEME					0.8
Development of wind power (buy-back price and off-shore wind farm invitations to tender)	Develop renewable electricity sources	CO <sub>2</sub>	Economics, planning	applied	MEDDE, ADEME					8.29
Development of hydroelectric power (business as usual)	Develop renewable electricity sources	CO <sub>2</sub>	Economics, planning	applied	MEDDE, ADEME					1.46
WAM										
Energy Saving Certificates (ESC)	Implement a third period of commitment	CO <sub>2</sub>		planned	MEDDE					
Achievement of the objectives of the investment programming plan dedicated to heating.	Develop Chaleur Renouvelable (Renewable Heating) by reinforcing the Fonds Chaleur (Heat Funds).	CO <sub>2</sub>	Economics, planning	planned	MEDDE ADEME					9.6

### C.9 Cost of policies and measures

Even if this may not be the only way of assessing a measure<sup>47</sup>, having an estimation of the cost per ton of CO<sub>2</sub> equivalent saved for the various possible measures that may be carried out systematically and homogeneously is an important aspect of the definition of GHG emissions reduction policies.

This helps when prioritising the various possible measures (with regard to future measures, particularly for achieving the “factor 4” target by 2050).

The necessary link between the methodologies for estimating physical savings (potential emission reductions) and cost evaluations should be emphasised. For this reason the costs of measures have been assessed, in particular, from potential emissions reductions obtained from the SceGES tool.

These assessments are delicate and only a few evaluations could be made.

#### *Example estimation in the residential/tertiary sector*

L'éco-prêt à taux zéro (2009-2012 period)

In view of emissions savings permitted by the measure up to 2020 and considering the average life of equipment installed by means of the éco-PTZ to be 29 years, the public cost per ton of CO<sub>2</sub> saved by the measure is €54/tCO<sub>2</sub> saved.

«Le crédit d'impôt «développement durable» (Sustainable Development) tax credit) (WEM and WAM: 2010-2012)<sup>48</sup>

#### *Evaluation of the public cost of a ton of CO<sub>2</sub> saved by equipment eligible for the CIDD*

<sup>47</sup> It is appropriate firstly to consider the other costs and benefits of a measure (effect on the reduction of atmospheric pollutants for example) and secondly the inertia factors in some sectors (building replacement should actually be taken into account).

<sup>48</sup> These are costs for the year *n* for work in year *n-1*

	Unit	2010	2011	2012
Condensation boilers	€/t CO <sub>2</sub>	43	43	33
Opaque walls (roofs)	€/t CO <sub>2</sub>	21	21	23
Glass walls	€/t CO <sub>2</sub>	81	70	139 <sup>(*)</sup>
Solar panels	€/t CO <sub>2</sub>	257	136	112
Solar power	€/t CO <sub>2</sub>	480	432	448
Heat pumps	€/t CO <sub>2</sub>	99	55	53
Wood boilers	€/t CO <sub>2</sub>	31	28	20

(\*) The indicators for glass walls from 2012 are not comparable with the results of previous years.

The average public cost per ton of CO<sub>2</sub> saved is estimated at €64 over the period 2009-2012. This result does not take into account either the rebound effect (consuming more heating when the housing is better insulated, in favour of more comfort) or the godsend effect (part of the retrofitting work undertaken by recipients of the CIDD would have been carried out without public expenditure), which reduce the effectiveness of the tax credit. On the other hand, other effects which reinforce the long-term efficiency of this measure are not taken into account either (development of the product range, qualification of professionals, etc.).

#### *Example estimation in the energy sector*

The purchase price for wind power installed in the WEM scenario

It is assumed that the wind power development target is achieved thanks to the purchase price. The public cost of the purchase price is calculated over the life of the equipment on the basis of the following hypotheses:

- Purchase price of €82/MWh for the first ten years, then €68/MWh for the next 5 years;
- Market price of electricity constant at €55;
- Life of equipment: 20 years;
- Update rate of 4%;

The emissions saved are calculated by the SceGES model (at constant electricity demand in France, the additional production capacity linked to development of wind power as a replacement for other marginal means of production used at this time (mainly gas, coal and fuel oil).

The cost of the wind power purchase price is therefore estimated at €27/t CO<sub>2</sub>e saved

The purchase price for photovoltaic solar energy installed in the WAM scenario.

It is assumed that the wind power development target is achieved thanks to the purchase price. The public cost of the purchase price is calculated over the life of the equipment on the basis of the following hypotheses:

- Purchase price of €300/MWh for 20 years, to which is added a building integration bonus of €250/MWh, from which half the production is assumed to benefit;
- Market price of electricity constant at €55;
- Life of equipment: 20 years;
- Update rate of 4%;

The emissions saved are calculated using the ScGES model.

The cost of the photovoltaic solar power purchase price is therefore estimated at €667/t CO<sub>2</sub>e saved

## Agriculture

An estimate by INRA of the potential mitigation and unit cost of 10 technical measures (in view of their technical foundation and the potential for adoption of the techniques by farmers), as part of a study commissioned by the Environment and Energy Management Agency (ADEME) and the Ministries for Agriculture and Ecology: "How can French agriculture contribute to reducing greenhouse gas emissions? Abatement potential and cost of ten technical measures."<sup>49</sup> Figure 31 gives the cost for the farmer per ton of CO<sub>2</sub> saved.

Cost - except costs of private transactions (in €/tCO<sub>2</sub>e saved) and mitigation potential of the sub-projects examined in 2030 in Metropolitan France (in Mt<sub>2</sub>e saved per year). The mitigation potential is calculated apart from emissions caused, with a calculation model proposed by experts, without taking interactions between projects into account.

Figure 31: cost for the farmer per ton of CO<sub>2</sub>e saved (metropolitan France, 2030)



<sup>49</sup> <http://institut.inra.fr/Missions/Eclairer-les-decisions/Etudes/Toutes-les-actualites/Etude-Reduction-des-GES-en-agriculture>

### **C.10 Other impacts**

The policies and measures described are implemented not only to reduce GHG emissions, but also in the light of environmental, social and economic issues.

Measures aimed at an economical use of resources, in particular, have reciprocal benefits between reduction of greenhouse gas emissions and other environmental issues (reduction of NO<sub>x</sub> and SO<sub>x</sub> emissions through less reliance on fossil fuels, reduction of many forms of pollution by managing waste volumes, improvements to water quality by managing nitrogen fertilisation).

The «plan de développement des énergies renouvelables à haute qualité environnementale» (high environmental-quality renewable energies development plan) resulting from the Grenelle Environment Round Table was presented on 17 November 2008. This plan, which comprises five operational measures concerning all sectors, gives particular attention to other issues in terms of air, water and soil quality, biodiversity, landscapes and limiting conflict with other socio-economic uses.

Guides were written in a spirit of participation, and brought together recommendations and proposals of methods and examples for facilitating and improving the quality of impact studies relating to photovoltaic installations on the ground (2011), wind farms (updated in 2010) and the completion of a detailed study of the environmental and socio-economic impacts of off-shore renewable energies (2012).

The reform of impact studies with the appearance of Decree no. 2011-2019 of 29 December 2011 in particular, introduced new requirements for projects producing energy from renewable sources, especially for large plants. Project proposers should analyse the impacts of the plants on the population, fauna, flora, natural habitats, sites and landscapes, ecological continuity, heritage, soil, water, air, noise, health and interaction between them. They should plan avoidance, reduction and compensation measures, as appropriate, which will be inserted in the authorisation decisions.

The consideration of land use conflicts gave rise to the development, in Europe, of a system for evaluating the sustainability of biofuel production. With respect to photovoltaic energy on the ground, improved vigilance mechanisms have been implemented to protect agricultural land. The circular of 18 December 2009 specifies that “installation of a solar power plant on land situated in an agricultural area [...] is generally unsuitable, in view of the need to retain the agricultural purpose of the land”.

The impact of wind turbines on people is managed through a regulation controlling the installation of machinery, now “Installations Classées pour la Protection de l’Environnement” (Classified Installations for Protection of the Environment) (ICPE), by Decree no. 2011-984 of 23 August 2011, requiring them to be sited a minimum of 500 m from residential areas. Impact on the landscape is included at an earlier stage as suitable areas have been determined in the regional wind power schemes, which have to be taken into account as part of ICPE procedure. Concerning solar power, a financial incentive is given to photovoltaic plants incorporated into buildings (defined by the Order of 4 March 2011, setting purchase conditions) while the architectural impact of the development of renewable energies was taken into account by an adjustment of the thermal requirements of buildings according to their architectural nature.

### **Consideration of air quality (and therefore public health issues) constitute a major issue in the development of wood fuel**

Human activities, especially combustion, generate particles of different sizes and compositions, responsible for health issues, particularly cardiovascular and respiratory disorders. Work carried out as part of the CAFE (Clean Air for Europe) programme shows that particles of anthropic origin of less than 2.5 micrometres in diameter (PM<sub>2.5</sub>) shorten life expectancy in Europe by 8.2 months. The Aphekom project, carried out in 12 European countries, also concluded that further reducing the fine particles in the air in European towns would bring about a considerable benefit in

terms of increasing life expectancy and reducing health costs. To the extent that emissions from the domestic sector account for 65% of emissions from wood combustion and 39% of PM2.5 emissions in France and that renewal of the stock of individual wood burning appliances by more efficient devices would permit significant reductions of particle emissions, the sustainable development tax credit has been amended to give priority to the renewal of wood burning appliances. The applicable rate is 15% in the case of a first purchase or 26% in the case of replacement of an old appliance. These rates are supplemented by up to 23% or 24% respectively in the case of a package of work. The green flame label implemented in 2010 integrates the most exacting new environmental criteria for dust.

### Better quantification of these impacts

In 2013 France started work on improving its SCoGES policies and measures impact assessment tool. The tool should enable the impacts of the following three atmospheric pollutants to be quantified: NOx, PM10, PM2.5. These three pollutants are the subject of particular surveillance due to the health issues they provoke, and special monitoring rendered necessary by the implementation of European Directives.

The extension to atmospheric pollutants will be made for all sectors of activity considered by the tool, apart from road transport.

### Consideration of indoor air quality

Furthermore, while France is implementing several measures to promote better building insulation, particular attention is given to indoor air quality, especially with the actions specified as part of the National Health and Environment Plan and the work of the Indoor Air Quality Observatory.

Social impacts Measures for combating climate change must also be designed carefully in order to bring positive social co-benefits. The social housing retrofitting programme and more generally the thermal improvement of existing housing are heading in this direction, with a reduction of household expenditure on energy, especially by

the poorest households, which often have the least energy efficient accommodation.

Transport infrastructure projects (high speed lines, dedicated-lane public transport, etc.) generate shorter travel times, improved safety and less congestion. Projects are studied on a case by case basis and only those with socio-economic profitability (taking into account trade, environmental and social effects) greater than the reference up-date rates for public projects (4%) are carried out.

### Economic impacts

Economically speaking, the policy supporting demand for green technologies could encourage technical innovation, structure sectors that will create new jobs and bring out champions of industry, with an export capacity in sustainable sectors (off-shore wind power, electric cars, etc.).

Furthermore, energy savings, replacing fossil fuels with renewable fuels especially in the construction and transport sectors, help to reduce France's energy dependency, and to improve its resistance to energy price fluctuations.

Across the board, the implementation of GHG reduction measures is supplemented by support measures (funding, information, awareness raising, etc.) to enable the transition in investment choices and behaviour.

### C.11 Long term effect of the policies and measures undertaken

As stated above, France has already set a long term objective (cutting its greenhouse gas emissions by 75% between 2005 and 2050). To reinforce the means already in place to achieve this, it is preparing a low carbon national strategy. Replacing the Climate Plan, which aimed at ensuring the achievement of medium-term commitments France had already made at European and international level (Kyoto commitment period 2008-2012, and also 2020 targets for 2009 and 2011 climate plans), this new strategy will take more account of long term impacts when ranking implemented measures

into a hierarchy. In fact, due to the longevity and central role of infrastructures in economic activity, investment choices (built environment, transport, electricity generation, etc.) structurally commit society to long term development. While public and private resources are limited, investment choices have an opportunity cost in terms of emissions “generated” in the future (lock-in).

Already, the majority of budgetary expenditure in the fight against climate change is focused on the long term (€4 billion of budgetary spending and €1.2 billion in tax spending in the Finance Law for 2013). It concerns research (in the order of €0.9 billion, if the “future investment” program is not taken into account) and infrastructure for modes of transport which produce the lowest amounts of greenhouse gas emissions (in the order of €1.8 billion). The same is true of tax spending, the majority of which is aimed at supporting the retrofitting of homes (€0.8 billion). Finally it is also true of regulations, which restrict investment to considerable energy savings over their entire life cycle. This is particularly the case for the Thermal Regulation in buildings, which was notably reinforced with Thermal Regulation 2012.

In terms of investment, priority is mainly given to the building stock and transport infrastructure pertaining to alternatives to air transport and fuel-engine road vehicles and also to renewable energies. In the latter case, it is a question of bringing closer the time when they will be more competitive than fossil fuels that they are to replace.

In the even longer term, the funding of research and development is likely to have the greatest impact. Therefore, support for the emergence of green sectors constitutes an essential lever for meeting the energy transition challenge. This alone will make it possible to tackle climate change mitigation appropriately, by controlling energy consumption and more generally by creating a way of life and methods of production that generate fewer emissions and are more economical on natural resources, in all sectors (energy, industry, agriculture and forestry).

## **C.12 Policies and measures implemented in accordance with article 2 of the Kyoto Protocol**

### **C.12.1 Policies and measures relating to international bunkers (article 2.2)**

The European Union adopted Directive 2008/101/EC of 19 November 2008, amending Directive 2003/87/EC, in order to include aviation activities in the EU GHG Emissions Trading Scheme:

- This provision has been in force since 2012 for all flights leaving or arriving in the European Union (a temporary suspension was agreed from 24 April 2013 for international flights). The emissions ceiling granted to the air sector is set in relation to the average annual emissions for 2004, 2005 and 2006: 97 % of such emissions in 2012 and 95 % thereafter.
- 15% of quotas are allocated through bidding. Member States continue to have responsibility for how they use the profit from the bids but it is recommended that it is used for combating climate change. The remaining quotas are distributed free of charge according to the relative share of activity of each operator (in kilometre tons transported) in the reference year (2010 for the period up to 2020), 3% of these quotas being reserved for new entrants or for operators whose business is growing rapidly;
- Air operators can also buy quotas on the European market and, to a certain limit (15% in 2012 and 1.5% from 2013), use credits from the flexibility mechanisms of the Kyoto Protocol: Clean Development Mechanism (CDM) or Joint Initiative (JI);
- A number of exemptions are planned, especially for commercial operators making fewer than 730 flights or emitting less than 10,000 t CO<sub>2</sub> per year;
- Furthermore, implementation of the Single European Sky and development of the future European air traffic management system (SESAR project), to which France will contribute up to €200 billion, will reduce the distances travelled by aircraft as well as waiting and taxiing times through better organisation of air navigation. The aim is to reduce emissions from flights within the EU by 6 to 12%.

The implementation of new procedures, especially continuous descents, will enable fuel consumption to be reduced and will have the additional advantage of reducing noise.

In France, an agreement was signed on 28 January 2008 with all partners in the aviation sector, bringing together various voluntary commitments for the environment. For example Air France-KLM has committed to a specific consumption objective of 3.70 litres per passenger per 100 km by 2012.

### C.12.2 Minimising adverse effects on developing countries due to the policies and measures implemented (article 2.3)

France has set up a large number of technology transfer projects and actions to reinforce the capacity of developing countries. Examples are the actions of UBI-France and COFACE. In 2009 UBIFRANCE, the agency for international business development and COFACE, which among other things manages public export guarantees on the Nation's behalf, decided to reinforce their cooperation by signing a partnership agreement to give more support to a larger number of SMEs (small and medium-sized enterprises) on foreign markets.

These technology transfer actions, which enable the adverse effects of domestic policies and measures to be minimised, are presented in chapter VII.

Furthermore, France aids developing countries by reinforcing and enhancing their climate change observation systems through its climate observation network and its research and cooperation projects (see chapter VIII). Concerning the policies and measures put in place as part of European policies France, as a Member State of the European Union, has to transpose European law into its legislative system. In the process of adopting European policies, Europe implemented a system enabling positive and negative impacts of its policies to be estimated, including effects on other countries, as part of impact studies. The consideration of impact studies is a key element of the final decision on the definition of the policy and measure. They ensure that the negative impacts of a European policy on developing countries are minimised and thus ensure that French legislative provisions resulting from European Law comply with the commitment taken as part of the Kyoto Protocol in accordance with its article 3.14. All these impact studies are available to the public on the website:

[http://ec.europa.eu/governance/impact/ia\\_carried\\_out/cia\\_2010\\_en.htm](http://ec.europa.eu/governance/impact/ia_carried_out/cia_2010_en.htm)

The table on the following page lists the estimated direct and indirect impacts of France's climate policies and measures.

**Table 20: direct and indirect effects of France's main climate policies and measures on developing countries**

Mesure	Effets directs			Effets indirects		
	Social	Environnemental	Economique	Social	Environnemental	Economique
SCEQE			Effet économique potentiellement positif sur les pays extérieurs à l'Union européenne en cas de différence de compétitivité induite par l'introduction d'un signal prix sur le carbone pour les activités économiques européennes		positif - Incitation des firmes internationales sous SCQE à développer des procédés plus efficaces au niveau environnemental potentiellement transférables dans les pays en développement	
MDP	Effet positif de maintien ou création potentielle d'emplois locaux dans les pays en développement accueillant des projets	Positif car permet l'implémentation de techniques sobres en carbone dans les pays en développement	Effet positif d'investissement étrangers dans le développement d'infrastructures dans les pays en développement		Négatif - Incitation potentielle pour les pays en développement à ne pas développer d'infrastructures moins émettrices pour générer une importante additionnalité environnementale des projets MDP	
MOC	Effet positif de maintien ou création potentielle d'emplois locaux dans les pays accueillant des projets	Positif car permet l'implémentation de techniques sobres en carbone dans les pays en développement	Effet positif d'investissement étrangers dans le développement d'infrastructures dans les pays en développement		Incitation potentielle pour les pays en développement à ne pas développer d'infrastructures moins émettrices pour générer une importante additionnalité environnementale des projets MOC	Effet potentiel de détournement de l'investissement du MDP
Développement des biocarburants	Effet positif de maintien ou création potentielle d'emplois dans les pays en développement exportateurs	effet positif à la condition que des critères de durabilité (cas européen) soient mis en place notamment par rapport au problème de changements d'affectation des sols	Effet positif sur les importations de biocarburants en provenance des pays en développement		Effet négatif sur la déforestation et sur la ressource alimentaire  Mais mise en place de critère de durabilité des biocarburants via des accords entre la commission européenne et les pays en développement	Effet de diminution de la demande de pétrole et potentielle moindre tension sur les prix des énergies fossiles
Affichage environnemental dont CO2			Effet négatif de diminution potentielle des importations en provenance des pays en développement (au profit des circuits courts)  Mais processus d'échange d'informations visant à une harmonisation des procédures d'étiquetage en cours (voir texte),			
Promotion de l'efficacité énergétique	Effet positif de maintien ou création potentielle d'emplois dans les pays en développement exportateurs		Effet positif sur les importations en provenance des pays en développement pour des équipements générant de l'efficacité énergétique		Amélioration de la qualité de l'air dans les pays en développement	Effet de diminution de la demande et potentielle moindre tension sur les prix des énergies fossiles
Promotion des énergies renouvelables dans le bâtiment	Effet positif de maintien ou création potentielle d'emplois dans les pays en développement exportateurs		Effet positif sur les importations en provenance des pays en développement pour des équipements de production d'énergie renouvelable		Amélioration de la qualité de l'air dans les pays en développement	Effet de diminution de la demande et potentielle moindre tension sur les prix des énergies fossiles
Obligation de réalisation d'un bilan d'émissions de gaz à effet de serre et d'un plan d'action associé pour les grosses entreprises		Potentielle participation accrue du secteur privé aux efforts de réduction des émissions de gaz à effet de serre			Effet d'apprentissage du management énergétique et environnemental sur les entreprises multinationales ayant des implantations en France	
Bonus/malus automobile	Effet positif de maintien ou création potentielle d'emplois dans les pays en développement exportateurs		Favorise les importations en provenance des pays en développement de véhicules peu émissifs			Hausse de la demande de matière premières (acier) et potentielle tension accrue sur leur prix
Réforme de la Politique Agricole Commune (2007-2013)	Effet positif de maintien ou création potentielle d'emplois dans les pays en développement exportateurs		Effet économique potentiellement positif en augmentant la demande dans ce secteur			

Two examples of measures implemented to reduce or prevent adverse effects of French climate policies, in addition to technology transfer and research, are given below:

Concerning the climate and energy package adopted in 2008, the directive on incorporation of biofuels in transport set a renewable energy target of 10% by 2020. It moreover specifies sustainability criteria for biofuels consumed in France:

- Reduction of greenhouse gas emissions by at least 35%, taking into account the whole production cycle and fuel consumption, compared with the use of fossil fuels in 2010; (50% from 2017);
- Preservation of land with a rich biodiversity and large natural stocks of carbon: forests, wet lands and peat bogs.

Only biofuels and bio-liquids meeting these criteria will benefit from tax incentives and be taken into account for reaching France's objectives in terms of development of renewable energies.

France has translated these sustainability criteria into a regulation. This testifies to France's desire to reconcile biofuel development with protection of biodiversity, natural areas and food supply in developing countries.

Environmental product labelling (multiple criteria including CO<sub>2</sub>)

- France has co-organised, co-financed and participated (MEDDE, CGDD) in four international seminars in the UN's South American Commission (ECLAC) in Santiago, Chile. These seminars were all very well attended, especially by developing or emerging countries in the South American region. Each of the four seminars concerned possible interaction between public and private environmental footprint measures in relation to products and international trade. Technical, scientific, legal and economic aspects were discussed.
- Held every year since 2009, these seminars have given France an opportunity to explain the objectives and advances of its national environmental labelling policy. France (MEDDE, CGDD) also participated in an equivalent seminar in Seoul (organised by the UN regional commission for South-East Asia) in October 2011. Two workshops on environmental labelling were co-organised with UNEP, in 2010 and 2011,

in New York as part of the UN Commission on sustainable development, in which delegations from developing countries participated.

- At present France and UNEP continue to work together as part of an annual agreement on a programme aimed at stimulating closer international relationships on methods, data and consumer information (environmental labels) and on activities to reinforce capacities in emerging and developing countries.

In accordance with Law no. 2010-788 of 12 July 2010 on the national commitment on the environment France supports similar initiatives at European level. France supports the Commission in the finalisation of the "Product Environmental Footprint" guide.

France carried out a national one year experiment between July 2011 and 2012 in which three companies located in foreign countries, two of them in developing countries (Chile and Colombia) participated. A large number of French branches of multinational companies also took part.

### Criteria for selection of JI and CDM projects

In the context of implementation of CDM and JI projects, France, requested to issue letters of approval for projects, in its capacity as an Annexe I country, endeavours to encourage the development of projects which maximise positive impacts for host countries, as well as cutting emissions, such as social impacts (job creation and access to public utilities) and protection of local biodiversity.

Three of these projects are described below by way of example:

- The "Araku Valley Livelihoods Project" is an afforestation/reforestation project in India. Situated in the Araku Valley, the project consists of planting trees over an area of 6,000 Ha in order to combine revenues from emissions reductions linked to reforestation for the project proposer with those linked to exploitation of these fruit trees by the local communities. The project extends over 302 villages bringing together diverse communities in which 90% of the population live below the

poverty threshold. This reforestation project could lead to a total reduction of 1.3 Mt CO<sub>2</sub> of emissions, i.e. an average reduction of 66.5 kt CO<sub>2</sub> per year.

- The “Sustainability CFL Replacement” programme of activity (POA) consists of the implementation of a series of energy efficiency projects to replace incandescent light bulbs (ICL) by compact fluorescent light bulbs (CFL) in the residential sector. The aim of the project is to distribute between 20 and 40 million “CFL” light bulbs. The POA will start on the date of its registration and last for 28 years.
- Situated on the Equator, the “Solar PV Project-Shyri-1” project consists of installing solar panels with a total nominal power of 50 MW which will generate 74,997 Mwh/year incorporated into the national network. This project with a credit period of 10 years, should lead to a reduction of 49.0 kt CO<sub>2</sub>/year and 491 kt CO<sub>2</sub> over the period.

## D. Main policies and measures cited in France’s 5th national communication no longer in place or for which implementation has been postponed

### D.1 In the energy sector

The carbon tax or climate energy contribution. Framework Law 2009-967 of 3 August 2009 on implementation of the Grenelle Environmental Round Table provided that France would look into the creation of a carbon tax with the aim of including the effects of greenhouse gas emissions in the price system. Such a measure was included as part of the 2010 Finance Law approved by Parliament, but in its decision of 29 December 2009 the Constitutional Council considered that this provision was against the Constitution on

the grounds that “the total exemption regimes [that it provides] blatantly undermine equality with regards to public charges”. This decision did not challenge the principle of a climate energy contribution. It ruled in particular that the CO<sub>2</sub> emissions trading scheme, allocated free of charge until 1 January 2013, did not justify total exemption from a carbon contribution for the plants concerned. A discussion was launched at the start of 2010 to look at the arrangements for including industries while preserving their competitiveness. After this discussion, it was decided to postpone the implementation of a carbon contribution, implementation on a European scale being the preferred solution. In 2013 work recommenced at national level as part of the committee for ecological tax exemption, implemented by the environmental conference of September 2012. The 2014 Finance Bill provided for a change to the existing taxes to enable CO<sub>2</sub> emissions from taxed products to be taken into account.

**CRE calls for tender (photovoltaic, etc.)** The CRE published a call for tender on 20 April 2009 aimed at construction of at least one photovoltaic power station on land in each region of France in 2011, for a total maximum power of 300 MW distributed in 27 tranches over four geographical areas. Applicants had until 25 February 2010 to submit their files. The call for tender was finally put on hold at the end of October 2010, as the strong dynamism of the solar sector, confirmed in 2010, places France beyond its objectives and the bids received proposed prices that were too high and not justified by an innovative nature. Creation of the off-shore wind farm accepted at the end of the call for tender launched in 2005 was also abandoned.

### D.2 In the construction sector

Since 1990 certain materials and equipment used to save energy and produce energy from renewable sources have benefited from accelerated depreciation. This measure ended on 1 January 2011.

**Eco-bonus as part of the Anah subsidies:** the French national housing agency (Anah) helps owner occupiers under the resource ceiling and owner

landlords to carry out housing improvements. The 2009 recovery plan made it possible to go beyond the traditional subsidy for improvement work with the provision of the eco-subsidy for low-income owner occupiers (38,893 beneficiaries in 2009) and eco-bonuses (€1,000 for very low-income owner occupiers and €2,000 for owner landlords). To benefit from the eco-bonus owner occupiers had to occupy a home in category F or G before work and obtain energy savings of at least 30% and owner landlords had to obtain progression of at least two levels and achieve category C or D. In the course of 2010 the creation of the “Habiter mieux” (Live Better) programme (cf. above) and the reform of the Anah subsidy system replaced the eco-bonus system from 1 January 2011.

**The requirement to incorporate wood in the construction.** Asked by the Conseil d’Etat to answer a priority question on constitutionality, the Conseil Constitutionnel made a ruling on whether article L. 224-1. V of the French Environment Code, providing that some new buildings should include a minimum amount of wood materials, complied with rights and freedoms. The members of the Conseil Constitutionnel considered that the attack on free enterprise was not justified by grounds of general interest in relation to the objective pursued.

### **D.3 In the transport sector**

Following the conclusions of the Mobility 21 committee, the development objectives of high speed railway line infrastructures were revised downwards by comparison with the construction programme of 2,000 km of additional lines by 2020. The initial programme for an additional 2,500 km was also postponed. Priority has been given to the regeneration of the existing network and allocate additional resources to the improvement of daily trains.

### **D.4 In the industrial sector**

In 2002, as part of a voluntary and collective initiative, French industrialists created the *Association des Entreprises pour la Réduction des Emissions de gaz à effet de Serre (AERES)* (Association of Businesses for the Reduction of Greenhouse Gas Emissions)

and undertook to reduce their GHG emissions. The majority of plants committed to this initiative are covered by the EU Emissions Trading Scheme or are subject to Joint Initiative projects. Consequently, a voluntary commitment for the period after 2008 was no longer justified.



# Emissions projections and quantification of the total effect of policies and measures

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## A. GHG emissions projections

### A.1 Definition of with measures and with additional measures scenarios

As part of the preparation of new GHG emissions projections for France, all measures aimed at cutting GHG emissions were listed (cf. Chapter IV).

Two scenarios of changes in France's GHG emissions by 2020 have been prepared from this list of measures:

- A "with existing measures" or WEM scenario which takes into account all policies and measures decided and implemented before 1 January 2012;
- A "with additional measures" or WAM scenario which, in addition to policies already considered in the WEM scenario, also considers new policies decided since 1st January 2012 and, in addition, planned policies even if they have not yet been implemented.

In addition, a "without measures" scenario represents the change in French emissions if no measures had been implemented since 1990. It will be used, in accordance with UNFCCC guidelines, to estimate the total effect of policies and measures. The methodology for preparation of these three scenarios is set out in paragraph V.D.

Following the commitment made by the President of France, a "Débat National sur la Transition Energétique" (National Debate on the Energy Transition) (DNTE) which ended in July 2013 focused on the energy transition trend up to 2050. This document gives an overview of the public policies for reducing GHG emissions decided before this debate. In its construction, it includes scenario building work which does not take account of the directions that will be decided at the end of the DNTE.

### A.2 Presentation of results

#### General change

The figure on the following page shows the change in France's total emissions in the context of with existing measures (WEM) and with additional

measures (WAM) scenarios within the geographical framework of the Convention (Metropolitan France and Overseas Departments and Territories). France's emissions for this framework are 565.4 Mt CO<sub>2</sub>e) in 1990. France's Kyoto target (563.9 Mt. CO<sub>2</sub>e) only applies to the geographical framework used in the Kyoto Protocol (i.e. Metropolitan France and the Overseas Departments).

In the WEM scenario (cf. figure 31) France's emissions in 2020 (Convention framework, Metropolitan France plus Overseas Departments and Collectivities) are 463 Mt CO<sub>2</sub>e, i.e. a reduction of 18 % compared with 1990.

In the WAM scenario they reach 426 Mt CO<sub>2</sub>e, in 2020, i.e. a 24.6 % reduction compared with 1990.

According to the without measures scenario the level of emissions would be 617 Mt CO<sub>2</sub>e, in 2010, and 689 Mt CO<sub>2</sub>e, in 2020.

The surprising change in emissions between 2005 and 2010 for the without measures scenario is due to the fact that the time interval used for modelling is only 5 years. As emissions are linearised between 2005 and 2010 the fall in emissions due to the economic crisis over the period 2008-2010 is shown from 2005. Modelling with an annual time step would certainly have given a better representation of the change in emissions in the context of the without measures scenario.

#### Analysis by sector of activity

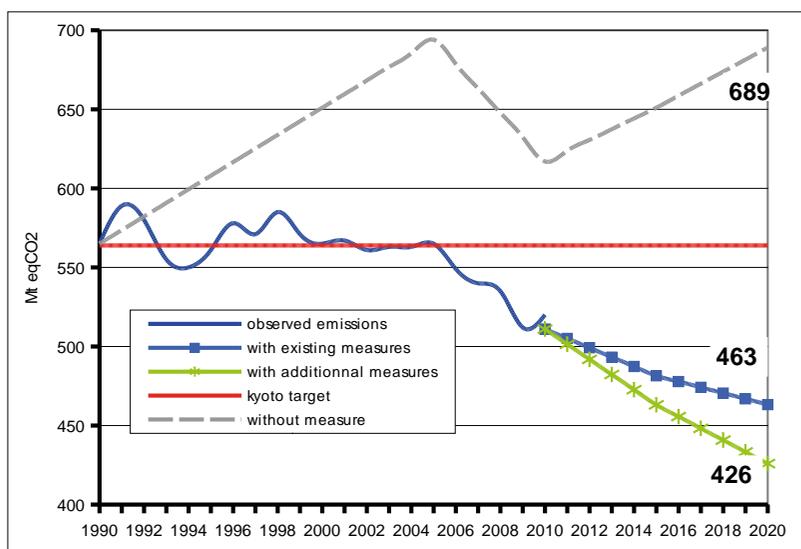
The graphs below give a breakdown of France's emissions projections by sector of activity<sup>1</sup> by 2020. The CRF categories are specified in the GIEC guidelines for national GHG inventories<sup>2</sup>. The results per sector are presented in turn for the WEM scenario and then the WAM scenario. The graphs entitled B correspond to detailed results from the energy sector.

<sup>1</sup> in CRF format (Common Reporting Format)

<sup>2</sup> Source: GIEC guidelines - Chapter 8 - Directives for preparation of reports and tables, 1996

Figure 32: Projections of GHG emissions (in Mt CO<sub>2</sub>e) for France, in the Convention framework, in 2010 and 2020 for WEM and WAM scenarios and for a without measures since 1990 scenario. Supprimer le 1<sup>er</sup> tableau

Sources: UNFCCC inventory, CITEPA/MEDDE, 2013 submission and MEDDE emissions projections, 2013



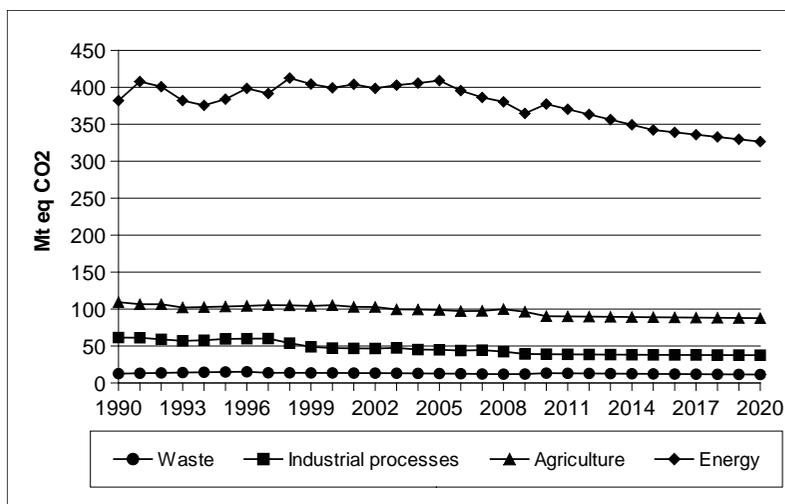
**WEM scenario**

Figure 33: Changes in emissions between 1990 and 2020 according to the WEM scenario.

**A: for the energy, agriculture, industrial processing and waste treatment sectors**

Interpretation of the figure: energy = CRF category 1; industrial processes and solvents = CRF categories 2 and 3; agriculture = CRF category 4; waste treatment = CRF category 6

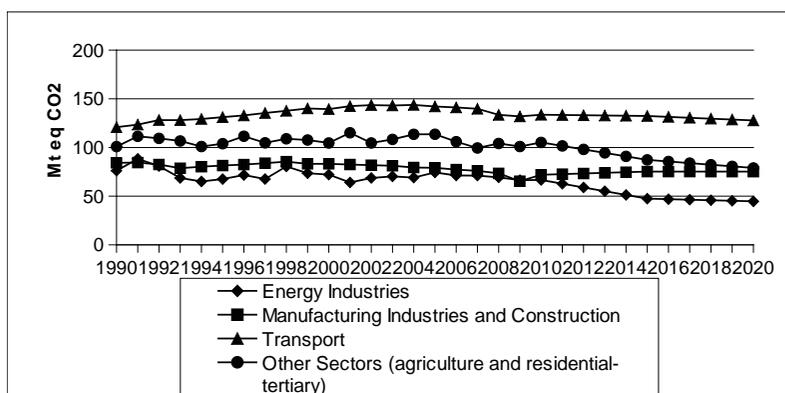
Sources: UNFCCC inventory, CITEPA/MEDDE, 2013 submission and MEDDE emissions projections, 2013



**B: Details of energy sector categories**

Interpretation of the figure: energy industry = CRF categories 1A1 and 1B; manufacturing and construction industry = CRF category 1A2; transport = CRF category 1A3; other sectors = CRF category 1A4

Sources: UNFCCC inventory, CITEPA/MEDDE, 2013 submission and MEDDE emissions projections, 2013



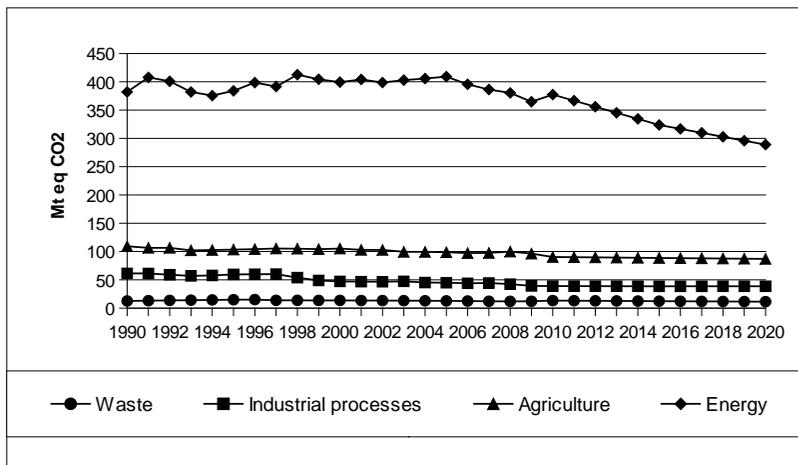
**WAM scenario**

Figure 34: Changes in emissions between 1990 and 2020 according to the WAM scenario.

**A: for the energy, agriculture, industrial processing and waste treatment sectors**

Interpretation of the figure: energy = CRF category 1; industrial processes and solvents = CRF categories 2 and 3; agriculture = CRF category 4; waste treatment = CRF category 6

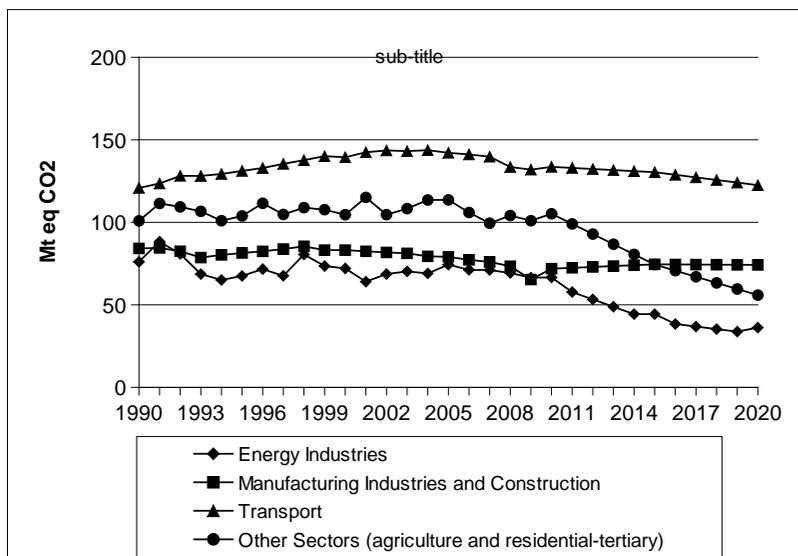
Sources: UNFCCC inventory, CITEPA/MEDDE, 2013 submission and MEDDE emissions projections, 2013



**B: Details of energy sector categories**

Interpretation of the figure: energy industry = CRF categories 1A1 and 1B; manufacturing and construction industry = CRF category 1A2; transport = CRF category 1A3; other sectors = CRF category 1A4

Sources: UNFCCC inventory, CITEPA/MEDDE, 2013 submission and MEDDE emissions projections, 2013





PFCs Mt eq. CO2	1990	2005	2005	2010	2010	2015			2020		
	real	real	SM	real	SM	SM	AME	AMS	SM	AME	AMS
Energy	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Industrial processes	4,29	1,43	1,43	0,38	0,65	0,64	0,37	0,39	0,64	0,38	0,38
Solvent and other product use	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Agriculture	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Waste	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total excluding LULUCF	4,29	1,43	1,43	0,38	0,65	0,64	0,37	0,39	0,64	0,38	0,38
LULUCF	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

SF6 Mt eq. CO2	1990	2005	2005	2010	2010	2015			2020		
	real	real	SM	real	SM	SM	AME	AMS	SM	AME	AMS
Energy	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Industrial processes	2,03	1,19	1,20	0,67	1,21	1,10	0,54	0,54	1,10	0,54	0,54
Solvent and other product use	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Agriculture	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Waste	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total excluding LULUCF	2,03	1,19	1,20	0,67	1,21	1,10	0,54	0,54	1,10	0,54	0,54
LULUCF	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Total GHG Mt eq. CO2	1990	2005	2005	2010	2010	2015			2020		
	real	real	SM	real	SM	SM	AME	AMS	SM	AME	AMS
Energy	386,72	411,82	425,20	377,36	411,98	443,92	342,28	323,72	479,52	326,55	288,87
Industrial processes	56,40	42,66	159,97	37,80	95,30	98,78	36,87	37,38	101,60	36,44	37,46
Solvent and other product use	2,06	1,48	1,48	1,10	1,15	1,21	1,15	1,15	1,25	1,17	1,17
Agriculture	108,20	92,80	92,80	90,34	90,31	88,91	88,92	88,61	87,70	87,70	87,01
Waste	12,11	14,30	17,23	13,29	17,91	18,51	12,23	12,23	19,15	11,39	11,39
Other	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Total excluding LULUCF	565,50	563,06	693,68	519,89	616,66	651,33	481,44	463,09	689,22	463,25	425,90
LULUCF	-40,04	-42,04	-35,61	-34,58	-65,35	-53,55	-53,55	-53,55	-50,25	-50,25	-50,25

Sources: UNFCCC inventory, CITEPA/MEDDE, 2013 submission and MEDDE emissions projections, 2013

It should be noted that the Land Use, Land Use Change and Forestry (LULUCF) sector is the subject of a CITEPA study, the results of which were not available when this chapter was written. For this sector, therefore, the data from France's fifth national communication has been used in the table shown above.

### A.3 Sensitivity analysis

#### Sensitivity of the WAM scenario

In the context of the WAM scenario there is a 24.6 % reduction in total GHG emissions between 1990 and 2020. These results reflect France's ambition in terms of combating climate change and in particular the proactive nature of national targets. They are not only in line with the EU's ambition to reduce its GHG emissions by 20 % as specified in the Climate and Energy Package, or even 30 % between 1990 and 2020 in the event of a satisfactory international agreement, but also with the French President's determination to see the EU set a new target of cutting GHG emissions by 40 % by 2030 and 60 % by 2040.

It should also be stressed that actual achievement of this ambitious outcome is conditional upon the

adequate treatment of several "vigilance points" and in particular:

- **The actual pace of retrofitting the existing housing stock over the entire period:** achieving the target of a 38% reduction in consumption of the existing building stock by 2020 requires a very ambitious pace of retrofitting, supported over the whole period. Finally, this scenario, like the WAM scenario, expects a rate of 500,000 new buildings per year. And a Thermal Regulation 2012 implemented in 2013. The WAM scenario assumes a sustained rate of 900,000 extensive retrofits per year between 2013 and 2020;
- Maintenance of powerful incentive tools supporting this rate of retrofits over the entire period, in an increasingly restrictive budgetary situation: even if residential energy efficiency improvement work is often identified as having low, or even negative, allowance costs there are many other constraints (access to credit for

households, imperfect information, loss of use caused by the works) on the effective execution of work which make it necessary to put incentive tools in place for the retrofitting of homes. This is the purpose of the éco-PTZ (zero rate eco-loan) and the crédit d'impôt développement durable (sustainable development tax credit), extended in the scenario until 2015 (cf. residential / tertiary sector);

- **Reinforcement of the modal share of freight:** the very ambitious target of a non-road and non-aviation modal share of 25% by 2022 is confronted by a change in industrial structure unfavourable to heavy rail freight transport by full train (which declined from 13% to 10.9% between 2005 and 2010 and which was only 9.4% in 2012, with water transport having a 2.3% share in 2012);
- Effective adaptation capacity of sectors and fields of activity (innovation, technological disconnections, etc.);
- Level of mobilisation of all stakeholders and effectiveness of the support provisions (training, changing behaviour, etc.).

**It is again specified that this state of affairs does not yet take account of decisions that will be taken after the French national debate on energy transition.**

### Sensitivity to the current economic crisis

France's "with measures" and "with additional measures" GHG emissions projection scenarios are based on an assumption of Gross Domestic Product (GDP) growth of +2.1% per year over the 2015-2020 period and on 2020 fossil fuel price hypotheses taken from the International Energy Agency's (IEA) World Energy Outlook "Current Policy" scenario. The DGEC carried out a sensitivity study to see the impact of lower growth (+1.6% per year over the 2015-2020 period) or lower fossil fuel price scenarios for gas and coal (based on a scenario issued by the European Commission in September 2012). In these two variants, the levels of GHG emissions obtained for the WEM scenario in 2020 would be 3 Mt CO<sub>2</sub> lower, for the GDP variant, to 11 Mt CO<sub>2</sub> lower for the energy price variant, compared with emissions in 2020 in the reference WEM scenario.

For the WAM scenario, the impact is similar with an additional reduction by 2020 which would be - 3 Mt CO<sub>2</sub> for the GDP variant, and - 10 Mt CO<sub>2</sub> for the energy price variant, compared with the reference WAM scenario.

## B. Estimate of the total effect of policies and measures

The ex-ante and ex-post effect of existing policies and measures and ex-ante effect of additional measures were estimated by comparing the emissions calculated in WEM and WAM scenarios with those of the without measures since 1990 scenario. The results are presented by gas in table 22.

### B.1 The without measures scenario

The without measures scenario presented here corresponds to a scenario reviewed in France's 5th national communication. The three scenarios are mainly based on the same macro-economic framework: the use of the same model, the same growth assumptions and the same fossil fuel price scenarios (cf. paragraph V.D).

### B.2 Estimate of the ex-post effect of measures

Table 22 shows that emissions reductions linked to measures have already permitted France's (Metropolitan France and Overseas Departments and Collectivities) emissions to be cut by 97 Mt CO<sub>2</sub>e out of a total of 520 Mt CO<sub>2</sub>e, compared with the level achieved in 2010 by the without measures scenario. This reduction is divided into 30 Mt for CO<sub>2</sub>, 31 Mt CO<sub>2</sub>e for N<sub>2</sub>O, 32 MtCO<sub>2</sub>e for F-gas emissions and 5 Mt CO<sub>2</sub>e for CH<sub>4</sub>.

By comparison with other gases, CH<sub>4</sub> is the one that was the least affected by measures in existence before 2012. The implementation of anaerobic digesters on farms should reduce emissions of this gas.

### B.3 Estimate of the ex-ante effect of measures and additional measures

The impact of all GHG emissions combined in 2020 in the with measures scenario is 226 Mt CO<sub>2</sub>e, compared with existing the level of emissions achieved in the without measures scenario. The impact of additional measures in 2020, considered in the with additional measures scenario, is equal to 37 Mt CO<sub>2</sub>e, compared with the level of emissions achieved by the with measures scenario. These evaluations remain conditional upon the vigilance and sensitivity points stated earlier (cf. section V.A.3)

#### Impact of policies and measures by gas

In 2020, CO<sub>2</sub> emissions reductions linked to measures and additional measures are in the order of about 185 Mt compared to the without measures scenario. Additional measures mainly relate to the

residential/tertiary sector and the transport sector. As these two sectors are responsible for 95 % of the CO<sub>2</sub> emissions, the additional measures will help to reduce CO<sub>2</sub> emissions by as much as 11 % compared with CO<sub>2</sub> emissions in 2020 in the with measures scenario.

CH<sub>4</sub> emissions reductions linked to measures and additional measures are equal to 11 Mt CO<sub>2</sub>e in 2020 compared with the without measures scenario, i.e. a reduction of about 18 % between the without measures and with additional measures scenarios. They correspond to the implementation of measures in the waste treatment sector (implementation of the European Directive requiring methane capture on landfills, a national waste plan, restricted use of landfills, etc.). About 21% of methane emissions observed in 2010 are avoided in 2020.

**Table 22: Estimate of the impact of policies and measures and additional policies and measures in Mt CO<sub>2</sub>e by gas**

Sources: UNFCCC inventory, CITEPA/MEDDE, 2013 submission and MEDDE emissions projections, 2013

PRG (Mt eq. CO <sub>2</sub> )	1990	1995	2000	2005	2010	2015	2020
Impact of existing measures	0	47	86	131	97	170	226
Impact of additional measures (WEM-WAM)	0	0	0	0	0	18	37
CO <sub>2</sub> (Mt)	1990	1995	2000	2005	2010	2015	2020
Impact of existing measures	0	4	7	11	30	99	149
Impact of additional measures	0	0	0	0	0	18	36
CH <sub>4</sub> (Mt eq. CO <sub>2</sub> )	1990	1995	2000	2005	2010	2015	2020
Impact of existing measures	0	1	2	3	5	8	10
Impact of additional measures	0	0	0	0	0	0	1
N <sub>2</sub> O (Mt eq. CO <sub>2</sub> )	1990	1995	2000	2005	2010	2015	2020
Impact of existing measures	0	29	58	88	31	28	28
Impact of additional measures	0	0	0	0	0	0	0
F-gas (Mt eq. CO <sub>2</sub> )	1990	1995	2000	2005	2010	2015	2020
Impact of existing measures	0	10	20	30	32	35	38
Impact of additional measures	0	0	0	0	0	0	0

Total N2O emissions reductions from measures and additional measures are 28 Mt CO<sub>2</sub>e in 2020, i.e. a reduction of about 32 % between the without measures and with additional measures scenarios. They concern the chemical industry and the agricultural sector (cf. chapter IV).

The reductions of F-gas emissions taken into account are solely due to measures already in existence (implementation of European regulations). Their impact was mainly before 2010 and achieve a saving of 38 Mt CO<sub>2</sub>e in 2020 compared to the without measures scenario (cf. chapter IV), i.e. a reduction of about 69% between the without measures and with measures scenarios. These assessments do not take into account the potential effects of reinforcements to the F-gas regulations at European level (at the end of 2012 the European Commission proposed a review of Regulation 842/2006 concerning F-gases).

### **C. Role of credits resulting from the mechanisms created by articles 6, 12 and 17 of the Kyoto Protocol in achieving the quantified objectives to France**

Through the public policies it has implemented France will be able to achieve its Kyoto objective without having to acquire international credits.

On the other hand, French businesses subject to the EU Emissions Trading Scheme (EU ETS) may, for compliance, return the Emission Reduction Units (ERU) and Certified Emission Reduction units (CER) up to a limit of 13.5% of their initial quota allocation (National Quota Allocation Plan for the period 2008-2012), for the period 2008-2020.

For new sectors entering the EU ETS, businesses may return up to 4.5% of their verified emissions during the period 2013-2020 in international credits.

Finally, aircraft are authorised to use international credits up to a maximum of 1.5% of the verified emissions during the period 2013-2020.

### **D. Methodological information**

In 2012 MEDDE launched an exercise called "Scénarios Prospectifs climat – air – énergie" (Prospective Scenarios on climate, air and energy), managed by the General Directorate of Energy and Climate (DGEC), the General Commission on Sustainable Development (CGDD) and the Environment and Energy Management Agency (ADEME). The exercise provided projections of energy consumption and greenhouse gas and pollutant emissions for 2020. It models the emissions of Metropolitan France, Overseas Departments (DOM) and Overseas Countries and Territories (PTOM) and takes an integrated approach to its modelling of the energy, climate and air quality perspectives. The results from this scenario modelling exercise are used among other things in this report. To carry out this exercise, MEDDE called upon a consortium in order to obtain better consistency of hypotheses and modelling methods and to ensure methodologically consistent reference projections between energy, climate and air quality approaches. The consortium consisted of:

- The design and engineering firm Enerdata which dealt with the implementation of the energy scenarios;
- The Réseau de Transport d'Electricité (RTE) (electricity transmission network) which participated in the modelling of the electricity sector;
- The Institut Français du Pétrole Energies Nouvelles (IFP Energies Nouvelles) (French Institut of New Petroleum Energies) which dealt with modelling of the petroleum supply;
- CITEPA (Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique) (Interprofessional Technical Study Centre on Atmospheric Pollution) which also compiles inventories of France's GHG and pollutant emissions and which carried out the modelling

of emissions of greenhouse gases and atmospheric pollutants in accordance with the methodology of the national inventory;

- The Centre Énergétique et Procédés (CEP – Armines) (Energy and Processes Centre) which carried out the modelling of refrigerant fluid emissions;
- The design and engineering firm Énergies Demain which provided its bottom-up modelling skills and detailed knowledge of the working of the SceGES model for developing methodological connections between the different modelling procedures used;
- The ERASME team in charge of the macro-economic linkages of the projections.

It should be stressed that this exercise was the subject of a consultation process with departments in the ministries concerned. Throughout the exercise sectoral hypothesis setting and results presentation steering committees were organised in partnership with the experts concerned.

The scenarios were developed from a common hypothesis base, particularly where national, European and international macroeconomics are concerned, by integrating the temporary effects of the economic crisis and associated recovery measures. They present energy demand, energy supply, GHG and atmospheric pollution emissions trends, taking into account a number of policies and measures. The measures taken into account vary according to the two scenarios studied.

The results used in this report are taken from the following two scenarios:

- A “with measures” or WEM scenario which takes into account all policies and measures decided and implemented before 1 January 2012;
- A “with additional measures” or WAM scenario which, in addition to policies already considered in the WEM scenario, also considers new policies decided since 1 January 2012 and, above all, **planned policies even if they have not yet been implemented**. This scenario assumes that all the sectoral greenhouse gas emissions reduction targets will be met.

## D.1 Reference energy scenarios

### Enerdata, MedPro, POLES: general operation

The energy scenarios were generated with the help of linkage between the MedPro technical and economic model developed by ENERDATA and the POLES model. Med-Pro is a technical and economic long-term final energy demand simulation model based on a detailed representation of energy consumption per sector, per use and per energy.

The POLES model is a simulation model of the world energy system up to 2050. It is a recursive simulation model: the process is given, from the initial point and then year by year, by progressive adjustments of supply and demand variables on the one hand and prices on the other.

The POLES model was needed to establish full prospective energy balance sheets for France, integrating energy supply and demand and taking into account influences of European and global energy changes, namely through international prices and environmental constraints on the French balance sheets.

The hypotheses considered are detailed below. Unless otherwise indicated these hypotheses are shared by the WEM and WAM scenarios.

### Macroeconomic linkage

The macroeconomic linkage was largely carried out with the help of the ENERDATA and ERASME teams on the basis of a report produced by the ERASME team for the Centre d'Analyse Stratégique (CAS) (Strategic Analysis Centre): “Les secteurs de la nouvelle croissance” (New growth sectors) (January 2012). The calculation hypotheses of these different scenarios are summarised below.

### International context

The hypotheses used for the international macroeconomic linkage (apart from Europe) are the results of the latest work of the OECD (Economic Outlook, last updated in June 2012). As this data has also been used by the SEURECO/ERASME team for generating the “Les secteurs de la nouvelle croissance” scenario for CAS, they are consistent with the hypotheses used for France.

### Economic growth trend for France

For France, two sets of economic growth hypotheses were used (a reference scenario and a variant scenario). These two sets of hypotheses are derived from the scenarios generated by the SEURECO/ERASME team.

The reference scenario of the DGEC study uses the growth figures of the CAS “constraint” scenario,

i.e. an average annual growth rate of 1.9% over the period 2010-2020. It should be noted that this figure, higher than that which may be found in other work, is explained by the fact that the pension reform and the new INSEE demographic scenario (higher projections of economically active population) were taken into account.

**Table 23: GDP growth hypotheses**

	2010	2011	2012	2013	2014	2015	2015-2020	2020-2025
<b>France</b>	1.5	1.7	1.0	1.9	2.1	1.7	2.1	1.8

### Demography

In the previous exercise INSEE’s “high fertility” scenario updated in 2006 was used. In fact, the latest population data indicated that the 2010 point of the central population growth scenario had already been reached in 2008. For this exercise

the latest update of INSEE scenarios was used, in its Central Scenario variant. In addition, the data for Overseas Departments (DOM) and Overseas Countries and Territories (PTOM) is available. With these figures the population of Metropolitan France is nearly 66 million in 2020.

**Table 24: demographic hypotheses**

In thousands of people	2000	2010	2020
<b>Mainland France</b>	58858	62881	65962
<b>Réunion</b>	716	824	918
<b>Martinique</b>	384	403	415
<b>Guadeloupe</b>	388	404	409
<b>French Guyana</b>	162	238	330
<b>New Caledonia</b>	211	249	287
<b>Other overseas collectivities (COM)</b>	406	492	607

### Sectoral growth

For the reference scenario the SEURECO/ERASME team supplied the associated sectoral growths, consistent with the national GDP trend.

	2010-2015	2015-2020
<b>Agriculture</b>	0.8%	1.3%
<b>Industry</b>	2.6%	1.3%
<b>Construction</b>	2.1%	2.5%
<b>Services</b>	1.6%	2.2%

For the variant scenario the CAS “target” scenario was used. The previous study in 2010 had used the projections of the Conseil d’Orientation des Retraites (COR) (Pensions Advisory Council) for the growth rates, however these updated projections were not available in 2012.

Energy prices

The hypotheses used for fuel prices are those estimated by the International Energy Agency (IEA) in World Energy Outlook 2011. The reference scenarios use the assumptions of the “Current Policy” price scenarios while the prices of the 450 scenario are used as a variant.

**Table 25: changes in energy prices**

			2010	2015	2020
<b>Petroleum</b>	Current Policies	€10/bbl	65	89	98
<b>Gas (European market)</b>	Current Policies	€10/Mbtu	6	8	9
<b>Coal</b>	Current Policies	€10/tonne	83	87	91
<i>Petroleum</i>	<i>450 ppm</i>	€10/bbl	<i>65</i>	<i>81</i>	<i>81</i>
<i>Gas (European market)</i>	<i>450 ppm</i>	€10/Mbtu	<i>6</i>	<i>8</i>	<i>8</i>
<i>Coal</i>	<i>450 ppm</i>	€10/tonne	<i>83</i>	<i>84</i>	<i>78</i>

The variant scenario in particular analyses the impact of international cooperation on GHG reductions (having the effect of reducing the prices of fossil fuels by lowering demand) on the French energy balance. In addition, prices are comparable with the hypotheses used by the European Commission in its projections generated with the aid of the PRIMES model.

### Coal prices

Hypotheses on coal prices were differentiated between the different measures scenarios on the one hand and between the ETS and non-ETS sectors on the other. For sectors covered by the ETS the value used comes from the IEA's World Energy Outlook (WEO) 2011 to ensure consistency with hypotheses used for fossil energy prices. For non-ETS sectors, no coal price is set for 2020 for any of the scenarios.

€10/t	WEM 2020	WAM 2020
ETS	25	25
Non-ETS	0	0

### Dollar/Euro exchange rate

To the extent that exchange rates are supposed to converge in the very long-term towards their purchasing power parity level (PPA) the Euro/dollar exchange rate was fixed at €1 = \$1.2 US, simulating a trend returning towards parity of the two currencies.

## D.2 GHG emissions scenarios

### CITEPA: the total method

From the activity scenarios described above, CITEPA developed emissions projection scenarios for 2020<sup>3</sup>. The emissions projections are consistent with the national greenhouse gas emissions inventory submitted to the UNFCCC. The methods used to convert the activity data into emissions conform to the inventory report<sup>4</sup>. The geographical framework of projections concerns not only Metropolitan France and the Overseas Departments covered by the Kyoto Protocol but also the Overseas Collectivities. In view of the specific features of Metropolitan France and the Overseas Departments and Collectivities, the methods used for making projections for 2020 for these two entities are different. The scenarios described below only concern Metropolitan France.

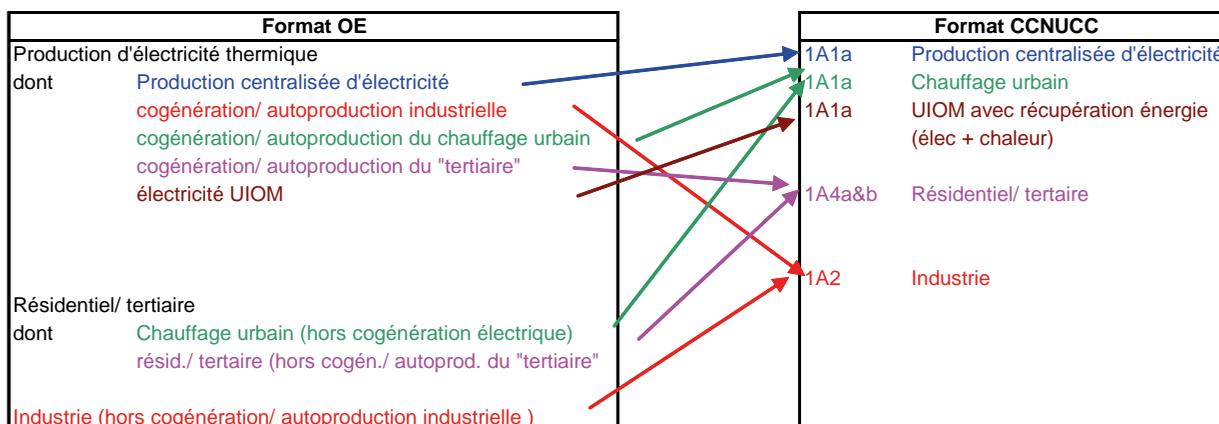
### Consideration of energy scenarios

Energy balance of WEM and WAM scenarios only provide data for 2020. 2015 data was determined by linear interpolation from the 2010 energy balance data corrected for climate.

The structures of the energy balance categories and inventories in CRF format (activities and fuel) are therefore different from their definitions. Energy Observatory data is therefore processed and presented in the correspondence table below:

<sup>3</sup> CITEPA- final report on GHG emissions projections in 2010, 2015, 2020 and 2011

<sup>4</sup> CITEPA-MEEDDAT, Emissions inventory in CRF format, 2009 submission



### Emissions from industrial processes

Changes in activity levels up to 2020 were evaluated using data provided by industrialists and data already used to develop the MedPro scenario.

Emissions factors over the period 2006-2020 were assumed to be constant except for certain activities subject to the EU ETS Directive (i.e. activities for which emissions are not entirely of chemical origin or those for which there is an effective system for capturing emissions of chemical origin): nitric acid production, adipic acid production and aluminium production by electrolysis.

### Emissions from agriculture

Projections of the "bioenergy" scenario produced by the French National Agronomic Research Institute (INRA) for the Ministry for Agriculture<sup>5</sup> were used for the non-energy GHG emissions of the agriculture sector. They are based on the simulations of the GOAL general equilibrium model.

The "bioenergy" scenario takes into account the change in the agricultural situation and enables the different activity variables (agricultural and agri-food assets and other services) to be estimated in 2010 and 2020. It is based on an activity scenario produced by INRA, not taking into account the future reform of the Common Agricultural Policy (CAP) in 2013.

<sup>5</sup> Projections of the Greenhouse Gas Absorptions and Emissions of the Land Use, Land Use Change and Forest (LULUCF) sector in France in 2020.

It responds to the following hypotheses:

- Calculation of the reference situation in 2014, from the trend of the agriculture sector since 1995, with integration of all political decisions adopted up to 2015;
- Implementation of the reform of the Common Agricultural Policy of 2003;
- Compliance with the objectives defined in the Directive on the promotion of renewable energies;
- Absence of a new agreement in the World Trade Organization (WTO), absence of new bilateral trade agreements.

**Table 26: Hypotheses of the bioenergy scenario**

Variables	Bioenergy scenario
Economic growth	moderate
International agreements	No agreement
CAP reforms	2003 reform and removal of compulsory set-aside, Energy Performance Plan (PPE), reduction of nitrogen fertilisation.
Climate and energy package	23% renewable energy in 2020 and 10% renewable energy in transport in 2015
Biofuel development	Incorporation target of 10% in 2015 and now 10% up to 2020.
Development of SRC	1 Mha in France in 2020 on cultivated or uncultivated agricultural land
Optimisation of the wood harvest	+21Mm <sup>3</sup> of wood harvested in 2020 compared with the start year

The GOAL general equilibrium model, provided for calculating the market equilibrium prices of agricultural products up to 2014, was supplemented by assuming that prices would grow at the general pace of inflation over the period 2014-2020. The increase in yields is the result of technical progress. The economic components linked to short term reductions in supply or demand are not modelled.

The different hypotheses (change in prices and yields; implementation of decoupling and other provisions linked to agricultural policy reform; reduction of agricultural land area) have had different impacts according to the technical and economic orientation of farms.

In general, for agriculture, the emissions factors used come from the GIEC's good practice guide<sup>6</sup> and are assumed to be invariants by 2020.

### Emissions of the forest sector (LULUCF - land use, land use change and forests)

The main parameters influencing GHG emissions are as follows:

- Increase of forests: the increase is linked to the growth of trees and therefore to the type of populations and pedoclimatic conditions of their region. They are estimated from the study "Projections d'émissions/absorptions de gaz à effet de serre dans les secteurs forêt et agriculture aux horizons 2010 et 2020" (Projections of greenhouse gas emissions/absorptions in the forestry and agriculture sectors by 2010 and 2020) (INRA central scenario), in which the LERFOB (Laboratoire d'Etude des Ressources Forêt-Bois- (wood and forestry resources study laboratory)) was the main participant for the forestry sector. The very considerable growth observed in French forests since 1990 suffers a slight drop from 2006-2007, although it continues to increase on the whole up to 2020;
- Forestry harvests: harvests consist of carbon removals and are converted into CO<sub>2</sub> equivalent emissions. They are estimated from the removal

targets set by the Forest Council and according to the Ministry for Agriculture communication of 25/03/2009<sup>7</sup>. A very considerable increase is thus expected for the harvest of wood fuel in the form of wood chips.

- Land conversions: land conversions can generate considerable storage or emissions of carbon. They are assumed to be constant from 2005 in this projection exercise.

In the context of European and international reporting, and in the interests of consistency with submissions as part of negotiations on the reference level for LULUCF, the projections used for this sector are those provided by the JRC.

### F-gases

For the F-gas sector, HFC emissions were assessed with the aid of the RIEP software developed by the Centre Energétique et Procédés de MINES ParisTech. This software was used for two databases, one combining the hypotheses and data for Metropolitan France and the other for the Overseas Departments and Collectivities.

The RIEP software groups equipment containing F-gases into 8 application areas: domestic cooling, commercial refrigeration, refrigerated transport, industry, the air-conditioning, chilled water groups, on-vehicle air-conditioning (including car air-conditioning) and heat pumps.

Each database, for 41 equipment sub-sectors, describes the national equipment production and markets, technical characteristics of the equipment (linked to the load, installed power, life, etc.) as well as the emission levels and recovery efficiency of the maintenance and end of life sectors. The markets and production data come from statistical sources available for Metropolitan France and references in French inventory studies updated each year. Other hypotheses come from the results of field surveys, communications from equipment manufacturers, results of experimental measurements and expert assessments.

The method of calculation established in RIEP

<sup>6</sup> GIEC, *Bonnes pratiques*, Editions 1996, 2000, 2003

<sup>7</sup> Ministry of Agriculture Communication of 25/03/2009 on harvest targets set by the Forest Council

enables all types of emissions produced over the life of the equipment to be considered:

- Emissions during production, linked to the equipment load and transport of capacities;
- "Fugitive" emissions, linked to the operation of all equipment containing refrigerant fluid installed on the territory;
- Emissions linked to the maintenance of this equipment (equipment subject to annual maintenance is included in fugitive emissions. In other cases, such as car air-conditioning, a calculation model enables the occurrence of maintenance operations and associated emissions to be taken into account, depending on the quality of maintenance, manifested by the maintenance effectiveness parameter);
- End of life emissions of the equipment.

The with additional measures scenario for F-gases is identical to the WEM scenario as no measure has been decided since 1 January 2012.

The development of this scenario is based on the 2009 hypotheses (French inventory results 2008-2009) in terms of average loads, emissions levels, recovery effectiveness, etc. Reduction trend curves of these different parameters were introduced up to 2020 taking into account two measures concerning F-gases:

- European Regulation n° 842/2006 and the measures put in place in France for its transposition (articles R 543-75 et seq. of the French Environment Code);
- Directive 2006/40/EC of 17 May 2006 on emissions from air-conditioning systems in motorised vehicles.

Projections of equipment markets were established according to the pace observed in the past and population growth curves supplied by INSEE, according to sector.

## Waste

WEM and WAM scenarios are identical for the waste sector. It should be stressed that the scenarios did not take account of the transposition of the Waste Directive, implemented in the first half of 2011 in France. This should make it possible to go

beyond the objectives of the Framework Law of 3 August 2009 concerning the implementation of the Grenelle Environment Round Table used in the context of this exercise. The main hypotheses used are as follows:

- Lowering of the rate of waste production by 7% over 5 years (2008-2012) then constant at the 2012 value<sup>8</sup>;
- Increased share of recycling (material recovery) to 35 % in 2012 and 45 % in 2020<sup>9</sup>;
- Composition of composted waste presumed constant compared with the 2009 value;
- Incineration capacity maintained at its current level;
- it should be stressed that in line with the CRF format and the emissions reporting rules, emissions from HWIP producing electricity or supplying district heat networks are transferred to the ENERGY category (CRF 1A1a). Emission factors applied for CO<sub>2</sub> and N<sub>2</sub>O are those of the national inventory and are considered constant over the entire period.

<sup>8</sup> Framework Law no. 2009-967 of 3 August 2009 on implementation of the Grenelle Environment Round Table (1)

<sup>9</sup> Framework Law no. 2009-967 of 3 August 2009 on implementation of the Grenelle Environment Round Table (1)



# Impacts, vulnerability and adaptation

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Climate change creates risks on the whole of French territory that need to be measured. Hazard characterisation and vulnerability assessment enable the implementation of recommendations and prevention and adaptation measures for reducing the risks associated with climate change. These measures concern land-use planning, water resources, public health, protection of life and property, biodiversity, cultural heritage and have to be pursued in all economic sectors. Taking into account the results of all research and studies in plans and laws will help to consolidate the implementation of these adaptation measures, which depends on the active involvement of local stakeholders.

France has been conducting research and study programmes since 1993 with the specific objective of assessing the possible effects of climate change on French territory (including the Overseas Departments and Territories) and the adaptation measures likely to be implemented in the most vulnerable geographical areas and sectors of activity. In 1993, the REGCLIM Programme: "Régionalisation des effets climatiques"<sup>1</sup> started (Regionalisation of climatic effects) (MEEDDM, 2001). It was followed in 1999 by the Gestion et impacts du changement climatique (GICC)<sup>2</sup> (Management and impacts of climate change) programme. Since its creation the GICC (cf. chapter on Systematic Observation and Research) has financed nearly one hundred impact and adaptation projects in a very wide range of fields. The most significant project is Drias, Les futurs du Climat. The Drias, les futurs du climat portal resulting from the project meets a need expressed by all the stakeholders affected by climate change, by making information and help for studying impacts and deciding on climate change adaptation measures easily available. The user-friendly provision of some of this material constitutes a first essential step in the development of a basis of French climate services.

<sup>1</sup> MEEDDM, 2001: "Régionalisation des Effets Climatiques" (REGCLIM) programme (Regionalisation of Climatic Effects), Final report of the MEDD/METEO France research contract, February 2001.

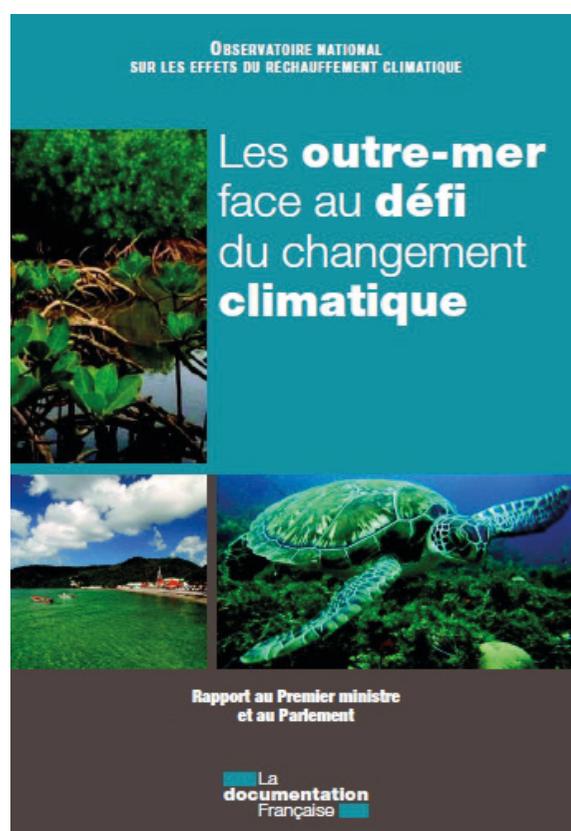
<sup>2</sup> MEEDDM: Calls for research proposals within the "Gestion et impacts du changement climatique" (GICC) (Management and impacts of climate change) programme [www.gip-ecofor.org](http://www.gip-ecofor.org).

The French national research agency launched the "Vulnérabilité : milieux, climat et sociétés" (climate change, vulnerability risk and impact of society) followed by the "Changements Environnementaux Planétaires et Sociétés" (Global environmental changes and impact on society) which have given rise to several calls for projects since 2006. These research programmes aim to reinforce the national scientific output, to generate useful knowledge for public action and reinforce French capacities in international negotiations in the area of "Environmental Change".

Institutionally, the Observatoire national sur les effets du réchauffement climatique (French national observatory on the effects of global warming) (ONERC), created by law in 2001, is responsible for collecting and disseminating information, studies and research on risks related to global warming and extreme weather phenomena. It can also make recommendations on prevention and adaptation measures apt to reduce climate-related risks. Within the Ministry of Ecology, Sustainable Development and Energy (MEDDE), ONERC is attached to the Direction générale de l'énergie et du climat (General Directorate of Energy and Climate), so that questions on adaptation are treated in the same framework as those of mitigation. ONERC reports are sent to the Prime Minister and to Parliament. They present the main consequences of global warming in France and include recommendations for adaptation. The report published in 2010 deals with towns and town planning. The adaptation process followed in France is explained in the 2011 report. Finally the 2012 report deals with the specific characteristics of French Overseas Departments and Territories. In addition, ONERC organises and participates in thematic seminars, issues a fortnightly technical watch letter (21 issues already sent out, about 700 subscribers). A specific publication aimed at MPs is produced quarterly (16 issues of about 5,000 copies already sent out). The ONERC website<sup>3</sup> serves as an adaptation portal by presenting a selection of publications and results of research and studies, together with methodological guides that are directly usable by the majority of stakeholders.

<sup>3</sup> [www.onerc.gouv.fr](http://www.onerc.gouv.fr)

Town and country planning and environmental protection laws together with the 2004 Climate Plan have opened the way to the implementation of adaptation to climate change and the adoption of the Plan National d'Adaptation au Changement Climatique (French national climate change adaptation plan) in 2011.



## A. Impacts of climate change

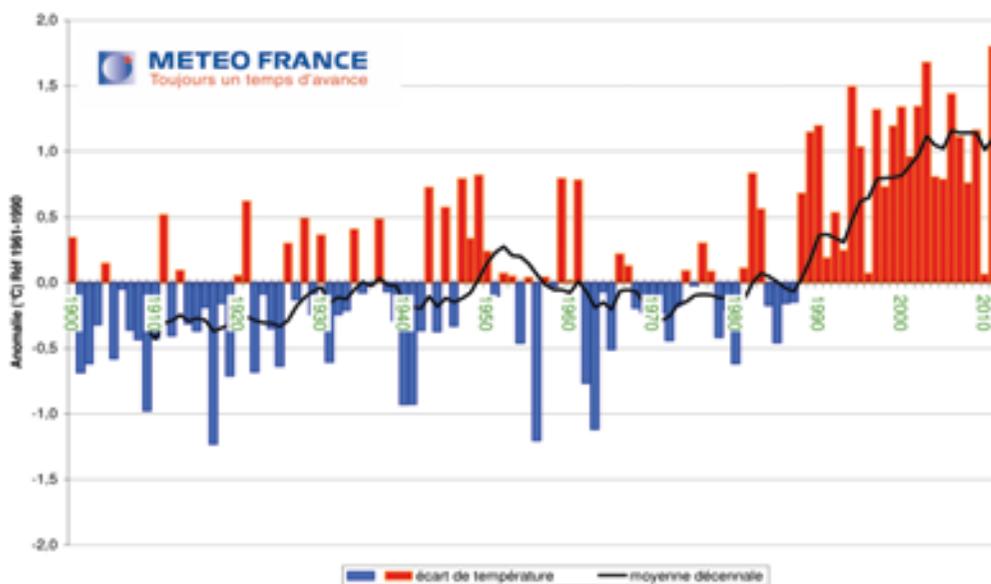
### A.1 Observed changes and trends

The change in the annual mean temperature of Metropolitan France is given as a deviation relative to the long-term mean for the period 1961-1990. It has the same characteristics on the national scale as on the global scale: the mean temperature warming is unequivocal. Until the mid 1980s the deviation is very often negative: the annual mean temperature is lower than the average for the period 1961-1990. Since the 1980s annual mean temperatures have increased rapidly and the deviation is systematically positive. After a particularly cold year in 2010 in metropolitan

France (the coldest of the last two decades and as cold as 1996), 2011 was the warmest year in mainland France since 1900. With an annual mean temperature 1.5 °C above normal, 2011 was warmer than 2003, which was the previous record holder with a temperature deviation of +1.3 °C.

While 2012 was close to the 1980/2010 average in France (Météo-France annual climate report) it was one of the six hottest years on the global scale. This is yet another reminder of the need for a global approach to the study of climate, climate variability and climate change.

Figure 35: change in mean temperature in metropolitan France over the period 1900-2011

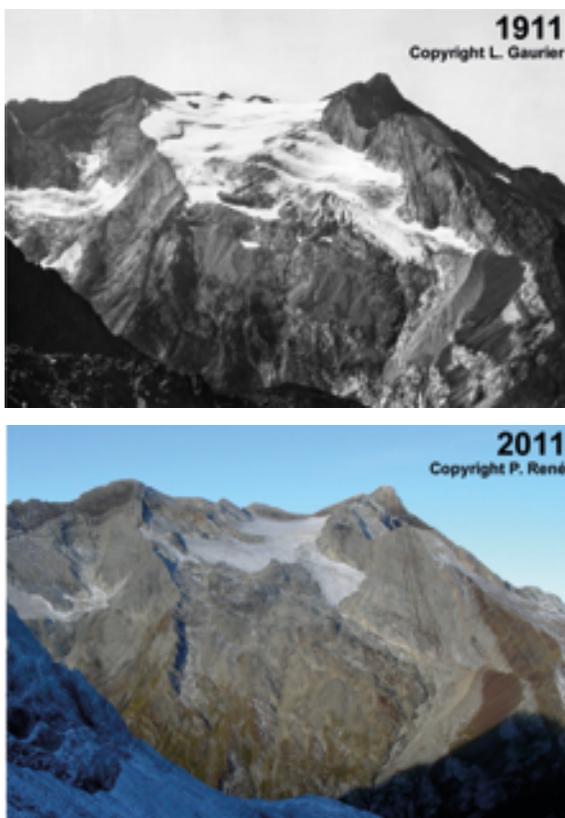


From: Météo-France

French Overseas Departments have experienced a similar trend, although less marked due to thermal inertia of the sea. Depending on the region, the temperature has increased by +0.65 °C to +1.5 °C over the last forty years.

The consequences of changing climate conditions are observed in many areas. Glaciers in the French Alps have lost some of their mass balance and the glaciers in the Pyrenees are showing the same trend. Despite fluctuating values of accumulation and ablation the balance has been negative every year since the 2001-02 cycle. In ten years the Ossoue Glacier has lost 14.2 metres of water equivalent, thus about 15.8 metres of thickness from its entresurface area.

Figure 36: The Ossoue Glacier

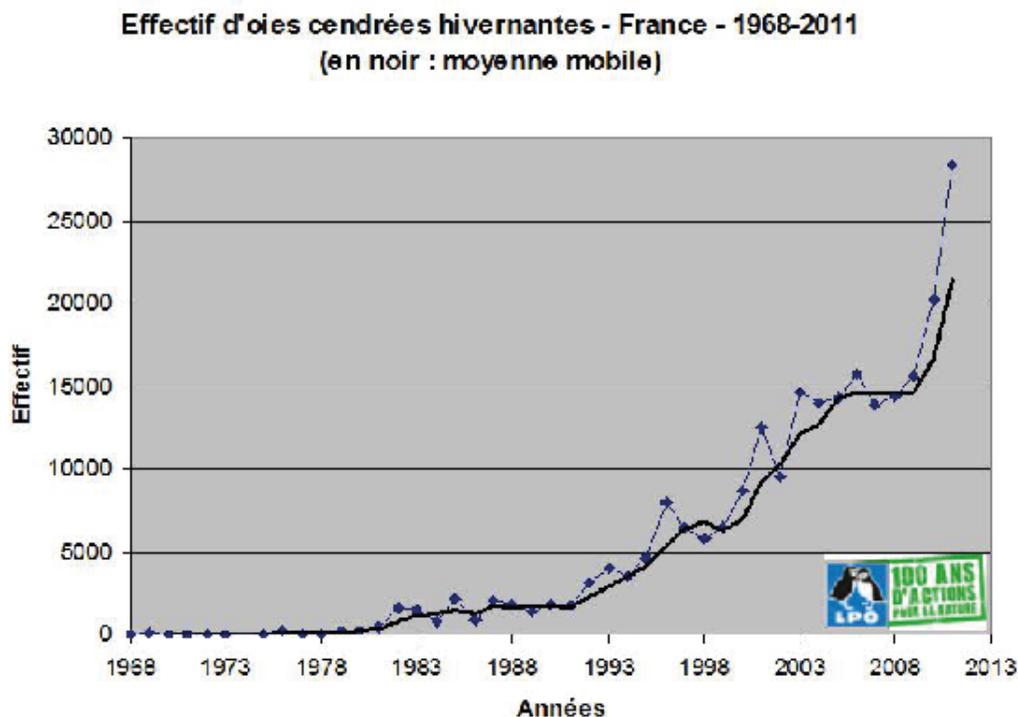


Source: Association Moraine (Association pyrénéenne de glaciologie)

Flora and fauna have also been affected by these changes. The influence of vine maturity dates and therefore the grape harvest are well known but other fruit trees also have variations in their vegetative cycles. Changes have been seen in bird behaviour, especially migration. In the first half of the twentieth century the Greylag Goose Anser was only a migratory bird, crossing France twice a year and wintering especially in Spain. Overwintering conditions, warmed by climate change, now enable birds to winter in temperate Europe, particularly in France, and also in the south of the Scandinavian Peninsula. The migration routes are shorter for birds.

This phenomena began discretely in the 1960s and increased greatly in the 1980s. At the same time, the wintering population decreased in Spain as some birds no longer cross the Pyrenees. The numbers of Greylag Geese wintering in France has increased significantly, especially between 1991 and 2003. A slight decline was observed in the period 2007-2009. From 2010 there was a further increase, with the highest score ever seen in January 2011 (28,342 birds).

Figure 37: Population of Greylag Geese wintering in France from 1968 to 2011



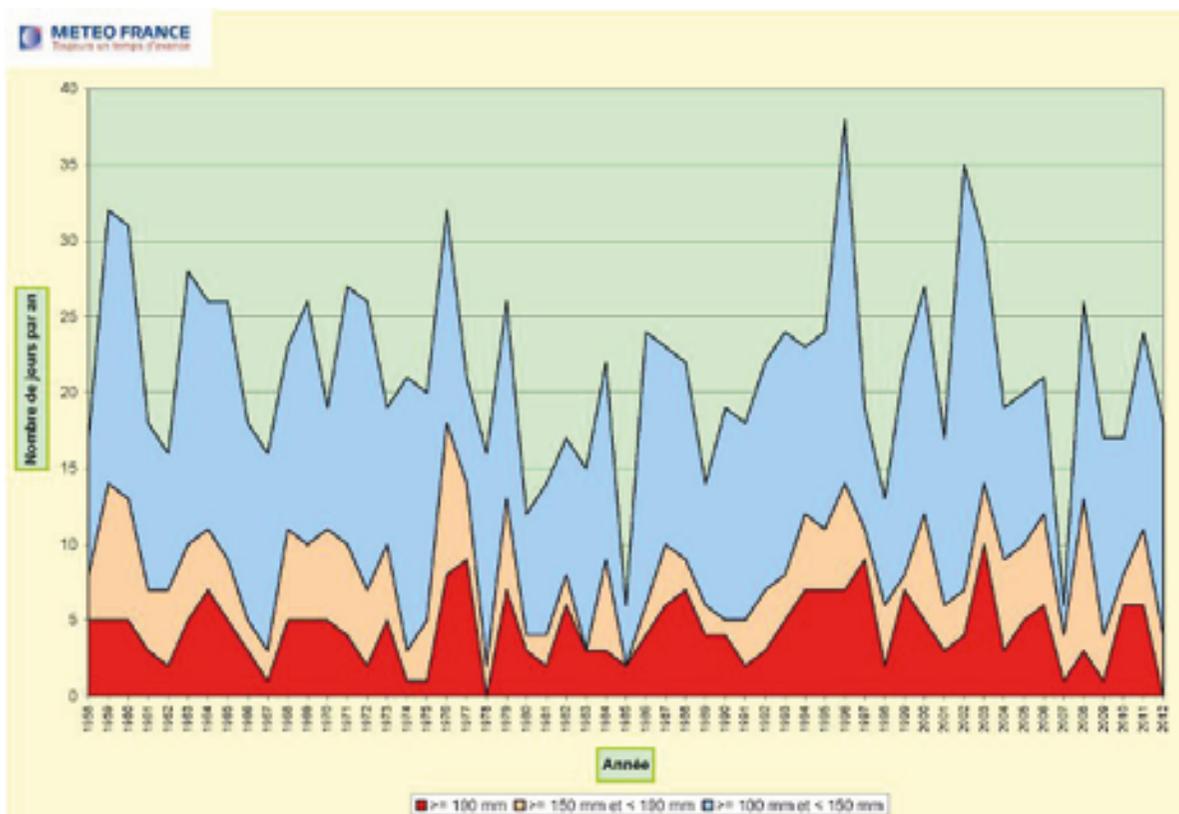
Sources: LPO/ Wetlands International/

The Mediterranean regions of France are regularly affected by episodes of heavy rainfall, with enormous quantities of water falling within a very short period of time: very often the normal monthly amount in a single day, and for the most extreme events, half (or even more) of the normal annual amount in just a few hours. Even though heavy rainfall, which occurs regularly in the Mediterranean areas of France, is an integral part of the "Mediterranean" climate, it often has disastrous consequences (loss of human life, considerable damage). In the context of recognised climate change, already visible in temperatures, it is important to be able to characterise the development of this type of event in regards to the frequency of occurrence and the intensity. Despite the fact that extreme weather leaves make a lasting impression, current observations do not demonstrate a trend in the change of occurrence of heavy rainfall in the regions of Mediterranean France, even though the inter-annual occurrences

of heavy rainfall vary a lot, for any threshold. . For the 100 mm threshold the average is 21 annual occurrences, and the record years, exceeding 30 events, are 1959, 1960, 1976, 1996, 2002 and 2003.

The graph shows the changes in the annual number of rainy days with 100, 150 or 190mm or more of rain in 24 hours in Mediterranean France (apart from Corsica) from 1958 onwards. For the 100 mm threshold, the average is 21 annual occurrences, and the record years, exceeding 30 events, are 1959, 1960, 1976, 1996, 2002 and 2003.

Figure 38: Changes in the annual number of days with heavy rainfall in South-East Mediterranean France



No trend is currently seen in the change of occurrence of heavy rainfall in Mediterranean France, but there is significant inter-annual variability in the number of occurrences of heavy rainfall whatever the threshold considered.

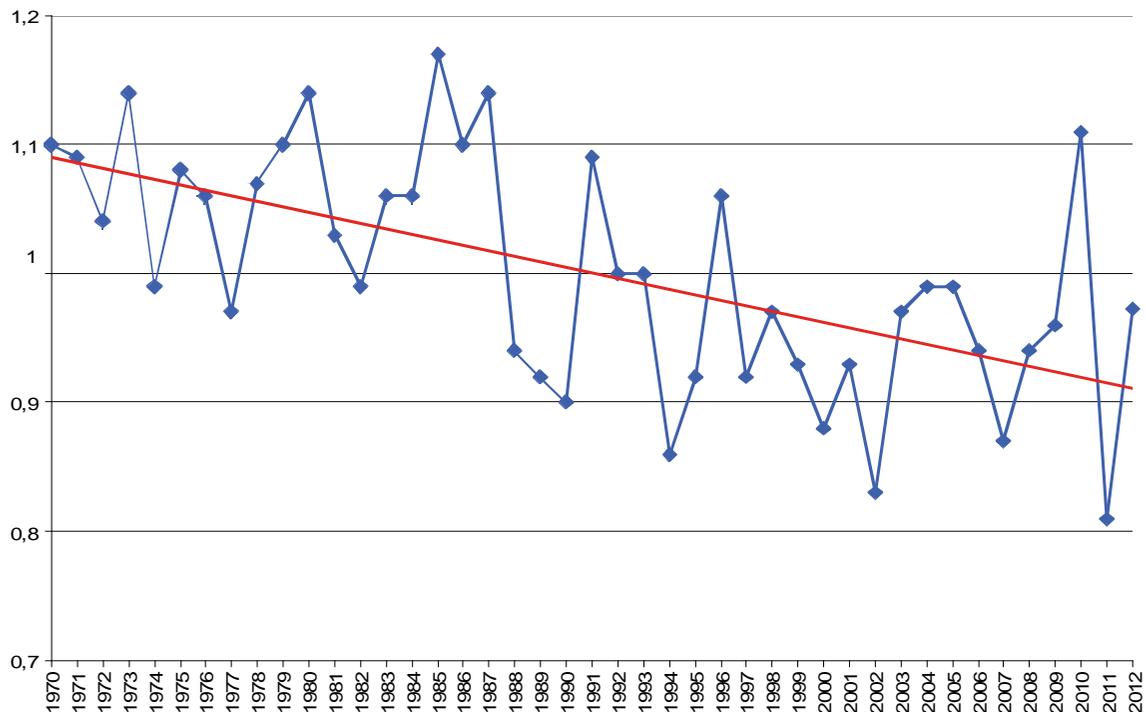
Météo France, with the support of the Ministry, has created a website dedicated to "pluies extrêmes"<sup>4</sup> (extreme rainfall). Its purpose is to give information on the frequency of extreme rainfall events and to present the most significant episodes that have occurred in metropolitan France since 1958. This website is updated in the first quarter of each year to include the events of the previous year.

In order to make the effects of climate change easier to see, several indicators have been developed. For example, the climate severity

index (indice de rigueur climatique) characterise the winter severity of a year (from January to May and October to December, the period generally requiring heating in homes) compared with a reference average. The thirty year reference period chosen is 1976 to 2005. An 0.9 index indicates the unified degree days of the winter period of the year considered was milder than the average of the reference period. It also means that the climate-sensitive energy consumption of this year was 10% lower than it would have been for the "normal" climate (equal to the reference period 1976-2005). A significant decline can be seen in this index, especially since 1988, which also coincides with a significant increase in air temperatures in the metropolitan France (annual mean temperatures).

<sup>4</sup> <http://pluiesextremes.meteo.fr/>

Figure 39: change in the climate severity index from 1970 to 2012



SOeS, energy observatory

## A.2 Characteristics of the future climate

In 2010 the Ministry of Sustainable Development asked the French climate sciences community to produce a report giving a scientific assessment of the climatic conditions of France in the 21st century. Dr Jean Jouzel was in charge of this report, carried out by researchers from CNRS/INSU/IPSL and LGGE, Météo-France, BRGM, CEA, CETMEF and CNES. This work is collected in the "Le climat de la France au xxi<sup>e</sup> siècle" (Climate of France in the 21st century) series: it gives reference climate indexes to be used as a basis for preparing climate change adaptation measures.

This tool is essential for many adaptation stakeholders who are, in particular, local authorities, the private economic sector, associations, government

services. For this reason, the production of this reference data is a key action in the Plan national d'adaptation au changement climatique<sup>5</sup> (French national climate change adaptation plan) which was adopted on 19 July 2011. The Observatoire national sur les effets du réchauffement climatique (ONERC) (French national observatory on the effects of global warming) organises and disseminates this scientific information. These are three volumes of these publications, enabling the most important subjects to be covered<sup>6</sup>:

- volume 1: Regional scenarios - January 2011;
- volume 2: Regional scenarios - Reference indexes for metropolitan France - February 2012;
- volume 3: Changes in sea level - February 2012.

<sup>5</sup> <http://www.developpement-durable.gouv.fr/IMG/pdf/ONERC-PNACC-complet.pdf>

<sup>6</sup> <http://www.developpement-durable.gouv.fr/-Rapports-climat-de-la-France-au-.html>

Based on such results, as well as other French scientific work on climate, the Drias les futurs du climat Web portal, resulting from the Drias (Donner accès aux scénarios climatiques Régionalisés français pour l'Impact et l'Adaptation de nos Sociétés et environnement) (Giving access to French regional scenarios for the impact and adaptation of our businesses and environment) project financed by the Gestion et Impact du Changement Climatique (GICC) (Management and Impacts of Climate Change) programme of the Ministry for Sustainable Development (MEDDE) meets a need for all the stakeholders affected by climate change, by giving easy access to information and help with studying the impacts and deciding on climate change adaptation measures.

By sharing some elements in a user-friendly way, this portal constitutes a first essential step in the development of the French climate service, as it allows easy access and use of French regional climate projection information. Now available via a unique access point, it also helps to promote research work and to standardise the work of French modelling groups.

The Drias les futurs du climat portal is designed for a wide spectrum of users, from experts (researchers, universities, etc.) to non-specialists (project leaders, decision-makers, etc.) involved in climate change adaptation and impact studies. It is aimed at stakeholders in the regions, whose actions form part of the implementation of a plan or scheme linked to climate, or an observatory, at stakeholders in the private sector who are confronted with the climate prospective in their businesses, adaptation and environment consultants, researchers involved in impact studies or adaptation work, and also at teachers eager to access to information from climate projections.

Access to this data is essential for regional vulnerability studies that local authorities need in order to define climate change adaptation policies.

### A.3 Expected impacts of climate change

The ONERC report "impacts du changement climatique, coûts associés et pistes d'adaptation" (Climate change - Costs of impacts and lines of adaptation) was published in September 2009<sup>7</sup>. Several adaptation lines have been identified which would enable the negative impacts of climate change to be limited. The majority of adaptation measures are however largely dependent upon regional characteristics and must therefore be defined for each case at local level.

For 2050 and 2100 it highlights:

- Losses for the agricultural sector, due to periods of heatwave and drought, which will cancel out the positive effect of the increased productivity of plants due to the increase of atmospheric CO<sub>2</sub>;
- Reduction of water resources in areas already suffering difficulties;
- In Languedoc Roussillon thousands of homes and businesses would be directly affected by a one-metre rise in sea-level;
- An estimated €2 billion national highway investment would be affected by a one-metre rise in sea level;
- An extension of areas affected by the shrinkage and swelling of clay soils, due to drought, causing damage to homes, increasing the current costs of such damage by 3 to 5 times;
- Savings in energy consumption, although increased use of air-conditioning would be a limiting factor for these savings.

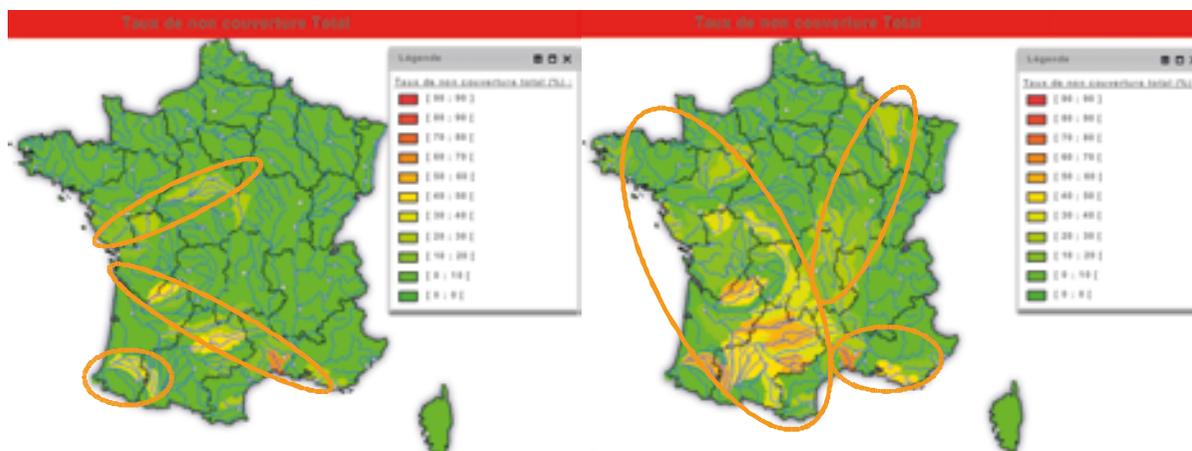
### Water resources

A huge impact study on water resources was carried out in the Explore 2070<sup>8</sup> project. Its aim was to make it easier to prepare and assess adaptation strategies in view of the hydrosystem and coastal environment changes. It included different climate, demographic and socio-economic scenarios for metropolitan France and the Overseas Departments up to 2050-2070.

<sup>7</sup> *Changement climatique - Coûts des impacts et pistes d'adaptation, November 2009; French documentation*

<sup>8</sup> *Explore 2070: <http://www.developpement-durable.gouv.fr/Evaluation-des-strategies-d.html>*

Figure 40: assessment of the ability to meet total water needs in % between the present climate (left) and the future climate in 2050-2070 (right) - Trend scenario.



Source: Explore 2070 MEDDE.

From this work maps were produced which indicate an almost general 10 to 25% decrease in water recharging, with two areas being particularly badly affected:

- the Loire basin with a decrease of between 25 and 30% over half of the surface area of its drainage basin;
- South West France with decreases everywhere of between 30 and 50%.

For all modelling carried out, the piezometer network shows a decrease in the average monthly level of the water table linked to the decline in recharging. Optimistic scenarios show a slight decrease in levels of 0.5 m to 1.5 m, or even, for some areas (Aquitaine, Poitou), a possible local increase. Pessimistic scenarios show a very limited decrease of piezometry on the alluvial plains and considerable decreases of as much as 10m on the plateaux or foothills in sedimentary basins.

Robust trends project a decrease in the majority of annual average flows between now and 2070: these could cause a 20% decrease in most drainage basins, and even more in the Adour-Garonne, Loire-Bretagne and Seine-Normandie basins. Very pronounced changes are also expected in low-water levels. These significant trends on surface hydrology would be accompanied by a general

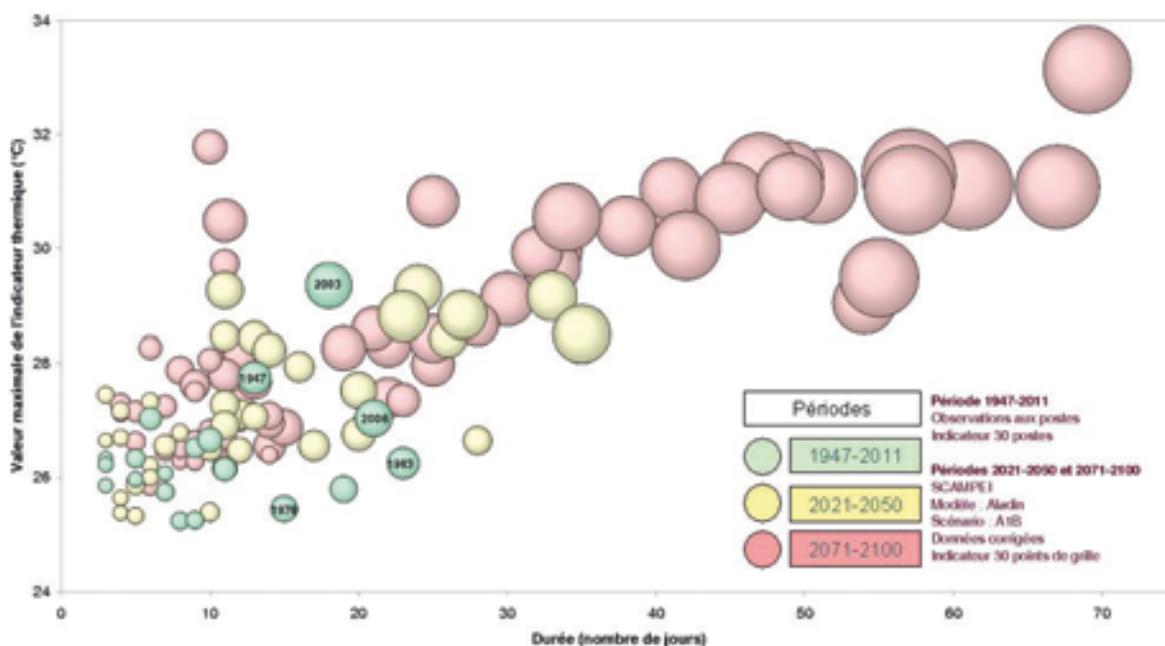
impoverishment in groundwater recharge. The decrease varies between 10 and 40% in the northern half and 20 and 50% in the southern half, with some extremes possibly reaching 70%. Despite the relative decrease in flows the possible appearance of significant winter flows can still be observed in some drainage basins (Somme, Rhine, etc.) and for some climate models, confirming the possibility of flooding in a global warming context. These results are consistent with those produced as part of the AMICE project in the Meuse basin (cross-border case study).

An additional pressure comes from the rise in sea-level and a significant summer demand for water which is in danger of generating a rise in the saltwater wedge influencing the quality of estuarine waters, marshes and coastal aquifers, especially in the Mediterranean region between Marseilles and the Franco-Spanish border.

### Heatwaves

Heatwaves are likely to increase significantly, to the point that the heatwave observed in 2003, and to a lesser extent in 2006, would be typical of a normal summer before the end of the 21st century, or even the middle of the century if global greenhouse gas emissions continue to grow rapidly.

Figure 41: average number of days of heatwave in summer over the reference periods (1947-2011), the near future (2011-2050) and the distant future (2071-2100). The size of sphere symbolises the overall intensity of heatwaves; the largest sphere corresponding to the most severe heatwaves.



Source: Météo-France

The 2003 heatwave in France led to an abnormally high death rate; 14,800 deaths between 1 and 20 August, mainly elderly people: in total 82% of deaths attributable to the heatwave were people aged 75 and above. In 2006, on the other hand, no significant impact was detected in terms of mortality. The adaptation implemented as the plan canicule<sup>14</sup> (Heatwave Plan) had immediate effects on the management of this type of crisis.

### Rise in sea-level

Due to the distribution of French Overseas territories in all the world's oceans, the subject of rising sea-levels is a fundamental issue for France.

The world's sea-level rose about 130 metres over the millennia which followed the end of the last glacial period (about 21,000 years ago) and then stabilised about 2,000 to 3,000 years ago.

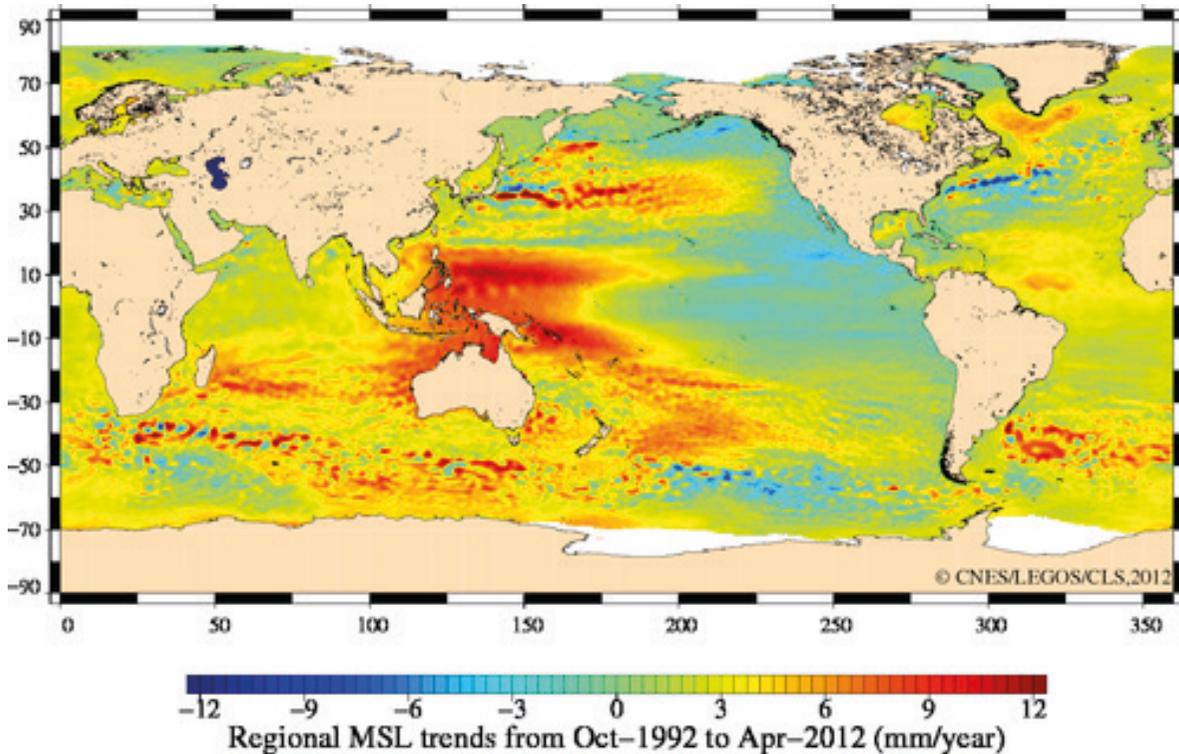
<sup>14</sup> <http://www.sante.gouv.fr/canicule-et-chaleurs-extremes.html>

Sea-level indicators show that the world's sea-level did not change much after that time until the 19th century. Measurements carried out to observe the current sea-level show that sea-levels began to rise again during the 19th century. Recent estimates indicate that the global mean sea level rose at a rate of 1.7 mm/year during the 20th century<sup>14</sup>.

Satellite images from the early 1990s provide more precise sea-level data for almost the whole world. The database of altimetric data provided by satellites over ten years shows that since 1993 the sea-level has risen at a rate of 3mm/year; much faster than the average for the previous half-century.

<sup>15</sup> Planton S. et al, *Le climat de la France au XXIe, Volume 3, Evolution du niveau de la mer, février 2012*

Figure 42: Regional trend of mean sea levels between October 1992 and April 2012 (in mm/year)



Source: CNES/LEGOS/CLS

Satellite data (figure) and hydrographical observations corroborate the climate models, indicating that the sea level rise is geographically unequal across the world. In some regions the rate of sea-level rise is much faster than the global mean, while in other regions sea-level is falling.

Sea-level is expected to rise even more rapidly during the 21st century. The two principal causes of the global rise in sea-level are thermal expansion of the oceans (water expands with heat) and the disappearance of continental glaciers due to increased ice melting.

Most French Overseas Territories have a territorial redeployment capacity lower than that of metropolitan territories. This reduces the flexibility available for companies and actors – both public and private – in response to the constraints.

Today, we know more about the major trends affecting climate change in the French Overseas Territories, apart from on the very small islands. During the last 40 years, the temperature has risen by +0.65 °C to +1.5 °C, depending on the territories. Climate projections predict a rise of between +1.4°C and +3 °C by the end of the 21st century. Sea levels have risen by less than 3 mm/year to over 5 mm during the last 20 years. Projections for the end of the 21st century are for rises of +40 cm to +60 cm and even +1 m in extreme cases. Precipitation trends are more difficult to highlight, in regards to the current state of knowledge, and vary from territory to territory. The current environmental and development conditions determine a territory's ability to adapt and thus its capacity to undertake a long-term adaptation process. At a local level, the main effect of climate change will be to exacerbate existing pressures, linked to unsustainable modes of development.

## B. Assessment of vulnerabilities

Man and Nature are no doubt able to adapt spontaneously to a certain extent to the upheavals caused by climate change but it is certain that if we are not prepared for this change, it will generate costs and damage far in excess of the effort of anticipation. We must therefore reduce our vulnerability to climate variations now, in order to avoid significant environmental, material, financial and also human damage. We should recall that the cost of inaction, according to the economist Nicholas Stern<sup>16</sup>, is between 5 % and 20 % of the world's GDP and that of action 1 to 2 % of the world's gross domestic product (GDP).

Published in September 2009, the report by the French National Observatory on the Effects of Global Warming (ONERC) entitled "impacts du changement climatique, coûts associés et pistes d'adaptation" (Climate change - Costs of impacts and lines of adaptation) shows that annual costs linked to climate change could reach several billion euros per year for metropolitan France if no adaptation measures are taken.

On the national scale, the population's exposure to climate risk is considered moderate for 30% of municipalities and high for 16% of municipalities.

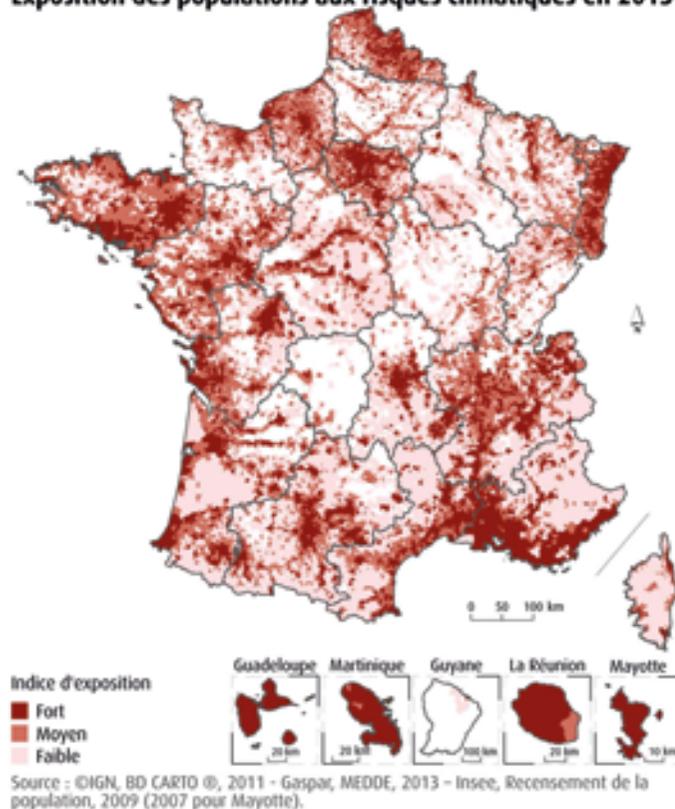
The vulnerability of areas at risk is likely to increase with climate change because some events and extreme weather events will become more frequent, more widespread and/or more intense. The extent of future risks is more than ever linked to development and town and country planning choices.

The map below illustrates the degree to which the population of France is exposed to natural hazards likely to increase with climate change (avalanches, storms, forest fires, flooding, landslides): the denser the population and the more natural hazards identified per municipality, the higher the index.

<sup>16</sup> Lord Nicholas Stern, "The Economics of Climate Change", Cambridge University Press, 2006

Figure 43: exposure to climate risk for people in France in 2013

### Exposition des populations aux risques climatiques en 2013



Source: ONERC/processing SOeS/data INSEE/MEDDE/DGPR

With a high risk index for all their municipalities Guadeloupe and Mayotte are the departments most exposed to risk. Martinique and Reunion have almost the same level of risk, with 94 % and 92 % of their municipalities respectively having a high risk index. The situation for islands or in low latitudes means a very high risk of exposure for these territories, with sometimes violent hydro-meteorological hazards (cyclones, storms, high rainfall, drought, etc.). These territories are also vulnerable to submersion (observed sea-level rise of 5 to 9 mm between 1993 and 2011 in Reunion).

In metropolitan France the areas most at risk are Alsace (48% of municipalities with a high risk index) and Provencal-Alpes-Côtes d'Azur (41% of municipalities with a high risk). In Alsace the

reason for this high risk is the population density. For municipalities with a high risk index in Alsace there are two climate risks per municipality. In the Provençal-Alpes-Côtes d'Azur region municipalities with a high risk index are exposed to an average of three risks. This risk is associated with a population density of more than 45 people/km<sup>2</sup>

Conversely, the regions least at risk are the Limousin, with 92% of municipalities of this region not at risk or at low risk. Guyana and Champagne-Ardenne come next with 86 and 83% of their municipalities respectively not at risk or very low levels of risk. This time, it is the lower number of risks per municipality combined with low population density of the municipalities that is responsible for this low level of risk.

MEDCIE studies ("Mission d'études et de développement des coopérations interrégionales et européennes") (European and inter-regional cooperation development and studies mission) aim to encourage inter-regional cooperation on major issues such as vulnerability to climate change. Several of these studies, financed by DATAR and led by the regional prefects, have been carried out in recent years in five large inter-regional areas of metropolitan France in order to characterise the probable effects of climate change on the regions and vulnerabilities or opportunities created in these regions.

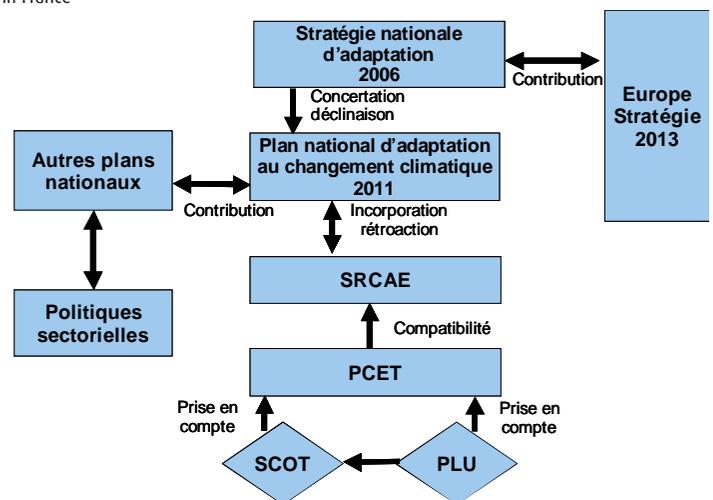
Similar studies with a cross-border scope were also carried out in metropolitan France (Meuse basin with the AMICE project, Alps with the alpine convention, Pyrenees with the Pyrenean climate change observatory) and in the overseas territories (islands in the Indian Ocean with the ACclimate project).

## C. Adaptation

France's adaptation to climate change is a major issue that must be planned as a now essential complement to the mitigation actions already undertaken.

Government action in the climate change adaptation area began in 2001 with the birth of the Observatoire national sur les effets du réchauffement climatique (ONERC) (French National Observatory on the Effects of Global Warming), followed by adoption of the National Adaptation Strategy in 2006. In July 2011 the Plan National d'Adaptation au Changement Climatique (French national climate change adaptation plan) was adopted. At regional and local level, adaptation policies are set out in the Schémas Régionaux Climat Air et Énergie (Regional Climate, Air and Energy Schemes) and Plans Climat Énergie et Territoire (Regional Climate and Energy Plans) which are required to have an adaptation section.

Figure 44: Focus of adaptation policies in France



SCOT: Schéma de Cohérence Territoriale (Coherent Regional Planning Schemes)  
 PLU: Plan Local d'Urbanisme (Local Development Plan)

### C.1 The French national adaptation strategy

Adopted in 2006 the objectives of the national adaptation strategy are to underpin all recommended measures concerning adaptation to climate change, namely:

- Act for public safety and health;
- Take account of social inequality,
- Limit costs, take advantage of benefits,
- Preserve the natural heritage.

Eight strategic priorities were then proposed and listed in the national strategy: developing scientific knowledge, consolidating observation, giving information, raising the awareness of all stakeholders, promoting a regional approach, funding adaptation projects, using legislative and regulatory instruments, taking account of the specific features of the Overseas territories, contributing to international discussion.

Adaptation must be taken into account in all areas of activity. Due to their cross-cutting nature and their relationships with the economic, social and environmental sectors, the following cross-cutting approaches are examined as a priority: water, risks, health, biodiversity. Clarification is then given to the following economic activities: agriculture, energy and industry, transport, construction and housing, tourism.

Finally, an integrated approach should be given to thinking on adaptation, considering not only the sectors of activity taken individually but the most relevant possible combination of sectoral policies in "environments" because of their particular vulnerability: towns, coastal regions and sea, mountains and forests.

In general, a strategic assessment of adaptation within cross-cutting or sectoral approaches or by environment depends on the ability to identify the impacts of climate change in these sectors in advance. This is without doubt the way in which the most urgent progress should be accomplished.

## **C.2 Plan National d'Adaptation au Changement Climatique (French national plan for adaptation to climate change)**

An adaptation policy is essentially a policy of anticipation: anticipation by all stakeholders of future problems, anticipation of society's perception of these changes (even if the climate fluctuates unpredictably from one year to another, the predominant warming trend is already unquestionable), anticipation of measures needed to solve the problems, in order

not to design or implement them in a hurry, with the potential costly errors for the future.

Adaptation measures may be physical (construction of sea walls, home insulation), institutional (crisis management systems or institution of specific regulations) or strategic (relocation of activity or assets). Even if some of these measures are easier to implement than others an adaptation policy endeavours to combine these various aspects.

In the light of uncertainties that still exist over the exact extent of changes, priority should be given to those measures that contribute to improving understanding and that take account of the issue in the broadest possible way, those that are "without regret" or easily reversible, those that increase the "margins of safety" of infrastructures with long lives or which are only implemented in the long-term (town planning).

Development of the national adaptation plan began in 2010 with a very extensive consultation process involving the State, MPs, civil society, employers' and employees' syndicates, scientists. At the same time, consultation took place in the regions of metropolitan and Overseas France and public opinion was sought through an electronic consultation process.

Published on 20 July 2011, the French national adaptation plan is based on many recommendations produced during consultation exercises. It comprises 84 actions, consisting of 240 measures. These actions are positioned at intervals over the entire duration of the plan, from 2011 to 2015. The actions of the plan are implemented according to the 20 themes covered by the plan: cross-sector, health, water, biodiversity, natural hazards, agriculture, forestry, fishing and aquaculture, energy and industry, transport infrastructure, town planning and the built environment, tourism, information, training, research, finance and insurance, coasts, mountains, European and international actions and governance actions.

PNACC measures mainly cover development of scientific knowledge and dissemination of information about adaptation, reviews of standards

and technical frames of reference for adapting to climate change, prevention and management of crises linked to climate change (coastal risks, periods of scorching heat, etc.) and investments useful for adaptation (water saving, etc.).

In the second quarter of 2013, after two years of implementation, a progress report was prepared on the basis of contributions from leaders of each of the 20 thematic files.

Overall the general items available at the start of 2013 show that:

- Of the 84 actions specified in the PNACC, 81 have been undertaken (96%).
- Of the 240 measures specified in the PNACC, 194 have been undertaken (81 %).

The PNACC was implemented according to a specific system for each themed file corresponding to the degree of mobilisation of the stakeholders concerned and the existence of concerns about climate change prior to the preparation of the PNACC. The majority of these actions are broken down into measures which are implemented over several years. As a result, no action can be considered completed at the start of 2013.

Final assessment of the plan is expected at the end of 2015. It will include recommendations for the later planning of adaptation to climate change.

### **C.3** The actions of territorial collectivities

While the impacts of climate change are still not very acute in France, apart from periods of heatwave and drought, they will in all probability increase in the course of time (several decades). This trend will be even more marked if efforts to reduce GHG emissions are limited. The main impacts in France would be a far more marked summer warming than winter warming affecting the southern regions in particular, with greater long-term impacts on the territories (especially coastal and mountainous areas) and consequently putting people at greater risk of exposure to natural hazards and technological and health risks.

The impacts of climate change are mainly driven by the characteristics of regions, which have varying degrees of sensitivity. Adaptation to climate change must aim to reduce a region's vulnerability when there is a danger of it increasing if nothing is planned. This vulnerability is the product of specific contexts which are environmental but also and above all societal.

Actions which reduce actual impacts or improve the capacity to adapt are anticipating and limiting exposure to risks, enduring changes, reacting and dealing with the consequences or recovering from damage.

The issue of adaptation at regional level is included in the schémas régionaux du climat de l'air et de l'énergie (SRCAE) (Regional climate, air and energy schemes) and plans climat énergie territoriaux (PCET) (Regional climate and energy plans) discussed in chapter IV.B.1. The SCRAEs include an analysis of the region's vulnerability to the effects of global warming, identifying the regions and sectors of activity most at risk. The majority of guidance and targeting documents such as SCRAEs or PCETs look for synergies where ever possible between the climate, air and energy policies. These include mutual integration in order to encourage the implementation of measures and above all to ensure that the various policies do not contradict each other. Adaptation measures must not contradict the mitigation measures but must be consistent with them.

Local public action on adaptation must concern all adaptation stakeholders, must take into account the issue of long-term uncertainties and the precaution principle, the development of certain practices, fairness and finally the need to raise awareness and inform the public, if they wish to gain social acceptance for the projects.

In the context of its mission to support local authorities in preparation of their Plan Climate Energie Territorial (Regional Climate and Energy Plan), ADEME has developed a tool for diagnosing the impact of climate change on the region: "Impact'Climat". It has also published four studies

on assessing regional climate vulnerability<sup>12</sup>, development and implementation of a local adaptation strategy or action plan<sup>13</sup>, monitoring and evaluating climate change adaptation at local and regional levels<sup>14</sup> and construction of the vulnerability index<sup>15</sup> respectively. Altogether this tool and the publications provide complete support to the regions in their preparation and evaluation.

## C.4 Adaptation governance in terms of stakeholders and tools

### Regional governance

The governance of adaptation policies requires the establishment of characteristic “good governance” practices in relation to local populations. Before regional public consultation can take place, stakeholders must be made aware of climate change and knowledge on the subject disseminated. Local public action on adaptation must involve all stakeholders in adaptation, if they wish to obtain social acceptance for the projects.

### Inter-regional governance

For a subject area as recent and cross-cutting as adaptation it is important to create networks of actors which share good practice, as this may improve the measures recommended by the local authorities. Among other things these networks may also be tools for reinforcing international cooperation. In fact, administrative borders and the sphere of activity of international strategy documents may be limited in themselves. Vulnerabilities often go beyond traditional geographical administrative lines.

Infra-national adaptation measures must comply with the national framework, while bearing in mind that the subject is very large and affects many

areas, and is therefore likely to interfere with many development tools and other planning documents. The focus of adaptation measures between regional levels is fundamental in improving the effectiveness of adaptation measures and governance. This should ensure fair distribution of skills while avoiding fragmentation of responsibilities. It is more relational than hierarchical.

The consistency of adaptation policies with other policies for combating climate change As recommended in Law n° 2010-788 of 12 July 2010 on the national commitment for the environment, the majority of guidance and targeting documents, such as SCRAEs or PCETs, look for synergies wherever possible between climate, air and energy policies. These include mutual integration in order to encourage the implementation of measures and above all to ensure that the various policies do not contradict each other.

More broadly, all the traditional public policies must include the adaptation challenges. In addition, the subject is still too recent, and uncertainties about impacts of climate change are still too great for the implementation of strictly “adaptation” policies to be realistic.

Without however guaranteeing a respectable dimension to the adaptation challenge, the holistic or general (“mainstreaming”) approach enables them to be more consistent with traditional sectoral policies. Adaptation is in fact a cross-cutting subject, which affects many sectors; hence the need to consider it as an essential objective for the majority of public policies and a decisive criterion in public investments.

As adaptation is a cross-cutting issue, it mobilises a large number of subjects and sectors that will be affected by its recommendations and measures. Consequently, this creates additional coordination opportunities and also needs. In fact, some subjects have a greater predisposition than others to be related to other sectors, such as water or health for example.

<sup>12</sup> *Assessing regional climate vulnerability*, Réf.: 7410, August 2012, Ademe Edition.

<sup>13</sup> *Elaboration and implementation of a local adaptation strategy or action plan*, Réf.: 7413, August 2012 Ademe Edition.

<sup>14</sup> *Monitoring and evaluating climate change adaptation at local and regional levels*, Réf.: 7412, August 2012 Ademe Edition.

<sup>15</sup> *Indicateurs de vulnérabilité d'un territoire au changement climatique*, Réf.: 7406, February 2013 Ademe Edition.



# Financial resources and technology transfer

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## A. Financial resources

### A.1 Bilateral cooperation through the Aide publique au Développement (APD) (Public Development Aid)

#### L'Agence Française de Développement (AFD) (French Development Agency)

The public financial institution Agence Française de Développement (AFD) has spent the last 70 years working to combat poverty and promote economic development in the countries of the South and Overseas. With a presence in four continents AFD has a network of 70 agencies and branch offices. It supports and finances projects in 90 countries to improve living conditions, support economic growth, protect the planet and help fragile States or countries recovering from crisis: education, maternal and infant health, support for farmers and small businesses, infrastructure, water supply, forest preservation, combating climate change, etc.

With nearly €7.2 billion of funding authorisations in 2012 the AFD is one of the world's leading development institutions. The development projects it supports are sponsored by States, local authorities, public or private enterprises and NGOs. Its subsidiary Proparco, dedicated to the private sector, supports job creation, competitiveness of companies and the emergence of enterprise.

AFD is the main operator in the French bilateral cooperation system. A public and commercial establishment with specialist financial institution status, its work is in line with the policy defined by France's development cooperation framework document. AFD implements the development aid policy defined by the French Government and coordinated by the deputy Minister for Development. The agency contributes to 31% of France's public development aid (APD).

#### The AFD Group's methodology for monitoring its "climate" commitments

Since 2007 the AFD Group has progressively set up robust criteria and instruments for monitoring

its "climate" activity. These are based on a systematic review during the process of examining competitive tenders allocated by AFD and Proparco with respect to their impact on climate. AFD classifies as "climate" development projects having one or more of the following three types of shared benefits on the climate issue:

**Reduction of greenhouse gas (GHG) emissions or carbon sequestration.** A project helps to bring about mitigation when the emissions reductions it leads to are greater than the emissions it generates over its life. Mitigation projects are counted as a "climate" commitment when: (1) either the estimate of their carbon footprint demonstrates that they reduce or save (in the case of renewable energy products) GHG emissions; (2) or if the carbon footprint cannot be estimated at the time of the commitment authority, this funding is dedicated to actions helping to bring about mitigation (study, capacity building and lines of intermediate bank-based finance for renewable energy or energy saving projects).

**Adaptation to climate change** Projects are considered to be helping towards adaptation when they limit the vulnerability of property, people and ecosystems to the consequences of climate change. For a project to be counted as "adaptation" the analysis must demonstrate that it potentially contributes towards reducing a vulnerability to climate change identified in the project area. To do so, an analysis is carried out crossing (i) a study of vulnerabilities to climate change in the project's geographical area with (ii) an examination of the activities planned by the project in the light of a positive list of actions capable of helping to reduce vulnerability or helping to improve the resilience of the population, property or ecosystems to climate change.

**Support for the implementation of policies for combating climate change.** For financial support and sectoral assistance there are three accounting possibilities:

(1) Financial support specifically dedicated to climate (climate loans or support for "plans climat

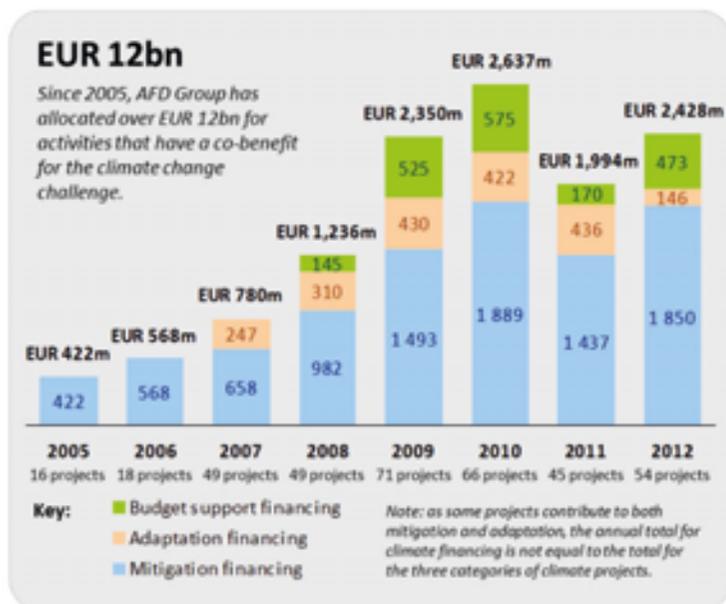


Figure 45: change in the AFD Group's "climate" activity since 2005.

nationaux" (national climate plans)) are counted as 100%;

(2) For the other financial aid for sectors or local authorities an ad-hoc method, compatible with those of other backers such as the World Bank or the Inter-American Development Bank, has been developed. It aims to account for the real import of the political and sectoral dialogue with the other party (monitoring of shared indicators) and the possible positive impact, in terms of combating climate change, of the integrated approach it promotes. This methodology enables the "climate" monitoring indicators to be accounted for on a pro-rata basis in relation to all the indicators of the monitoring matrix, and is backed by a positive list of actions that are considered by their nature to have a shared-climate benefit.

(3) In the absence of indicators, standardised and shared with the other party, for monitoring its public policy, it is possible to count the finance provided as 40% provided there is "cross-sector" climate activity enabling the dynamic behind the action of the authority or State to be understood.

Detailed definitions and methodologies of impact accounting and measuring are published in the "climat" section of the AFD website (<http://climat.afd.fr>).

### Change in the AFD Group's "climate" activity since 2005.

In all, over the 2005-2012 period over €12 billion were allocated by the AFD Group for activities having a shared positive benefit for the issue of climate change. The graph below shows the change in amounts committed for each of the three "climate" project families since 2005.

Quantitatively, AFD is one the largest funders of climate action in the International Financial Institution community at levels generally higher than those of multilateral development banks (apart from the World Bank) and comparable to those of the KfW and the JICA.

### The AFD Group's «climat – développement» strategy

In November 2011 and April 2012 respectively the Boards of Directors of AFD and Proparco adopted a strategic intervention framework dedicated to the climate issue. It specifies a dual objective for AFD:

- To be a key actor in France's bilateral "climate" funding;
- To be a renowned international financial institution capable of mobilising international and European mandates and resources on "climate".

Sectorial breakdown of AFD Group's mitigation projects 2005-2012

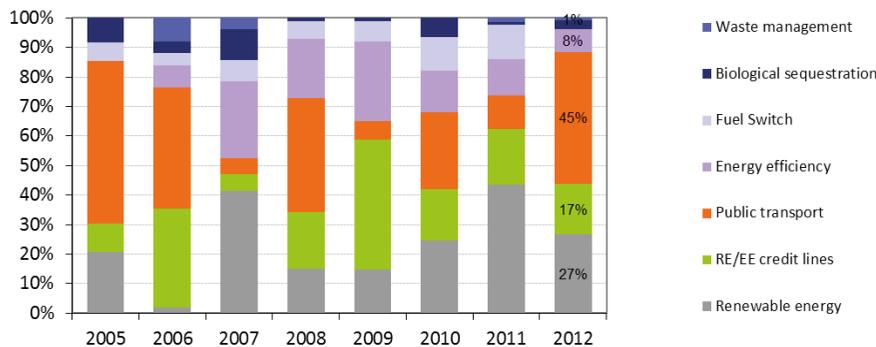


Figure 46: Sectoral distribution of amounts committed to adaptation to climate change

As part of this strategic plan the AFD Group has set the following objectives;

- Maintain AFD's annual commitment authorities<sup>1</sup> with shared "climate" benefits in foreign States at a level of 50% and Proparco's at 30 %<sup>2</sup>;
- Systematically assess the carbon footprint of direct funding projects;
- Apply a selectivity grid to its operations with regard to their "climate" impact.

Variability caused by approval schedule trade-offs and constraints specific to certain intervention zones led to an examination of the quantitative climate indicator on a basis smoothed out over 3 years: average over 3 years (n-2, n-1 and n) in the ratio (annual climate grants) / (annual grants). For 2012 the average of the ratio over 3 years gives 47% for AFD and 26% for Proparco.

### Sectorial distribution of finance having a shared benefit in terms of mitigation

The sectorial distribution of "mitigation" commitments varies every year but on average over the period 2005-2011 the energy sector (financing renewable energies and energy efficiency directly

or through lines of credit) represents almost 75% of committed amounts.

Every year the AFD Group examines between 15 and 25 competitive tenders with a shared benefit in terms of adaptation to climate change. These projects fall into three categories:

- Projects aimed at preserving water as a resource, and thus ensuring long-term preservation of this resource;
- Projects enabling better management and preservation of natural resources (forests, agricultural land, etc.);
- Projects aimed at improving understanding about the impacts of climate change.

For several years the vast majority of AFD's funding devoted to adaptation has been concentrated in the water and sewage sector with the aim of preserving the resource (75% of adaptation activity in 2012 compared with 87% in 2011). In 2012 there was a slight rebalancing in favour of rural development projects and protection of natural resources (17% of adaptation activity in 2012, compared with 10% in 2011). The geographical distribution shows predominance in Africa and the Mediterranean, some of the areas most vulnerable to the effects of climate change, consistent with the most urgent adaptation needs.

<sup>1</sup> For AFD Foreign State allocations are considered annual allocations (approval by the annual turnover) of projects in foreign States, including delegated funds but excluding implementation of resources on behalf of the State, Global Aid Budgets, Debt Reduction - Development Contracts (C2D), AFD sub-participation and participation in international funds or mechanisms (such as ICCF or CTF).

<sup>2</sup> Annual allocations by Proparco include AFD sub-participations and delegated funds.

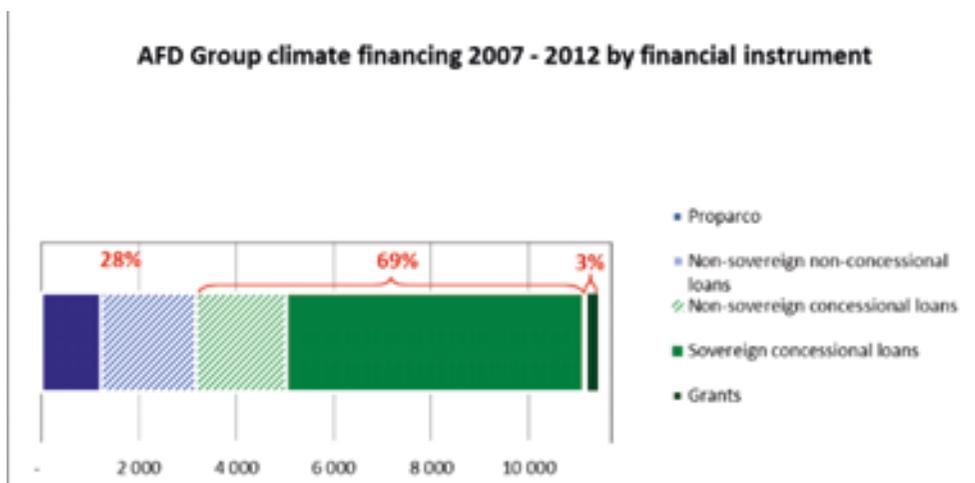


Figure 47: change in the AFD Group's "climate" activity since 2005.

All the Group's financial instruments are mobilised for funding the fight against climate change. With 66% of "climate" allocations in 2012, concessional loans still represent the main type of instrument used.

In accordance with the "climate - development" strategy, a systematic carbon balance procedure was put in place for financial operations. It concerns

AFD and Proparco projects in foreign countries. Of the competitive tenders allocated, only direct funding (apart from financial support, financial intermediation and capacity building) having a significant and quantifiable impact in terms of GHG emissions (upwards or downwards) is the subject of an ex-ante analysis of its carbon footprint.

<sup>3</sup> The sovereign concessional loan includes subsidised and non-subsidised loans

## A.2 Le Fonds français pour l'environnement mondial (FFEM) (French Fund for the World Environment)

Manifesting its involvement in the domain of climate change in developing countries and countries in transition, France set up a bilateral financial instrument specifically dedicated to the global environment. In addition to its endowment of the GEF (Global Environment Facility), France created the Fonds français pour l'environnement mondial (FFEM) (French Fund for the World Environment) in 1994. This fund commits resources in the order of €20M per year.

**The FFEM has become a major instrument of cooperation and development in the global environment arena.** On 31 December 2012 the FFEM's portfolio comprised 237 committed subsidised projects for a total amount of €276 million, including 69 projects for €93 million related to combating climate change, distributed by amount as follows:

- Sub-Saharan Africa, Maghreb and Mediterranean 66.5%
- Asia - Pacific 19.8%
- Latin America 8.3%
- Eastern countries 5.4%

The FFEM intervenes along the same lines as the GEF. Its priorities are characterised by:

- The priority given to the continent of Africa: in the light of the special needs of this region and geographical priorities of all of France's foreign aid;
- The importance given to the economic and social development objective: the FFEM's purpose is to finance additional costs linked to protection of the world environment in development projects. It therefore directly fits in to a development objective that it is required to meet and comply with;
- The emphasis placed on the reproducibility of projects: in the light of a project's necessarily limited impact on the environment, the FFEM's leaders and its scientific committee give priority to projects that have a high potential for reproduction in other sites or other countries. In

this, the FFEM seeks to play an active role in promotion and sharing experience;

- The emphasis placed on innovation in the projects: the FFEM intervenes to encourage innovation and experimentation for protection of the global environment.

Innovation may be scientific, technical, technological, financial or institutional. It very often involves direct or indirect costs that justify a particular financial investment. The aim is therefore to encourage a real dynamic of learning and change.

These priorities apply directly to the **field of climate change, to which the FFEM's scientific committee attaches three criteria:**

- A global dynamic of learning and developmental - environmental synergy;
- Institutional, financial and social testing of conditions for appropriating generally mature techniques;
- Pursuit of reproducibility in these techniques and appropriation methods.

By sector of application, it is the energy efficiency (EE) and renewable energy sectors, including biomass, housing and transport issues, that are the most developed, followed by forestry and agroecology with respect to carbon sequestration. This financing adds to the aid and cooperation projects and measures carried out by the French aid partners, by a section on the prevention of the greenhouse effect.

Particular effort was made to meet France's forestry commitment in respect of the so-called "fast-start" finance resulting from the Copenhagen Accord. The FFEM should in fact increase its commitments to contribute to Reducing Emissions from Deforestation and forest Degradation (REDD+) activities in developing countries. The objective was achieved with €30.8 million counted over the period 2011-2012 for protection of forests.

The 2013-2014 strategic programme framework puts the emphasis on five concentration areas, three of which present opportunities to support

actions to combat climate change, namely:

- Sustainable urban living;
- Sustainable agriculture;
- And sustainable energy in Africa.

### A.3 Multilateral cooperation

**Multilateral development aid has got the measure of the main aspect**, to enable effective mobilisation of the international community and implement aid coordinated with a significant leverage effect. France is a major player in the multilateral development aid system, with the main objective of providing the essential financial, institutional and operational resources for effective aid.

France allocates financial resources for multilateral aid through multilateral development banks, the European Union and the United Nations. France applies the same effectiveness requirements to the international development institutions (see table 27) as it does to its bilateral aid. It therefore supports the efforts at reform carried out within these institutions in order to improve the effectiveness of aid, the implementation of essential institutional reforms, and the definition of operational strategies by the these institutions to ensure compliance with the objectives of sustainable development, concentration of effort on the least developed countries, fighting poverty and achieving environmental compliance. The organisation of the Second High-Level Forum on Aid Effectiveness, held in Paris in March 2005, was an important step illustrating this commitment. It was followed in September 2008 by the Accra High-level Forum and then the Fourth High-Level Forum on Aid Effectiveness in Busan at the end of 2011 with the Busan Partnership for Effective Development Cooperation.

France committed €3.2 billion of financial resources in multilateral development aid in 2011. This aid was allocated through multilateral development banks, the European Union and the United Nations. France is therefore the world's 4th largest backer by volume and is ranked second of G7 countries in terms of share of Gross National Income.

Table 27: France's financial contributions to multilateral institutions and programmes (in €million)

	2012	2011	2010	2009
1. World Bank Group	418.55	445.59	447.44	442.60
International Development Association	400.00	423.60	423.00	423.00
Afghanistan trust funds, TP, LAB/LAT, Star Initiative	4.08	9.17	14.08	7.17
IMF - Subsidised PRGF / ECF	14.47	12.82	10.36	12.43
2. Regional Banking Group	155.71	154.75	149.25	147.64
African Development Fund	126.97	126.97	121.18	120.73
Asian Development Fund	24.28	24.32	24.33	24.18
FIAS	1.00	0.00	2.00	1.00
IDB - MIF2	1.74	1.74	1.74	1.73
IBD - FSO	1.72	1.72	0.00	0.00
3. Sectoral funds	146.27	128.78	85.82	88.58
IFAD	11.70	11.70	11.60	8.00
METAC	0.36	0.36	0.33	0.33
AFRITAC	1.04	1.04	0.72	0.00
Lebanon and RCI* Financial Institutes	0.62	0.15	0.18	0.00
IFFIm	26.82	24.74	22.81	21.04
G20 initiative	0.19	0.00	0.00	0.00
Nuclear: NDEP	0.00	0.00	3.50	13.40
Nuclear: NSA	0.00	0.00	3.85	2.50
Nuclear: FSC	23.50	15.00	0.00	0.00
GEF	65.24	63.99	34.13	34.61
Nagoya Biodiversity Funds	0.00	0.00	0.00	0.00
Green Funds	0.00	0.00	0.00	0.00
FEMIP (Facility for Euro-Mediterranean Investment and Partnership)	1.50	0.00	0.00	0.00
Oriental partnership trust fund (EIB)	0.80	0.00	0.00	0.00
BERD Cooperation Fund, Transition Fund, G8 Trust Fund	5.00	3.00	0.00	0.00
EITI / OECD unit / Global Fiscal Transparency Fund	0.00	0.10	0.00	0.00
Fund for fighting non-cooperative jurisdictions	0.00	0.00	0.00	0.00
Aid for Trade Fund (Doha, LDC Fund)	2.00	2.00	2.00	2.00
Montreal Protocol	7.50	6.70	6.70	6.70

\*Attributed as management on multilateral aid but credits in line with LFI on bilateral aid.

France promotes climate questions in the multilateral forums, and in particular their inclusion in the policies and operations of multilateral development banks. France promotes this message on the occasion of reconstitution of the various concessional funds such as the African Development Fund or the International Development Association.

Table 28: bilateral and regional contributions relating to the Convention in €millions  
A: in 2012

Institution	Recipient country/region	Program	Mitigation						Adaptation		
			Energy	Transport	Forestry	Agriculture	Waste management	Industry	Capacity-building	Coastal zone management	Other vulnerability assessment
FFEM	AFRIQUE	Accès aux données satellitaires			1,75						
FFEM	AFRIQUE	Appui aux banques forêts tropicales			2,7						
FFEM	AFRIQUE	Fonds Livelihoods			1,2						
FFEM	AFRIQUE	Foyers de cuisson			2						
FFEM	AFRIQUE	Projet PHYTOTRADE			0,45						
FFEM	AFRIQUE	Voute nubienne	0,5								0,5
FFEM	AFRIQUE	SEP2D			1,5						
FFEM	AFRIQUE	Projet FLEGT & REDD+			1,4917						
FFEM	AFRIQUE	FONABES			1,5						
FFEM	RCA	Pilote REDD+			1,5						
FFEM	AMERIQUE LATINE	Gran Chaco			1,5						
FFEM	BRESIL	Projet PETRA			2						
FFEM	PACIFIQUE	RESCCUE							0,4	1,6	
FASEP	AFRIQUE DU NORD		2,2				0,38				
FASEP	BALKANS			0,72			0,37				
FASEP	CEI		0,91			0,29					
FASEP	PROCHE-ORIENT ET TURQUIE		0,16					5	0,55		
FASEP	ASIE DU SUD-EST		0,37	0,92			0,35				
FASEP	AFRIQUE SUBSAHARIENNE		0,37				0,31	0,18			
FASEP	AMERIQUE LATINE		1,04							0,46	
RPE	AFRIQUE DU NORD			123,8							
RPE	AMERIQUE LATINE			90							
RPE	AFRIQUE SUBSAHARIENNE									7	
RPE	PROCHE-ORIENT						65,8				
AFD	AFRIQUE DU NORD		105,0	633,5			10,0				57,8
AFD	AFRIQUE SUBSAHARIENNE		315,1		22,7				1,0		3,9
AFD	AMERIQUE LATINE		356,1	198,0							
AFD	ASIE		350,0	190,7	30,6						24,0

B: in 2011

Institution	Recipient country/region	Program	Mitigation						Adaptation		
			Energy	Transport	Forestry	Agriculture	Waste management	Industry	Capacity-building	Coastal zone management	Other vulnerability assessment
FFEM	AFRIQUE	Structuration filière paysanne du jatropha/biocarburant	1,1								
FFEM	AFRIQUE	DYNAFOR			2,54						
FFEM	AFRIQUE	Africompost					1,0				
FFEM	AFRIQUE	Données satellitaires (phase 1)			1,6						
FFEM	AFRIQUE	Plan climat	0,75						0,75		
FFEM	KENYA	Conservation nord Kenya			1,5						
FFEM	MOZAMBIQUE	REDD+ Réserve de Gilé			2,0						
FFEM	MEDITERRANEE	Ecosystèmes boisés			2,65						
FFEM	COLOMBIE	REDD+ Rio Grande Magdalena			1,46						
FFEM	GUATELAMA	Cogestion système aires protégées			1,496						
FASEP	AFRIQUE DU NORD		1,73	1,09			0,56		0,07		
FASEP	BALKANS			2,72			0,68				
FASEP	CEI			1,18			0,46				0,70
FASEP	PROCHE-ORIENT ET TURQUIE		0,43								
FASEP	ASIE DU SUD-EST			1,05			0,46				
FASEP	AFRIQUE SUBSAHARIENNE						0,43				
FASEP	AMERIQUE LATINE			2,83		0,58					
RPE	AFRIQUE DU NORD										
RPE	CEI										18
RPE	AMERIQUE LATINE										
RPE	ASIE DU SUD-EST			22,05							
RPE	AFRIQUE SUBSAHARIENNE										
RPE	PROCHE-ORIENT										
AFD	AFRIQUE DU NORD		452	94	-	-	-	-	-	-	106
AFD	AFRIQUE SUBSAHARIENNE		305	-	0	-	-	-	-	-	277
AFD	AMERIQUE LATINE		329	0	-	-	-	-	1	-	-
AFD	ASIE		715	0	0	-	-	-	-	-	13

C: in 2010

Institution	Recipient country/region	Program	Mitigation						Adaptation		
			Energy	Transport	Forestry	Agriculture	Waste management	Industry	Capacity-building	Coastal zone management	Other vulnerability assessment
FFEM	AFRIQUE	ACFAO - forêts			1,64						
FFEM	AFRIQUE	PRGDT - Changt climatique au Sahel & Afrique Ouest							1,0		1,0
FFEM	AFRIQUE	Filière du jatropha	1,4								
FFEM	AFRIQUE	ECOFORAF - Eco-certification			1,5						
FFEM	MOZAMBIQUE	Parc National des Quirimbas								0,5	0,5
FFEM	MEDITERRANEE	PSM - Plan solaire méditerranéen	0,75								
FFEM	TUNISIE	Parc National de Chaâmbi			0,9						
FFEM	TURQUIE	Efficacité énergétique dans les PME	1,5								
FFEM	AMERIQUE LATINE	REDD+ - Plateau des Guyanes			1,0						
FFEM	BRESIL	Forêt AMAPA			1,6						
FFEM	ASIE	Planification secteur électrique	1,00								
FFEM	ASIE	Technologies sobres en carbone	1,35								
FFEM	CHINE	"Carbon rural" Yunnan & Sichuan			0,5			0,5			
FASEP	AFRIQUE DU NORD							0,18	0,61	0,52	0,34
FASEP	BALKANS		0,49	0,97				0,43			
FASEP	CEI		0,41	1,16							
FASEP	PROCHE-ORIENT ET TURQUIE		0,46	4,45				0,12			
FASEP	CHINE								0,21	0,40	0,20
FASEP	ASIE DU SUD-EST							1,77			
FASEP	AFRIQUE SUBSAHARIENNE										
FASEP	AMERIQUE LATINE			2,96				1,80		0,45	0,59
RPE	AFRIQUE DU NORD			31,32							
RPE	AMERIQUE LATINE							78,5			
RPE	ASIE DU SUD-EST							63,74			
RPE	PROCHE-ORIENT										
AFD	AFRIQUE DU NORD		268	124	-	-	-	-	-	-	87
AFD	AFRIQUE SUBSAHARIENNE		338	75	30	-	-	-	-	2	139
AFD	AMERIQUE LATINE		631	281	-	-	-	-	-	9	1
AFD	ASIE		389	-	-	-	-	-	-	-	184

D: in 2009

Institution	Recipient country/region	Program	Mitigation						Adaptation		
			Energy	Transport	Forestry	Agriculture	Waste management	Industry	Capacity-building	Coastal zone management	Other vulnerability assessment
FFEM	MAURICE	"MID" Pg Maurice ile durable"	1,00								
FFEM	AFRIQUE	Centrales de cogénération (gestion déchets bois scierie)	1,00								
FFEM	BENIN	Gestion durable forêts communales			1,00						
FFEM	MALDIVES	Cartographie climatique									1,50
FFEM	EGYPTE	Transports urbains du Caire		1,00							
FFEM	MAROC	Efficacité énergétique dans le bâti	0,90								
FASEP	AFRIQUE DU NORD		0,37							0,40	
FASEP	BALKANS							1,13			
FASEP	CEI			0,59				0,34			
FASEP	PROCHE-ORIENT ET TURQUIE		0,36	0,74				0,27	5,00		
FASEP	CHINE		0,37					0,45			
FASEP	ASIE DU SUD-EST		1,54	0,69		0,61		1,45	0,57		0,76
FASEP	AFRIQUE SUBSAHARIENNE		0,99								
FASEP	AMERIQUE LATINE		0,25					1,68			0,65
RPE	AFRIQUE DU NORD			169,00					40,00		
RPE	CEI			8,50				15,00			
RPE	PROCHE-ORIENT			200,00							
RPE	ASIE DU SUD-EST									13,90	55,80
RPE	BALKANS										11,19
AFD	AFRIQUE DU NORD		452	94	-	-	-	-	-	-	106
AFD	AFRIQUE SUBSAHARIENNE		305	-	0	-	-	-	-	-	277
AFD	AMERIQUE LATINE		329	0	-	-	-	-	-	1	-
AFD	ASIE		715	0	0	-	-	-	-	-	13

Source: MINEFI, AFD

### The Global Environment Facility (GEF)

France was one of the countries behind the creation of the Global Environment Facility, one of the main multilateral instruments for protection of the global environment. There are six main areas: protecting biodiversity, reducing greenhouse gas emissions, combating soil degradation, combating the depletion of the ozone layer, combating persistent organic pollutants and protecting international waters. The GEF is the financial system for four conventions:

- Convention on Biological Diversity (CBD);
- United Nations Framework Convention on Climate Change (UNFCCC);
- Stockholm Convention on Persistent Organic Pollutants (POP);
- And the United Nations Convention to Combat Desertification (UNCCD).

On 5 June 2009 the Comité interministériel de la coopération internationale et du développement (CICID) (French Inter-ministerial Committee on International Cooperation and Development) recalled the importance of this instrument, indicating that *"France would actively take part in the international debate on financing the fight against global warming, by consolidating the central role of the Global Environment Fund"*. This support for the GEF is largely shared at international level as demonstrated by the success of the fifth reconstitution of the GEF in May 2010 for the period 2011-2014, which reached \$4.5 billion. France is the fifth largest contributor to the GEF and is committed to providing funds of €215 million over the period 2011-2014 (including contribution to the Least Developed Countries Fund - LDCF - managed by the GEF), which represents a 57% increase in the French contribution compared with the previous reconstitution (2007-2010) and 8.4% of the fund budget. France is actively taking part in the work of the 6th reconstitution of the GEF currently in progress, which will finish at the start of 2014 for the period 2015-2018.

Table 29: French contributions to the GEF in €million

GEF 1	GEF 2	GEF 3 (2003- 2006)	GEF 4 (2007- 2010)	GEF 5 (2011- 2014)
123	131.5	164	154	215

Source: MINEFI/DGT

### Green Climate Fund

The creation of the Green Climate Fund was decided at the Copenhagen Climate Summit in 2009. Alongside the Global Environment Facility it constitutes the financial mechanism of the Climate Convention. It should eventually become a key player in the financial architecture of the fight against climate change, while contributing to its rationalisation.

The Green Fund Board, of which France is a member, has met four times since its members were appointed. These meetings enabled the Fund to be put into operation with decisions setting up the organisational foundations and certain operating arrangements, which should ultimately finance the fund and make it operational.

France has already contributed €250,000 to the operating costs of the Green Fund for 2013. In addition, it is specified that part of the 10% tax on financial transactions to be dedicated to development, health and climate will be allocated to the Green Fund. France is very involved in the work of the Board and will host the next meeting in Paris in the autumn of 2013.

### Other climate-related funds

Alongside its G8 partners and volunteer countries France is involved in an initiative intended to deploy and distribute clean technologies in order to achieve the target of 50% reduction of GHG emissions in 2050. It announced a contribution of \$500 million to the Clean Technology Fund (CTF) launched in 2008 and managed by the World Bank, \$200 million of which is for project labelling.

Some additional multilateral funding passes through the European Development Fund (EDF). The Commission stated that it had committed

€56.5 million (weighted by Rio markers). As France accounted for 19.5% of the 10th EDF, a contribution of €11 million can be counted in this respect.

France is also the 4th largest backer of the Multilateral Fund for Implementation of the Montreal Protocol (MFIMP), which supports developing countries in their efforts to comply with the control measures of the Protocol, which aims to reduce and then eliminate substances that deplete the ozone layer. The last reconstitution was completed at the end of 2011 and covers the period 2012-2014. The amount of the reconstitution was \$450 million, i.e. an amount equivalent to the previous reconstitution (2009-2011). Nevertheless, between these two reconstitutions France's share increased from 7.6% to 7.81%. France's total contribution was therefore €22.5 million (i.e. €7.5 million per year).

#### **A4 Support instruments of the Direction Générale de la Mondialisation, du Développement et des Partenariats, du Ministère des affaires étrangères (DGMDP/MAE) (General Directorate of Globalisation, Development and Partnerships, of the Ministry of Foreign Affairs)**

In the area of climate change the DGM defines French development aid strategy in liaison with other ministries and public institutions in accordance with CICID trade-offs.

**Adaptation to the impacts of climate change** is clearly a very important issue in Africa, particularly in the Least Developed Countries (LDC), and also in island states. By providing international technical experts (ITE) to multilateral bodies, the DGM helps these countries to include adaptation to climate change in their sectoral policies and through practical adaptation projects on the ground. France supports regional and continental centres such as ACMAD (African Centre of Meteorological Applications for Development) or the AGRHYMET Regional Centre of CILSS (Permanent Interstate Committee for Control of Drought in the Sahel).

An example is the DGM's support, particularly through provision of ITEs, for climate change adaptation projects co-financed by the FFEM, in Africa:

- VigiRisC project of setting up alert systems in view of the climate risk in five activity sectors and five regions of Africa, €4 million for 2009-2013, operator: ACMAD (Niger);
- FFEM CC project (project on adaptation to climate change in water and agriculture sectors in West Africa), operator: AGRHYMET (Niger), €3 million over 3 years (2011-2014);
- For example, the website [www.agrhymet.ne/portailCC](http://www.agrhymet.ne/portailCC) is one of the FFEM CC extranets;
- Regional Programme on Sustainable Land Management and Adaptation to Climate Change, €13.25 million in total over 5 years (2011-2015), operator: CILSS (Burkina Faso).

**Concerning the reduction of GHG emissions**, the DGM is making a special effort to implement national and regional energy policies in liaison with ADEME (Agence pour le développement et la maîtrise de l'énergie) (French Environment and Energy Management Agency). In all cases, it systematically tries to mobilise the Kyoto Protocol's Clean Development Mechanism (CDM) and look for synergy with the Global Environment Facility as these instruments constitute an additional source of finance for developing countries.

**Building capacities** related to understanding climate change is essential for African countries, especially the French-speaking countries. The DGM participated in the European Capacity Building Initiative and, together with ADEME, UNEP (the United Nations Environment Programme) and the IEPF (Institut de l'énergie et de l'environnement de la francophonie) (Energy and Environment Institute of French-speaking countries) financed a project known as NECTAR (€2 million), for building the capacities of African LDCs in their negotiations within the UNFCCC (Sectoral studies and restitution seminars with experts and African focal points on climate). Through the FFEM CC project in particular, France also supports the training of West African high-flyers by creating and running a Masters in Climate Change and Sustainable Development at

the AGRHYMET Regional Centre (co-financing of the FFEM CC project).

Finally, support (presence of an international technical expert) for a South African think tank on research and for the GEF on funding questions.

### **A.5 Scientific and technological cooperation and university studies**

French public research establishments (IRD, CIRAD) and ADEME devote some €5 million per year to this work. The DGTPE (French General Directorate of the Treasury and Economic Policy) does the same for FASEP (Private Sector Aid and Studies Fund) studies.

Like its substantial participation in the very large multidisciplinary AMMA (African Monsoon Multidisciplinary Analysis) programme in West Africa co-financed by the EU Framework Fund for Research and Development, France supports various regional authorities in Africa on this subject with the aim of meeting the need to collect and the available data on climate change, at regional level, and measure the impacts of this data (see also chapter VIII).

Projects such as the FSP RIPIECSA (Recherche interdisciplinaire et participative sur les interactions entre les écosystèmes, le climat et les sociétés d'Afrique de l'Ouest) (Interdisciplinary and Participative Research on Interactions between Ecosystems, Climate and Societies in West Africa) were set up by the French Ministry of Foreign Affairs between 2005 and 2011 to promote scientific research and build the capacities of African researchers.

ADEME has also made a contribution. Internationally, and in its areas of expertise (energy management, renewable energy, waste treatment and management, air quality, etc.), it supports the implementation of multilateral conventions on climate change and sustainable development and supports cooperation work carried out by its supervisory administrations or by French cooperation players. In this respect, its work helps to reduce GHG emissions and promote adaptation

to climate change, by developing skills, tools and methodologies or carrying out pilot operations.

It carries out projects in developing countries in particular:

- Scientifically: ADEME has signed numerous cooperation agreements with Asian universities (Tsinghua and the Asia Institute of Technology) in order to finance research, training and technology transfer programmes relating to energy efficiency, the environment, energy and waste management;
- Institutionally: bilateral partnerships have been made in the Mediterranean and Sub-Saharan Africa with local institutions, mainly for administrative and technical collaboration in the implementation of energy efficiency and sustainable city policies, combating climate change and promoting French businesses. ADEME relies on the MEDENER network, which brings together Mediterranean energy control agencies. ADEME held the presidency of this network in 2012 and 2013. The agency is currently coordinating an institutional energy twinning programme with its Moroccan counterpart, ADEREE. In Africa, cooperation has begun with CEREE (Regional Centre for Energy Efficiency and Renewable Energy) of ECOWAS. Similar partnerships have been set up in Asia (India, China, etc.);
- In support of the structuring of a French eco-technology offer to the international community, ADEME also supports international testing of French methodologies such as GHG Assessments (projects in progress in Morocco and Tunisia) or Regional Climate and Energy Plans (two tests are under way in the states of Rio Grande do Sul and Minas Gerais in Brazil) in partnership with French eco-businesses.

Other public establishments help to disseminate environmental technologies to developing countries, particularly as part of calls for projects by the French National Research Agency (ANR). In particular the "Changements Environnementaux Planétaires" (Global Environmental Changes) programme includes a theme on adaptation to climate change.

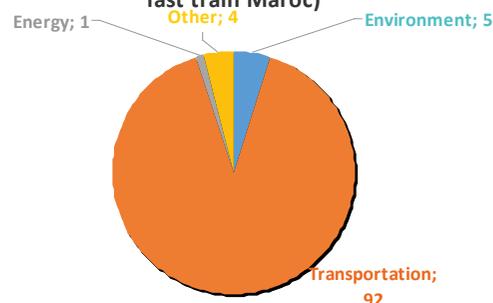
ADEME also funds research and study programmes. For example, the agency works with CERNA, an industrial and finance economics laboratory, which concentrates its research in three main areas: the economy (including digital economy), quantitative finance and analysis of globalisation. A study on the impact of the European carbon market on green innovation was published in 2012, for example. The fonds d'étude et d'aide au secteur privé (FASEP)<sup>4</sup>, (Private Sector Aid and Studies Fund) managed by the Direction Générale du Trésor (DGT) (General Directorate of the Treasury) of the Ministry of the Economy and Finance is a French development aid system which takes the form of a State to State gift in-kind. It intervenes at the request of local beneficiaries and provides finance for research or technical assistance services in emerging and developing countries (136 countries in which the tool can theoretically intervene in 2013). By promoting transfers of know-how and technology to beneficiary countries it contributes to the development of technological cooperation. Between 2005 and 2012, 227 projects were carried out or started with a climate change-related objective, particularly in the energy, transport or environment fields, for a total of €60.2 million (apart from the Rabat-Tangiers high-speed train line). On average over the period and excluding the exceptionally high gift of €75 million for the Rabat-Tangiers high-speed train line in 2008, this represents an average annual commitment of €7.5 million (cf. table 30).

Table 30: unweighted FASEP commitment linked to climate change (unit: €million)

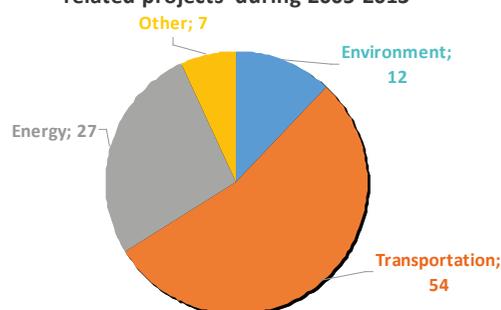
Year	Commitment
2005	4.1
2006	6.2
2007	4.7
2008	10.7
2009	5.5
2010	12.3
2011	9.8
2012	6.9

<sup>4</sup> The term FASEP is used to designate FASEP-Études; it is behind FASEP's "research" section.

Sectoral distribution of FASEP AMOUNT (%) for climate related projects during 2005-2013 (without fast train Maroc)



Sectoral distribution of RPE AMOUNT (%) for climate related projects during 2005-2013



In order to encourage technical cooperation with emerging countries in the environment sector it was decided in May 2009 to set up the FASEP "Innovation Verte" (green innovation) to support pilot projects implementing innovative environmental technologies. Fifteen projects of this type have been implemented since this date.

**Also managed by the General Directorate of the Treasury**, the Réserve Pays Emergents (RPE) (Emerging Markets Reserve) is a State to State highly concessional loan system (gift component of at least 35 % compared with a reference market rate; the rules are set by the OECD's arrangement on officially supported export credits). This public development loan finances infrastructure projects in emerging countries, mainly in the transport, water, environment and urban development fields. Between 2005 and 2012 some thirty projects which included an objective of combating climate change

were approved. The average annual amount of RPE loans allocated to these projects is about €255 million per year.

It is however difficult to distinguish what part of the costs of RPE projects is linked to the infrastructures themselves and what part is linked to technological cooperation.

France also contributes to multilateral development funds. In particular, MINEFI contributes to trust funds in five multilateral financial institutions: the World Bank Group (IBRD and IFC), the European Bank of Reconstruction and Development (EBRD), the Inter-American Development Bank (IDB), the African Development Bank (AfDB) and the Asian Development Bank (ADB). These funds devote a considerable amount of their resources to combating the effects of climate change. In this respect, France promotes climate issues, and in particular their inclusion in the policies and operations of multilateral development banks. COFACE manages public export guarantees on behalf of the State and proposes insurance services for export, prospection and in particular, investment. These offers are intended to support

the international activities of French companies, by insuring risks that cannot be insured by the private sector.

The total amount of guarantee applications accepted since 2007 in climate change related fields is €7.85 billion, for 183 guaranteed files. The following statistics show the credit-insurance guarantee applications accepted between 2007 and June 2013<sup>5</sup>.

Guarantees for climate-related projects have represented substantial amounts every year since 2007, sometimes reaching several hundred million euros, or even several billion euros.

In 2009 and 2010 the amounts reached a peak, with €2.7 billion in guarantees linked to climate-related projects in 2009 and €2.5 billion in 2010.

These substantial amounts are due to two particular projects concerning the transport sector: The delivery of 54 electric trains for the Winter Olympics in Sochi, Russia, in 2014, for €754 M in 2009, and the supply of 200 electric freight locomotives to Kazakhstan for €998 M in 2010.

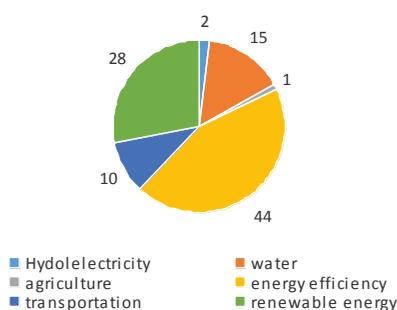
<sup>5</sup> It should be noted that accepted guarantee applications may include contracts not actually entered into, or in which no guarantee ultimately materialised.

The amounts allocated to this type of project then fell in 2011 (€748 million) and 2012 (€374 million).

The first six months of 2013 indicated a significant recovery, with €510 million guaranteed at the end of the first part of the year.

Concerning the number of files guaranteed, there was a marked decrease between 2007 with 48 files and 2012 when only 16 files were guaranteed.

### Sectoral distribution of guaranteed amounts for climate-related projects (2007-2013)



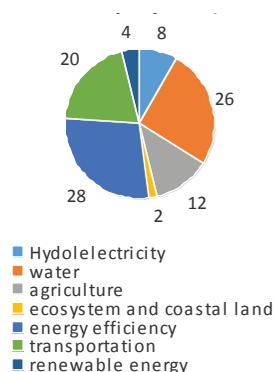
The transport sector accounts for a predominant share with €3.3 billion in guarantees, i.e. nearly 44% of amounts granted to these climate-related projects.

Guarantees for energy efficiency related activities also account for a significant share with €2.2 billion and 28% of guaranteed amounts. These were mainly guarantees related to the design, production or supply of electrical materials.

Water-related activities (water distribution, construction of water treatment stations or research on water treatment) are in third positions with €1.2 billion in guarantees, i.e. a 15% share.

The renewable energy sector accounts for 10% with a total of €816 million in guarantees. These are mainly photovoltaic solar installation projects. Hydro-electricity and agriculture complete this classification with shares of 2% and 1% respectively.

### Sectoral distribution of guaranteed amounts for climate-related projects (2007-2013)



Sectoral distribution by numbers of files emphasises the predominance of the energy efficiency and water domains which account for 28% and 26% of the total files respectively.

The transport sector is in 3rd position with 20% of the total of files.

Agriculture, with just 1% of guaranteed amounts accounts for 12% of guaranteed climate-related files and is in 4th place.

Hydro-electricity (8%), renewable energy (4%) and files relating to ecosystems and coastal areas (2%) complete the classification.

UbiFrance, the French agency for international business development, is an industrial and commercial public establishment under the supervision of the Ministry of the Economy and Finance (General Directorate of the Treasury) and the Minister of Foreign Trade. UbiFrance's mission is to support French companies with their export procedures by providing a full range of service provisions: consultancy (knowing and targeting an export market, rules, or international projects and calls for tender), contacts (identifying, meeting and winning its future customers), communication (achieving visibility with professionals through full services and customised press relations, trade promotion and professional publicity) relying, in particular, on its network of UbiFrance Offices.

The eco-business sector is particularly targeted by UbiFrance and was the subject of a framework partnership agreement between UbiFrance and ADEME signed in May 2009. This agreement is intended to support the international development of French eco-businesses and to promote links between innovation and export in this sector.

This agreement should lead to several shared actions aimed at strengthening the international presence and exports of eco-businesses: for example, UbiFrance launched the *Green Pass*, a customised international support system for eco-businesses registering during its life. This is an on-quotation service for SMEs which is presented in the form of a lump sum valid for 6 to 18 months, benefiting from a maximum subsidy rate. This sequential offer is applicable to many developing countries (Mediterranean area, China, India, Brazil, Russia, Indonesia, South-East Asia, Mexico, South Africa, etc.)

On 3 December 2012 the Minister of Foreign Trade presented the country/produce analysis of French foreign trade carried out by the General Directorate of the Treasury of the Ministry for the Economy and Finance.

This analysis reveals new needs concerning “Mieux Vivre” (Live Better), including “Mieux Vivre en Ville” (better urban living) (urban engineering, energy efficiency, urban transport, environmental services, etc.), a subject on which UbiFrance is mobilised.

## B. French technological cooperation other than public development aid

In addition to bilateral and multilateral channels of development aid, France is also involved in many international projects and forums which generate extensive technological cooperation. This cooperation is intended as a transfer, in the broad sense, of know-how, methods or tools necessary for implementing low-carbon transition technologies.

### B.1 Technological transfer close to the ground

Since the fifth French national communication the technological situation has developed considerably. Low-carbon sectors have developed and been deployed on a large scale, especially in the renewable energy sector in which the variety of technologies has increased and costs have fallen significantly. The fact that more and more countries wish to implement these technologies is both cause and effect of this development. It is estimated for example that more than 120 countries have set up a renewable energy production objective<sup>6</sup>, half of which are developing countries. This is a major prerequisite to the extent that low-carbon technologies remain highly dependent on an environment of strong political support.

An extensive research project recently carried out by the CERNA laboratory (Mines ParisTech) on behalf of the Commissariat général à la stratégie et à la prospective<sup>7</sup> (General Commission for Strategy and Long-Range Planning) quantifies and confirms this view: by analysing data on patents, exchanges of goods and low-carbon foreign direct investments, this study shows that the dissemination of low-carbon technologies has started and is growing steadily. This is mainly, but not solely, through foreign direct investments and the exchange of low-carbon goods and services. Licence transfers seem to play a more secondary role, although the study emphasises that the inadequacy of the data makes the analysis difficult in this section. It also notes that obstacles to trade now seem to have a greater influence than obstacles to patent transfers in the transfer of low-carbon technologies in recent years, and gives a reminder of the important role of other transfers through the circulation of information or skilled labour.

<sup>6</sup> REN 21, 2012

<sup>7</sup> “Promoting the International Transfer of Low-Carbon Technologies: Evidence and Policy Challenges”; April 2013, CERNA on behalf of the General Commissariat for Strategy and Long-Range Planning

This development denotes the start of a new phase: operational implementation of low-carbon technologies in a larger number of countries. Emerging countries are at the forefront of this development, with disparities between them. Less developed countries however remain largely absent from the technological flows.

While institutional cooperation remains important for continuing to hold discussions on the development of increasingly effective public policies (see section below), it should also be noted that private stakeholders or stakeholders closest to the ground, such as regional authorities, now play a decisive role in the large scale achievement of this transfer.

Private or decentralised stakeholders make a threefold contribution in the acceleration of the technology transfer. In the first place, even if this still remains a minor share of technology transfer according to the CERNA study referred to above, private stakeholders own technological patents that they can assign or share in the form of a licence depending on the project. Above all, their intervention is supported by a transfer of capacity through training, procedures and tools required locally for the implementation of these technologies, improving the country's technological absorption capacities. The issue of local content and local employment is moreover at the heart of current concerns on low-carbon policies. Finally, these stakeholders can come with useful funding capacities for carrying out the projects.

Technological distribution channels also develop and are speeded up by globalisation and the presence of subsidiaries or joint ventures between energy companies in a large number of countries. Thus, state-of-the-art technologies can now be tested and developed in developing countries as well as in Northern countries, as the examples below show.

## **B.2** Industrial projects

Well-known French companies are present in the sector and help to spread the technologies and skills necessary for their implementation. Whether it is a design and engineering firm, state-of-the-art or general company, these players provide technologies, know-how, tools or methods to recipient countries or partners.

Their projects are mainly related to development projects on the ground in the context of calls for tender or industrial partnerships. But these firms also help to disseminate standards and best practice on the subject of preservation of the environment and combating climate change in the numerous developing countries in which they operate. This is particularly important for disseminating the culture and tools necessary for integrating these aspects into all operations. We also note considerable vigilance on energy efficiency and progressively, consideration of resilience and adaptation to climate change.

Their presence is strong and of long-standing in the main emerging countries. But with the greater development of climate or energy policies, more and more countries are calling for these low-carbon technologies and the essential know-how for their implementation. Developed projects need stable regulatory environments in the countries concerned and largely call on local partners, thus enabling not only a transfer of know-how but also access to local skills and characteristics. We will see an interesting phenomenon of co-development of technologies with developing countries wishing to position themselves in these sectors.

### Some practical examples of projects illustrating these transfers and cooperation in progress:

#### ■ Technology transfers:

##### **China and Brazil: the example of Alstom.**

Alstom has several very active Chinese factories. In recent years, the group has invested in all its energy activities such as hydro-electricity, steam turbines, gas turbines (with the Harbin Group, etc.). Alstom expressed an interest in the development of clean carbon and entered into a study project with the Datang Group. In the nuclear field, Alstom Power signed several contracts to supply turbo-alternator generators, including the last signed in June 2013 with its partner Dongfang, for the construction of turbines and alternators for the Xudapu project. In Brazil, Alstom, which has been in the country for nearly 50 years, is the leading supplier of electrical equipment (35% of the hydro-electricity market with about one hundred projects carried out in ten years). The group also supplies transport equipment (metros in Sao Paulo, Rio and Brasilia) and developed expertise and production capacity in the energy and transport fields in Brazil with a regional, or even international, export vocation.

##### **Indonesia and Morocco: example of GDF-Suez.**

In Indonesia, the GDF SUEZ Group is using its know-how in geothermal energy and developing 3 projects with a total power of 680 MW on the island of Sumatra in cooperation with the local company PT Supreme Energy. In Morocco, GDF SUEZ, in partnership with the Moroccan energy company Nareva, is developing the largest wind farm in Africa at Tarfaya. This 300 MW complex should be operational at the end of 2014. It will account for about 40% of the total wind power production capacity of the country and enable CO<sub>2</sub> emissions to be reduced by 900,000 tonnes per year. This project was possible thanks to the financial cooperation of the Moroccan banks.

**Gabon: the example of Total.** The project to redevelop the "Anguille" field, brought into production in 1966 and operated by Total Gabon, (company incorporated under Gabon law, 58% held by the Total Group and 25% by the Republic of Gabon) aims to substantially reduce greenhouse gas emissions resulting from gas flaring. An important part of this innovative, multidisciplinary project was carried out on the existing site by Gabonese companies in the first two phases of the project, and the third phase permitted the installation of a low pressure gas return pipe to the neighbouring field of "Torpille". This solution will limit gas flaring to what is strictly necessary on the "Anguille" field (for the security of the installations).

##### **Development of a subsidiary and economic diversification in Kazakhstan (SME consortium):**

supply of a factory making vertically integrated photovoltaic panels. A French industrial consortium, with the support of the CEA, carried out a project in Kazakhstan in 2011 to supply turnkey factories for the whole photovoltaic production chain. With total capacity of 60 MW, the various production technologies (wafer, cell and module) were transferred by French companies ECM Technologie and SEMCO Engineering, under the coordination of the CEIS. This project costing a total amount of 165 million, includes the supply of equipment made in France by a dozen SMEs and the transfer of technology and know-how by these companies. In addition, a training component was set up in France to train operational Kazakh teams in advance phase. The first production phases have started, thus enabling Kazakhstan to be counted as one of the industrial producers of photovoltaic panels.

This structural industrial programme was possible because of financial support from the State through a FASEP programme allocated to CEIS and scientific and institutional support from CEA, a public research organisation.

**Indonesia: development of Carbon Capture - Storage know-how (Total).**

On the fringe of the UN Climate Conference in Bali in 2007, Total signed a protocol agreement with the Indonesian Ministry of Energy and Mining Resources, giving the Indonesian Agency for research and energy development and mining resources (Lemigas) access to the main results of Total's pilot CO<sub>2</sub> Capture and Storage (CSC) project in the Lacq basin in south-west France. This project which represents considerable investment in Research and Development tests the full chain of this process, which the International Energy Agency considers to be a significant means of reducing greenhouse gas emissions. This agreement was extended by technical cooperation with Lemigas on potential applications of CSC to reduce the country's emissions. A discussion forum on the subject was opened in 2011 by the Minister for Energy and Mining Resources, with more than 300 participants.

■ Co-development of technologies:

**Chile: development of a solar boiler (GDF-Suez):** this 2.5 MW global pilot project called EOS I, consists of injecting steam produced from a concentrated solar power plant directly into a high pressure turbine of an existing coal-fired electricity production unit at Mejillones, in the north of Chile. This technology enables 800 kg of coal per second to be saved in this 2.5 MW unit. This innovative project is supported by GDF SUEZ's research department with the aim of capitalising on this full-scale test.

**Brazil: converting wave power to electricity (GDF-Suez):** this prototype developed by Tractebel, subsidiary of the GDF SUEZ Group at Pecem near Fortaleza is the first in Latin America. It is carried out in collaboration with the Institute of Research of the University of Rio de Janeiro, the National Agency of Electrical Energy and Brazilian companies for the production and supply of the material. While this project demonstrates that it is possible to capture wave energy, more research is needed to improve the technology and bring it to maturity.

**United Arab Emirates: development of a Shams Concentrated Solar Power Station (Total):**

in partnership with other companies, Total is participating in the Shams Power Company joint venture which is constructing and developing Shams 1, the largest concentrated solar power station operating in the world. This solar power station with 100 MW capacity will supply 20,000 homes in the United Arab Emirates (UAE) and save about 175,000 tonnes of CO<sub>2</sub> per year. Integrating the most recent cylindrical-parabolic technologies and a dry cooling system which significantly reduces water consumption, Shams 1 illustrates the effectiveness of collaboration between the various companies to bring about large scale environmentally friendly energy solutions meeting the increasing global energy needs and diversification of energy mixes.

■ Cross-sector projects and commitments:

**The example of Total:** the Group is committed to reducing its greenhouse gas emissions by 15% between 2008 and 2015 and halving gas flaring between 2005 and 2014. The Group is also working to increase the energy efficiency of its plants (with the target of a 1.5% per year improvement) and its products. To implement these commitments, Total has in particular set specific targets and procedures to integrate climate change related issues in its decision-making processes and in operations implemented in all those countries in which it is involved. Total is also a committed player in renewable energies, being a group leader in the solar sector. With companies of the countries concerned, the group develops and invests in technical solutions to limit greenhouse gas emissions to a strict minimum, and involves local businesses and populations. The group also contributes to the dissemination of training on issues relating to preservation of the environment and combating climate change, by supporting an association called Total Professeurs Associés (TPA) (Total Associate Teachers) which now brings together 280 Total executives, all volunteers, to share their knowledge and experience with students

from a catalogue of 400 courses in French and English.

**The example of sociétés de service décentralisées (decentralised service companies) (EDF):** the sociétés de service décentralisées (SSD) (decentralised service companies) created by EDF with ADEME support, is a model guaranteeing the viability of rural electrification projects and their long-term reproducibility. Their purpose is to sell decentralised energy services, improving the daily life of rural households, tradespeople, industrialists and the health sector. The SSD install, run, maintain and renew electricity generation plants, often using renewable sources, from renewable concession and for territories of about 60 to 150,000 people. The strength of the SSDs is their ability to integrate into the local socio-economic fabric: they are local companies managed by local directors and staff. Six rural SSDs created with the support of EDF in 5 countries (South Africa, Botswana, Mali, Morocco, Senegal) providing electricity to more than 450,000 beneficiaries at the beginning of 2013. EDF aims to supply nearly 1 million additional people in the next 5 years, mainly through the development of new programmes in Africa and Asia.

The study of these projects shows the diversity and importance of the work of these stakeholders for technological cooperation, which goes beyond developed commercial projects. The social responsibility and the internal or external cooperation programmes they engender (cf. the Total Professeur Associés (Total Associate Teachers) or Électriciens Sans Frontière (electricians without borders) created by EDF employees) have a significant role here.

Some, as the one in Kazakhstan presented above, underline the importance of links between private technological transfers and public cooperation and support systems. These systems remain key elements for bringing about and facilitating projects in countries that have just implemented ambitious climate policies or which lack the

capacity to implement them. Not only countries, but also decentralised public stakeholders, have a role to play in disseminating the necessary skills and know-how.

### A decentralised cooperation dynamic

Aware of the issues related to climate change, French local authorities have been strongly motivated in recent decades in participating, directly or through networks, in debates and projects carried out at local, national or international level.

The French Atlas of decentralised cooperation produced by the CNCD (Commission Nationale de la Coopération Décentralisée) (National Commission on Decentralised Cooperation), and accessible on the Ministry of Foreign Affairs website since 2009<sup>8</sup>, highlights the importance of this activity in the context of decentralised cooperation projects. In this context the fight against climate change may consist of:

- A main objective: projects related to energy efficiency, renewable energies, etc. And in this case the local authorities often include experts such as ADEME, GERES, etc. in their programme;
- A secondary objective: projects carried out in the water, transport, waste sectors, etc.
- Project details also vary but may be classified in 2 groups:
  - Investment projects: construction or renovation of a dam, electrification, wind turbines or tramway;
  - Institutional support projects, building capacity, skills transfer.

The most active of the French local authorities include: the regions of Brittany, Rhône Alpes, Poitou Charente, Nord Pas de Calais, La Réunion, etc., the towns of Nantes, Paris, Dunkerque, Strasbourg, Lille, Grenoble, Bordeaux, Marseilles, etc. Since the last national communication the practices of local authorities have changed a great deal towards more pooling of resources particularly around important subjects (water, rural development, energy, etc.) enabling the acquired expertise to be developed

<sup>8</sup> [www.diplomatie.gouv.fr/cncd](http://www.diplomatie.gouv.fr/cncd)

and built upon. The Ministry of Foreign Affairs provides support in terms of visibility, coordination or finance (co-financed as part of calls for projects). Cooperation projects are increasingly numerous (see section below) on the subject of climate or climate-related subjects (water, transport, waste).

France pays particular attention to the increasing power of local authorities and their mobilisation on the climate change issue. While acknowledgement of the role of local authorities is steadily increasing, particularly among international organisations (UNP, FAO, etc.), when it comes to the issues most frequently debated at world level and implemented at local level this increase remains slow. For this reason Ronan Dantec, Senator for Loire Atlantique and President of the united cities of France (association of French local authorities) was given a mission concerning the role of local authorities in the preparation of negotiations on climate change. Alongside this reflective and motivational work, decision-making tools need to be transferred, such as through the draft integrated Plan climat territorial (Regional Climate Plan) implemented by the Dakar regional council with the support of the Regional Council of the Ile de France and the French Ministry of Foreign Affairs.

### Details by theme:

#### ■ Projects concerning climate change and energy

There are some forty active projects in the energy field, ranging from governance projects in Cameroon to operational projects to install innovative solutions in Mali, and electrification projects in Senegal or Benin. Some authorities are also working to define action programmes to promote renewable energies (for example the Regional Council of Poitou-Charentes in Senegal). It will be noticed that local authorities increasingly carry out these projects in cooperation with *Électriciens sans frontières* (Electricians without borders) in order to benefit from the synergies and the expertise available. Projects in support of the development of the plan climat (climate plan) are also in progress in Senegal or in South Africa. Several cross-sector governance or decentralisation support

programmes now include a section on climate change.

#### ■ Projects relating to water and sewage

Projects relating to water and sewage are particularly numerous in the context of decentralised cooperation, with over 300 active projects. In these fields, local authority involvement mainly consists of institutional support, but they are also involved in projects that form part of a strategy to promote adaptation to climate change, such as renovation of water distribution circuits or renovation of waste water networks. These activities are increasingly carried out with the intervention of Water Authorities, which provide human and financial resources. A partnership was also entered into with the UNDP.

We can also cite: access to drinking water and waste treatment for vulnerable populations in 4 districts of Southern Ethiopia (city of Paris); access to drinking water in Niger (Grabels), in Mali (Calais, Ivry sur Seine, Allones), in Burkina Faso (Narbonne), several towns or villages in Togo or in Cambodia (Paris).

#### ■ Projects relating to natural resources

Agriculture, rural development, agro-ecology are now the themes most frequently tackled in decentralised cooperations, in response to a request from partners, especially in Sub-Saharan Africa. The international network ORU FOGAR (organisation of regions united) works on this basis with the FAO. To this end the French Ministry of Foreign Affairs provided an expert to the FAO to link local with national and international networks of local authorities. The forest development also shows "potential" in decentralised cooperations in connection with the International COFOR platform, with which France has renewed an agreement for three years. Projects in these sectors have the aim of preserving the living conditions of the population, preserving biodiversity and redeeming or improving the management of public forests. Projects with a "reafforestation"

(in Madagascar, Mali and Cameroon) or drainage basin management component can also be listed.

- Projects concerning the urban environment: transport, waste management and recycling of sewage sludge.

Numerous projects have been carried out in this area. They generally concern waste management, organisation of collections, elimination of fly-tipping, recycling of certain types of waste including fermentable waste, with significant impact on the environment.

In terms of transport, there are some twenty projects with local authorities in developing countries. These projects concern the implementation of public transport strategies or sustainable urban planning, as well as the development of practical projects such as a light rail system (Regional Council of the Ile de France and the City of Hanoi). A very large number of urban development projects rely on integrated approaches of sustainable development of urban areas and also include a transport component.

### **B.3 Institutional cooperation that remains central**

Public cooperation remains such a key component of this technological transfer that this transformation must be supplied by voluntary public policies. Although the price of energy was the main driver of low-carbon innovation up to the 1990s, environmental and climate policies have since taken over and underpin innovation and need for technology. Governments must aim to define a framework favourable to investment in these new technologies and building absorption capacities and implementation by countries.

#### **B.3.1 France's financial contribution to the UNFCCC**

The United Nations Framework Convention on Climate Change (UNFCCC) occupies a special place in the matter of technology transfer. As an

irreplaceable formal negotiation authority and incentive tool for action by all, it is most particularly interested in promoting technology transfers. For this reason it recently set up a Technology Mechanism, consisting of an executive technology committee and a climate technology centre and network. To enable this work to be done, France pays two compulsory contributions each year to the UNFCCC and the Kyoto Protocol (€1.3 million in total) and some voluntary contributions to these same bodies or other beneficiaries (International Panel on Climate Change (IPCC) €0.60 million in 2013).

#### **B.3.2 France in the major forums and international partnerships**

France is fully involved in various multilateral forums supporting and helping to accelerate technology transfers, and sharing of experiences. The field of low-carbon solutions for energy and more recently, energy efficiency, are particularly active, with French participation in the majority of these forums (IEA, the Clean Energy Ministerial (CEM) or the International Partnership for Energy Efficiency Cooperation (IPEEC)).

In this area, the increased power of IRENA, an agency created in 2009 and now with a hundred members, should be mentioned. The agency aims to operate by providing a platform to support countries wishing to implement renewable energies. It develops and shares tools to promote the deployment of renewable energies on a large scale and in all countries. The support it gives specifically to developing countries, including the least developed and small island states, is considered by France to be a priority. Thus, through human and financial support and improved cooperation France is actively working within IRENA to facilitate energy transition in developing countries to a low-carbon growth. France is the sixth largest contributor to the Agency (\$1.4 million in 2012). In this respect it welcomes and supports recent studies, tools and support measures implemented by IRENA in 2012.

The work of this Agency now fits into the unifying framework of the Sustainable Energy for All (SE4All)

measure proposed by the General Secretary of the United Nations. Pursuing three major objectives for low-carbon development<sup>9</sup>, this broad initiative has catalysed action by offering a common framework and greater visibility to these issues. France is actively participating in this initiative, directly by providing human support or by mobilising its cooperation stakeholders on the ground, or indirectly through the work of the European Union and the financial facility put in place. Access to energy is a subject France holds dear and supports through its cooperation projects. The Paris-Nairobi initiative for Climate which it helped to launch with Kenya is funding this process. The AFD made it an important part of its strategy. Decentralised or private cooperation stakeholders are also strongly mobilised on this subject, working on the development of new technologies (such as small electricity storage stations developed by the HYSEO) or setting up local organisations able to manage an energy service.

Other multilateral forums or organisations contribute to the spread of technologies and know-how for combating climate change. This is the case for several programmes supported by UNEP, such as the ten year framework of programmes on sustainable production and consumption patterns (10YFP), adopted by the United Nations Conference on sustainable development in 2012. France is very mobilised in the development of this framework and steered one of the seven working groups of the Marrakech Process, that of sustainable tourism. Today, France holds the Vice-Presidency of the World Partnership for Sustainable Development after holding the Presidency for two years. France is also involved in other 10YFP programmes, especially those relating to consumer information and sustainable buildings. Informing the consumer through environmental labelling has come to be a structuring tool for transition to more sustainable consumption. France is implementing a progressive national policy on the subject and shares the skills and tools it develops on various international forums.

<sup>9</sup> *Universal access to modern energy services; doubling the rate of improvement of energy efficiency; doubling the share of renewable energies in the global energy mix.*

In another subject area, France wishes to underline the role of the FAO in seeking more effective agriculture, more resilient to climate change.

### B.3.3 An active bilateral cooperation, built around the Mediterranean basin

Regional and bilateral cooperation continues to be the level at which issues are dealt with in finer detail and projects brought to successful conclusion. This cooperation is through the work with Africa in particular, mainly through the support of its diplomatic network and the work of AFD, but also of large emerging countries like Brazil or China. France has also set out to develop strategic bilateral cooperation with an increasing number of countries that produce and consume fossil fuel. A cooperation agreement on renewable energies and sustainable development was also signed in April 2010 with Kuwait and in January 2013 with the United Arab Emirates. A Franco-Russian energy efficiency centre was created in December 2010, whose programme of work was validated at its first strategic board meeting in April 2011.

France has been very involved in recent years in improving public cooperation around the Mediterranean basin. The Union for the Mediterranean (UfM) has relaunched policy promoting the development of joint frameworks and projects. The Mediterranean Solar Plan, which results from it, is an emblematic project, rich in mutual benefits of successful cooperation: better promotion of climate conditions for solar production, improved administrative, technological and industrial cooperation, creation of new skills and new markets. Thus, to stimulate these advances, France signed cooperation agreements in the renewable energy and energy efficiency field with Morocco and Tunisia (two of the region's most advanced countries in this field, now possessing national solar plans). It also entered into an administrative arrangement with Tunisia to implement study and demonstrator projects in the renewable energy arena in December 2012. It also actively contributes to project sharing on the development of sustainable public policies, through the Centre de Marseille pour l'Intégration en

Méditerranée (Marseille's Centre for Mediterranean Integration) (CMI), for example. This centre run by the World Bank aims to facilitate access to the best knowledge and to build sustainable development. France also works with the Mediterranean Action Plan (MAP, lead by UNEP) and supports the Plan Bleu, which provided long-term analysis on sustainable development issues with strong links to low-carbon transition and the search for resilience (transport, irrigation and water resources, urban concentration, etc.).

### B.3.4 Adaptation transfers that are gathering speed

In the field of institutional cooperation concerning public policies and their tools, we note the increasing potential of exchanges on adaptation to climate change. Progress on the matter at international cooperation level manifests recent awareness of the importance of this issue. This effort must continue to be built upon so that adaptation is fully integrated in technology transfer.

On the basis of experience acquired in development of the Plan National d'Adaptation au Changement Climatique (PNACC) (National Climate Change Adaptation Plan) in 2010 and the beginning of 2011, France helps to share this experience in the planning of adaptation policies in order to spread the methods and tools used for understanding this field more quickly. We can cite projects in support of developing climate policies with a marked adaptation component, as in the case of the "Programme d'appui à la définition de stratégies de développement sobre en carbone et résilient au changement climatique" (support for the definition of low-carbon and climate change resilient development strategies) carried out by AFD and FFEM in several African countries. Limited exchanges have also taken place to aid the implementation of various components useful for adaptation, such as structuring the implementation of a national climate change observatory (Mauritius), current involvement in extending of the area of the Indian Ocean Commission (IOC) as part of the Acclimate project aimed at helping IOC Member States to build their

climate change adaptation capacities (see also chapters VI and VIII).

The monitoring and assessment of adaptation policies is a very complex subject. France has a very pragmatic approach to this question as part of its PNACC which may be useful to many countries (see appendix VI). An initial exchange on the "mise en place d'une évaluation du coût des impacts du changement climatique" (implementation of a cost assessment of the impacts of climate change), on the basis of the 2009 ONERC national report on this subject<sup>10</sup>, took place with a Vietnamese delegation in October 2011. This type of exchange could be reproduced.

We might also point out that the provision of climate projections on a fine scale is an essential tool for supporting the design of climate change adaptation policies. France therefore set up the DRIAS-les futurs du climat<sup>11</sup> platform, soon to be translated into English (see chapter VIII). The interface and data provided are examples of state-of-the-art tools which could be developed in the context of cooperation with other countries.

Because of its geographical situation, France possesses a very high level of expertise on the issue of coastal risk zoning, including island environments (see chapter on the national situation). This know-how enables it to anticipate the management of coastal areas and to limit the harmful effects of climate change on societies. On this subject, a workshop in Polynesia was co-financed<sup>12</sup> in particular by the Ministry for Ecology, in December 2011. This consisted of a transfer of techniques and know-how to limit the harmful effects of climate change on societies, especially combating soil erosion and rising sea-levels.

<sup>10</sup> ONERC, Report to the Prime Minister and Parliament: Climate change – Costs of impacts and lines of adaptation, November 2009

<sup>11</sup> <http://www.drias-climat.fr/>

<sup>12</sup> [http://www.developpement-durable.gouv.fr/IMG/pdf/ONERC\\_actes-colloques-web-fr.pdf](http://www.developpement-durable.gouv.fr/IMG/pdf/ONERC_actes-colloques-web-fr.pdf)

This large institutional cooperation and mobilisation on the subject encourages private stakeholders to follow suit. In the same way as for the transfer of mitigation technologies, these will have a role to play in adaptation. Some manufacturers are now asking for studies on resilience to climate change for their investments abroad, which could enable wider dissemination of good practice and adaptation-related tools within subsidiaries and joint ventures.



# Research and systematic observation

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## A. Overview of climate research and observation in France

In view of the reality of climate change, scientists have drawn the attention of decision-makers to the risks related to anthropic greenhouse gas emissions. Climate change, through its observed and probable impacts on the water cycle, agriculture, biodiversity, and infrastructure, threatens the motivating forces of economic and social development. Aware that the temperature increase measured during the 20th century is mainly of anthropic origin, policy directors have initiated policies to combat global warming (reduction of greenhouse gas emissions and adaptation to the inevitable changes).

Climate forecasting, which requires an understanding of the fundamental mechanisms, the role played by anthropic disturbances, impacts and mitigation of climate change as well as adaptation to it, have become major global concerns and French research priorities. This involves, moreover, setting up or keeping observation systems in operation beyond the life of the research programmes.

### A.1 Public authority action on research

France finances the research projects of public and private laboratories by means of various support systems, including the creation of the Agence Nationale de la Recherche (ANR) (French National Research Agency) in 2005. In order to remedy the low level of support for innovative medium-sized enterprises the Agence de l'Innovation Industrielle (AII) (French National Industrial Innovation Agency) became part of OSEO in 2008<sup>1</sup>. New funding has allocated €300 million to medium-sized enterprises, enabling more than 10 research projects to be selected each year. Other measures provide support for collaborative research projects: Programme d'Investissements d'Avenir (Investment for the

Future Programme), competitiveness clusters, European Union Framework Programmes for research.

### The Programme d'investissements d'avenir (Investment for the Future Programme)

With a budget of €35 billion, the Programme des Investissements d'Avenir (PIA) (Investment for the Future Programme) launched in 2010 as part of the Grand emprunt (great public loan) is shaping a new landscape of research and innovation in France. Since its launch the PIA has committed over €26 billion in finance for almost 900 projects. Funding is mainly accessed through calls for projects launched by various State operators (ANR, OSEO, Caisse des Dépôts, Agence De l'Environnement et de la Maîtrise de l'Energie (ADEME) (Environment and Energy Management Agency)). The Programme d'Investissements d'Avenir also encourages the pooling of the most innovative technologies between public research and private research, and reinforces the links between research and industrial development, by relying on the competitiveness clusters in particular.

### Competitiveness clusters

Launched in 2004, competitiveness clusters reinforced the links between business and research bodies between 2005 and 2008. This system was extended from 2009 to 2012 through the implementation of performance agreements between the State, the regional authorities and the clusters. The ANR and OSEO contribute to the funding of competitiveness clusters and supplement the joint action of ADEME, the Ministry for Ecology and the Ministry for Research in defining the directions of national programmes, consistent with the major international programmes.

### La Stratégie Nationale de Recherche et d'Innovation (French national strategy for research and innovation): 2009-2012

At the Government's initiative, the Ministry for research drew up a stratégie nationale de recherche et d'innovation (S.N.R.I.) (national strategy for research and innovation). Almost 600 high-profile members of the academic research community and

<sup>1</sup> Private enterprise that finances French SMEs for employment and growth. The State has a majority holding in it. OSEO was integrated in the Public Investment Bank (BPI) on 12/07/2013

the business and associations world were involved in the six-month scientific long-term exercise which resulted in the definition of three priority research themes for the period 2009-2012:

- Health, well-being, food and biotechnology;
- Environmental urgency and eco-technology;
- Information, communication and nanotechnology.

### Launch of Joint Programming Initiatives (JPI)

At the 2008 Competitiveness Council, EU Member States decided to get involved, by means of joint programming, in large unifying projects that would lead to innovation and become the forerunners of future markets.

Joint Programming establishes a new mode of cooperation between Member States in order to take on a series of key challenges for Europe. It helps them define a shared vision and strategic research agenda on those social issues that cannot be dealt with by national programmes in isolation. It consists of the coordinated definition and implementation, at European level, of research programmes on the major issues for European society, science and technology.

### A.2 Public authority action on climate change research

The new provisions for research and innovation presented in part A1 have reinforced the French effort in the fight against climate change. The emphasis has been placed on key areas such as construction, agriculture, mobility and sustainable energy.

Since France's fifth national communication of 2009, the public authorities have continued to act on climate research.

### Monitoring of the Grenelle Environment Round Table actions

The Grenelle Environment Round Table was set out in two laws: the Framework Law on Implementation of the Grenelle Environment Round Table of 3 August 2009 and the loi d'engagement national

pour l'environnement (Law on the National Commitment for the Environment) of 12 July 2010. Various financial instruments were set up as a result.

€1.5 billion devoted to research over 4 years. In this context, a research «demonstrator» fund with a budget of €325 million over the period 2009-2012, managed by ADEME, was created to support research demonstrator experiments on subjects related to new energy technologies. This mechanism is supplemented by funds allocated as part of the Investment for the Future Programme and the definition of the National Research and Innovation Strategy (SNRI).

### Les Investissements d'Avenir (Investment for the Future)

The Programme Investissements d'Avenir (Investment for the Future Programme) provided an opportunity to support research and innovation in the field of climate change and to organise the communities involved by means of various calls for tender, enabling them to acquire a significant critical mass.

Laboratories or groups of laboratories and excellence teams receive funding, particularly to ensure that high-level scientists or those with great potential stay in France. These excellence laboratories known as Labex have received €33.5 million in funding from Investissements d'Avenir since 2010. Excellence equipment known as Equipex has also received €28.18 million in funding from Investissements d'Avenir. A description of Labex and Equipex is provided in Appendix VII.

**L'Observatoire National sur les Effets du Réchauffement Climatique** (French National Observatory on the Effects of Global Warming) Created in 2001 at the joint initiative of the French Parliament and the public authorities, the Observatoire National sur les Effets du Réchauffement Climatique (ONERC) (French national observatory on the effects of global warming) keeps a scientific watch on climate change and provides the French government, parliament and the public with the most characteristic results on the subject of climate

change. It collects and disseminates information, studies and research on risks related to global warming and extreme weather phenomena. ONERC can also issue recommendations concerning the need for knowledge on the impacts of global warming and adaptation to climate change in France. To do this, ONERC works closely with research bodies (CNRS, Météo-France, IRD, etc.) in mainland France and the Overseas Departments and Territories.

By law ONERC has been designated the French national focal point for the International Panel on Climate Change (IPCC). As a result, ONERC coordinates France's contribution to the work of the IPCC, monitors the Global Framework for Climatological Services of the World Meteorological Organization and contributes to international negotiations in relation to the UNFCCC, mainly on research and adaptation aspects.

On its website [www.ONERC.gouv.fr](http://www.ONERC.gouv.fr), ONERC provides a selection of climate change indicators in France, sent in by several operational research teams in order to illustrate the impacts of climate change in France. It also gives an overview of French climate expertise. In addition, ONERC is the world leader on public policies for adaptation to climate change.

### Plan National d'Adaptation au Changement Climatique (French national plan for adaptation to climate change) (PNACC)

The first national plan for adaptation to climate change (2011-2015) contains a large research section consisting of 4 actions comprising 16 measures. All actions are in progress and 94% of the measures have been started. Wiklimat, the «Wiki» discussion platform on local adaptation initiatives aimed in particular at promoting pilot projects on applied research opened in 2013. This key measure of the PNACC research file will permit direct exchange between local adaptation stakeholders highlighting local achievements. Details of the progress of PNACC are available in Appendix VI.

### Role of the ANR and ADEME agencies

The French State's financial commitment to climate research is about €1 billion for 2011 and 2012.

France has two main funding agencies supporting research and innovation projects: the Agence Nationale de la Recherche (ANR) (National Research Agency) and the Agence de l'environnement et de la maîtrise de l'énergie (ADEME) (Environment and Energy Management Agency). Since its creation in 2005, the Agence Nationale de la Recherche (ANR) has supported projects in the basic research, industrial research or pre-competitive development stage, for which market openings are expected in the relatively long-term. The ANR has since launched some thirty calls for projects, selected nearly 1,500 files and committed nearly €540 million in credits (according to the ANR report of September 2012). The agency intervenes in the context of widely published open calls for projects which contribute to European and global exchanges, particularly by calling on international experts for project selection.

The ANR was able to commit €739 million in 2012 of which €98 million was devoted to climate change research.

ADEME also carries out research and innovation actions as part of about ten large programmes according to three intervention areas:

- Energy and reduction of greenhouse gases;
- Waste, waste limitation and recycling;
- Control of pollutant emissions and their effects on health and the environment.

As part of its role, ADEME is responsible for managing the financial resources coming under funds for development of renewable heating (€252 million on 2011), management of the waste plan (€173 million in 2011), treatment of contaminated sites (€15 million in 2011), noise prevention (€34 million in 2011). In addition, ADEME has recently carried out programmes on the subjects of «Consommation et Production durables» (Sustainable Consumption and Production) and «Villes et Territoires durables» (Sustainable Towns and Regions).

The agency is mainly financed by the Taxe Générale

sur Activités Polluantes (TGAP) (General Tax on Pollution-Generating Activities) and by the Ministry for Ecology (nearly €66 million in 2012<sup>2</sup>).

ADEME's total budget devoted to «Energy and Climate» for 2012 is estimated at €644.9 million, of which €236.8 million was devoted to research.

### The French national strategy for research and innovation:

On the subject of the environment, the priority development area of the national strategy is «urgence environnementale et les écotecnologies» (environmental urgency and eco-technology). This area of research is organised around the following major objectives:

- Understanding and modelling changes in climate and biodiversity with the aid of measuring instruments, particularly satellites, and simulation;
- Understanding how living things react to external aggression (toxicology and eco-toxicology) linked to human activities and providing them with greater protection;
- Developing eco-technologies and eco-design in order to design products and competitive services with low or even no environmental impact throughout their life cycle;
- Ensuring a carbon-less energy future with balance between research on nuclear and research on renewable energy in order to protect the environment.

France's substantial involvement in research on climate change places it at the centre of European and international projects. The main ones are listed below.

### Contribution to ERA-NET projects

ERA-NET (European Research Area Network) projects came into being with the 6th Framework Programme (2002 – 2006). Their purpose is

to permit networking and coordination at the transnational scale as well as the mutual opening of national and regional research programmes. ERA-NET projects are therefore aimed at the directors and financial backers of these programmes. The ERA-NET Review, published in 2006, specifies that 5 calls for proposals have been published in respect of the coordination of research activities and have led to the financing of 71 ERA-NET projects.

Since France's fifth national communication ERA-NET has continued during the 7th Framework Programme (2007-2013) with a budget of €44.6 billion. Following a survey carried out between 2009 and 2010 by the IPTS (Institute for Prospective Technological Studies) on 47 ERA-NET projects, the European Commission published a report mainly concluding that 15% of ERA-NET projects are linked to a major social challenge such as water or climate change.

France is the main participant (only country present in more than 80% of ERA-NET projects) ahead of Germany.

### Launch of Joint Programming Initiatives (JPI)

France participates in 10 joint programming initiatives approved to date, five of which are related to the fight against climate change:

#### ■ JPI Climate (Coordinated development of knowledge on climate for Europe)

The joint programming initiative on coordinated development of knowledge about climate for Europe was launched in April 2010. JPI Climate is a European initiative providing coordinated funding of climate research (in the broad sense). It contributes to development of knowledge to improve the scientific expertise on climate change risks and adaptation options.

#### ■ JPI Oceans (healthy and productive seas and oceans)

The aim of this initiative, launched in 2010, in which IFREMER participates, is to create a knowledge base that will help to implement an integrated policy on the sustainable use of marine resources, while limiting the impact of

<sup>2</sup> According to the 2012 ADEME activity report and ADEME, «Données et Chiffres clés 2009-2012» (Key figures and data 2009-2012), July 2013

climate change on the marine world and coastal regions.

#### ■ JPI Urban Europe

The (JPI) «Urban Europe» joint programming initiative was chosen by the European Council to form part of future modes of implementing the European Research Area (ERA). Urban Europe has great benefits for transport. It aims to use emerging technologies to offer new urban policies and new design strategies for the future of towns and transport. Its proposed solutions respond to the following issues:

- Providing a sustainable energy supply;
- Meeting individual mobility demands;
- Reducing the ecological footprint;
- Understanding the impacts of demographic change.

French participation in this initiative is coordinated by IFSTTAR in the name of the Alliance ALLEnvi with the Ministry for Ecology.

#### ■ JPI Water (Water-related challenges in a changing world)

French participation in this initiative is coordinated by IRSTEA in the name of ALLEnvi with the Ministry for Ecology. JPI Water currently brings together fourteen countries of the European Union or States associated with the European Commission. It responds to the major challenge of implementing sustainable systems, in relation to water, for a sustainable economy in Europe and abroad. Europe is an international leader in water-related industrial and commercial activities and research and innovation, with a third of the total volume of world activities, scientific publications and international patents. The integration of efforts will bring about progress in the sustainability of ecosystems, develop safe systems for citizens, promote the competitiveness of businesses, implement a bioeconomy particularly attentive to water and restore the quantitative balances in the water cycle.

#### ■ JPI FACCE (Agriculture, food security and climate change)

JPI FACCE is an initiative directed jointly by the INRA (Institut National de la Recherche

Agronomique) (French National Institute of Agronomic Research) and the BBSRC (Biotechnology and Biological Sciences Research Council- United Kingdom). Launched in 2010, the joint programming initiative on agriculture, food security and climate change, in which twenty one European countries participate, brings together existing programmes and supervises joint research efforts for better food security and the fight against climate change.

The JPI FACCE's Strategic Research Agency (SRA) defines five research areas:

- Sustainable food security in the face of climate change;
- Sustainable increase and intensification of agriculture;
- Compromise between food production and supply, biodiversity and ecosystem services;
- Adaptation to climate change;
- Mitigation of climate change.

In this context, it was decided to launch a pilot project in July 2011 entitled «A detailed assessment of risks linked to climate change for European agriculture and food security» for an estimated budget of €15 billion. It relates to the modelling of impacts of climate change on European agriculture and food security and the reduction of uncertainties in climate change scenarios.

#### Research for development in countries of the South

Dedicated to research for development, with the mission of helping to develop the research capacities of partners of the South, the IRD gives its entire research strategy an international dimension.

The IRD aims to acquire a better understanding of the processes behind climate variability and improve prediction capacities in tropical environments in order to refine climate change scenarios at ten-year and hundred-year scales. Scheduled activities in the Atlantic and Pacific Oceans are based on the observation of atmospheric, oceanic and continental mechanisms and their interactions. These are supplemented by reconstitutions of palaeoclimates and modelling on different scales. They combine

physical and biogeochemical processes or climate change and health.

### **A.3 Structure of the French scientific community**

The French research and innovation system is organised around 4 functions:

- **The orientation of research:** defines the research policy, general objectives and the total budget allocated to research. The Ministry for Research and the High Council of Science and Technology set the direction;
- **Programming:** formulates the thematic priorities of research by analysing gaps in each activity sector by integrating physical and financial parameters;
- **Research (in the proper sense):** following the Programme/Projects dichotomy, programming will orientate the research projects in order to respond to precise issues;
- **Assessment:** improving the overall performance of the system. Assessment is carried out by the Agence d'évaluation de la recherche et de l'enseignement supérieur (A.E.R.E.S.) (Agency for assessment of research and higher education).

### **Research mechanism and stakeholders**

**French public scientific research** is centred around the Ministry for Research, and is mainly carried out within laboratories of higher education establishments (universities, schools of engineering, écoles normales supérieures (training colleges for higher education teachers)) and research bodies. The aim to bring two structures together is manifested by the implementation of mixed research units (or combined units) which are laboratories for which supervision is shared by one or more research bodies or universities.

**Private scientific research** provided by businesses has many national and community tools it can contribute to funding each step of the R&D and innovation process (from fundamental research to experimental development), either by direct aid, or by tax incentives. The crédit impôt recherche (CIR) (research tax credit) launched in 2009, in partnership with the Ministry of Research and

OSEO, continues to be a driving force for finance. This is a fiscal aid intended to encourage business investment in R&D. It is a tax reduction calculated according to the R&D expenses of the business. If the amount of the CIR is greater than the tax owed by the business, the company can make a claim upon the State. As explained in France's 5th national communication, the CIR rate applied on the volume of R&D expenses is 30% up to €100 million and 5% above this €100 million threshold. Businesses entering the system for the first time benefit from a rate of 40% in the first year, then 35% the second year. Representing a receivable of a little over €5 billion, the crédit d'impôt recherche (CIR) (research tax credit) constitutes a major support tool for R&D. The OSEO budget dedicated to financial grants for innovation in 2011 was €569 million.

The French research system has an original organisation.

### **An organisation in networks**

The State encourages the establishment of research laboratory networks and major international, European, national and regional infrastructures.

At international level, French teams are substantially involved in the work of the IPCC and the Ministry for Research supports major international programmes (IGBP, WCRP, DIVERSITAS, IHDP).

At European level, France plays a dynamic role in the definition and development of the large GMES-Copernicus programme which aims to observe the atmosphere, ocean and continental services by combining satellite and in-situ observations. In addition, the MESR (Ministry for Higher Education and Research) actively supports the Joint Programming Initiatives (JPI, EU), one of which is devoted entirely to climate (JPI Climate) and others partially devoted to climate (JPIs Water, Facce, Urban group, Cultural Heritage).

At national level, there are public establishment networks such as AllEnvi, and networks of researchers like the Commission Spécialisée Océan-Atmosphère (Dedicated Commission on the Ocean and the Atmosphere).

### **L'Alliance nationale de recherche pour**

### **l'Environnement (The national alliance for research on the Environment): AllEnvi**

AllEnvi was created in 2010 under the aegis of the Ministry for Research. The alliance consists of twelve founder members: BRGM, CEA, IRSTEA, CIRAD, (International Centre for Cooperation on Agronomic Research for Development), CNRS, CPU (Conference of University Presidents), IFREMER, INRA, IRD, IFSTTAR, Météo France, and the National Museum of Natural History.

AllEnvi is in line with the French government's national strategy of research and innovation. AllEnvi shares the expertise of research bodies, universities and Grandes Ecoles in the field of environmental sciences. It embodies a wish to coordinate and programme in order to create a dynamic of scientific excellence in France and in Europe, and to promote a society capable of meeting the challenges of ecological transition towards green growth.

AllEnvi coordinates 12 themed groups which bring together over 300 scientific experts:

- Agro-ecology and soil;
- Food and the food industry;
- Biodiversity;
- Plant biology;
- Climate: change, adaptation, observation, impact (detailed in appendix VIII);
- Water
- Eco-technology and sustainable chemistry;
- Sea sciences and marine resources;
- Environmental, natural and eco-toxic risks;
- Natural territories and resources;
- Towns and mobilities;
- Environmental assessment and life cycle.

### **La Commission Spécialisée Océan-Atmosphère (CSOA) (Dedicated Commission on the Ocean and on the Atmosphere)**

Consisting of thirty researchers and teacher-researchers, La Commission Spécialisée Océan-Atmosphère (CSOA) (Dedicated Commission on the Ocean and the Atmosphere) gives independent advice to the INSU-CNRS management on the

consistency of means and structures regarding the scientific needs of the Ocean and Atmosphere sector. As part of this mission, through their long-term reflection, animation, assessment and recommendation activities, its members have a national vision of the communities of this sector and are privileged observers of its research structures and the effects of regional, national or European policies.

The disciplines of the Ocean and Atmosphere sector, include oceanography, marine biochemistry, physics and chemistry of the atmosphere, hydrology, meteorology, climatology and paleoclimatology. These fields deal with issues of great interest to all of society. They range from local pollution to the working of the Earth's system, including change in resources, habitability and climate change.

At regional level, the creation of Réseaux Thématiques de Recherche Avancée (RTRA) (Thematic Advanced Research Networks) will enable projects of scientific excellence to be carried out with financial support from the State. RTRAs bring together very high-level researchers as part of a shared strategy united around a shared scientific objective and around research units in close geographical proximity, such as the GIS Climat-Environnement (cf. Appendix IX).

## **A.4 Research in view of the climate change issue**

In 2009 the French National Research and Innovation Strategy identified four major objectives:

### **1°/ Gaining a better understanding of climate change and ecosystems**

The French research effort is in line with the IPCC, whose work enables climate change scenarios to be developed over the medium and long term, according to various hypotheses on GHG emissions. A major advance will be to model ecosystem change over the long term. This requires an understanding of the biological resources system, ecosystem components and change, and being able to measure the impacts of socio-economic activities.

## 2°/ Controlling energy in four key areas

As a leader in the nuclear industry, France intends to consolidate its position while developing clean energies, and in particular solar photovoltaic, second generation biofuels and marine energies.

- **Nuclear power:** fundamental technological research is needed to respond to the increase in world demand for energy, by fitting nuclear energy into the scheme of sustainable development, by, for example, developing fourth generation reactors. This necessitates anticipating technological leaps (gas or metal coolants, performance of materials under irradiation and high temperatures) and permanent levelling of our research tools (research reactors, combustible cycle facilities). At the same time, it is essential to study the best solutions for managing radioactive waste, particularly in respect of the framework of the law of 2006 on radioactive materials and waste;
- **Solar photovoltaic energy:** the INES network (Institut national de l'énergie solaire) (French national institute of solar energy) supports the creation of a photovoltaic industrial sector, based particularly on the PV Alliance project which brings together the CEA, EDF Energies nouvelles and Photowatt. Thin slice technologies, which constitute the start of a technological breakthrough, and research on organic materials should enable solar photovoltaic energy to gain in competitiveness, provided sufficient industrial capacity is kept in the country;
- **Second generation biofuels:** two families of processes, thermal and biological, make it possible to envisage the utilisation of the entire plant. However, the organisation and structure of supply sectors remain, in both cases, a major concern justifying the joint action of the State and the private sector;
- **Marine energies:** as the country with the world's second largest exclusive economic zone, because of its Overseas Departments and Territories, France has real potential in this area. However, technologies capable of achieving an industrial stage are still rare, and it is difficult to install and maintain power plants in a marine environment.

France intends to develop integration centres for each of the technological pathways mentioned above by reinforcing existing sites or creating new ones (in the same way as photovoltaic with INES, or for energy storage). The purpose of these centres is to become the leading stakeholders at international level and to unite with their European counterparts in the form of alliances. At the same time, France will continue its efforts to develop CO<sub>2</sub> storage, convert energy (by means of fuel cell technology in particular) and save hydrogen, which will also help to limit the effects of climate change.

## 3°/ Promoting sustainable towns and mobility

The attainment of sustainable development objectives under acceptable conditions for the people requires a substantial change in the design and working of urban systems and their networks, a steady but significant change in our way of life and the development of services stimulating the whole of social and economic life into action. Thus globalisation and the development of society's knowledge lead to a very considerable increase in global urbanisation and the mobility of people and property.

Low-carbon energy in transport, construction and industrial or agricultural processes is the basis for decoupling economic growth and energy consumption. In sectors in which energy is a major preoccupation, innovative optimisation techniques are one solution for reducing energy consumption:

- In the transport sector: current vehicle ownership still has substantial scope for improvement but we must prepare for a breakthrough in electric vehicles via hybrid vehicles. Public transport must also continue to change to innovative technologies. Air transport should reduce its GHG emissions by using satellite navigation technologies and through a defragmentation of the air space. Furthermore, all these modes of transport should use lighter, more efficient and more recyclable materials able to operate with biofuels;
- In the construction sector: the objective is to reduce the energy consumption of new and existing buildings. Energy equipment

and systems should be miniaturised and store energy. By 2050 it is planned to have positive energy buildings thanks in particular to the contribution of solar energy.

If breakthrough technologies complying with the objectives are to be available and distributed in the stocks of housing, vehicles and processes a number of options must be validated and the practical uses that the people will make of them must also be anticipated, ahead of the opening of markets. Some of these options will not find a market until 2020 or after.

#### 4°/ Developing eco-technologies and eco-design

Developing eco-technologies will enable products and competitive services to be designed with little or no environmental impact throughout their life cycle. The applications are extremely varied and concern the subjects mentioned above, but more generally all economic activity. «Green» chemistry is a particular area in which France, whose strengths lie in its assets and its industrial fabric, is positioned. It contributes to the development of new solutions for reducing and eventually eliminating the use and generation of polluting substances through innovative chemical processes or new applications offered by synthetic biology.

By definition, eco-design requires many scientific and industrial and architectural creation sectors. A multi-disciplinary dialogue and close partnership with businesses, designers and architects should be initiated in order to develop the applications to the best.

#### A.5 Research in the face of the climate change challenge

In view of the climate change challenge, French research gives priority to consistency with major international programmes. French participation in assessment authorities like the IPCC (Intergovernmental Panel on Climate Change) as well as its mobilisation around the large projects such as MISTRALS and the Arctic Project demonstrate France's interest in climate-related research.

#### French climate research consistent with major international programmes

Several well-known international research programmes, producers of the majority of scientific data on environmental change, were combined in 2012 as part of an «Earth System Sustainability Initiative» (ESSI), described as an unprecedented mobilisation of science to help the world adapt to rapid global-scale changes.

The World Climate Research Programme (WCRP, created in 1980), the International Geosphere-Biosphere Programme (IGBP, created in 1986), the International Human Dimension Programme on Global Environmental Change (IHDP, created in 1996), and DIVERSITAS, International Programme of Biodiversity Science (created in 2002), were grouped together to constitute an integrated strategy on the research into environmental changes, allied to social sciences. Together, these programmes (described in Appendix X) work under the aegis of a unique framework called an «Earth System Sustainability Initiative» (ESSI) for international research on global environmental changes.

#### French participation in the IPCC assessment authorities

French participation in the IPCC assessments has increased considerably in recent years. A dozen French scientists had already collaborated directly, as both leading authors or chapter editors, in the writing of the fourth report (i.e. nearly 10% of the total). Numerous French working groups were cited, on aspects linked to the carbon cycle and the cycles of other greenhouse gases, or for observations relating to climate changes in the past.

Météo-France, the main operator of French meteorological research, makes a significant contribution to IPCC assessment exercises in respect of the drafting of the 5th report. This contribution involves developing global and regional climate models and carrying out simulations and analysis leading to publications. Météo-France's contribution to the fifth IPCC report (the first section of which was published in September 2013) is thus manifested by the running of new climate simulations as part of the WCRP's CMIP5 project (Coupled Model

Intercomparison Project Phase 5) and covering a total of nearly 9000 years.

The Institut Pierre Simon Laplace (IPSL) also contributes to the IPCC assessment authorities. Of the 831 scientists in the three working groups, thirteen scientists from the IPSL are part of the first group which gives an up-to-the-minute report on the scientific bases of global warming. Two others are part of the second group which deals with the impacts of climate change and possibilities of adapting to them.

The two LATMOS and IPSL teams also actively participated in the development of a joint inventory of anthropic emissions and emissions linked to biomass combustion over the period 1850-2000 as well as coordinating a detailed assessment of emissions over the period 1980-2010. These are the emissions currently used to simulate the past and current climate in the 5th IPCC report.

### Mobilisation around large projects

To ensure some themes of climate research are given the best coverage, French research is organised around large projects.

#### **MISTRALS: Observing and understanding the Mediterranean basin (2010-2020)**

France is involved in the international MISTRALS programme. Launched in 2008 for an expected duration to 2020, the geographical extent of MISTRALS was expanded in 2010. This is a ten year research and systematic observation project, dedicated to understanding the environmental working of the Mediterranean basin and its change under pressure of global changes. It aims to coordinate interdisciplinary research programmes, on the scale of the Mediterranean basin and bordering countries, relating to the study of the atmosphere, the hydrosphere, the lithosphere and palaeo-climates, and also the ecology of environments and human and social sciences. This project brings together numerous researchers, policy decision-makers and Mediterranean financiers. French participation is represented by the CNRS, the IRD and eleven other French institutions.

#### **Polar research, including the scientific Arctic observatory (2008)**

Following the recommendations of an OPECST report (Office Parlementaire d'Evaluation des Choix Scientifiques et Technologiques) (Parliamentary Office for Evaluation of Scientific and Technical Options) a scientific Arctic observatory was launched in 2008 with the aim of reflecting on working methods and finding the best means to meet the crucial challenges of the Arctic at global level.

Responsibility for setting up the Arctic project was given to CNRS-INSU, with the supervision of several other French organisations (CNRS-INEE, CNRS-INSHS, MAEE, IPEV, Météo-France, IFREMER, CNES, CEA, BRGM, MESR). The aim of this project is to mobilise the scientific community and highlight a long term reflection revealing the basic scientific approaches to be considered in the Arctic. This reflection should enable the causes of climate change and their repercussions on the environment and human health to be understood, and will tackle climate change, by obtaining physical action pathways for the environment and the economy and enabling the population to benefit from them.

The first conference launching the Arctic Project took place in Paris in July 2010 and demonstrated the richness and diversity of French research in the Arctic.

In the context of this approach, there are many scientific issues:

- Environmental: adaptation of polar ecosystems to changes in the cryosphere, protection of the natural environment in relation to the pollution caused by human activities.
- Social: adaptability of local communities to climate change and globalisation;
- Economic and political: strategic control of new maritime routes, exploitation of mineral resources, change in fishing zones, sovereignty over the maritime spheres of influence of neighbouring States.

Another Arctic conference on the Arctic Project held at the Collège de France in June 2013 brought together scientists working on the polar theme at international level.

## **A.6 Shared elements of observation systems**

The Global Climate Observing System (GCOS) is the main source of global climate-related observations. It provides global coordination of the conventional networks of meteorological observation used by countries. In France, the GCOS programme is carried out by Météo-France in relation to the atmosphere, but other bodies and institutions are also working in the oceanic and terrestrial domains.

In order to optimise the development of data collection methods and the essential distribution of data for research, France has set up observation organisations and participates in the European GMES-Copernicus project.

### **GMES-Copernicus: developing the pre-operational monitoring of the environment**

Data observed from space, combined with the measurements supplied by the networks on the ground, provide information useful for managing the environment and the safety of people and property. After a study carried out by the European Commission and space agencies, there appeared to be a strong will to mobilise resources and the main stakeholders concerned in order to implement services in domains considered a priority in terms of environment and security management.

The aim of the European GMES (Global Monitoring for Environment and Security) initiative is to supply information from satellite observations on the environment and security. This project, a joint initiative of the ESA (European Space Agency) and the European Union, aims to unify and rationalise European Earth observation activities. It consists of a collection of themed services considered to be a priority (management of the ocean and coastal zones, land use, monitoring plant resources, risks, water management, quality of the atmosphere and safety of people and property). As a result, not only has the use of existing and future infrastructures been optimised since 2008 but the means of collecting and disseminating data has also been developed and integrated in systems for monitoring

and forecasting the state of the environment. It also ensures the permanence and development of the necessary infrastructures in space and in-situ for the acquisition of this data.

### **Structure of the network**

On the national scale, the Observation Services are services approved by the 'Institut National des Sciences de l'Univers (INSU) (French National Institute of Universal Sciences) and managed by the Observatoires des Sciences de l'Univers (OSU) (Universal Sciences Observatories).

Since 2010, MESR (Ministry of Higher Education and Research) has developed the concept of SOERE (Services d'Observation et d'Expérimentation et de la Recherche en Environnement) (Observation and Experimentation and Environmental Research Services). The purpose of this initiative is to encourage the creation of a network of multiple agency observation systems and the dissemination of available information. AllEnvi is responsible for their evaluation, organisation, approval and monitoring. The SOEREs are systems supported by one or more financial backers including research bodies and establishments and/or the MESR. The French systematic observation system has therefore been more organised since 2010.

**The system is progressive and aims to make existing observation systems permanent.**

## B. Research

This chapter presents the main research programmes on climate in France during the period 2009-2013.

### B.1 The climate system and past climates

Thanks to the efforts of researchers to understand the climate system, our planet more than ever appears as a whole in which climate depends on complex interactions between the ocean, the atmosphere, the cryosphere, the biosphere and human activities. Glaciological recordings provide information on the Earth's past climate conditions. By combining a temporal resolution to the fossilisation of physical and chemical characteristics of the atmosphere in the ice matrix, analyses obtained by French researchers have provided unquestionable advances in the understanding of the climate system and its variability.

#### B.1.1 A programme dynamic: LEFE

LEFE (Les Enveloppes Fluides et l'Environnement) (Fluid Envelopes and the Environment) is a national and inter-organisation programme on projects. It was created in 2006 and is coordinated and managed by the INSU. It assesses full scientific projects based on consolidated budgets, allocates resources and awards specific labels. It is co-financed by ADEME, the CEA, the CNES, the CNRS, EDF, the IGN, the INSU, IFREMER, INRIA, IPEV, IRD and Météo France, in liaison with the Ministry for Ecology.

Inter-organisation work (LEFE) supports research aimed at meeting the priorities defined for the 2011-2016 Ocean and Atmosphere long-term exercise and issues an annual call for tender. Research themes are based on the orientations of the major international research programmes and on the strengths of national laboratories.

Following the 2011-2016 Ocean and Atmosphere long-term exercise a large scale reorganisation of the LEFE programme was carried out. The EVE and IDAO projects, detailed in France's 5th national

communication were grouped together in a new project called IMAGO. These two projects in fact share numerous themes, including the study of processes controlling the variability of the atmosphere and the ocean mechanism. The ASSIM project, also detailed in France's 5th national communication extended its perimeter to mathematical and digital methods (MANU) for modelling and forecasting. Finally, the MCMG (Mercator Coriolis Mission Group) is now part of the LEFE programme.

The programme is organised around five projects related to the major international projects (cited below in italics):

- Atmospheric chemistry: CHAT (IGAC, SPARC);
- Biogeochemical, environmental and resource cycles: CYBER (IMBER, LOICZ, SOLAS, GEOTRACES, etc.);
- Mercator Coriolis Mission Group: MCMG (GODAE OceanView, ARGO, OSTST);
- Multiple interactions in the atmosphere, ice and oceanography: IMAGO (CLIVAR, GEWEX, CLICS, PAGES, AIMES, GCP (WCRP, WWRP, etc.);
- Mathematical and digital methods: MANU.

Typically 60 projects receive incentive funding from LEFE of about €2 million per year at a consolidated cost of €30 million<sup>3</sup>.

#### B.1.2 An example of projects: Past climates: The NEEM project (2007-2012)

NEEM is an international drilling project for extracting ice cores in the North West of Greenland. Announced in France's 5th national communication, the history of the climate has just been reconstructed over 130,000 years in Greenland thanks to the analysis of ice cores extracted during the NEEM drilling carried out by an international team of scientists involving France, the CNRS, the CEA, the UVSQ (Université de Versailles-Saint-Quentin-en-Yvelines), the University Joseph Fourier and the IPEV (Institut polaire français Paul Emile Victor). This drilling is a real success. The deepest drilling

<sup>3</sup> According to the CNRS statement «LEFE: Les enveloppes fluides et l'environnement» (Fluid envelopes and the environment) of 2009

previously carried out in Greenland was only able to cover the last 100,000 years (for GRIP and GISP drilling at the summit of the ice cap) and 123,000 years (for the NorthGRIP drilling).

Led by the University of Copenhagen and involving 14 countries, including France, the NEEM team drilled more than 2.5 km to the rocky base in two years, between 2010 and 2012. It therefore extracted the first complete recording of the Eemian, providing estimates of temperature changes, the amount of precipitation and atmospheric composition. For the first time in the Arctic, researchers have been able to recover ice formed during the last interglacial period, 130,000 to 125,000 years ago, marked by substantial Arctic warming. This study provides precious information for understanding the future development of the climate.

In France, the NEEM project mainly benefited from €1.2 billion in support from the CNRS, the CEA, the IPEV and the ANR.

### B.1.3 - Climate of the last millennium

#### The HistClim database: 2010

The new HistClim database (History of Societies and Territories in the face of Climate and Extreme events) was put on line at the start of October 2010 by the Quantitative History Research Centre (CRHQ-UMR CNRS University of Caen) and consists of over 10,000 items of French textual and instrumental data. HISTCLIME is the culmination of almost ten years of research on climate history financed by European cross-disciplinary projects FP7 Drought R&SPI and FP6 Millennium and French ANR and GIS «Climat Environnement Société» (Climate, Environment Society) projects.

HISTCLIME aims to present the specific methodological aspects and issues of climate history, in particular the contribution that this history can make to the current debate on climate change. The long term principles of research include the reconstruction of past climates and their variations over the course of the last 500 years, the study of extreme events as well as the reactions of past societies when confronted by climate risk.

HISTCLIME provides members of the public and scientists with a totally new historical database covering the period between the 15th century and the start of the 20th century. The very diverse climate history information contained in HISTCLIME exclusively concerns France, more specifically the North, the West, the Ile de France, Rhône-Alpes, the East, the Centre, Languedoc-Roussillon and Midi-Pyrénées.

#### The ESCARSEL project: 2007-2010

Launched in 2007, the ESCARSEL project (Evolution Séculaire du Climat dans les régions circum-Atlantiques et Réponse des systèmes Eco-Laustres) (Secular evolution of climate in the circum-Atlantic regions and response of Eco-lacustrine systems), uses a dual data/model approach and works over a sufficiently long time scale. Its objectives are to understand the past and future variability of climate, how the ecosystems studied will respond to these changes and to what type of change will they be more vulnerable. The ESCARSEL project is thus a fundamental research project coordinated by the CEREGE, and the LSCE, IMEP (Mediterranean Institute of Ecology and Palaeoecology), LOCEAN and CERFACS laboratories.

The project is focused on five pilot sites in Africa, South America and in Europe.

The total cost of this project is €4.7 million.

### B.1.4. Recent variability

#### The CLIMSEC project: 2008-2011

The CLIMSEC project carried out by the Météo-France Department of Climatology in partnership with the CNRM GAME (Groupe d'études de l'Atmosphère Météorologique) (Group of Meteorological Atmosphere studies), the CERFACS, the UMR SISYPHE (Mines Paris Tech) and the CEMAGREF, and with the support of the Fondation MIAF enabled the typology of drought in mainland France over the period 1958-2008 to

be characterised and tests to be carried out on their expected changes in the course of the 21st century.

The cost of this project is €374.5 thousand with €177.8 thousand in support from the Fondation MAIF.

### **OVIDE programme: 2002-2012**

OVIDE (Observatoire de la Variabilité Interannuelle et Décennale en Atlantique Nord) (Observatory of inter-annual and ten-year variability in the North Atlantic), developed since 2002, is a ten year programme to observe the currents and properties of the water masses of the subpolar gyre of the North Atlantic Ocean, and aims to gain a better understanding of the variability of the oceanic component of climate. The team is composed of 24 French, Spanish and Argentinian researchers from 6 bodies and universities including IFREMER and IPSL.

OVIDE contributed, as part of the European CLIVAR, IOCCP, CARBOOCEAN and CARBOCHANGE projects, to the observation of currents and properties of water masses in the North Atlantic. Data collected by the OVIDE surveys will improve our understanding of the impact of oceanic variability on the climate of Europe. Along a great radial between Portugal and the extreme south of Greenland, hydrological and geochemical measurements were made at certain predefined positions. The 2008 campaign also put about a dozen weather buoys and fifteen floats (international ARGO programme) in the water. These have supplied a temperature and salinity profile from a depth of 2000 m to the surface every ten days for three years.

The OVIDE programme was financed by IFREMER, the French LEFE programme coordinated by the CNRS/INSU and the European CARBOCHANGE project for a total cost of €7 million.

## **B.2 Climate modelling and forecasting**

In France, modelling and forecasting of climate change relies on a community of several hundred

researchers and engineers concerning the many aspects of the working of the Earth's climate. The current research issues in this area are to determine the phenomena and mechanisms governing the changes in the climate system and the various biogeochemical cycles and to assess the impact of human activities (emissions of GHGs and aerosols, land use, deforestation, etc.) on climate change at global and regional scales.

Covering the period 2007-2013, the seventh framework programme of technological research and development (FP7), with a budget of €53.2 billion over seven years supports climate research work by funding projects, to which France contributes, such as «Ensembles» (2004-2009 project), «Combine» (2009-2013, €7.9 million), «Euclid» (2010-2012), or «SPECS» (2012-2017, €8.2 million).

As part of the SCAMPEI project (detailed below) an original approach was developed to estimate snow coverage in France at the regional scale.

In addition, three groups of French researchers on climate modelling, the CNRM (Météo-France), the IPSL (CEA and CNRS) and the CERFACS participated in the IPCC simulation exercise as part of the CMIP5 project. For the first time this CMIP5 exercise includes a section on ten-year forecasting in which the French community participated as part of the EPIDOM project (detailed below).

### **B.2.1 IPSL and Météo-France climate modelling centres**

France has three climate models, one developed by Météo-France and CERFACS, another by the Institut Pierre-Simon-Laplace (IPSL) and a third developed by the LGGE (Laboratoire de Glaciologie et Géophysique de l'Environnement) (Laboratory of Glaciology and Geophysics of the Environment).

The contribution of the first two models to the next IPCC report is manifested by the running of new climate simulations as part of the CMIP5 project, covering a total of nearly 9000 years.

### B.2.2 The SCAMPEI project: 2009-2011

Launched in 2009, the purpose of the SCAMPEI project (Scénarios Climatiques Adaptés aux zones de Montagne : Phénomènes extrêmes, Enneigement et Incertitudes) (Climate Scenarios adapted to Mountain areas: extreme weather, snow coverage and uncertainties) is to provide a more precise answer to the issue of climate change in the mountainous regions of Metropolitan France. Producing regional climate scenarios is one of the major issues of climatological research. This work is carried out using models supplied by Météo-France, IPSL/LMD (Laboratoire de Météorologie Dynamique) (Dynamic Meteorology Laboratory) and LGGE (Laboratoire de Glaciologie et Géophysique de l'Environnement) (Laboratory of Glaciology and Geophysics of the Environment).

SCAMPEI receives funding of €555,000 from ANR for a total cost of €2.3 million.

### B.2.3 The EPIDOM project: 2010-2014

The EPIDOM project (Evaluation de la Prévisibilité Interannuelle à Décennales à partir des observations et des Modèles) (Assessment of Inter-annual to Ten-year Forecasting from observations and models) aims to estimate ten-year forecasting, its sources and its level of uncertainty, from the coupled model intercomparison Project phase 5 (CMIP5).

EPIDOM receives funding of €490,000 from the GICC for a total cost of €552,000.

## B.3 Impacts of climate change

Consistent with the major international programmes, French research on the impacts of climate change continues to make progress, by increasing the number of calls for projects since the last national communication and French involvement in European programmes such as the ERA-NET projects. The main programmes developed since 2009 are outlined below.

### B.3.1 The ERA NET CIRCLE 2 project

ERA-NET CIRCLE 2 (Climate Impact Research & Response Coordination for a Larger Europe) is a project of the European Commission's 7th framework programme for research, on theme 6 (Environment). Its main objective is to fund research projects on adaptation to climate change, share knowledge, promote cooperation between national and regional programmes on climate change, and share good practice on the subject of adaptation with national and European decision-makers.

In 2009 a call for research projects was launched in this context. It concerned «le changement (facteurs naturels et anthropiques) et les options de réponse dans les zones montagneuses» (the change (natural and anthropic factors) and response options in mountainous areas), including effects on water resources, infrastructure, soil stability, agriculture, tourism, public health and biodiversity.

In 2013 a new call for research projects was launched. Its aim was to encourage scientific cooperation between natural and social sciences in relation to adaptation to climate change in the water sector. This is a call by the Mediterranean ERA-NET CIRCLE-2 group. The Ministry for Ecology is associated with this call, one of the conditions of which is the formation of partnerships between French, Portuguese and Greek teams. The total budget for the call is €610 thousand.

### B.3.2 The ANR «ERA NET BIODIVERSA» project: 3 calls for proposals in 2011, 2012 and 2013

Although not specifically targeted on climate change the ERA NET BIODIVERSA programme launched in 2011 is worthy of mention. Its purpose is to study the effects of climate change on biodiversity in the next few decades. This objective represents a major challenge in view of its importance for the ecosystem services and human well-being.

Constructed under the FP7 ERA-NET plan, BIODIVERSA is a continuation of the «BIODIVERSITY» (3 calls for projects between 2005 and 2007) and

«6th extinction» programmes (1 call for projects in 2009). This programme is open to teams of scientists in 10 European countries for a total of €7 million. For France, the Agence Nationale de la Recherche (ANR) (National Research Agency) and the Office national de l'eau et des milieux aquatiques (ONEMA) (National Office for Water and Aquatic Environments) have confirmed their contribution of a total of €2 million.

### B.3.3 The GICC programme

The research programme «Gestion et Impacts du Changement Climatique» (GICC) (Management and Impacts of Climate Change) is one of the research programmes funded by the Direction de la Recherche et de l'Innovation (DRI) (Research and Innovation Department) of the Commissariat Général au Développement Durable (CGDD) (General Commissariat on Sustainable Development) of MEDDE. It was launched in 1999 by the Ministry for Ecology.

It provided funded a hundred research projects and emerging or innovative studies on the subjects of the impacts and adaptation to climate change since 1999. The first Plan national d'adaptation au changement climatique (PNACC) (National Plan for adaptation to climate change) adopted in July 2011 is partly based on the knowledge resulting from the programme.

The GICC programme is intended to:

- Develop knowledge relating to the identification and extent of the impacts of climate change;
- Providescientificbasedresponses to questions raised by national, European and international policy authorities on the implementation of national climate policies;

Perfect tools and methods that will enable the authorities to optimise prevention and adaptation strategies to deal with current or future consequences.

It therefore helps to develop the necessary understanding for the public debate and it is

supplementary to other major research programmes in France (ANR for example) or in Europe (ERA-Net CIRCLE2, JPI Climate).

Two subjects were highlighted in the last call 2012-2015:

- An integrated approach which explores new methodologies and new tools useful for adaptation strategies and actions by relying on the AR5 models and scenarios as and when available;
- A regional approach giving priority to co-construction by researchers and decision-makers and transfer to stakeholders.

#### Example: The FAST project (2009-2013)

The aim of the FAST project is to analyse various scenarios of change in the composition and spatial distribution of French forests over the next few decades. Several realistic hypotheses crossing climate scenarios and forest management itineraries were chosen for creating simulations with a high spatial resolution up to 2100. The effect of biotic attacks was also taken into account in an exploratory way for some typical cases including Pine Processionaries.

The project started at the end of 2009 for a period of 2 years. It received €330,000 in subsidies from the GICC for a total cost of €1,716,000.

### B.3.4 The ANR «CEP&S» programme: 2010-2011

The ANR CEP&S programme (Changements Environnementaux Planétaires et Sociétés) (Global Environmental Changes and Impact on Society) is structured on four key themes:

- Societies and Territories in the face of Global Environmental Changes - Vulnerability, Adaptation and Mitigation;
- Global Environmental Changes and interactions with ecosystems and their biodiversity;
- Natural resources and food security in the context of Global Environmental Changes;
- Global Environmental Changes and effects on health.

The 2010 call for projects provided funding for 12 projects for a total of about €9.5 million.

**Example: The GREENLAND project: 2011-2013**

This project relates to impacts of climate change and variability in the coastal area of Greenland («green Greenland»). It combines a human science approach (History of the environment and climate, environmental psychology, geography, archaeology) and a climate and environmental science approach (observation of atmospheric composition, reconstruction of palaeo-climates and palaeo-environments, modelling of global to regional climate, detection and attribution of climate change, modelling of vegetation and mass balances of glaciers). The project is part of several international programmes focused on the observation of the Arctic. It receives €1.2 million in financial support from the CEP&S programme.

**Example: The COCORISCO project: 2011-2014**

The COCORISCO project has been financed since 2011 for a period of three years by ANR as part of the CEP&S programme for an amount of €1 million. It combines a team of researchers from different disciplines (Geology, Geomorphology, Geography, Ethnology, Law, Economics and Psychology of the Environment) bringing together six research laboratories (Laboratoire GEOMER – Université de Bretagne occidentale, Laboratoire Domaines Océanique – Université de Bretagne occidentale, Institut de Géoarchitecture – Université de Bretagne occidentale-, UMR Aménagement et usage des ressources de l'environnement (Development and use of environmental resources) – Université de Bretagne occidentale, Centre de Recherches en Psychologie, Cognition et Communication – Université de Bretagne occidentale, Laboratoire de Science de la Terre – Université Lyon 1) and two design and engineering firms (ALLEGANS network, GEOS AEL).

Its aim is to understand the vulnerability of coastal areas to the risks of erosion and submersion and to move towards prevention and management strategies.

**Example: The ORACLE project: 2011-2015**

The ORACLE project (Opportunités et Risques pour les Agro-écosystèmes et les forêts en réponse aux changements Climatique, socio-économiques et

politiques en France et en Europe) (Opportunities and Risks for Agro-ecosystems and forests in response to climate, socio-economic and political change in France and Europe) has been financed since 2011 for a period of 4 years by ANR as part of the CEP&S programme for an amount of €1,199,996.

ORACLE is a multidisciplinary project involving climatologists, agronomists, foresters, economists, hydrologists and statisticians. Many partners are involved in this project (LSCE, CNRM/GAME, INRA, CNRS) which has the ultimate aim of contributing to the fifth report of the IPCC.

ORACLE aims to provide spatially explicit assessments of future changes in terms of the operation of agro-ecosystems and land use in France at high resolution (8x8 km<sup>2</sup>) and in Europe at average resolution (50x50 km<sup>2</sup>). These evaluations will rely on the development of data and tools enabling the links between climate change, land use change and public policy change to be studied.

## **B.4 Socio-economic analysis of the impacts and responses to climate change**

The increasing anthropic use of natural resources causes global environmental changes which have impacts on human societies: health, food resources, socio-economic development, security, etc. The programmes presented in this section attempt to assess the economic and social impacts of climate change and to provide reliable, operational and relevant solutions.

### **B.4.1 The ANR «Changements Environnementaux Planétaires» (CEP) (Global Environmental Changes) programme**

The purpose of this ANR-funded programme is to develop long-term or retrospective research on the study of processes and impacts, and also to encourage research on changes in various economic, social and ecological systems, interacting under the effect of global change, in order to provide projections, especially over the

next 30 to 100 years. The programme covered the years 2009, 2010 and 2011. It allocated a budget of between €500,000 and €1.5 million per selected project. It was also positioned at the interface with the following programmes: «6e extinction» (6th extinction), «Contaminants-Ecosystèmes-Santé» (Contaminants-Ecosystems-Health), «Villes Durables» (Sustainable Towns) and «Systèmes complexes» (Complex systems), and was designed as a continuation of the «Vulnérabilité : milieux, climats et sociétés» (Vulnerability: environments, climates and societies) programme which was the subject of three calls for projects between 2006 and 2008.

As the CEP project was essentially intended to link international partnerships it was open to international consortia and in particular teams from developing countries. For example, the 2009 call for projects was open to Franco-Brazilian projects.

#### B.4.2 The ANR «Risques Naturels : Compréhension et Maîtrise» (Natural Risks: Understanding and Managing) programme

The ANR proposed two calls for tender for the RiskNat programmes, in 2008 and in 2009. The twelve projects in line with the 2008 call received an average of €540,000, i.e. a budget of €6.5 million in total for the first publication. The objective of this programme is to reduce the human, physical, social and economic impacts of rapidly occurring natural hazards.

The range of research areas tackled by this programme is extensive and includes:

- A quantitative estimate of these natural hazards, especially probabilistic;
- An analysis of different vulnerabilities (physical, social, economic, organisational): methods of estimation, interactions, means of reduction, cost/benefit studies;
- Precision of risk acceptability and management of uncertainties;
- Improvement of early warning and rapid reaction procedures;
- Technological innovations concerning the measurement, transmission and analysis of

relevant parameters (precursors, indicators of harmfulness, etc.).

The programme was a response to the need to ensure the transfer of skills. RiskNat was therefore also directed at the various stakeholders involved in operational risk management (MPs, local authorities, State services, manufacturers, insurance companies, design and engineering firms, etc.).

#### B.4.3 The ANR «Villes Durables» (Sustainable Towns) programme

The sustainable town is a research area relatively unexploited as a whole by the research community (example of the 7th FPRD), covering many themes and mobilising a great deal of scientific knowledge. By encouraging the emergence of highly multidisciplinary project consortia, the «villes durables» programme aims to make our towns more compatible with sustainable development, by consolidating the corpus of knowledge, developing new tools for practitioners (methodologies to aid decision-making and assessment, etc.) and helping businesses that model the framework of urban life (engineers, service offerers, infrastructure designers and managers, etc.) to take better account of the three aspects of sustainable development in their service offer.

The three-year (2008-2010) programme financed eleven projects in 2008 for a total of €8.2 million, of which 30% was given to businesses.

#### B.4.4 The ANR «Contaminants, Ecosystèmes et Santé» programme (Contaminants, Ecosystems and Health)

The 24 projects selected by the 2008 call for projects received a total budget of €11.2 million, i.e. €450,000 per project. The core of the programme only marginally concerns climate change. However, it must be envisaged in relation to the ANR «Changements environnementaux planétaires» (CEP) (Global Environmental Changes) programme opened in 2009 for aspects linked to the pathologies generated by climate change.

#### B.4.5 The ADEME «Prospective et socio-économie» (Long-term socio-economic) programme

The budget devoted to this programme over the period 2007-2010 is €4 million. The programme has three objectives:

- Improving skills and strategies of stakeholders, by monitoring the changes of opinion, values and practices of the French people and by analysing the interactions of stakeholders and the capacities for change of consumers, businesses and public authorities;
- Continuing to develop skills in the areas of design, analysis and evaluation of public policy tools of an environmental nature in order to achieve the best adaptation to institutional, economic, social and political changes;
- Constructing long-term macro-economic, sectoral, regional and technological views in order to base public policies and identify priority research subjects on consistent, shared long-term views.

The nature of research work and the way it is managed and promoted must be such as to encourage new teams to tackle these issues, to encourage collaboration between French teams and between French and European teams, to create a durable dialogue between researchers and policies so that the research results will be better used, for example in the (re)definition of energy and environmental policies, and to encourage greater consideration of energy and environmental themes in higher education and continuing professional development.

#### B.5 Preparation of climate services

Recent advances in science and climate modelling are a source of information which is still largely unexploited, particularly in relation to their benefit for the development or maintenance of socio-economic activities in the context of future climate change. The third World Climate Conference, held in Geneva in September 2009, launched the concept of climate services by putting international discussions on climate on the agenda for the first time. The term climate services covers a wide

variety of potential uses: information on climate change and its effects, supply of data from climate models (raw or extracted in the form of adapted indicators), design of more developed products meeting sectoral or individual needs.

This new section presents the main projects set up, mainly concerning the provision of data from climate models (regional and global data; raw or developed).

##### B.5.1 The ANR «SECIF» project: 2011-2014

Launched in 2011, the SECIF project (Vers des Services Climatiques pour le secteur Industriel Français) (Towards Climate Services for the French Industrial Sector) is in line with the continuity of initial experimental thinking carried out in partnership with IDDRI (Institut du Développement Durable et des Relations Internationales) (Institute of Sustainable Development and International Relations) and the GICC programme on the issue of vulnerability to climate change of industrial and service businesses. Among other things this collaboration has resulted in the identification of targeted needs within some businesses in terms of climate products and expertise.

Firstly, work was carried out for two target sectors: the energy and water sectors. The work proposed in this project is therefore an exploratory step towards the implementation of climate services for French businesses. These services will eventually enable data and knowledge about climate change to be better integrated in industrial adaptation strategies.

SECIF has been financed for three years since 2011 by ANR (about €900,000) as part of the CEP&S 2010 programme. It involves various partners such as ARIA, IPSL/CNRS, CNRM/GAME, CLIMPACT, EDF, IDDRI, INSA Strasbourg and VEOLIA EAU.

##### B.5.2 The Drias les futurs du climat portal: 2008-2013

Launched by the GICC programme in 2008, the Drias les futurs du climat (<http://www.drias->

climat.fr) project has been open since July 2012 and enables all stakeholders concerned by adaptation to climate change to have access to and use climate data and information produced by climate research laboratories. It makes it easier to view and obtain data and products resulting from digital climate simulation models.

In line with the Plan National d'Adaptation au Changement Climatique (PNACC) (National Plan for adaptation to climate change), the DRIAS project (Donner accès aux scénarios climatiques Régionalisés français pour l'Impact et l'Adaptation de nos Sociétés et environnement) (Giving access to French regional climate scenarios for the impact and adaptation of our societies and environment) has received substantial support from the Ministry for Ecology; particularly through the GICC (Gestion des impacts au changement climatique) (Management and Impacts of Climate Change) research programme. It was developed by Météo-France in collaboration with researchers from French laboratories (CERFACS, IPSL), in close partnership with users from the regional authorities, the research world, large manufacturing groups or SMEs, design and engineering agencies or associations.

During 2013-2014 the portal was extended to include the Overseas Departments and Territories and will offer the results of the Climsec project, which studied the effects of climate change on water resources and droughts in Metropolitan France.

A wide range of possible futures for the French climate in the 21st century is accessible through the Drias les futurs du climat portal and the ONERC website, which has:

- Various scenarios: Drias les futurs du climat is based on the scenarios used by the IPCC (A1B, A2 and B1).
- Various models: agreement between the results produced by different models (French, Canadian, German or American) makes it possible to assess the robustness of an analysis.
- Different temporal horizons: Drias les futurs du climat groups the end points of future

projections at various ranges (short range: 2035; medium range: 2055; long range: 2085)

- Different parameters accessible in the «Le Climat du XXe siècle» (20th Century Climate) publications: 24 standard climate parameters and indicators are available on the basis of temperature and rainfall projections (minimum and maximum temperatures, number of days of frost, number of days of heavy rainfall, total precipitation, daily rainfall, etc.). Values are presented by month, season and year, with a spatial resolution of the representation grid of 8 km (for the most detailed).

The total cost of the Drias project is about €628,000.

### B.5.3 The AGRI BALLYSE project: 2010-2013

Resulting from the desire to pool and improve knowledge on the environmental impacts of agricultural products ADEME decided to launch a programme to make Inventaires de Cycle de Vie (ICV) (Life-cycle inventories) and Analyses de Cycle de Vie (ACV) (Life-cycle analyses) of agricultural products, called Agri-BALYSE. This three-year programme was mounted in close collaboration with partners from the research environment (INRA, Station de Recherches Agroscope Reckenholz-Tänikon ART and CIRAD) and the agricultural world (technical institutes of all agricultural sectors).

The aim of the Agri-BALYSE programme is therefore to create a database of the ICV and ACV of agricultural products. The database should be public and as homogeneous as possible between agricultural products. It will enable a method suitable for the agricultural sector to be designed, that is both consensual and standardised between branches, to encourage its implementation by a larger number of operators. In addition, this database will provide visibility of French studies on the international scale.

The programme has a budget of about €700,000.

## B.6 Technological research for mitigation of and adaptation to climate change

ANR and ADEME are the two main agencies financing French technological research. These agencies use a large number of programmes covering all subject fields linked to the development of environmental technologies: sustainable development, engineering and production cycles, CO<sub>2</sub> storage, transport and biological resources.

In order to promote the development of technologies, Investissement d'Avenir (Investment for the Future) programmes have been launched since 2010, thereby adding to the research demonstrator funds entrusted to ADEME since 2008. Demonstrator funds are described below.

Created in 2008 as a continuation of the Grenelle Environment Round Table, demonstrator funds for research on new energy technologies (NET) are intended to finance research demonstrators. This fund has a budget of €325 million for the period 2009-2012. Demonstrators constitute an important step in the research, development and industrialisation processes of technologies. This step comes after the laboratory research stage and before the industrialisation stage. The demonstrator thus enables technologies to be produced and tested in order to optimise them and validate their feasibility and performance. It can also refer back to earlier research if necessary.

Since the creation of research demonstrator funds, ADEME has published several calls for expressions of interest (CEI) which were examined in 2009 and 2010 on the following subjects:

- The transport sector provides specific support for the production of vehicle prototypes with low greenhouse gas emissions and hybrid vehicles implementing new chain drive designs. 11 projects were financed in 2008 for a total of €57 million in financial support, 6 projects in 2009 for €24 million and 12 projects were examined in 2010 for an amount of €52 million.
- The energy sector uses the demonstrators

in a general way, and in particular for the development of geological CO<sub>2</sub> capture and storage technologies, the production of second or third generation biofuels (development of processing technologies for converting a wider range of resources into biomass: agricultural and forestry resources, dedicated crops, waste, etc.), or for new renewable energy or energy converter sectors (marine energies for example).

- In the second generation biofuels sector, 2 projects were examined in 2009 for a total of €49 million.
- For the geological capture and storage of carbon, 4 projects were examined for a total of €45 million.
- In the marine renewable energies sector, 21 projects were examined in 2009.
- For intelligent electrical systems and networks incorporating renewable energies, 20 projects were examined in 2010.

In 2009, €151 million were committed as part of research demonstrator funds. These projects account for an R&D budget in the order of €600 million committed by project partners: manufacturers and research bodies.

The programmes presented in this section are a continuation of those presented in France's fifth national communication. Some modifications have been made to the key development areas and objectives in order to better respond to current needs.

### B.6.1 Sustainable energy

#### 1. The ANR «BIO-Matières et Energies» (Bio-materials and Energies) programme: 2012-2013

ANR has been financing projects in the bioenergy field since 2005 by means of three successive programmes: the Programme National de Recherche sur les Bioénergies (National Programme of Bioenergy Research) (PNRB, 2005-2007 publications), the Bioénergies (Bioenergy) programme (Bio-E, 2008-2010 publications) and the Bio-Matières et Énergies (Biomaterials and Energies) (Bio-ME, 2012-2013). Some 69 projects

have been funded since 2005 for a total of €55 million in subsidies.

Of all the renewable energies biomass has the greatest potential for reducing atmospheric CO<sub>2</sub> emissions. Biomass can be used for energy purposes by the utilisation of both materials and energy, in particular, by the development of plant chemistry applications (platform molecules), in the concept of bio-refineries. The thermochemical or biological processing of biomass not only provides biogas and synthetic fuel gas that can be used in cogeneration plants but also enables second and third generation biofuels to be developed for use in the transport sector.

The Bio-ME Programme also aims to support scientific and technical projects in support of demonstrators set up for the industrial development of second generation sectors, in particular, by reinforcing the initiatives of SMI-SMEs in this area.

## **2. The ANR «Systèmes énergétiques efficaces et carbonés» programme: (Efficient Carbon Energy Systems)**

The SEED «Systèmes énergétiques efficaces et carbonés» (Efficient Carbon Energy Systems) programme is in line with the general issue of increasing energy efficiency in industry and reduction of CO<sub>2</sub> emissions. It is based on the mechanisms started as part of the EESI programmes (Efficacité Energétique et réduction des émissions de CO<sub>2</sub> pour les Systèmes Industriels) (Energy Efficiency and reduction of CO<sub>2</sub> emissions for Industrial Systems) begun in 2009, the CO<sub>2</sub> (Captage et Stockage du CO<sub>2</sub>) programme (CO<sub>2</sub> capture and storage) that was the subject of calls for projects between 2005 and 2008, the Stock-E programme (Stockage innovant de l'énergie) (innovative energy storage) for thermal aspects, the H-PAC programme for the production of hydrogen from fossil fuels and the HABISOL programme for energy efficient buildings. All these programmes were presented in France's fifth national communication.

It has the purpose of stimulating research in the area of energy efficiency of components and systems in industry and buildings, with a view to reducing

the consumption of primary energy and cutting greenhouse gas emissions. It is also interested in the development of CO<sub>2</sub> capture and storage technologies. The SEED programme helps towards achieving the objectives of the European Climate - Energy Package of improving energy efficiency by 20% and reducing greenhouse gas emissions by 20% by 2020, and also reducing greenhouse gas emissions in France by a factor of four by 2050.

This programme is organised on three key subject areas:

- Efficiency of energy systems;
- Transfer, transport, storage and utilisation of calorific energy;
- CO<sub>2</sub> capture, storage and utilisation (CCSU).

The 2011 call for projects provided funding for 13 projects for a total of more than €9.7 million. The 2012 call for projects provided funding for 10 projects for a total of €8 million.

## **3. The ANR «PROGELEC» programme: 2011-2013**

The aim of the PROGELEC programme «PROduction renouvelable et Gestion de l'ÉLECTricité» (Renewable production and management of electricity) is to promote research on the production, storage and management of electricity. It is in line with ANR's new energy programme (2011-2013). It is largely based on the foundations of the three old programmes: Habitat Intelligent et Solaire Photovoltaïque (HABISOL) (Intelligent Habitat and Solar Photovoltaic power), Stockage Innovant de l'Énergie (Stock-E) (Innovative energy storage) and Hydrogène et Piles à Combustible (H-PAC) (Hydrogen and fuel cells).

In 2012, the call for projects provided funding for 14 projects for a total subsidy of more than €10 million.

## **4. The «ADEME-TOTAL» programme on energy efficiency in industry: 2009-2013**

The ADEME and TOTAL programme on energy efficiency consists of supporting the demonstration of innovative technologies enabling the energy efficiency of cross-sector industrial technologies to be improved.

ADEME and TOTAL decided to get involved in managing and funding a programme to support the development of cross-sector energy-saving utilities and processes by public or private research teams, SMEs and large corporations, with a view to strengthening the R&D efforts in this currently under-supported sector. This programme is manifested by recurrent calls for expressions of interest (CEI) on demonstrator projects that concern industrial utilities and cross-sector industrial processes in the following areas of application:

- Recovery and utilisation of thermal waste;
- Energy storage;
- Heat exchangers;
- Ovens, boilers;
- Separation and drying processes;
- Electrical equipment and industrial thermal equipment;
- Energy integration.

#### **5. The ADEME «Bioressources, Industries et Performance» programme: 2008-2013**

The BIP programme «Bioressources, Industries et Performance» (Bioresources, industries and performance), launched for the first time in 2008, is devoted to the acquisition of new skills to support improvements to be made to the assessment of global impacts and balances (energy, mass, environmental, economic).

This programme is organised according to 3 key areas:

- Biofuels;
- Plant chemistry;
- Production of clean renewable energy from biomass.
- In 2012 the budget for this project was about €4 million

#### **B.6.2 Engineering and production cycles**

R&D projects on eco-innovation and environmental technologies have developed a great deal. This area aims to improve the environmental efficiency of production systems, reduce pressure on natural environments and improve management of the use of resources.

#### **1. B.3.4 The ANR «ECO-TS» programme: 2012-2013**

The ECO-TS programme was launched in 2012 and takes over from the ECOTECH programme (3 publications from 2009 to 2011). The 2011 call for projects provided funding for 14 projects for a total subsidy of more than €10.38 million. This programme aims to reinforce the French community in the eco-innovation area. The ECO-TS programme is moving towards technology and design of technology and services for future markets linked in particular to the impacts of global change and anthropic pressure on natural resources.

#### **2. B.3.4 The ANR «ERA-NET ECO-INNOVERA» programme: 2011-2012**

ECO-INNOVERA's first call for transnational projects in 2011 was intended to bring out projects on the subjects of eco-innovation, processes, sustainable products and recycling. ERA-NET involves 24 national and regional organisations in 18 countries, including ADEME and ANR for France. Under this programme ANR supports 3 projects, for an amount of €790,000.

The main issues of this programme are as follows:

- Economic: improving dependence on resources, energy, recycling;
- Environmental: participating in setting up a sustainable to zero environmental impact industry and moving from environmental concern to environmental development;
- Social: predicting social changes in relation to environmental issues and their development, behavioural changes, new needs and uses, promotion of associated eco-innovation;
- Political: making clear and realistic recommendations for public policies concerning the measures to be taken to promote the implementation of eco-innovation throughout the value chain and its spread through society.

#### **3. B.3.4 The ANR «CORTEA» programme: 2011**

ADEME's CORTEA research and development programme «Connaissances, Réduction à la source et Traitement des Émissions dans l'Air»

(Knowledge, Reduction at source and Treatment of Emissions in the Air) aims to bring out projects oriented towards improving indoor and outdoor air quality, consistent with the agency's work in the agriculture, construction, industry and transport sectors. Launched for the first time in 2011, CORTEA's annual call for projects has so far financed 37 R&D projects for a total of €7.5 million.

CORTEA helps to support developments enabling the air quality objectives of the second Plan National Santé Environnement (PNSE2) (National Environment and Health Plan) to be achieved. This plan comprises the national commitments on health and the environment over the period 2009-2013. The PNSE2 defines the priority actions for reducing the health impacts of the deterioration of the environment. CORTEA also provides shared benefits on other issues linked to pollutant emissions such as acidification or eutrophication of environments and the formation of ozone in the lower layers of the atmosphere.

### B.6.3 Storage of CO<sub>2</sub>

#### 1. ADEME's «Stock CO<sub>2</sub>» (CO<sub>2</sub> storage) programme

The aim of the geological CO<sub>2</sub> storage programme is to support applied industrial research and experimental development projects. The aim of this programme is to develop and test monitoring and remediation tools and to study the potential environmental and health impacts in order to ensure controlled deployment of CSC (Carbon Storage and Capture)<sup>4</sup> by 2025 and the safety of geological CO<sub>2</sub> storage sites.

As part of the STOCKCO<sub>2</sub> 2012 programme 2 projects have been supported with funding of €409,000 (total cost €733,000). In 2011, 3 projects received €934,000 in financial aid (total cost €2.27 million) and in 2010, 2 projects received €697,000 in financial aid (total cost €1.38 million).

<sup>4</sup> Continues from the Capture et Stockage du CO<sub>2</sub> (CO<sub>2</sub> storage and capture) programme of France's fifth national communication.

### B.6.4 Transport

Due to its dependence on fossil fuels and the extent of its CO<sub>2</sub> emissions transport is one of the top priorities for technological research into mitigation and adaptation to climate change. Exclusively linked to land transport up to 2011 this research has expanded to air and sea transport.

#### 1. B.3.4 The ANR «TDM» programme: 2012

The Transports Durables et Mobilité (TDM – 2012) (Sustainable Transport and Mobility) programme is a development of the Transports Terrestres Durables (TTD – 2011) (Sustainable Land Transport) and Véhicules pour les Transports Terrestres (VTT – 2008-2009-2010) (Vehicles for Land Transport) programmes cited in the fifth national communication. It is dedicated to research on the basic elements required for technological advances in transport. For its first publication in 2011 the TTD programme tackled the vehicle/infrastructure and user interfaces of modes of transport. It concerned all modes of land transport (road, rail, inland waterway) and all their applications (private individuals, professionals, passengers and goods).

The 2012 publication of the TDM programme is open to air and sea sectors on shared research themes with the land transport sector so as to promote a cross-fertilisation effect. It thus aims to improve communication between the scientific communities of the various sectors and thus promote synergies between these communities and bring out new types of projects benefiting from the appearance of scientific and technological breakthroughs.

### B.6.5 Biological resources

#### 1. B.3.4 The ANR «NET-BIOME» programme: 2011

ERA-NET's Net-Biome combines the European Overseas authorities of tropical and sub-tropical areas (which have exceptional biodiversity) that are more vulnerable than the rest of Europe to climate change, natural hazards and pressure from human activities. Launched in 2011, ANR has allocated an estimated €1.8 million in grants to 7 projects.

Biodiversity is an essential asset for economic development. The European Overseas authorities are developing original strategies and models that could beneficially be shared with or transposed to continental Europe, such as adaptation to climate change and anthropic pressure or integrated sustainable management and conservation of biodiversity. The aim is to initiate and stimulate cooperation and coordination of research programmes for sustainable and integrated management of biodiversity in support of sustainable development. The Net-Biome call for projects combines the Overseas authority partners of ERA-NET with the national agencies of France (ANR) and Portugal (FCT).

### **2. B.3.4 The ANR «AGROBIOSPHERE» programme: 2011-2012**

The Agrobiosphere programme is based on a better understanding of the ecological working of productive systems. It aims to enlarge the range of technological, economic and social solutions that may be mobilised to resolve the viability and adaptation problems of productive ecosystems to global changes.

Calls for projects in 2011 and 2012 permitted 16 projects to be funded for a total of €10.3 million in financial aid.

### **3. B.3.4 The ADEME REACTIF programme:**

The (APR) REACTIF (REcherche sur l'Atténuation du Changement Climatique pour l'agriculture et la Forêt) (Research on the Mitigation of Climate Change for agriculture and Forestry) call for projects launched by ADEME in 2011 aims to improve knowledge of the contribution of agriculture and forestry to the fight against climate change (mitigation, production of biomass and energy efficiency).

The three priority areas identified target the various scales of analysis and intervention: from plot to region. They are separated for research and problem issues and will supply and enrich each other with the aim of proposing global improvement pathways for agriculture and forestry

on the issues of the fight against climate change and the growing shortage of fossil fuel resources.

Area 1: process scale (soils, forests, animals and effluent), the objectives of which are to increase knowledge about GHG flows and carbon stores in agriculture and forests in order to improve inventories and evaluation tools.

Area 2: agricultural and forest systems scale, the objectives of which are to improve methods of assessing GHG balances and identify systems and practices that contribute to the fight against climate change and improving energy efficiency. Insofar as possible the proposed projects should also include other issues (environmental, economic and social).

Area 3: regional scale, the objectives of which are to propose new regional agricultural and forestry organisations, in connection with other policies, in order to combat climate change more effectively.

Following this first call for projects, 36 projects have been received and 15 selected for funding. The selected projects include several concerning GHG flows and carbon stores in soils in connection with the management of crops, grasslands or forests on the plot scale and regional scale, others are trying to establish the GHG balances of French forests and finally some are aiming to improve the environmental balances of livestock farming.

## **C. Systematic observation**

France is participating in the Global Climate Observing System (GCOS). This climate observation programme operates under the aegis of the World Meteorological Organisation (WMO, [www.wmo.int/pages/prog/gcos](http://www.wmo.int/pages/prog/gcos)), the International Council for Science (ICSU), the Intergovernmental Oceanographic Commission (IOC) and the United Nations Environment Programme (UNEP). The purpose of the French national GCOS communication is to verify that the French system enables the climate to be monitored (spatial resolution, temporal frequency, working condition) and complies with specific aspects relating to

the Climate Convention (Rio, 1992) and the Kyoto Protocol (1997).

GCOS is a composite observation system comprising four observation areas with specific networks: the atmosphere, the ocean, land networks (glaciers and carbon flows) and space. These areas will be tackled in succession in the next four paragraphs.

### Observation Services

On the national scale, the Observation Services are services approved by the 'Institut National des Sciences de l'Univers (INSU) (French National Institute of Universal Sciences) and managed by the Observatoires des Sciences de l'Univers (OSU) (Universal Sciences Observatories).

Since 2010, MESR (Ministry of Higher Education and Research) has developed the concept of SOERE (Services d'Observation et d'Expérimentation et de la Recherche en Environnement) (Observation and Experimentation and Environmental Research Services). The purpose of this initiative is to encourage the creation of a network of multiple agency observation systems and the dissemination of available information. ALLEnvi is responsible for their evaluation, organisation, approval and monitoring. The SOEREs are systems supported by one or more financial backers including research bodies and establishments and/or the MESR. The French systematic observation system has therefore been more organised since 2010.

**The system is progressive and aims to make existing observation systems permanent.**

### Observation systems

Météo-France occupies a central place in the systematic observation system due to its history, its links with the WMO and its location. This body represents France on a number of European and international forums due to its climate observation role. At the same time as managing its networks, it carries out important work in finding and restoring long series of climate data from written archives.

Meteo-France took all ten GCOS principles (GCOS Monitoring Principles) into account for all its

observation networks and stipulated them in specific quality management actions for Observation. At the same time as managing its networks, it carries out important work in finding and restoring long series of climate data from written archives.

On French territory there are:

- 70 long homogenised hundred-year series of monthly temperatures, with fairly uniform coverage of the country, including the 6 GSN stations.
- 27 homogenised hundred-year series of monthly pressure;
- 18 homogenised hundred-year series of monthly insolation;
- about 250 homogenised series of at least one hundred years of monthly precipitation, but with unequal coverage of the country.

In addition, daily reference series were drawn up, relating to shorter homogeneous periods.

## C.1 Essential climate variables in the atmospheric domain

### C.1.1 The GCOS surface network (GSN)

The GCOS surface network (GSN) includes the following **6** stations in **Metropolitan France**: Rennes, Strasbourg-Entzheim, Bourges, Toulouse-Bagnac, Marseille-Marignane and Mont-Aigoual. The latter was selected as a mountain station. These stations are part of the Regional Basic Climatological Network (RBCN) at WMO level for the dissemination of data. Daily data is regularly supplied to the World Climate Centre at Asheville (USA) in the form of CLIMAT<sup>5</sup> messages.

**36** other RBCN stations in mainland France also produce CLIMAT messages (see DSO catalogue). **For Overseas France**, the GSN network comprises the following **19** stations:

- French Guyana: Cayenne-Rochambeau.
- Guadeloupe: Le Raizet.
- Indian Ocean and French Southern Territories: Dzaoudzi-Pamanzi (Mayotte), Martin de

<sup>5</sup> Name for messages sent to the WMO.

Vivies (Amsterdam Island), Port-aux-Français (Kerguelen Island), Europa (Scattered Islands), Alfred-Faure (Crozet Island), Dumont d'Urville (Antarctica).

- New Caledonia: Koumac, Nouméa, Hififo (Wallis Island).
- French Polynesia: Bora-Bora, Faaa, Mangareva, Hereheretue, Hiva-Oa, Rapa, Takaroa, Tubai.

8 other stations of the RBCN network for Overseas France produce CLIMAT messages: Le Lamentin, Saint Georges de l'Oyapock, Saint Laurent du Maroni, Maripasoula, Gillot, Glorieuses Islands, Juan de Nova, and Tromelin.

The data is permanently archived within the national climate database. Access is possible via NCDC Climate Data on-line (<http://www.ncdc.noaa.gov/cdo-web/>) or the Météo-France Climathèque service (<http://climatheque.meteo.fr/okapi/accueil/okapiWeb/index.jsp>).

Météo-France sets out to encourage collaboration such as collaboration with the services of the Ministry for Ecology in order to optimise observation of rainfall: the Salamandre system (Stations pluviométriques AutoMatiques mises en œuvre pour la Direction de l'Eau) (Automatic Rainfall Stations set up by the Water Board). In this respect the deployment of automated stations for forecast floods, begun in 2006, was completed in 2009 with one hundred stations having been set up.

### C.1.2 The altitude network

#### Radiosonde investigations

This network concerns measurement at altitude (radiosonde investigations). Metropolitan France has no GUAN station, but the RBCN's 7 altitude stations (Brest, Trappes, Nancy, Lyon, Bordeaux, Nîmes and Ajaccio) issue CLIMAT TEMP<sup>6</sup> messages. They include the following 12 stations in Overseas France:

- French Guyana: Cayenne-Rochambeau.
- Indian Ocean and French Southern Territories: Serge Frolow (Tromelin Island), Martin de Vivies (Amsterdam Island), Port-aux-Français (Kerguelen Island), Dumont d'Urville (Antarctica);
- New Caledonia: Nouméa;
- French Polynesia: Hiva-Oa, Tahiti-Faaa, Rapa.

Three other Overseas stations of the RBCN network send out CLIMAT TEMP messages: Le Raizet, Mangareva, Takaroa.

#### AMDAR airborne measurements (Aircraft Meteorological Data Relay)

To enrich their data on the state of the atmosphere at altitude meteorologists use airborne pressure, temperature and wind measurements using instruments on board aircraft. Since 2001, as part of the E-AMDAR (EUMETNET AMDAR) project the European association of meteorological services has provided Europe with data collected from voluntary companies.

Data with frequency ranging from 10 seconds to 2/3 minutes depending on altitude is communicated to the WMO. These measurements enable the number of radiosonde investigations to be reduced.

#### Measurements at sea

Of the 67 boats taking measurements in 2012 between le Havre and the French West Indies, four were carrying out radiosonde investigations. Balloons are also released twice a day. The data is incorporated into the WMO information system. Ships are progressively being equipped with a BATOS automatic weather station developed by Météo-France. Atmospheric observation is sometimes combined with oceanic observation.

### C.1.3 The GAW physical - chemical network

#### Network of physical and chemical measurements of the atmosphere (NDACC/GAW)

The GAW (Global Atmosphere Watch) network concerns physical and chemical measurements of the atmosphere. It consists of the following four observation stations in Metropolitan France:

<sup>6</sup> CLIMAT TEMP is the code used for monthly aerological synoptic averages from a land station.

Abbeville, Gourdon, Carpentras and the Observatoire de Haute Provence (OHP). The GAW/BAPMoN network, managed by Météo France, aimed to monitor the chemical composition of precipitation (the acidity of precipitation to be precise). It was set up in France in 1977 with 6 regional stations. Because the network was automated in 1988, 3 were operational in 2009 (Abbeville, Carpentras and Gourdon). However, the environment of measurement stations has changed and no longer complies with the recommendations on the positioning of sampling sites, in particular with respect to the minimum recommended distance from potential sources of pollution. This network was therefore closed in 2010. Ozone measurements (total columns and profiles) are regularly taken by the Aeronomics Department of the CNRS at the OHP and at Dumont d'Urville (Antarctica), Saint Denis in Réunion (in collaboration with the University) and in the Kerguelen Islands as part of the ORE/NDACC network. In addition to these French stations, total ozone column measurements are also taken by the Aeronomics Department of the CNRS in other stations of the NDACC network distributed across the globe. Measurements are carried out as part of the NDACC-France network (Network for Detection of Atmospheric Composition Change).

The first measurements began in 1988 for the SAOZ (Système d'Analyse par Observations Zénithales) (Analysis System by Zenithal Observations) and in 1986 for Lidar. They are archived on the NDACC.

Link to other programmes: the data is linked to several research programmes at national and international level: NDACC, EU/GEOMON, ESA/MULTI-TASTE. NDACC provides re-analysis programmes.

#### **The MERA network (Measurement of Atmospheric Fallout)**

Coordinated by ADEME and the Ecole des Mines de Douai, and part of the EMEP programme (European Monitoring and Evaluation Programme), the MERA network has a dozen stations for measuring the chemistry of precipitation included in the GAW network.

The MERA system is the French contribution to the

European cross-border, long distance atmospheric fallout surveillance programme. It continually monitors humid deposits and gaseous pollutants and particles in the atmosphere in areas away from any source of pollution.

#### **The greenhouse gas effect measurement network (RAMCES-ICOS)**

The RAMCES network of atmospheric observatories measures concentrations of the main gases contributing to the additional greenhouse effect (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O and SF<sub>6</sub>) in the atmosphere. It is led by the Laboratoire des Sciences du Climat et de l'Environnement (Laboratory of Environmental and Climate Sciences).

The first observatory making continual CO<sub>2</sub> measurements has existed since 1981 on Amsterdam Island (French Southern and Antarctic Lands). A second continuous CO<sub>2</sub> monitoring observatory was opened in 1992 at Mace Head, on the west coast of Ireland. These two troposphere observatories are part of the WMO's GAW network. In 2001 CO<sub>2</sub> analysers were installed in the Puy de Dôme and Saclay stations in France, and two new observatories were equipped in 2005 at Biscarosse, France, and Hanle, India.

As well as CO<sub>2</sub>, several atmospheric components are measured in some observatories (Radon-222, CO, CH<sub>4</sub>, N<sub>2</sub>O) which enable a multi-tracer approach to be developed for better understanding the sources of these species and to trace the origins of air masses. CO in particular is very useful for separately inferring CO<sub>2</sub> of fossil origin.

The Laboratoire des Sciences du Climat et de l'Environnement (Laboratory of Environmental and Climate Sciences) in Gif sur Yvette, in France, coordinates the ICOS system on the European scale. The ICOS system is the integrated European greenhouse gas effect observation system (stations plus data management). Its aim is to network the various European atmospheric measurement stations in order to obtain precise, long-term data on climate change and the greenhouse effect in Europe, Africa and Siberia. The issue is to measure trends and variability of GHG emissions

for the European continent and adjacent regions, in particular Siberia and Africa. The observatory consists of a network of atmospheric measuring stations (20 observatories of CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O concentrations) and flows exchanged by ecosystems (20 flow measurement revolutions). A second objective is to draw up daily GHG balances at the scale of 10 km in Europe thanks to a data assimilation system and daily maps.

### Measurements in the Indian Ocean

To make the network denser in key regions, a French network was set up in the Indian Ocean. This is the OISO observation system based on the ocean-going vessel the Marion-Dufresne. The OISO programme (Océan Indien Service d'Observation) (Indian Ocean Observation Service) was approved as a Service d'Observation INSU (INSU Observation Service) in July 1997.

It is supplemented by the MINERVE programme (Mesures à l'Interface Eau-air de la Variabilité des Echanges de CO<sub>2</sub>) (Measurements at the Water-Air interface of variability of CO<sub>2</sub> exchanges) which is based on the use of transit surveys on board the ship, the Astrolabe. It enables the seasonal variabilities of partial CO<sub>2</sub> pressure and the Total of Inorganic Carbon in surface waters to be observed and understood in association with hydrological and biogeochemical measurements in-situ and with the aid of satellite data (temperature, sea colour).

The CARAUS Environmental Research Observatory groups the long-term observation of oceanic and atmospheric properties linked to the carbon cycle in the South Indian Ocean and Southern Ocean. Since 2003 it has combined the Service d'Observation OISO (OISO Observation Service) and MINERVE surveys, thus supplementing the international network of oceanic CO<sub>2</sub> measurements in a sector poorly observed at that time.

### The European GEMS, GEOMON and MACC projects

The European GEMS project (Global Earth-system Monitoring Satellite and in Situ Data) is part of the GMES programme (now COPERNICUS) and aims to prepare the monitoring of the composition of the atmosphere (BAMS, vol 89, August 2008, pp

1147-1164). This project combines expertise on research and observation of the composition of the atmosphere (such as RAMCES for the greenhouse gas effect or NDACC for ozone) and on digital weather forecasting and transport models for building a surveillance and forecasting system for GHGs, reactive gases, aerosols and air quality, at the global and regional scale. This project extended the data assimilation centre of the European Centre (CEPMMT) to include various components, for which satellite observation exists, in a global chemical transport model which is used as an input for regional models. 32 European bodies collaborate on this project, including 8 French bodies (INERIS, Météo-France and the CNRS and universities with laboratories LA, LMD, LSCE, LOA, LISA, SA). Completed in May 2009 it is continued through the European MACC, and subsequently MACC II projects.

The purpose of the MACC<sup>7</sup> projects (Monitoring Atmospheric Composition and Change) is to prepare the operational installation of the air quality and GHG analysis and forecasting system at the global scale and for Europe. Sectors producing observations in-situ and from space, as well as modelling sectors have thus demonstrated their ability to produce the expected regular forecasts, in coordination with European partners.

At the same time, the European GEOMON (Geo monitoring) project, launched in February 2007 in Paris, had the role of collecting and coordinating flows of observations made in-situ or in space in the fields of chemical composition of the atmosphere, GHGs and aerosols. In France, this project has involved teams from the IPSL, which coordinated the project for the CEA, CNRS/INSU, the CNES and the Universities. The purpose of the Geomon project is to construct an integrated European system of observations of the composition of the atmosphere from the observation systems already in use. It is in line with international strategy (Global Earth Observation System of Systems - GEOSS) and has

<sup>7</sup> <http://www.gmes-atmosphere.eu/>

contributed towards the MACC strategy.

## **C.2 Essential climate variables of the oceanic domain**

The French contribution to oceanic observation for climate developed as part of the GOOS system (Global Ocean Observation System), coordinated by the mixed WMO-IOC Commission for maritime meteorology and Oceanography (JCOMM). This contribution includes the following components: volunteer observation ships (VOS) and ships of opportunity (SOOP), tide gauges, drifting and moored weather buoys and finally underwater floats (ARGO). The pre-operational orientation of this ocean observation, with the MERCATOR modelling and CORIOLIS observation projects should be noted.

Many studies use data collected by the Argo floats, which drift at a depth of 1000 m and take temperature and salinity measurements every 10 days at depths between 2000 m and the surface. There are 3000 floats permanently distributed almost uniformly over the entire surface of the ocean. This programme began in 2000 and could continue up to 2020. It is therefore a data source of the highest importance in the context of global warming. Besides the ARIVO programme, work to accurately estimate the sites of Argo floats at 1000 m is in progress, in order to obtain (among other things) a quick absolute surface reference, covering the world's oceans, at degree resolution. Some floats are fitted with oxygen sensors and their measurements are beginning to be analysed in the laboratory. This will provide (when coverage is global) an essential component in the understanding of biogeochemical cycles.

### **Volunteer observation ships (VOS)**

This is a WMO observation programme with 67 vessels in 2012 for France (see above).

### **Ship-of-opportunity programme (SOOP)**

This consists of measurements of the upper layer of the ocean (0-700m) thanks to XBT probes launched by ships of the ship-of-opportunity programme (SOOP). This programme is carried out by the IRD

and the CNRS (probes supplied by NOAA). Nearly 300 profiles are disseminated every year thanks to the ARGOS system (73 floats in 2011<sup>8</sup>), then inserted in the SMT in Toulouse (archived at the Coriolis data centre).

About 17 vessels were involved in 2012, of which 10 are equipped to measure salinity and 7 are research vessels. Real time data is received at LEGOS (ORE Sea Salinity Service, LEGOS <http://www.legos.obs-mip.fr/observations/sss>) and transmitted to the Coriolis data centre (Ifremer-Brest). The corresponding databases are managed by the IRD (Brest, Nouméa and Toulouse).

Since 2011 the French deep-sea research ships managed by Ifremer, and naval oceanographic ships, transmit routinely acquired temperature and salinity data and XBT data in real time to the Coriolis data centre.

### **Tide gauge network (GLOSS)**

Tide gauges supply sea level data useful for the general circulation of the ocean and for monitoring climate. This data is also used for setting altimetric satellites (ERS-1 Topex/Poseidon, JASON2).

French tide gauge networks contribute to the Global Sea Level Observing System (GLOSS), through ROSAME, réseau d'observation sub-antarctique du niveau de la mer (Sub-Antarctic and Antarctic Sea Level Observation Network). This French contribution to the international GLOSS network is carried out at four sites in the Sub-Antarctic, Antarctic and Indian Oceans. The GLOSS network comprises 15 stations under the responsibility of France: Brest, Marseille, Nouméa, Nuku Hiva (Marquesas Islands), Rikitea (Gambier), Matavai (Tahiti), Kerguelen, Amsterdam St Paul, Crozet, Dumont d'Urville, Clipperton, Fort de France, Pointe des Galets (Réunion), Cayenne, Dzaouzi (Mayotte). These tide gauges are operated by the SHOM (Service hydrographique et océanographique de la Marine (Naval Hydrographic and Oceanographic Service) for the RONIM network (Réseau d'Observation du Niveau de la Mer) (Sea level observation network), LEGOS and INSU for the ROSAME network (Réseau d'Observation Subantarctique et Antarctique du niveau de la Mer)

<sup>7</sup> Coriolis activity report 2011

(Sub-Antarctic and Antarctic Sea Level Observation Network) and the CEA in French Polynesia.

The average daily, monthly and annual levels recorded by the SHOM are fed to the permanent average sea level service (Proudman Oceanographic Laboratory, United Kingdom). The SONEL portal hosted by the University of La Rochelle disseminates French tide gauge data free of charge for use by students and researchers, especially for the benefit of studies on changing sea levels.

### Free-drifting weather buoys

Météo-France regularly deploys free-drifting buoys in the context of the DBCP (Drift Buoy Cooperation Panel) cooperation group, a subsidiary of JCOMM. These buoys measure atmospheric pressure, surface temperature of the sea (SVP-B) and, certainly, the wind (Marisonde G or SVP-BW) and sea temperature at depths up to 300 m (Marisonde GT). The Argos and Iridium systems are used for locating and transmitting hourly observation data.

Météo-France coordinates two networks of free-drifting buoys on the international scale. Every year, Météo-France deploys about 170 buoys, about 100 of which are European (E-SURFMAR) in the North Atlantic (responsibility of Météo-France) and about 20 other buoys in the different oceans and about forty buoys equipped with barometers in the Indian Ocean and tropical Atlantic ocean.

### Moored weather buoys

In addition to the Brittany and Gascony oceanic stations located in the Near Atlantic in cooperation with the United Kingdom Meteorological Office, Météo-France has placed moored oceanic buoys at three other sites since 1999. Two off the coast of the French West Indies, at depths of 5500 m and another off the coast of Nice at a depth of 2300 m. A fourth site was set up in the Golfe du Lion in the Mediterranean in 2001.

Hourly observations of atmospheric pressure, temperature, humidity and wind are made, as well as the sea temperature at a depth of 1 m. The data is transmitted via Météosat. Buoys are sited by means of the GPS system and an Argos beacon. Finally weather instruments are maintained in the

mer d'Iroise (Iroise Sea) on the large navigational buoy moored on the Ushant shipping land (Centre d'Etudes Techniques Maritimes et Fluviales) (French Institute for Inland and Maritime Waterways).

Four directional wave recorders are moored near the French West Indies. The following data: significant wave height, period and spectrum as well as the sea temperature are measured half-hourly and transmitted by the Argos system.

### PIRATA observatory (Buoys in the tropical Atlantic)

The PIRATA programme (Pilot Research moored Array in the Tropical Atlantic) consists of maintaining a network of meteorological and oceanographic measurements at representative points of climate variability in the Tropical Atlantic. It was set up in 1997 with 10 buoys as part of the international CLIVAR programme. It is managed by teams of French, Brazilian and American scientists. The surveys are managed by the IRD and coordinated by Météo-France and INSU.

Since 2007, it has included 17 ATLAS buoys, two moored current measuring buoys on the Equator and meteorological stations on the Island of São Tomé (Gulf of Guinea) and in Brazil.

This network makes it possible to study forcing and coupling between the atmosphere and the ocean in the Tropical Atlantic, the influence of air-sea heat flows (and quantity of movement) on the position and intensity of the intertropical convergence zone (ITCZ) and convection systems of the Gulf of Guinea. It also studies the variability of the ocean surface temperature in relation to the thermal content, and existing remote connections between this region and other regions (ENSO, NAO, South Atlantic variability).

The PIRATA programme makes the measurements available to the scientific community:

- In real time for daily averages from the ATLAS buoys, tide gauge data from São Tomé and thermal profiles obtained during surveys;
- As and when possible for data acquired during surveys (current data), after processing and

validation via its website (in 2011 on average 85% of observed data was available).

PIRATA has enabled many studies to be carried out in French laboratories, in relation to air-sea flows, oceanic processes and data assimilation techniques, especially as part of the MERCATOR project.

### The CORIOLIS operational oceanographic project<sup>9</sup>

The seven French agencies concerned by oceanography (CNES, CNRS, Ifremer, IPEV, IRD, Météo-France, SHOM) have jointly developed a full and consistent operational oceanographic system comprising three key areas: satellite altimetry (JASON), global digital modelling with assimilation (MERCATOR), in-situ measurements (CORIOLIS). The CORIOLIS project constitutes a pre-operational structure for acquisition, collection, validation and dissemination of global oceanic data (temperature and salinity profiles, and currents) meeting the needs of modellers (such as MERCATOR) and the scientific community (as part of CLIVAR). The CORIOLIS project has four objectives:

- Building a data management centre, which is one of the two ARGO centres with GODAE global experience, capable of supplying data in real and deferred time. The CORIOLIS centre acquires all the temperature and salinity profiles in virtually real time (on a daily basis) coming from the SMT and also the international Argo, Gosud and Ocean-SITES (data from moored buoys) programmes. This data comes from XBT probes, CDT sensors, moored buoys, profiler floats and free-drifting buoys;
- Contributing to deployment of the ARGO network, especially in the Atlantic, but also in the Southern and Indian Oceans. The Coriolis project coordinates the French contribution to ARGO which corresponds to nearly 10% of the global network;
- Developing and improving ARGO profilers;
- Acquiring, validating and real time processing of other data routinely acquired today by various French bodies and coming from surface floats, PIRATA moored buoys and research ships (XBT

bathythermal probes, thermo-salinographs and ADCP current profilers).

### The OVIDE Programme

The « Observatoire de la Variabilité Interannuelle et Decennale en Atlantique Nord » (Observatory of Interannual and Ten-year Variability in the North Atlantic) programme aims to measure currents and the thermohaline structure between Portugal and Greenland every 2 years, in order to estimate the variability of oceanic circulation, transport of associated heat and salt, and also the various water masses concerned.

Ovide is an observation programme participating in testing climate change and understanding the mechanisms at work, within the Laboratoire de Physique des Océans (LPO) (Laboratory of Ocean Physics), in which CNRS, Ifremer and the IRD and the Université de Bretagne Occidentale (University of Western Brittany) participate. It contributes to the international CLIVAR (Climatic Variability) and IOCCP (International Ocean Carbon Coordination Project), CARBOCEAN and CARBOCHANGE programmes. The Ovide programme has been active since 2002.

## C.3 Essential climate variables of the terrestrial domain

The Global Terrestrial Network (GTN) includes the observation of mountain glaciers, hydrological and nivological observations. Carbon flow measurements connected with terrestrial ecosystems or observations of river levels and observation of forest ecosystems are also recorded.

### Observation of mountain glaciers: GLACIOCLIM

These observations are made through the Observatoire GLACIOCLIM<sup>10</sup> which is an Observatoire de Recherche en Environnement (ORE) (Environmental Research Observatory), first recognised as an INSU Observation Service in 2004 and then SOERE in 2011. It studies the working of glaciers at different latitudes (mid-latitudes; the tropics; the Antarctic). Glaciers monitored as part

<sup>9</sup> <http://www.coriolis.eu.org/The-Coriolis-Infrastructure/Activity-reports-in-French>

<sup>10</sup> <http://www-lgge.ujf-grenoble.fr/ServiceObs>

of GLACIOCLIM are representative of 3 different climate zones:

- Temperate climate (Northern Hemisphere): the Alps;
- Tropical climate: the Andes;
- Polar climate (Southern Hemisphere): the Antarctic.

Since 2002, this ORE has included the Laboratoire de Glaciologie et de Géophysique de l'Environnement (LGGE) (Glaciology and Environmental Geophysics Laboratory) network, which made its first glaciology observations on Alpine glaciers in 1956.

These long series of observations (about 50 years) are archived at ORE GLACIOCLIM and WGMS (World Glacier Monitoring System). The WGMS, which is part of UNESCO, collects observations of front and mass balance fluctuations (about 65 glaciers) and variations in thickness in glaciers situated in various mountain ranges around the world.

When it was approved and funded as SOERE in 2011 geographical and thematic extensions were made to this first basic network. The geographical extensions related to the Himalayas (India and Nepal), the Pyrennees (Ossoue Glacier) and the Astrolabe outlet glacier in the Antarctic. The thematic extensions relate to the hydrological and remote detection sections and cold sites at high altitudes.

### The GLACIOCLIM Observatory has the following partners:

Ministry for Research, INSU, OSUG, IRD, LGGE, IPEV (ex. IFRTP), CEMAGREF, CNR-ISAC (Italy), IHH in Bolivia and INAMHI in Ecuador. Attachment to the international glacier observation network: WGMS (World Glacier Monitoring System) and GLIMS (Global Land Ice Monitoring from Space).

### The following national and international scientific programmes are associated with the observatory

WCRP/CLIC (World Climate Research Program/CLimate and Cryosphere), WCRP/CLIVAR (CLimate VARIability), SCAR/ISMASS (Scientific Committee for Antarctic Research/Ice Sheet MASS balance),

SCAR/ITASE (International Trans-Antarctic Scientific Expedition), PNEDC (Programme National d'Etude de la Dynamique du Climat) (National Climate Dynamic Study Programme), ACI (Actions Concertées Incitatives) (Concerted Initiative Actions) «Potentiels et limites de la télédétection pour le suivi des glaciers de montagne» (Potentials and limits of remote detection for monitoring mountain glaciers) and «Changement Climatique et Cryosphère» (Cryosphere and Climate Change).

### The observation network of the Institut de Recherche pour le Développement (IRD) (Institute of Development Research)

The IRD's glacier study programme 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 its dynamic, and determination of the surface energy balance since 1996) and the Chacaltaya Glacier (monthly monitoring of the mass balance and annual monitoring of the position of its front) and then, from 1995, Antisana 15 Glacier in Ecuador.

Data archived on computer media has been available to the scientific community since May 2001 on the LGGE's server. Part of the data concerning mass balance and length fluctuations is published in «Fluctuations of Glaciers», a five-yearly publication of the Permanent Service on Fluctuations of Glaciers of the International Commission on Snow and Ice of the UGGI (6 volumes since 1959). The annual mass balance of the Saint Sorlin and Sarennes glaciers have been published since 1988 in the biennial «Glacier Mass Balance Bulletin» of the World Glacier Monitoring Service. Those of the Zongo, Chacaltaya and Antisana glaciers have been published since 1995.

### Hydrological observation

#### Height and flow of water in French rivers

The main water courses of France and monitored by the State. Monitoring currently concerns continental Metropolitan France, covering about 20,000 km of the 120,000 km of water courses over a metre wide. Over 12,000 municipalities and 5 million

people are located in areas at risk of flooding on French territory. 6,300 municipalities benefit from flood forecasting provided by the State, covering over 90% of people situated in areas at risk from flooding. Hydrological monitoring units are being set up in Corsica and Reunion, and demands to extend the geographical extent of flood monitoring in mainland France will enlarge the area monitored by the State.

The State maintains measurement networks in water courses, mainly water height, comprising over 1100 measurement points in real time for flood forecasts. There are other measurement points particularly dedicated to monitoring water as a resource and low water levels. This results in a network of some 1500 measurement points. Flow is calculated at certain points from a stage-discharge curve drawn up on the basis of gauging carried out at the calculation point (about 10% only, i.e. one hundred flow measurement points). The majority of measurements made are fed into the national hydrometric database (Banque HYDRO) which contains historical data from over 3500 measuring points (2,400 currently in use), belonging to about 150 data producers (the State, research bodies such as CEMAGREF and also public establishments, Water Authorities and private producers such as EDF or the CNR). SCHAPI is responsible for managing this database, accessible for free on the public website: <http://www.hydro.eaufrance.fr/>. The location of real time measurement points and their data are also visible on the public flood monitoring website: <http://www.vigicrues.ecologie.gouv.fr/>.

### The river observation network

The measurement of new variables such as the chemistry of rivers, the data of which is collected in the SOERE «réseau des bassins versants» (drainage basin network). The data measured includes: precipitation, flow of streams and rivers and the water content of the soil. This network is located in Metropolitan France and the Overseas Departments and also internationally in the countries of the South.

There are also strong links with the network of Critical Zone Observatories in the United States and other European and international networks,

thus giving the drainage basin network strong international visibility.

### Observation of snow

For the high mountains, snow (height, coverage) is measured in the following three mountain ranges: the Alps (137 manned stations and 15 automated stations); Corsica (5 manned stations and 2 automated stations); the Pyrenees (59 manned stations and 5 automated stations). i.e. in total: 201 manned stations and 22 automated stations. For the observation of snow in medium-sized mountains (Vosges, Massif Central, Jura), there are 155 daily observations and 25 additional weekly observations by manned stations. To this can be added about ten automated stations equipped with a snow height sensor. Data is centralised by the Centre d'Etudes de la Neige<sup>11</sup> (Snow Study Centre) (CEN of the CNRM, Météo-France Grenoble).

### The FLUXNET Programme

Measurements of carbon flows in terrestrial ecosystems are made as part of the international Fluxnet programme and the Carboeurope integrated research programme (study of flows at regional scale).

The purpose of this European programme is to improve our knowledge about the size, location and temporal change of Carbon sinks and sources in terrestrial ecosystems and to understand their causes. This integrated research programme has four components: Ecosystems, Atmosphere, Regional Experience and Continental integration.

### Observation of forest ecosystems

Forest ecosystems occupy 30 % of the territory of Metropolitan France<sup>12</sup> and are the subject of regular observations by the Institut de l'information géographique et forestière (IGN) (Institute of Geographical and Forest Information) resulting from the merging of the IFN (Inventaire forestier national) (national forest inventory) and the IGN (Institut géographique national) (national

<sup>11</sup> <http://www.cnrm-game.fr/spip.php?rubrique85>

<sup>12</sup> *The IFN website, on the basis of measurement surveys from 2007 to 2011*

geographical institute) in October 2011. For nearly 40 years the IFN, later the IGN, has evaluated forest resources and productivity and, for ten years, ecological data, especially flora and forest soils.

Since 2005, the IGN has made a forest inventory every year from a sample of points covering the whole territory, enabling it to establish annual information on the forest estate at national and regional scale. As the inventory points are checked every 5 years, this new methodology has enabled changes in the forest biomass, mortality and removal rates and biological production to be monitored by species and by region since 2010. The national forest inventory thus enables the carbon stocks in the forest biomass and changes to them to be quantified annually.

### The peat bog observation network

Observation of peat bogs is now organised around the measurement of carbon flows and for the development of permafrost as part of the TOURBIERE network (PEAT BOG network). The Service national d'observation «Tourbières» (national peat bog observation service) is a long-term operational facility based on the observation and modelling of the working of temperate peat bogs subject to climatic and anthropic disturbances. Its aim is to create a synergy of multidisciplinary and interdisciplinary scientific skills around 3 sites equipped with measuring instruments (Frasne, Doubs; La Guette, Cher et de Landemarais, Ille et Villaine) to observe and model carbon flows between the atmosphere and the ground.

## C.4 Observation of the climate from space

### CEOS clusters and the role of the CNES

CEOS (Committee on Earth Observation Satellites) was created in 1984 to coordinate the Earth observation work of space agencies. The French Centre National d'Etudes Spatiales (CNES) (National Space Study Centre) is part of it and has often led it.

Since 2005 CEOS has been working in liaison with various space agencies to supply a coordinated response on observation data from space,

particularly through the «CEOS clusters».

Six virtual clusters have been set up, representing data collection groups:

- The «Topographie de la surface des océans» (Topography of the ocean surfaces) cluster;
- The «Imagerie des terres émergées» (Imagery of emerged lands) cluster;
- The «Précipitations» (Precipitation) cluster;
- The «Composition de l'atmosphère» (Composition of the Atmosphere) cluster;
- The «Radiométrie de la couleur de l'océan» (Radiometry of the ocean colour) cluster;
- The «Vecteur vent à la surface de l'océan» (Wind vector on the ocean surface) cluster;

as well as several working groups, including one on climate, which held its first meeting in 2011. The remit of the «climate» group is to facilitate the exploitation of long series of variables essential for CEOS and to organise activities of other working groups<sup>13</sup>.

The CNES is a stakeholder in 6 clusters to which it has contributed or still contributes through its current or planned space missions (Jason 1 and 2, Saral for the «Topographie de la surface des océans» (Topography of the ocean surfaces) cluster, Spot 4 and 5, Pléiades for the «Imagerie des terres émergées» (imagery of emerged lands) cluster, Megha-Tropiques for the «Précipitations» (Precipitations) cluster, Iasi and Traq/Sifti for the «Composition de l'atmosphère» (Composition of the atmosphere) cluster.

### The COPERNICUS project, formerly GMES («Global Monitoring for Environment and Security»)<sup>14</sup>

Launched by the European Union in 1998, it has consisted of implementing an observation capacity in Europe since 2008. At first, these services were based on existing infrastructures: observation facilities, whether acquired on land or from space,

<sup>13</sup> [http://www.ceos.org/index.php?option=com\\_content&view=category&layout=blog&id=168&Itemid=278](http://www.ceos.org/index.php?option=com_content&view=category&layout=blog&id=168&Itemid=278)

<sup>14</sup> <http://copernicus.eu/pages-principales/overview/>

and data processing facilities. As COPERNICUS developed, new tools and services, ranging from spatial, terrestrial, aerial and oceanic techniques were developed. These services are supplemented by projects and by the database of former GMES projects.

With GMES, France has a reliable and accurate surveillance system at local and global level for the environment and security. It brings together **all the means of observing the world, both terrestrial and spatial, at European level in order to improve environmental management and security of people and property.**

The CNES is widely represented with its Earth observation satellites such as Spot, Jason and Pléiades.

This environmental information helps to direct decision-makers in relation to humanitarian crises or natural disasters:

Reducing the vulnerability of people and property, wherever Europe or its Member States have responsibilities;

Economic development of regions, in Europe and in the world;

Reasoned exploitation of natural resources: water, fish, agriculture, mineral resources, energy resources, among others.

### **C.5 Support for developing countries in implementing and maintaining observation systems**

The AMMA (2002-2020) and AMMA-CATCH networks Sub-Saharan Africa is one of the world's most sensitive areas to climate variations. Drought in the 70s and 80s and its impacts (desertification, food insecurity, etc.) were the motivation behind the creation of a project on the African monsoon. The African Monsoon Multidisciplinary Analysis (AMMA) project is an international operational and scientific project aimed at improving the understanding and forecasting of the monsoon and its socio-economic impacts. The AMMA project (2002-2010) was started as a French initiative and then became international. AMMA was started

as part of the «Observatoires de Recherche pour l'Environnement» (ORE) (Research Observatories for the Environment) initiative of the French Ministry for Research. Approved as an ORE in 2002, and then «Service d'observation» (SO) (Observation Service) of INSU (Institut National des Sciences de l'Univers) (National Institute of Universal Sciences) in 2005, it benefits from support of the IRD (Institut de recherche pour le Développement) (Institute of Research for Development) and the INSU. One of its great successes has been training and the transfer of skills to African countries. AMMA is supported by the WMO through the world climate research programme (WCRP) and the CLIVAR, THORPEX, GCOS, GOOS and GEWEX projects.

The results obtained with AMMA concern the study of extreme weather events, such as intense rainfall and floods, drought, intra-seasonal pulses of the monsoon, genesis and development of cyclones of the Atlantic basin and assessment of the impact of special observation surveys on the quality of African monsoon forecasting.

The AMMA-CATCH observation system represents the «surface continentale et hydrologie» (continental and hydrological surface) component of the long period of observation established in the observation strategy of the AMMA project.

The AMMA observation system has entered a second operational phase up to 2020.

### **The regional «Adaptation aux changements climatiques dans les États de la Commission de l'Océan Indien» (Adaptation to climate change in the States of the Indian Ocean Commission) project**

The IOC is a regional body created 25 years ago which brings together the Union of Comoros, France (Reunion), Mauritius, Madagascar and the Seychelles. This body aims to reinforce regional cooperation in the areas of economic, human, social and environmental development and health and security. Several projects funded by AFD or the FFEM have already been implemented with the IOC:

- Protected marine environments network

funded by the FFEM (€700,000 ), the PNUE and the WWF;

- Epidemiological monitoring network with €6 million in funding from AFD;
- IOC regional programme on natural hazards, started in 2011, for an initial 3-year period;
- The Acclimate project, since the end of 2008, with financial support (€1.7 million) from the Fonds français pour l'Environnement Mondial (FFEM) (French Fund for the World Environment) of the French Ministry of Foreign Affairs, the Agence française de Développement (AFD) ( French Development Agency) and the Réunion Region. The latest results were presented at the conference from 2-14 December 2012 in St-Denis, Réunion;
- The ISLANDS project, with a grant of €10 million from the European Union (10th EDF), started in August 2011 for an initial period of three years, in which ONERC<sup>15</sup> actively participates.

The 28th Council of Ministers of the Indian Ocean Commission (IOC), held on 18 January 2013 in the Seychelles, adopted the framework document on the regional strategy for adaptation to climate change, prepared as part of the Acclimate project (IOC) which ended on 31 December 2012. This decision firmly anchors climate change in the IOC's cooperation and regional development policy.

ISLANDS aims to make certain points of the Stratégie de Maurice<sup>16</sup> (Mauritius Strategy) a reality. This aims to consolidate regional collaboration by developing a consistent national and regional process through sustainable development by contextualising the 20 themes of the Mauritius strategy, by identifying the key-actions and resources required and defining a monitoring and assessment system for each country.

Development of an observatoire régional des impacts du changement climatique (ORACC)

(Regional observatory of the impacts of climate change) is one of the sections making this strategy operational which received know-how from ONERC during the development phase.

### The MISTRALS project (Mediterranean Integrated Studies at Regional And Local Scales)

Launched in 2008, for an initial period planned to last until 2020, MISTRALS is an international meta-programme of fundamental research and systematic interdisciplinary observations dedicated to understanding how the environment of the Mediterranean Basin operates and develops under the pressure of global human-generated change in order to predict future change. France is fully involved in this programme which grew in extent in 2010 and brings together a total of 37 countries, including several European countries, Canada, New Zealand and the United States.

<sup>15</sup> *Observatoire National sur les Effets du Réchauffement Climatique (French national observatory on the effects of global warming)*

<sup>16</sup> <http://www.unesco.org/csi/B10/msibroch-fr.htm>

# Education, training and raising public awareness

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## A. State of public opinion

### A.1 The French people and the climate change issue: a relationship dependent on current issues and international negotiations

After a notable decline in 2009 and 2010 global warming is once again one of the greatest environmental concerns of the French people. According to surveys, it is the number one concern with 20% of citations in the Insee-SOeS<sup>1</sup> survey and third in the Ademe survey with 17%.<sup>2</sup> These results are nevertheless comparable insofar as the same three subjects occur in the top three (water, air and the greenhouse effect).

It must however be noted that this sensitivity to the climate issue remains well below (-14 points) its 2008 level. This is all the more marked when surveys tackle general issues intended to set priorities on various subjects concerning society: the employment issue stands out clearly in recent years and is considered the most important issue by 47% of French people. The environment was mentioned by only 16% of respondents in 2012. On the other hand, even though natural disasters are no longer at the top of the list, they continue to concern the French people. While 7% were worried about them in 2008, this proportion has more than doubled since Windstorm Xynthia in 2010.

From all the surveys three main lessons can be learnt about the social representations of the greenhouse effect in France;

- Societal and environmental priorities are totally reversible depending on the issues of the day. Thus, while the climate change issue reached its largest number of citations in 2009, this was in part due to the issue of the fourth IPCC report, the Grenelle Environment Round Table and preparation for the Copenhagen conference. The glass half full of Copenhagen caused these

results to fall in 2010 (-9% compared with 2009), certainties were shaken giving way to a pervading sense of scepticism. The Fukushima accident in Japan in 2011 made the nuclear issue a priority;

- Confidence in the scientific community was upset by the difficulties of negotiations. While 70% of French people were in agreement in 2009 in acknowledging that the increase in the greenhouse effect causing warming of the atmosphere was a certainty for the majority of scientists, only 51% believed it in 2010, while 45% considered that it was only a hypothesis on which scientists were not all in agreement. Since resumption of international negotiations and the Cancun and Durban Accords the proportion of sceptics has continued to fall, reaching a record level in 2010 (35 % of sceptics compared with 61 % convinced in 2012). These same changes in results can be seen in the issue of human responsibility for global warming: while 81% of French people were convinced of this in 2009 and 18% thought it was due to natural phenomena, in 2012 72% were convinced and 25% unconvinced;
- Perception of measures for combating global warming is resigned, while knowledge about the sources of greenhouse gas emissions continues to increase. While the choice of a change in behaviour still predominates with 50% in first place, it has continued to fall since 2009. The idea of technical solutions is not always convincing (11% of citations). And the amount of "nothing can be done" responses per item increased slightly (15%).

### A.2 The French people and energy: environmental awareness and the cost of energy at the centre of the relationship

In the context of a think tank on the ecological transition and more particularly on the energy issue, it is crucial that we know the state of French public opinion on different forms of energy and

<sup>1</sup> CGDD, *Chiffres et statistiques*, April 2013

<sup>2</sup> ADEME survey, 13th survey, June 2012

<sup>3</sup> "Le point sur : Les français et l'énergie", (Discussion on: The French people and energy) CGDD, August 2012

their consumer behaviour. Three surveys carried out by the Ministry responsible for Energy<sup>3</sup> between 2011 and 2012 show that the French people are in favour of renewable energies. Nearly 60% of people would choose solar energy, wood and heat pumps if they had the opportunity. Wind power is also warmly received. In view of climate change the French people are prepared to modify their behaviour and 2/3 would even make sacrifices. The cost of energy remains a central issue: in view of rising prices half the population would reduce their consumption. Be that as it may, information about energy and renewable energy should nevertheless be greatly improved, as the French people would be the first to ask for it.

## B. Education

The French Environmental Charter made *éducation à l'environnement pour un développement durable* (EEDD) (environmental education for sustainable development) a national priority. This charter, written into the Constitution since 2005, recognises the place of environmental issues, and in particular, environmental education and training, in the main principles of the French Republic.

Its general implementation plan consists of three key additional areas:

- Inclusion of sustainable development themes and issues in the educational programmes of primary and secondary schools, and technical and professional schools;
- Developing overall approaches for schools and establishments;
- Training teachers and supervisory staff in the production of suitable educational resources.

A framework cooperation agreement for education on sustainable development signed in 2010 between the Ministry responsible for Sustainable Development and the Ministry responsible for Education formalised improved collaboration between the two ministries. This collaboration facilitates the synergy of resources, skills and expertise to support the educational community and its partners in this approach to consideration of

the issues of sustainable development. Agricultural, technical and higher education also offer numerous environmental courses.

### **B.1 Primary and secondary education: sustainable development has been written into the programmes of study**

Education about sustainable development has been written into the common grounding of knowledge and skills that students must have acquired by the end of compulsory education. This cross-curricular education has the aim of helping them to understand the complexity of the world in its scientific, ethical and civic aspects, and forms an integral part of students' initial education in all primary and secondary schools. Education on climate change is included in this education on sustainable development.

From the teaching point of view, education about sustainable development is not a new area of study. The issues and challenges of sustainable development are included in each subject area taught (French, geography, technology, physics, biology, physical education, etc.) in order to provide various ways, in time and space, of understanding the consequences of human activities.

#### **Primary school**

Since the start of the 2008 academic year the science, human culture and geography programmes of study have included sustainable development issues. Due to an investigative approach the sciences aim to understand and describe the real world, the natural world and the man-made world, to act on it and to manage the changes caused by human activity. The energy theme (needs, consumption, economics, etc.) contributes more particularly on education about climate change.

#### **Secondary school**

The current secondary school programmes date from 2009. Sustainable development is studied in the first year as part of civic education. The second year geography syllabus is devoted to the study of sustainable development. The geographical

approach gives priority to case studies, while postulating the three aspects of sustainable development, from which students observe inequalities and imbalances, perceive interactions between stakeholders and impacts of human action on the environment and measure the importance of policy choices.

### Secondary school - last three years (general stream)

In the fifth year particular emphasis is placed on additional approaches of geography, life sciences, Earth sciences and physics and chemistry programmes, for example on themes such as diet and food production, water or energy.

In the sixth year each geographical theme must be the opportunity for rekindling sustainable development issues, applied this time to French and European territories. Students understand the scientific issues in relation to social questions such as sustainable development, while casting a critical eye over them in order to act as responsible citizens. This approach is particularly respected in the economics and social sections. In physics and chemistry “the energy challenge” them provides an opportunity to look at all sources of energy and to understand the issues of managing resources in a sustainable development logic. In the final year, the specialist scientific area of Life and Earth Sciences, directly tackles climate change as a whole.

### Initial professional training of young people

Educational reforms affect the training programmes and basic skills of technological and professional high schools, by “greening” qualifications in line with the Plan de mobilisation des métiers et des formations pour l'économie verte (Plan to mobilise trades and training for a green economy).

Effective since the start of the 2010 academic year the new technological training pathway known as “Sciences et technologies industrielles et du développement durable” (STI2D) (Industrial technologies and sciences and sustainable development) is arranged in four specialist areas:

energy and sustainable development, technological innovation and ecodesign, architecture and construction, digital and computer information systems. The economics strand now includes an introduction to corporate social responsibility.

### B.2 Educational projects and sustainable development

Education on sustainable development is also based on cross-curricular projects in order to develop the students' critical sense and their ability to raise questions about complex situations. The E3D approach (educational establishments approaching sustainable development) is an integral part of the introduction plan and enables the institution's whole educational community to become involved in an educational approach, in conjunction with the region's other stakeholders.

Parents, regional authorities and all the school's other partners are rallied and brought together to support this very innovative approach. More than 3000 institutions were involved in these approaches in 2011, i.e. 5.5% of the total number of public and private schools.

### B.3 Teachers

Like any education, education about sustainable development and climate change relies on teachers, who have a very important role. In order to support the work of teachers, a large number of resource centres, mainly on-line, have been developed, and grouped according to the students' ages. The “[La main à la pâte](#)” (Hands on) and “[Le climat, ma planète et moi](#)” (Climate, my planet and me) scientific training programmes for primary classes offer educational modules on climate change. For secondary schools, on-line resources are supplied by institutional websites such as those of the [Ministry](#) responsible for sustainable development, [Eduscol](#) or thematic selections from [Éducasources](#).

Like health education, sustainable development is part of “convergence themes” on which teachers are encouraged to collaborate. As part of the international [Eco-School](#) award programme, which

promotes sustainable development in schools, over 1,500 schools have started to work in an environmentally responsible way.

#### **B.4 Higher education: a wide variety of environmental qualifications**

Of the 40,000 higher education courses listed in France, 2,500 concern the environment in the broad sense of the word (science, economics, arts, law, human sciences, health), i.e. about 6%. There is also a Master Environnement (Master of the Environment) which meets the very substantial need to train experts in the various sectors related to the environment.

These experts will be required to work in various public or private sectors affecting the areas of regulations, assessment, monitoring, research, engineering and economic or human development. They may get involved in issues as varied as biodiversity, climate change, natural hazards and pollution as well as aspects related to sustainable development, land remediation and ecosystems.

The environment is the fourth sector of Masters courses (5 years of university education), behind marketing, management of technologies and finance. Engineering schools and agricultural establishments offer the widest range of courses (les Ponts, les Mines, l'École nationale du génie rural (rural engineering), des eaux et des forêts (water and forests), l'École nationale de la météorologie (meteorology), etc.). There is even a specialist Masters in climate change: The Groupe École Supérieure de Commerce de Toulouse, the École Nationale de la Météorologie (ENM) and the École Nationale Supérieure Agronomique de Toulouse (ENSAT) have combined their network of experts to offer a new course at Toulouse called "[Gestion du Développement Durable et du Changement Climatique](#)" (Management of Sustainable Development and Climate Change).

French students on Masters, Engineering or Science and Technology courses can complete their higher

education by joining the European Climate-KIC Masters programme, which is financed by the European Institute of Innovation and Technology.

In addition to their studies, students get personally involved in the challenge of sustainable development and climate. For example: the Réseau Français des Étudiants pour le Développement Durable ([REFEDD](#)) (French Network of Students for Sustainable Development) is a network for promoting sustainable development created for students by students in 2007. It currently combines 100 associations across the entire country. Another example is the student "[Climate](#)" think tank based in Paris but with branches in a hundred countries: it brings together students specialising in climate change who act and participate in international negotiations in particular.

#### **B.5 Agricultural education: for sustainable production**

All over France agricultural educational institutions will develop their educational tools to raise student awareness of alternative, more economically and ecologically sustainable methods of production. Biological, no-labour, agriculture using beneficial insects, etc. Sustainable development is a key area of educational action in public agricultural educational institutions. In 2008, the "Education pour le développement durable" (education for sustainable development) network was set up in the agricultural education sector. A network which supports the process of change in sustainable development and education on sustainable development in institutions, both on cross-sector and systematic subjects (global management of sustainable development introduction plans, Agenda 21, educational, etc.) and more thematic, targeted subjects (eco-delegates, energy, water, food production, landscape, biodiversity, integration, transport, agriculture, etc.) in liaison with regional dynamics (Regional council, estates, regions, etc.) and related subjects.

## C. Training

While the energy transition could create 600,000 to 800,000 jobs in France between now and 2030, the environment, sustainable development and climate change are already the subject of many training courses, both initial and continuing. They also meet the needs of workers from troubled economic sectors such as the automotive industry, who wish to retrain for work in expanding green jobs. In addition, each sector studied as part of green economy job plans includes refining and passing on knowledge about the impacts of adaptation to climate change: the emphasis is placed on governance / risks / civil security / secure operation of facilities and installations which gives cross-sectoral coverage of adaptation to climate change.

### **C1** Initial training: managing energy and renewable energies

At the start of the 2010/2011 academic year, 67,000 students were enrolled in the final year of an initial environmental training course. But these training courses, numbering a thousand in 2010, cover different realities, in both the subject matter and type of qualification issued. There are 6 major sectors in France. "Managing energy and renewable energies" is related to energy efficiency, energy management, renewable energy, energy and climate engineering, eco-building, timber construction, etc. as well as the carbon balance and the greenhouse gases. 12% of "Environment" courses are in this area and more than half the courses in this area issue professional degrees or masters degrees.

### **C2** Continuing professional development: for the energy transition

There is no information system structuring continuing professional training on the environmental subjects. There are many organisations, but data sources are difficult to assemble. In this context the Observatoire national des emplois et métiers de l'économie verte (2010) (National observatory of jobs and trades in the green economy) aims to

draw up an overview of available training courses relating to the green economy. France currently has a large number of modules on renewable energy and energy efficiency aimed at workers and craftsmen in the building industry.

In the renewable energy sector the Observatoire des énergies renouvelables (Renewable Energy Observatory) lists 38 long continuous professional development courses, 123 short continuous development courses and 33 courses given by manufacturers.

[http://www.energies-renouvelables.org/b2b/livre\\_detail.asp?liv=258](http://www.energies-renouvelables.org/b2b/livre_detail.asp?liv=258)

The public body for innovation in the building sector, the CSTB (Centre Scientifique et Technique du Bâtiment) (Scientific and Technical Centre for Building) supports and trains professionals in the construction and development sector to meet the challenges of sustainable construction. Its training courses are based on 6 major themes, including "Aménagement et villes durables" (Development and sustainable towns) (sustainable towns, eco-districts and sustainable housing, heritage management) and "Bâtiments durables" (Sustainable buildings) (environmental performance, HQETM measures and energy performance, thermal regulation). 2,000 professional receive this training each year.

<http://formation.cstb.fr/>

Other measures are specifically aimed at the private sector. In order to help businesses implement energy efficiency actions, energy and environment representatives are employed in Chambers of Commerce and Industry, professional and trade associations and farmers' associations. These representatives can carry out "energy inspections" of businesses, arrange for group energy audits to be carried out by inspection centres and organise awareness meetings and training sessions. A specific energy training course has been set up for these representatives. The course has several modules, including: "Notions sur l'énergie et ses utilisations" (Energy concepts and uses), "Visites énergie en entreprise" (Company inspections), "Être acteur d'un PCET" (Being a regional Climate

and Energy Plan stakeholder). On the energy and regional approach a new module was planned in 2013: "EnR : les clés d'un projet territorial réussi". (Renewable energy: keys to a successful regional project).

More generally ADEME also offers climate change-related training courses in the agriculture and forestry, waste, energy saving, building or renewable energy fields. Since 2011 the Institut de Formation Carbone (Carbon Training Institute) has managed and administered all Carbon Balance training: training courses aimed at design offices, businesses and local authorities or even to students wishing to assess the greenhouse gas emissions of their institution.

<http://formations.ademe.fr/>

At the Ministry for Agriculture continuous professional training is mainly delivered in the CFPPA (Centre de Formation Professionnelle et de Promotion Agricoles) (Centre for Professional Agricultural Training and Promotion) and in higher education establishments.

## D. Information campaigns

### **D.1 «Économies d'énergie, faisons vite ça chauffe» (Energy savings. Let's act fast, it's heating up): a long-term awareness-raising strategy**

Since 2004 a national campaign has been organised to rally national support for energy saving and climate change. The «Économies d'énergie, faisons vite ça chauffe» campaign ran over the period 2004-2007. The strategy for deployment of this campaign was organised in three complementary annual phases (awareness of good actions; promotion of "improved" and "reinforced" tax credits). The total budget of €10 million was allocated for conducting the publicity campaigns, organising partner networks and producing dedicated response tools.

On the basis of positive results obtained, it was decided to continue the campaign by intensifying

this public information and awareness action plan with a new campaign over the period 2008-2011. With a total budget of € 21 million over three years the action plan comprised three sections combining:

- A multi-media advertising campaign (television, radio, Internet, magazines and newspapers) promoting "good practice", technical solutions favourable to energy management and incentive measures decided on by the public authorities;
- Promotion of "response tools": Energy of points (EIE Energy Info Points) network, free phone number, Eco-citizen website, dedicated campaign website, guides, etc.
- Calling on numerous public and private partners undertaking to implement tangible actions to promote energy savings with the support of the EIE network.

The campaign led to a number of regional versions and promoted incentive measures particularly for economic and regional stakeholders. In respect of the general public and with the aim of helping to encourage action, three further levers were used.

- Explaining and communicating information about new measures and effective solutions;
- Encouraging good practice at different "times of life" (moving, finding accommodation, kitting yourself out, consuming);
- Emphasising the dual benefit of the action: "I win on my bill and in my quality of life".

The effectiveness of these using campaigns (memory, acknowledgement, agreement, incentive, etc.) has been measured thanks to a posteriori tests carried out with the general public and businesses. The campaigns are achieving their information and incentive objective. In fact 82% of respondents said they were clear and easy to understand, 76% said they made them want to take action and make savings, 53% wanted to get more information from an EIE and 84% were encouraged to look at to quality signs. Opinion polls carried out at the same time as the impact measures particularly revealed that the various stakeholders now made more connection between energy savings and sustainable development.

They also highlighted the public interest in having precise information independent of commercial interests supplied by the Espaces INFO#ENERGIE.

## **D.2 Energy labels and environmental labels: a tangible and quantitative incentive**

Numerous actions have been implemented and regularly reinforced in order to inform users about consumption and greenhouse gas emissions resulting from their consumption:

**DPE dans le bâtiment (energy performance assessment of buildings):** the Diagnostic de Performance Énergétique (DPE) (energy performance assessment) has been mandatory when selling any accommodation or building, for both private individuals and professionals, since 2006 in Metropolitan France. In 2007 it was extended rental agreements and the delivery of new buildings. The vendor or landlord of a building or part of a building for sale or rent must supply the results to any potential buyer or tenant who asks for them. Public establishments open to the public and occupied by the services of a public authority or establishment must display the energy performance assessment in the reception area. From 1st January 2011 a home's energy classification must be displayed on any estate agency advertisement concerning the sale or rent of a property. In addition, inspectors are required to send all the energy performance assessments to ADEME. This will eventually improve our knowledge of the existing building stock.

**Energy labelling of household appliances:** since 1992, energy labelling on household appliances has been mandatory. A new labelling system, approved by the European Parliament and the Council in May 2010 helps consumers to make better assessments of the operating costs of household appliances. It is still based on a graduated scale from "A" (ecologically green products) to "G" (low performance red products) but provides up to three further classes ("A+", "A++" and "A+++") depending on technological progress. The energy classes of specific products are specified by regulation. The

regulations for washing machines, dishwashers, televisions, refrigerators, air-conditioning units and tumblers driers have been adopted.

**CO<sub>2</sub> labelling of private cars:** the CO<sub>2</sub> consumption and emissions label has been mandatory since May 2006 and must be affixed to each new car or displayed near it, in such a way as to be visible in all points of sale in France. Any potential car buyer can therefore find readable and comparative information about the vehicle's CO<sub>2</sub> emissions. Fuel consumption is also shown on the label.

**CO<sub>2</sub> information supplied by transport service providers:** in order to promote transport with lower CO<sub>2</sub> emissions, from October 2013 operators (passenger or goods transport, removals companies, taxis, couriers, and travel agents) are required to inform their clients about the CO<sub>2</sub> emissions produced by their service for every journey. The calculation methodology is based on the European standard on the calculation and declaration of energy consumption and greenhouse gas emissions of transport services (standard NF EN 16258). The amounts of carbon dioxide considered are those emitted while the means of transport is in operation and those produced during the production of energy sources (refinery, transport, distribution, etc.). This approach ensures fair treatment between transport using fuel and transport using electrical energy.

**Environmental labelling of products:** consumer information about the environmental impacts of products meets a dual objective: giving consumers the power to act in their purchasing choices and encouraging businesses to improve their products by giving indicators of environmental performance. This experimental labelling takes into account the life cycle and main impacts of products. Between the summer of 2011 and 2012, 168 volunteer businesses tested environmental labelling, presenting the consumer with the "green" (CO<sub>2</sub> emissions, impact of water or air quality, waste production, etc.) balance of a selection of 10,000 products ranging from foodstuffs to clothing. Labelling has taken very different forms (absolute quantified values, percentages, colours, scales with

different gradations) and is placed on various types of media (packaging, rail, flashcode, Internet). A report on the experiment was sent to the French Parliament at the beginning of 2013. This experiment demonstrated that a potential benefit of environmental labelling is that it would encourage companies to make environmental advances: 73% of participants consider that the labelling could be a source of competitiveness. A second stage of dialogue in progress will enable decisions to be made on the necessary arrangements for national deployment of labelling. Furthermore, the French State has carried out information workshops on this labelling aimed at developing countries (see paragraph IV.C).

## E. Participation of the public and civil society

In view of the complex nature of the climate challenge and the considerable issues it raises for society, the principle of public consultation and participation has always guided the development of French national mitigation or adaptation policies. Not only constructive, this principle also enables the measures to be fully accepted and totally taken up by economic and social stakeholders. It also encourages them to take action themselves developing their own assessments and tools. They thus become new channels of information and awareness.

### **E.1** Consultation on the Plan national d'adaptation (French national adaptation plan): adaptation on the same level as mitigation

The development of the French National Adaptation Plan (PNACC) was subject to an enormous consultation exercise in 2010, resulting in over 200 recommendations which were used as a basis for its creation. This consultation exercise responded to two main objectives:

- Gaining the support of all public authorities, private stakeholders and civil society so that

adaptation is acknowledged on the same level as mitigation, and raising awareness of the challenges that this involves;

- Gathering opinions and recommendations for defining the national plan of adaptation to climate change.

The national consultation phase is organised on the basis of five colleges: MPs and local authorities, the State, employers, trade unions and associations. Since adaptation is inconceivable without a regional approach, consultation meetings were also organised in regions of Metropolitan and Overseas France. Members of Parliament were consulted and public opinion was also sought over the Internet. A final round table was organised to summarise the proposals and comments received. The outcome of this process provided material for drawing up the national adaptation plan that was adopted in 2011.

### **E.2** The national energy transition debate: organised with representation from the whole of society (March-July 2013)

Based on the principles of efficiency, low-carbon energy and the development of renewable energy, the energy transition required by the French President began in 2013 with an enormous national debate involving the whole of civil society.

This open debate involving participation from the French people was organised around seven authorities. The French national public debate commission invited the stakeholders from seven colleges representing French society to the debate. This body formulated recommendations in view of the forthcoming framework law on energy transition. The commission relied on a group of experts who were asked to assist with the work. The steering committee, whose members were appointed by government, ensured that the rules of the debate were complied with and also coordinated the various authorities. The general secretariat dealt with the operational organisation of the debate. The Citizen's Committee ensured that this debate was accessible to the people and provided the keys for taking their views into

account. The decentralised liaison committee facilitated and coordinated the organisation of the debate in the regions. The energy company contact group organised the consultation with all economic energy stakeholders and ensured it was transparent.

### How did the people actually participate?

The French people's participation in the national debate on energy transition began in March 2013. Firstly, by means of a website: Internet users could find the components of the debate and the points of view of the various stakeholders, demonstrating the diversity of opinions on subject. Everyone the opportunity to have their say on the contribution area of the national debate website and on Twitter and Facebook accounts. People could therefore follow the discussion and participate in it in real time. Energy days were then arranged: designed along the lines of heritage days, with energy facilities open to the public and attracting about 200,000 visitors to 450 sites.

Citizen Day on 25 May, organised in 11 volunteer regions of Metropolitan France and 3 Overseas Departments also marked an important stage in the national energy transition debate. In each region groups of 100 to 150 people were selected according to various criteria (occupation, gender, age, place of residence, settlement type, size of household and form of transport) and met to discuss the issue for a day. The objective of this unusual day was to air well-informed public opinion on the major issues of the debate through a participative process enabling ordinary citizens to consider the issues of energy transition.

By June 2013 almost 1,200 contributions had been received by the debate General Secretariat of the debate or posted on the debate website, of which about 1,100 were usable. In the main these were individual, sectoral or thematic contributions. Several things were learnt from a summary of these contributions. Managing energy consumption provoked considerable interest as it was mentioned by a third of contributions. Unsurprisingly, the composition of

the energy package itself gave rise to very divided contributions. The choices to be made in terms of renewable energies, another major theme of the debate, accounted for 15% of total contributions. Developing auto-consumption of energy and the role of regions were dealt with. Solar and wind power were the energy sources that gave rise to the most contrasting opinions, while energy sources which attract less media attention, such as biomass and geothermal energy, received support. Finally, on the subject of funding the energy transition, taxation (diesel tax, carbon tax, etc.) and electricity and gas prices received a lot of attention.

### E.3 Greenhouse gas assessment and compensation: participation of all stakeholders

All stakeholders and all activity sectors are affected. For businesses, public buildings and local authorities, carrying out an assessment enabled them to meet the regulations, show an example, initiate a more comprehensive approach to environmental management, identify strategic issues (energy saving, etc.) and unite their employees or users around a common issue (cf. chapter IV). People are also invited to participate through a number of websites. They can also use a free "carbon coach" service to estimate their carbon emissions over the past year. More importantly it also suggests action plans for reducing their emissions by major themes (food, house, etc.). It has become very popular and easy in France for people to assess their carbon footprint. In 2013 almost 40,000 French households had registered on this site and 31,000 had completed the test and action plans.

<http://www.coachcarbone.org/>

After a period of substantial expansion, carbon compensation, which compensates for emissions that remain fixed, has stabilised. This has also been professionalised. Carbon compensation, if done in total transparency and entrusted to a reliable body, has proven that it can help with the collective reduction of greenhouse gas emissions.

#### **E.4 Traditional media and social networks: complementary channels**

After several years at their peak and the creation of programmes or pages dedicated to climate change it has to be acknowledged that coverage of this subject in the media is now more subdued or assumes different forms. Television now offers this subject in short advertiser-sponsored programmes, which receive overwhelming acclaim from viewers. The concept is based on the eye-witness accounts of professionals or anonymous citizens who suggest alternative actions as solutions for every day actions or open their low-carbon home.

In view of the subject's media decline, social networks are a new source of information and communication. For several reasons social networks have become essential. They are the preferred forums for targeting young people aged 16 to 25 and raising their awareness to various messages. They can be directed to expert networks depending on the type of social network used. In addition, this new media enables the public authorities to talk to identified web users who are concerned about climate change issues, in order to engage in dialogue, share their experiences and be attentive to the trends and changes of opinion that emerge.

In 2013 the Ministry responsible for sustainable development had over 6,000 "fans" on Facebook and 14,000 "followers" on Twitter. Every day the Ministry posts messages containing added value for web users. Information comes from all the Ministry's websites and is made significant for the community (by showing content in the form of photo albums for example).

#### **E.5 Advertising professionals: support and guides for real mobilisation**

##### **Advertising support for use by advertisers**

In order to raise public awareness to energy efficiency and cutting greenhouse gas emissions and so that advertising does not distort the perception of the issues, several actions have been implemented to control advertising. The

slogan "l'énergie est notre avenir, économisons-la" (Energy is our future, let's save it) has been compulsory since 2006 for any advertising carried out by a company selling electricity, heating or cooling, solid fuel, liquid fuel or gas and or fuel, or services using such energies.

An environmentally responsible advertising charter was signed in 2008 between advertising professionals and the Ministry responsible for sustainable development, in order to control advertising more strictly with regard to sustainable development and the environment in order to ensure environmentally compliant advertising. In 2011, 89% of environment-related visuals complied with the recommended good practice with respect to sustainable development issued by the Autorité de Régulation Professionnelle de la Publicité (ARPP) (French Advertising Standards Authority).

##### **Environmental responsibility and events: professionals rally to the cause**

Whether organising a conference, trade fair or just a meeting, event advertising professionals incorporate certain good practice for reducing their carbon footprint into the preparation of their events. Several tools are available to help: [Environmental self-testing for Responsible Events](#), good practice guide etc.

##### **Paperless communication: beware for accepted ideas**

To enlighten advertising professionals, ADEME assessed the environmental impacts of information and advertising technologies. They warn that the Internet and USB flash drives are not as environmentally friendly as one might think and often produce more CO<sub>2</sub> emissions than paper. AFNOR has published an ISO 26000 user guide for advertising professionals in which, among other things, it gives advice on web advertising, in order to cut emissions (free software, graphic creation, etc.).

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### E.6 Non-governmental organisations: essential stakeholders

For a long time NGOs (environmental, humanitarian, human rights, etc.) and trade unions have each operated on very separate grounds. The fight against climate change puts a new complexion on matters by bringing these different stakeholders together. Their aim: to raise public awareness and protect the public from the issues of climate change, ensure that public policies do justice to the climate challenge and ensure their area of activity is understood and supported. All were consulted in the public consultation debates or during the preparations for negotiation sessions.

The influence of environmental protection associations dominates the debate. Grouped within the RAC-F, they participate in international climate negotiations and implement numerous climate change awareness projects, including publications, letters, conferences, kits or training courses. Significantly, these environmental protection associations now work with associations involved in development or North-South relations.  
<http://www.rac-f.org/>

Because manufacturers and businesses have responsibility for meeting the climate challenge, they have formed several groups that have become involved in the subject. Some have created their own Climate Change or Sustainable Development Committees, whose role is to put forward ways and means by which the productive sector can contribute to the reduction of greenhouse gas emissions, enabling the environmental objective to be reached while preserving the competitiveness of businesses. They also support their members' efforts to reduce their GHG emissions. Entreprises pour l'Environnement (Enterprises for the Environment) organise Student Prizes to promote sustainable development within higher education establishments. <http://www.epe-asso.org/index.php>. Lastly, under the NRE Law<sup>4</sup>, the environmental impact of businesses must be transparent: information on energy efficiency and greenhouse gas emissions must be published.

Elected representatives have also rallied to the climate challenge: all associations of elected representatives whether mayors or regional representatives also have their own sustainable development committee. The preparation of local authority regional climate and energy plans really raises the awareness of regional stakeholders and constituents to the climate challenge, in relation to mitigation and adaptation. They attend negotiations in large number to ensure actions and participation of local authorities in achieving the aims are recognised. Like businesses, municipalities of over 50,000 people have to draw up an assessment of their greenhouse gas emissions and make them public.

[www.amgvf.fr](http://www.amgvf.fr)

The various aspects of sustainable development are now also permanently included by the main groups of affiliated trade unions. Trade unions demand that climate negotiations are not solely focused on cutting greenhouse gas emissions. An approach encompassing all living things and the economic and social consequences of the environmental crisis is also essential. The requirement for a fair transition to a low-carbon society and the inseparable objective of decent work for all remains the priority aim of the trade union movement in international climate negotiations.

<http://cgt-devdurable.com/>

## F. Public access to information and sources of information

Climate change is a vast and complex subject for which numerous sources of information are available and accessible to the largest number of people.

<sup>4</sup> *Loi sur les Nouvelles Régulations Economiques (Law on New Economic Rules) published in the French Official Gazette on 15 May 2001 and the decree on the requirement for businesses to be transparent in relation to social and environmental matters was published on 24 April 2012.*

## **F.1** Observation and climatology: centres of excellence

In France, systematic observation of the state of the climate is mainly based on Météo France for the atmosphere and ocean surface. Meteorological research is a major part of Météo-France's activity, alongside production of satellite images and weather forecasts.

[www.meteo.fr](http://www.meteo.fr)

Other bodies also participate in climate observation and monitoring (see chapter 8):

- The Department of Universal Science at the Centre national de la recherche scientifique (CNRS) (French national scientific research centre);
- The Institut Pierre-Simon Laplace (IPSL);
- The Bureau de Recherche géologiques et minières (BRGM) (geological and mining research office);
- The Observatoire national sur les effets du réchauffement climatique (ONERC) (National observatory on the effects of global warming) which collects and disseminates information, studies and research on risks related to global warming and extreme weather phenomena.

Other bodies include INRA ([www.inra.fr](http://www.inra.fr)), CEMAGREF ([www.cemagref.fr](http://www.cemagref.fr)), CIRED ([www.centre-cired.fr/forum/index.php3](http://www.centre-cired.fr/forum/index.php3)), CEA ([www.cea.fr](http://www.cea.fr)), IDDRI ([www.iddri.org/iddri](http://www.iddri.org/iddri)) and many others also publish data on the various aspects climate change and its manifestations. Similarly, the GIS (Groupement d'Intérêt Scientifique CLIMAT-ENVIRONNEMENT-SOCIETE) (Climate-Environment-Society Scientific Interest Grouping) under the aegis of the Ministries responsible for research and sustainable development encourages, supports and coordinates interdisciplinary research on climate change and its impacts on society and the environment.

<http://www.gisclimat.fr/index.html>

## **F.2** Statistics and inventories: chapter 3

As part of the SNIÉBA<sup>5</sup> order, CITEPA publishes on its website emissions inventories produced on behalf of France.

SOeS is the statistics department of the Ministry responsible for sustainable development. It publishes official statistics on subjects such as housing, construction, transport, energy and climate, the environment, and sustainable development on its website

(<http://www.statistiques.developpement-durable.gouv.fr/>)

MEDDE publishes the most up-to-date information on the environment and sustainable development (<http://www.developpement-durable.gouv.fr>).

## **F.3** Policies and measures of mitigation and adaptation

The "toutsurlenvironnement.fr" portal gives access to the information produced by French public stakeholders concerning the environment and responds to the French State's commitment to the first pillar of the Aarhus Agreement: "Access to environmental information". Almost 68,500 resources are currently referenced, of which nearly 10% are devoted to climate.

<http://www.toutsurlenvironnement.fr/>

Moreover, in order to honour its objectives of cutting greenhouse gas emissions, France has published and implemented several Plans Climat (Climate Plans). They have always been described and followed in regular publications and postings on the website of the Ministry responsible for sustainable development. The same is true of its national adaptation plan which has been the subject of regular presentations and follow-ups.

In 2013 France published the report on the monitoring mechanisms which is due at community

<sup>5</sup> *Order of 24 August 2011 on the national system of inventories of emissions and balances in the atmosphere.*

level. This report describes France's policies and measures up to 2013.

#### **F.4 Tools and advice: creating a local connection**

So that individuals receive the best support and information, numerous tools and guides have been developed under the aegis of the State:

- ADEME's general public guides devoted to climate change and energy management issues. Nearly 4 millions guides are distributed each year;
- AZUR number In response to a flood of requests, ADEME set up an AZUR telephone platform to provide rapid response to questions about energy from individuals;
- The MEDDE and ADEME websites are veritable resource centres for all French citizens;
- ONERC's website shows changes in 23 climate change indicators and provides a climate simulator representing the possible climate of the second half of the 21st century for each town of Metropolitan France.

#### **Espaces Info Energie (Energy Information Points): a very effective source of local information**

Resulting from an ADEME initiative and supported by partner authorities, EIEs advise private householders on energy efficiency and renewable energies. In 2012 there were 261 EIEs across France, run by 500 impartial and independent advisers. More than 620,000 people were given information in 2012, i.e. 8 million individuals since 2003. Their advice resulted in more than €520 million of work being carried out, thus saving 158,000 tonnes CO<sub>2</sub> equivalent per year.

#### **F.5 Leisure and culture: available offers in the service of the climate challenge**

The publishing world continues to offer numerous works on the theme of climate change, through all the subjects it covers (science, climate, energy, etc.). Bookshop shelves are also regularly filled with controversial works. Cartoons, especially

documentaries, have also seized on the subject (e.g. Philippe Squarzoni's *Saison brune*, 2012).

Documentaries and fiction on this subject are presented to television viewers as meteorological or political issues become topical.

The subject has also received treatment in the theatre: such as "Les Chroniques du Réchauffement" developed by the Vertical Détour company, a theatrical cycle exploring human landscapes through the prism of climate change.

New games or adaptations of games have been developed to encourage people to take up the climate theme and take good decisions to meet the challenge. Board games, video games, on-line games ([www.2020Energy.eu](http://www.2020Energy.eu); [www.mtaterre.fr](http://www.mtaterre.fr) etc.).

But the tone of this media has changed: catastrophic predictions up to 2050 or 2100 receive less interest. Calling on self-control, they have sometimes brought frustration and have sometimes had perverse effects. Humour is a new weapon for championing the climate challenge. The Réseau français des étudiants pour le développement durable (The French Network of students for sustainable development) for example, organises bogus environmental demonstrations through its O-Verts-Dose movement. A specialist environmental journalist became "Bridget Kyoto" in 2011 in order to make jokes about the subject by creating mini sketches in which she explained how to successfully bring about the end of the world. This off-centre stance is designed to make an original impression.

## **G. Cooperation**

### **G.1 Regional cooperation**

Local authorities, which hold power in relation to town planning, regional development and energy, play an important role in the fight against global warming by implementing regional climate and energy plans. A regional network of the main ministries and public

bodies supports the measures of the local authorities. Numerous publications, forums, conferences, guides and training courses are available to them. Where adaptation is concerned, the Observatoire national sur les effets du réchauffement climatique (ONERC) (French national observatory on the effects of global warming) develops tools to help local authorities adapt to the impacts of global warming: indicators, future climate simulations and documentation help local authorities to gain a better understanding of the impacts of climate change and to plan adaptation actions.

All these activities are also supported by regional development associations: AMF (Association des maires de France) (Association of French mayors), AMGVF (Association des maires des grandes villes de France) (Association of mayors of large towns in France), ARF (Association des régions de France) (Association of French regions) have now written the subject of climate change into their regional cooperation mission.

## **G.2 International cooperation**

Under article 6 of the Convention, governments must also cooperate with each other in order to encourage the preparation, exchange and use of equipment and programmes designed to meet the educational, training and public awareness objectives. France, particularly in respect of French speaking countries, takes on an important role in the implementation of this requirement.

It makes a financial contribution to the French translation of the daily "Earth Negotiations Bulletin" published by the IISD (International Institute of Sustainable Development) during the negotiations. <http://www.iisd.ca/enbvol/enb-background.htm>

It also supports the work of the Institut de la Francophonie pour le développement durable (Francophone Institute for sustainable development) and in particular the writing and publication of guides and interpretation notes on climate negotiations. <http://www.ifdd.francophonie.org/ressources/ressources-pub.php?id=13>

A large number of publications on climate change written in French by France have been widely distributed within the international French speaking community.

Finally, through its embassy network France organises press workshops on the subject of climate in several countries. Journalists from around the world have been invited to France to meet with French climate experts.

Reinforcing the carbon funding capacity in AfricaThe Ministry responsible for sustainable development funds training courses via the agence de coopération technique internationale des ministères français (Adetef) (International technical cooperation agency of the French Ministries). In 2012, it supported a training course organised by the Geres association (Groupe Énergies Renouvelables, Environnement et Solidarités) (Renewable energy, Environment and Collaboration Group). This NGO founded in 1976 works in the energy and climate change arena in France and abroad. In Benin, the association carries out a dissemination project for better homes in order to reduce the use of fuel and deforestation, reduce toxic smoke and thus reduce GHGs. This project will soon be the subject of an application for approval with the Autorité Nationale Française (French National Authority) in view of its registration as a CDM project by the UNFCCC. In Mali, the GERES is carrying out a project of setting up local agro-fuel supply chains, with a double objective: generating a new source of income for the local populations and improving their access to energy. This network is based on the production and consumption of pure Jatropha Curcas (HVP) vegetable oil, a shrub with oily seeds that grows locally. The objective is to build a "replicable pattern" of access to sustainable energy for people living in the rural areas of West Africa.

With its experience and contacts in West Africa, the NGO organised a three-day carbon funding training course in Cotonou, Benin. The target audience consisted of fifty West African carbon finance stakeholders: entrepreneurs, NGO representatives, administrators and consultants. In 2013 France plans to support the second level of this training.

### Reinforcing emissions inventory capacity and management system in the Maldives

France also helped to strengthen the capacity of the government of the Maldives by organising a training session on the French national inventory system in December 2010. This three-day workshop held in Malé brought together experts from the Ministries of Transport and the Environment and a large number of industrialists.

The objective of the training was to provide a constructive criticism of the inventory used by the Maldives with regard to French know-how, suggest a strategy for ensuring that work on the inventory carried out in 2010 was made permanent and set up a national system.

### Bilateral or multilateral cooperation with regard to adaptation

In the interests of sharing experiences and mutual reinforcement with regard to planning adaptation to climate change, ONERC (see chapter VI), Observatoire National sur les Effets du Réchauffement Climatique (French national observatory on the effects of global warming), participated in various projects:

- The adaptation steering group set up by the European Commission to develop a community strategy for adaptation to climate change (2009-2013);
- The adaptation working group on the knowledge base set up by the European Commission to structure and test the Climate-Adaptation experience exchange platform (2009-2012);
- Meeting with countries of southern Europe to share experience about adaptation planning (Rome, 2012);
- Multilateral meeting of European countries to share experiences concerning the study of the impacts of and vulnerabilities to climate change; Switzerland, Germany, Italy, Austria, Slovenia (Berne, 2012);
- Workshop with Mediterranean countries organised by the Plan Bleu (Cairo, 2012);
- Multilateral dialogue with countries of the Alpine arc in the context of the Alpine Convention (Vienna, 2013);

- Poland-France bilateral workshop on adaptation policies (Warsaw, 2013);
- Participation in the stakeholder group of the European Impact2C research project (Vienna, 2013);
- Bilateral experience sharing meeting concerning the study of vulnerability and adaptation policy with Vietnam (Paris, 2011);
- Technical exchange for structuring a climate change observatory in Mauritius (Port-Louis, 2011);
- Météo-France and the Ministries concerned participate in work to implement the global framework for climate services as part of the WMO (since 2009).

# Appendices

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# Appendix I. Contributions to the fifth French national communication to the UNFCCC

This document was prepared by the Département de la Lutte Contre l'Effet de Serre de la Direction Générale de l'Energie et du Climat (Department responsible for the fight against the Greenhouse Effect of the General Directorate of Energy and Climate) with the following contributions:

## Chapter II

Contributions from: Gilles Croquette, Lisa Sutto (MEDDE/DGEC), Jérôme Duvernoy (MEDDE/ONERC), Murielle Trouillet and Ludovic Larbodière (MAAF)

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## Chapter V

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## Chapter VI

Contributions from: Jérôme Duvernoy, Bertrand Reysset, Sylvain Mondon (MEDDE/DGEC)

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## Chapter IX

Contributions from: Marie Jaudet (MEDDE/DAEI)

# Appendix II. GHG emissions inventory, CRF format, Convention framework

## A: CO<sub>2</sub>

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year ( 1990 )	1991	1992	1993
	(Gg)	(Gg)	(Gg)	(Gg)
<b>1. Energy</b>	<b>371 213,60</b>	<b>396 498,53</b>	<b>390 409,41</b>	<b>367 567,03</b>
A. Fuel Combustion (Sectoral Approach)	367 090,59	392 286,43	386 190,32	363 547,23
1. Energy Industries	63 747,78	75 918,70	68 512,29	56 204,59
2. Manufacturing Industries and Construction	87 329,14	88 061,70	86 644,84	79 100,90
3. Transport	120 301,94	123 061,69	127 745,35	127 601,90
4. Other Sectors	95 711,73	105 244,34	103 287,84	100 639,84
5. Other	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	4 123,00	4 212,11	4 219,09	4 019,80
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	4 123,00	4 212,11	4 219,09	4 019,80
<b>2. Industrial Processes</b>	<b>24 461,16</b>	<b>23 686,49</b>	<b>21 464,20</b>	<b>20 949,39</b>
A. Mineral Products	16 525,07	15 816,80	14 491,27	13 606,06
B. Chemical Industry	3 185,60	3 073,48	2 626,54	2 811,13
C. Metal Production	4 750,48	4 796,21	4 346,39	4 532,20
D. Other Production	NA	NA	NA	NA
E. Production of Halocarbons and SF <sub>6</sub>				
F. Consumption of Halocarbons and SF <sub>6</sub>				
G. Other	NO	NO	NO	NO
<b>3. Solvent and Other Product Use</b>	<b>1 992,48</b>	<b>1 909,27</b>	<b>1 860,20</b>	<b>1 749,68</b>
<b>4. Agriculture</b>				
A. Enteric Fermentation				
B. Manure Management				
C. Rice Cultivation				
D. Agricultural Soils				
E. Prescribed Burning of Savannas				
F. Field Burning of Agricultural Residues				
G. Other				
<b>5. Land Use, Land-Use Change and Forestry<sup>(2)</sup></b>	<b>-25 759,56</b>	<b>-22 044,97</b>	<b>-25 967,25</b>	<b>-32 358,19</b>
A. Forest Land	-38 059,61	-34 235,47	-38 033,72	-44 667,75
B. Cropland	16 837,15	16 752,20	16 589,42	16 728,06
C. Grassland	-12 361,60	-12 438,14	-12 467,20	-12 441,52
D. Wetlands	-2 015,83	-2 089,64	-2 176,28	-2 275,76
E. Settlements	10 349,08	10 488,66	10 657,39	10 850,37
F. Other Land	150,64	137,25	123,48	109,34
G. Other	-659,40	-659,83	-660,34	-660,92
<b>6. Waste</b>	<b>1 736,65</b>	<b>1 711,13</b>	<b>1 729,35</b>	<b>1 709,10</b>
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	NA,NO
B. Waste-water Handling				
C. Waste Incineration	1 736,65	1 711,13	1 729,35	1 709,10
D. Other	NA	NA	NA	NA
<b>7. Other (as specified in Summary I.A)</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
<b>Total CO<sub>2</sub> emissions including net CO<sub>2</sub> from LULUCF</b>	<b>373 644,32</b>	<b>401 760,45</b>	<b>389 495,91</b>	<b>359 617,01</b>
<b>Total CO<sub>2</sub> emissions excluding net CO<sub>2</sub> from LULUCF</b>	<b>399 403,88</b>	<b>423 805,42</b>	<b>415 463,16</b>	<b>391 975,20</b>
<b>Memo Items:</b>				
<b>International Bunkers</b>	<b>17 065,59</b>	<b>17 045,09</b>	<b>18 055,20</b>	<b>18 151,09</b>
Aviation	8 976,85	8 661,56	9 947,10	10 355,92
Marine	8 088,75	8 383,53	8 108,10	7 795,17
<b>Multilateral Operations</b>	<b>1,30</b>	<b>1,73</b>	<b>1,51</b>	<b>1,51</b>
<b>CO<sub>2</sub> Emissions from Biomass</b>	<b>42 016,19</b>	<b>48 359,34</b>	<b>47 370,41</b>	<b>46 032,92</b>



## B: CH4

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year ( 1990 )	1991	1992	1993
	(Gg)	(Gg)	(Gg)	(Gg)
<b>1. Energy</b>	500,21	517,13	514,73	510,35
A. Fuel Combustion (Sectoral Approach)	235,94	268,80	260,84	250,74
1. Energy Industries	6,26	6,92	6,34	6,70
2. Manufacturing Industries and Construction	11,25	11,10	11,06	9,76
3. Transport	40,47	40,10	40,38	38,57
4. Other Sectors	177,96	210,68	203,06	195,70
5. Other	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	264,27	248,34	253,89	259,61
1. Solid Fuels	193,59	179,75	187,57	195,63
2. Oil and Natural Gas	70,67	68,58	66,32	63,98
<b>2. Industrial Processes</b>	<b>3,76</b>	<b>4,15</b>	<b>4,49</b>	<b>4,17</b>
A. Mineral Products	NA	NA	NA	NA
B. Chemical Industry	3,69	4,09	4,42	4,10
C. Metal Production	0,07	0,07	0,07	0,06
D. Other Production				
E. Production of Halocarbons and SF <sub>6</sub>				
F. Consumption of Halocarbons and SF <sub>6</sub>				
G. Other	NO	NO	NO	NO
<b>3. Solvent and Other Product Use</b>				
<b>4. Agriculture</b>	<b>1 870,97</b>	<b>1 842,41</b>	<b>1 826,08</b>	<b>1 819,58</b>
A. Enteric Fermentation	1 465,83	1 441,20	1 422,48	1 412,31
B. Manure Management	398,37	394,13	395,91	399,23
C. Rice Cultivation	4,79	5,03	5,62	6,08
D. Agricultural Soils	NA	NA	NA	NA
E. Prescribed Burning of Savannas	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	1,98	2,06	2,07	1,97
G. Other	NO	NO	NO	NO
<b>5. Land Use, Land-Use Change and Forestry</b>	<b>55,47</b>	<b>55,40</b>	<b>54,01</b>	<b>51,21</b>
A. Forest Land	39,18	36,87	35,99	33,67
B. Cropland	6,32	7,28	7,05	6,84
C. Grassland	7,90	9,15	8,82	8,52
D. Wetlands	0,40	0,40	0,40	0,39
E. Settlements	1,58	1,63	1,68	1,72
F. Other Land	0,08	0,07	0,06	0,06
G. Other	NA,NO	NA,NO	NA,NO	NA,NO
<b>6. Waste</b>	<b>446,79</b>	<b>469,78</b>	<b>494,37</b>	<b>518,64</b>
A. Solid Waste Disposal on Land	404,41	425,36	447,90	470,12
B. Waste-water Handling	40,31	42,28	44,27	46,25
C. Waste Incineration	0,86	0,87	0,88	0,89
D. Other	1,20	1,26	1,31	1,37
<b>7. Other (as specified in Summary I.A)</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
<b>Total CH<sub>4</sub> emissions including CH<sub>4</sub> from LULUCF</b>	<b>2 877,19</b>	<b>2 888,87</b>	<b>2 893,67</b>	<b>2 903,94</b>
<b>Total CH<sub>4</sub> emissions excluding CH<sub>4</sub> from LULUCF</b>	<b>2 821,72</b>	<b>2 833,48</b>	<b>2 839,66</b>	<b>2 852,73</b>
<b>Memo Items:</b>				
<b>International Bunkers</b>	0,35	0,32	0,32	0,29
Aviation	0,22	0,19	0,19	0,16
Marine	0,13	0,13	0,13	0,12
<b>Multilateral Operations</b>	NE	NE	NE	NE
<b>CO<sub>2</sub> Emissions from Biomass</b>				

1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Change from base to latest reported year %
(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	
481,46	476,77	436,45	386,74	379,18	357,74	337,43	290,71	265,48	247,42	222,39	194,95	174,03	156,81	152,65	143,62	150,16	128,63	-74,29
219,64	219,27	228,90	201,76	197,74	183,26	167,31	161,89	144,89	146,01	141,09	129,69	113,30	103,60	98,71	90,85	92,63	74,18	-68,56
2,88	2,88	2,96	2,88	3,01	2,84	2,77	2,75	2,83	2,86	2,94	2,97	2,94	2,97	2,84	2,83	2,70	2,46	-60,66
10,91	11,00	10,25	10,83	11,34	11,09	11,16	10,27	10,87	10,23	11,62	10,07	8,63	10,54	8,89	6,26	7,64	7,75	-31,07
35,86	32,94	31,05	29,31	28,09	26,87	25,10	23,77	22,18	20,36	19,22	17,49	15,67	14,31	12,48	11,26	10,33	9,19	-77,30
169,99	172,44	184,64	158,75	155,30	142,47	128,28	125,11	109,01	112,56	107,32	99,16	86,06	75,79	74,50	70,50	71,95	54,77	-69,22
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
261,82	257,50	207,54	184,97	181,44	174,48	170,12	128,82	120,58	101,41	81,29	65,26	60,73	53,21	53,94	52,77	57,53	54,45	-79,40
199,80	198,06	150,93	128,67	125,02	118,74	114,42	73,81	65,90	47,31	28,15	15,59	10,87	2,88	2,90	2,47	2,50	2,11	-98,91
62,02	59,44	56,61	56,31	56,42	55,74	55,71	55,01	54,68	54,09	53,15	49,67	49,87	50,33	51,04	50,30	55,03	52,34	-25,95
4,35	4,53	4,70	5,01	4,67	4,79	4,88	5,06	4,80	5,36	5,67	4,53	4,26	4,02	3,53	3,14	3,77	2,52	-32,89
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,00
4,28	4,45	4,62	4,92	4,58	4,70	4,78	4,97	4,71	5,27	5,58	4,44	4,18	3,94	3,45	3,07	3,70	2,45	-33,62
0,07	0,08	0,08	0,09	0,09	0,09	0,10	0,09	0,09	0,09	0,09	0,09	0,09	0,09	0,08	0,06	0,07	0,07	6,29
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
1 828,77	1 848,15	1 857,80	1 848,54	1 850,92	1 856,74	1 925,80	1 937,17	1 902,44	1 853,47	1 834,32	1 831,60	1 836,10	1 857,91	1 887,04	1 861,76	1 852,87	1 828,89	-2,25
1 418,59	1 428,00	1 425,66	1 410,61	1 404,64	1 404,37	1 454,45	1 457,64	1 420,56	1 377,28	1 359,49	1 355,51	1 358,79	1 369,90	1 388,32	1 373,05	1 366,23	1 345,97	-8,18
401,71	412,12	424,48	430,52	439,14	445,73	464,21	473,07	475,56	470,50	468,61	470,56	471,92	482,65	493,34	482,42	480,40	476,46	19,60
6,45	6,06	5,49	5,26	4,82	4,39	4,87	4,67	4,52	4,39	4,89	4,51	4,40	4,42	4,29	5,11	5,14	5,37	12,11
NA	0,00																	
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
2,03	1,97	2,18	2,16	2,32	2,25	2,26	1,78	1,79	1,30	1,33	1,02	0,99	0,94	1,09	1,18	1,09	1,09	-44,88
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00

C: N<sub>2</sub>O

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year ( 1990 )	1991	1992	1993
	(Gg)	(Gg)	(Gg)	(Gg)
<b>1. Energy</b>	<b>12,21</b>	<b>13,30</b>	<b>13,14</b>	<b>12,59</b>
A. Fuel Combustion (Sectoral Approach)	12,10	13,19	13,03	12,47
1. Energy Industries	1,92	2,33	2,22	1,81
2. Manufacturing Industries and Construction	2,76	2,82	2,82	2,64
3. Transport	3,23	3,25	3,33	3,47
4. Other Sectors	4,19	4,78	4,66	4,55
5. Other	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	0,11	0,11	0,11	0,11
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	0,11	0,11	0,11	0,11
<b>2. Industrial Processes</b>	<b>79,20</b>	<b>79,95</b>	<b>81,47</b>	<b>81,48</b>
A. Mineral Products	NA	NA	NA	NA
B. Chemical Industry	79,20	79,95	81,47	81,48
C. Metal Production	NA	NA	NA	NA
D. Other Production				
E. Production of Halocarbons and SF <sub>6</sub>				
F. Consumption of Halocarbons and SF <sub>6</sub>				
G. Other	NO	NO	NO	NO
<b>3. Solvent and Other Product Use</b>	<b>0,25</b>	<b>0,25</b>	<b>0,26</b>	<b>0,26</b>
<b>4. Agriculture</b>	<b>196,10</b>	<b>190,17</b>	<b>192,61</b>	<b>179,53</b>
A. Enteric Fermentation				
B. Manure Management	19,97	19,75	19,51	19,45
C. Rice Cultivation				
D. Agricultural Soils	176,08	170,36	173,05	160,02
E. Prescribed Burning of Savannas	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	0,05	0,05	0,06	0,05
G. Other	NO	NO	NO	NO
<b>5. Land Use, Land-Use Change and Forestry</b>	<b>5,81</b>	<b>5,72</b>	<b>5,73</b>	<b>5,74</b>
A. Forest Land	0,38	0,27	0,27	0,26
B. Cropland	5,36	5,38	5,39	5,42
C. Grassland	0,05	0,06	0,06	0,06
D. Wetlands	0,00	0,00	0,00	0,00
E. Settlements	0,01	0,01	0,01	0,01
F. Other Land	0,00	0,00	0,00	0,00
G. Other	NA,NO	NA,NO	NA,NO	NA,NO
<b>6. Waste</b>	<b>5,06</b>	<b>5,19</b>	<b>5,11</b>	<b>5,09</b>
A. Solid Waste Disposal on Land				
B. Waste-water Handling	4,52	4,65	4,56	4,54
C. Waste Incineration	0,34	0,34	0,35	0,35
D. Other	0,19	0,20	0,20	0,21
<b>7. Other (as specified in Summary I.A)</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>
<b>Total N<sub>2</sub>O emissions including N<sub>2</sub>O from LULUCF</b>	<b>298,63</b>	<b>294,58</b>	<b>298,33</b>	<b>284,69</b>
<b>Total N<sub>2</sub>O emissions excluding N<sub>2</sub>O from LULUCF</b>	<b>292,82</b>	<b>288,86</b>	<b>292,59</b>	<b>278,95</b>
<b>Memo Items:</b>				
<b>International Bunkers</b>	<b>0,47</b>	<b>0,47</b>	<b>0,50</b>	<b>0,51</b>
Aviation	0,29	0,28	0,32	0,34
Marine	0,18	0,19	0,18	0,17
<b>Multilateral Operations</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>	<b>NE</b>
<b>CO<sub>2</sub> Emissions from Biomass</b>				

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1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Change from base to latest reported year
(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
13,74	15,58	16,09	17,17	14,37	14,24	14,39	14,24	14,85	15,03	15,13	14,77	14,67	14,63	13,67	14,26	13,25	8,49
13,63	15,46	15,96	17,04	14,25	14,11	14,26	14,12	14,74	14,91	14,98	14,62	14,48	14,47	13,53	14,17	13,19	8,98
1,77	2,07	1,99	2,41	2,12	2,15	1,93	2,06	2,29	2,31	2,43	2,26	2,34	2,25	2,24	2,27	1,98	3,38
2,79	2,85	2,90	2,98	2,90	2,95	2,71	2,71	2,88	2,78	2,85	2,97	2,97	2,91	2,59	2,74	2,62	-5,10
4,75	5,83	6,72	7,14	4,79	4,67	4,82	4,89	4,94	5,04	4,93	4,87	4,89	4,81	4,17	4,37	4,56	41,18
4,31	4,72	4,35	4,51	4,44	4,33	4,81	4,45	4,62	4,78	4,77	4,52	4,28	4,51	4,53	4,80	4,02	-4,00
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
0,11	0,12	0,13	0,13	0,12	0,13	0,13	0,12	0,11	0,12	0,15	0,16	0,19	0,15	0,14	0,09	0,06	-44,93
NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
0,11	0,12	0,13	0,13	0,12	0,13	0,13	0,12	0,11	0,12	0,15	0,16	0,19	0,15	0,14	0,09	0,06	-44,93
<b>86,40</b>	<b>86,72</b>	<b>86,06</b>	<b>61,87</b>	<b>44,33</b>	<b>39,39</b>	<b>39,39</b>	<b>31,63</b>	<b>31,16</b>	<b>21,89</b>	<b>22,07</b>	<b>19,65</b>	<b>18,26</b>	<b>14,95</b>	<b>12,61</b>	<b>7,03</b>	<b>4,01</b>	<b>-94,93</b>
NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,00
86,40	86,72	86,06	61,87	44,33	39,39	39,39	31,63	31,16	21,89	22,07	19,65	18,26	14,95	12,61	7,03	4,01	-94,93
NA	0,00																
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
0,26	0,26	0,26	0,26	0,26	0,27	0,27	0,27	0,27	0,27	0,28	0,28	0,28	0,28	0,28	0,28	0,29	12,50
<b>183,37</b>	<b>185,67</b>	<b>190,36</b>	<b>190,02</b>	<b>188,09</b>	<b>191,59</b>	<b>182,97</b>	<b>183,61</b>	<b>174,81</b>	<b>177,44</b>	<b>175,28</b>	<b>170,30</b>	<b>170,83</b>	<b>177,34</b>	<b>167,97</b>	<b>165,90</b>	<b>171,54</b>	<b>-12,52</b>
19,47	19,21	18,87	18,59	18,17	18,37	18,13	17,51	16,87	16,33	16,01	15,72	15,66	15,68	15,57	15,54	15,25	-23,66
163,85	166,40	171,43	171,36	169,85	173,16	164,80	166,05	157,90	161,08	159,25	154,55	155,14	161,64	152,38	150,33	156,27	-11,25
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
0,05	0,06	0,06	0,06	0,06	0,06	0,05	0,05	0,03	0,03	0,03	0,03	0,02	0,03	0,03	0,03	0,03	-44,55
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
<b>5,62</b>	<b>5,60</b>	<b>5,55</b>	<b>5,51</b>	<b>5,38</b>	<b>5,29</b>	<b>5,16</b>	<b>5,10</b>	<b>5,04</b>	<b>4,81</b>	<b>4,78</b>	<b>4,73</b>	<b>4,73</b>	<b>4,83</b>	<b>4,85</b>	<b>4,79</b>	<b>4,67</b>	<b>-19,62</b>
0,26	0,25	0,26	0,26	0,23	0,26	0,23	0,28	0,33	0,22	0,23	0,19	0,19	0,19	0,21	0,22	0,20	-47,38
5,30	5,28	5,23	5,19	5,09	4,97	4,86	4,76	4,65	4,53	4,48	4,47	4,47	4,57	4,57	4,50	4,41	-17,79
0,05	0,06	0,05	0,05	0,05	0,04	0,05	0,04	0,04	0,05	0,05	0,05	0,05	0,05	0,05	0,05	0,04	-24,17
0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-16,58
0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,02	0,01	0,02	0,01	124,61
0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-11,40
NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
<b>5,18</b>	<b>5,16</b>	<b>5,06</b>	<b>5,02</b>	<b>5,03</b>	<b>5,08</b>	<b>5,02</b>	<b>4,84</b>	<b>4,65</b>	<b>4,49</b>	<b>4,41</b>	<b>4,51</b>	<b>4,20</b>	<b>4,11</b>	<b>4,03</b>	<b>4,06</b>	<b>4,07</b>	<b>-19,59</b>
4,56	4,50	4,41	4,33	4,21	4,24	4,10	3,82	3,55	3,33	3,16	3,12	2,81	2,71	2,55	2,46	2,47	-45,29
0,36	0,35	0,34	0,34	0,33	0,35	0,34	0,34	0,33	0,33	0,34	0,34	0,29	0,24	0,22	0,22	0,22	-37,32
0,26	0,30	0,31	0,35	0,48	0,49	0,58	0,68	0,77	0,84	0,91	1,05	1,10	1,16	1,26	1,38	1,38	616,05
NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0,00
<b>294,56</b>	<b>298,98</b>	<b>303,38</b>	<b>279,85</b>	<b>257,46</b>	<b>255,85</b>	<b>247,19</b>	<b>239,69</b>	<b>230,78</b>	<b>223,93</b>	<b>221,94</b>	<b>214,24</b>	<b>212,96</b>	<b>216,13</b>	<b>203,42</b>	<b>196,33</b>	<b>197,83</b>	<b>-33,76</b>
<b>288,94</b>	<b>293,39</b>	<b>297,83</b>	<b>274,34</b>	<b>252,07</b>	<b>250,56</b>	<b>242,03</b>	<b>234,59</b>	<b>225,74</b>	<b>219,12</b>	<b>217,17</b>	<b>209,51</b>	<b>208,23</b>	<b>211,30</b>	<b>198,57</b>	<b>191,54</b>	<b>193,16</b>	<b>-34,04</b>
<b>0,51</b>	<b>0,54</b>	<b>0,57</b>	<b>0,61</b>	<b>0,66</b>	<b>0,68</b>	<b>0,66</b>	<b>0,65</b>	<b>0,67</b>	<b>0,73</b>	<b>0,72</b>	<b>0,76</b>	<b>0,79</b>	<b>0,76</b>	<b>0,72</b>	<b>0,71</b>	<b>0,75</b>	<b>58,14</b>
0,35	0,37	0,38	0,41	0,45	0,47	0,48	0,48	0,48	0,52	0,52	0,55	0,58	0,58	0,53	0,53	0,55	89,00
0,16	0,17	0,18	0,20	0,20	0,21	0,18	0,17	0,19	0,22	0,20	0,21	0,21	0,18	0,18	0,18	0,19	7,42
NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	0,00

## D: F-gases

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	base year ( 1990	1991	1992	1993
	(Gg)	(Gg)	(Gg)	(Gg)
<b>Emissions of HFCs<sup>(3)</sup> - (Gg CO<sub>2</sub> equivalent)</b>	<b>3 742,63</b>	<b>4 315,56</b>	<b>3 722,93</b>	<b>2 423,78</b>
HFC-23	0,14	0,18	0,17	0,18
HFC-32	0,01	0,01	0,01	0,01
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO
HFC-43-10mee	NA,NO	NA,NO	NA,NO	0,01
HFC-125	0,02	0,02	0,02	0,03
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	0,07	0,07	0,08	0,13
HFC-152a	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	0,51	0,53	0,40	0,02
HFC-227ea	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed HFCs <sup>(4)</sup> - (Gg CO <sub>2</sub> equivalent)	NA,NO	NA,NO	NA,NO	NA,NO
<b>Emissions of PFCs<sup>(3)</sup> - (Gg CO<sub>2</sub> equivalent)</b>	<b>4 293,45</b>	<b>3 973,31</b>	<b>4 047,57</b>	<b>3 953,72</b>
CF <sub>4</sub>	0,39	0,35	0,36	0,32
C <sub>2</sub> F <sub>6</sub>	0,16	0,15	0,16	0,18
C <sub>3</sub> F <sub>8</sub>	0,00	0,00	0,00	0,00
C <sub>4</sub> F <sub>10</sub>	NA,NO	NA,NO	NA,NO	NA,NO
c-C <sub>4</sub> F <sub>8</sub>	0,01	0,02	0,01	0,01
C <sub>5</sub> F <sub>12</sub>	NA,NO	NA,NO	NA,NO	NA,NO
C <sub>6</sub> F <sub>14</sub>	0,02	0,02	0,02	0,03
Unspecified mix of listed PFCs <sup>(4)</sup> - (Gg CO <sub>2</sub> equivalent)	NA,NO	NA,NO	NA,NO	NA,NO
<b>Emissions of SF<sub>6</sub><sup>(3)</sup> - (Gg CO<sub>2</sub> equivalent)</b>	<b>2 019,81</b>	<b>2 059,52</b>	<b>2 099,81</b>	<b>2 140,75</b>
SF <sub>6</sub>	0,08	0,09	0,09	0,09

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## E: Abstract

GREENHOUSE GAS EMISSIONS (CO <sub>2</sub> equivalent Gg)	Base year ( 1990 )	1991	1992	1993
CO <sub>2</sub> emissions including net CO <sub>2</sub> from LULUCF	373 644,32	401 760,45	389 495,91	359 617,01
CO <sub>2</sub> emissions excluding net CO <sub>2</sub> from LULUCF	399 403,88	423 805,42	415 463,16	391 975,20
CH <sub>4</sub> emissions including CH <sub>4</sub> from LULUCF	60 421,08	60 666,31	60 767,01	60 982,75
CH <sub>4</sub> emissions excluding CH <sub>4</sub> from LULUCF	59 256,18	59 502,99	59 632,85	59 907,41
N <sub>2</sub> O emissions including N <sub>2</sub> O from LULUCF	92 576,06	91 318,26	92 480,83	88 255,24
N <sub>2</sub> O emissions excluding N <sub>2</sub> O from LULUCF	90 775,64	89 545,42	90 703,39	86 475,25
HFCs	3 742,63	4 315,56	3 722,93	2 423,78
PFCs	4 293,45	3 973,31	4 047,57	3 953,72
SF <sub>6</sub>	2 019,81	2 059,52	2 099,81	2 140,75
<b>Total (including LULUCF)</b>	<b>536 697,35</b>	<b>564 093,42</b>	<b>552 614,06</b>	<b>517 373,25</b>
<b>Total (excluding LULUCF)</b>	<b>559 491,59</b>	<b>583 202,22</b>	<b>575 669,71</b>	<b>546 876,11</b>
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year ( 1990 )	1991	1992	1993
1. Energy	385 503,27	411 480,85	405 293,15	382 186,02
2. Industrial Processes	59 147,34	58 906,02	56 685,29	54 815,39
3. Solvent and Other Product Use	2 071,10	1 988,30	1 939,63	1 829,46
4. Agriculture	100 082,77	97 642,25	98 055,82	93 866,01
5. Land Use, Land-Use Change and Forestry <sup>(5)</sup>	-22 794,24	-19 108,80	-23 055,66	-29 502,85
6. Waste	12 687,11	13 184,80	13 695,82	14 179,23
7. Other	NO	NO	NO	NO
<b>Total (including LULUCF)<sup>(5)</sup></b>	<b>536 697,35</b>	<b>564 093,42</b>	<b>552 614,06</b>	<b>517 373,25</b>



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# Appendix III. Evaluation of key sources and related analysis excluding LULUCF

EVALUATION OF KEY SOURCES - Tier 1 - ANALYSIS OF CHANGE IN EMISSIONS EXCLUDING LULUCF (*)							Sec-
source CITEPA /UNFCCC format - March 2013							teurs_s_cle_hors_UTCF.xls/s_cle_evol
Row	Classification Source/Fuel	Direct greenhouse gas effect	CO <sub>2</sub> equivalent (Gg)	CO <sub>2</sub> equivalent (Gg)	Assessment of the change (**)	Contribution to the change (%)	Total (%)
	CRF		1990	2011			2011
1	1A3b Road Transportation	CO <sub>2</sub>	113,458	124,624	0.058	13.99%	14.0%
2	1A4b Residential / gas	CO <sub>2</sub>	20,831	32,722	0.033	8.08%	22.1%
3	1A1a Public Electricity and Heat Production / coal	CO <sub>2</sub>	36,159	17,962	0.032	7.74%	29.8%
4	2B3 Adipic Acid Production	N <sub>2</sub> O	14,806	126	0.030	7.22%	37.0%
5	2F1 Refrigeration and Air Conditioning Equipment	HFC	85	11,718	0.027	6.53%	43.6%
6	1A4b Residential / oil	CO <sub>2</sub>	31,043	17,315	0.023	5.58%	49.1%
7	1A1a Public Electricity and Heat Production / gas	CO <sub>2</sub>	983	9,541	0.020	4.86%	54.0%
8	1A2a Iron and Steel / coal	CO <sub>2</sub>	18,779	10,944	0.013	3.11%	57.1%
9	2B2 Nitric Acid Production	N <sub>2</sub> O	6,570	670	0.012	2.86%	60.0%
10	1A1a Public Electricity and Heat Production / other fuels	CO <sub>2</sub>	1,792	5,488	0.009	2.19%	62.2%
11	1A4a Commercial/Institutional / gas	CO <sub>2</sub>	8,939	11,633	0.009	2.12%	64.3%
12	1A4b Residential / coal	CO <sub>2</sub>	4,168	294	0.008	1.89%	66.2%
13	1A2e Food Processing, Beverages and Tobacco / gas	CO <sub>2</sub>	3,688	6,410	0.007	1.78%	68.0%
14	4B Manure Management	CH <sub>4</sub>	8,366	10,006	0.006	1.49%	69.4%
15	2C3 Aluminium Production	PFC	3,032	86	0.006	1.44%	70.9%
16	1A2e Food Processing, Beverages and Tobacco / oil	CO <sub>2</sub>	3,596	783	0.006	1.33%	72.2%
17	2B5 Chemical Industry / Other	N <sub>2</sub> O	3,175	449	0.005	1.31%	73.5%
18	1A2f Manufacturing Industries / Other / oil	CO <sub>2</sub>	14,558	10,606	0.005	1.22%	74.8%
19	1A4b Residential / biomass	CH <sub>4</sub>	3,512	957	0.005	1.19%	75.9%
20	2F4 Aerosols/ Metered Dose Inhalers	HFC	0	2,106	0.005	1.18%	77.1%
21	1A4a Commercial/Institutional / oil	CO <sub>2</sub>	19,006	14,720	0.005	1.11%	78.2%
22	1A2c Chemicals / gas	CO <sub>2</sub>	7,146	8,155	0.004	1.05%	79.3%
23	2E2 Fugitive Emissions	HFC	1,972	44	0.004	0.95%	80.2%
24	1A2c Chemicals / oil	CO <sub>2</sub>	7,650	8,345	0.004	0.91%	81.1%
25	1A1a Public Electricity and Heat Production / oil	CO <sub>2</sub>	8,081	5,497	0.004	0.90%	82.0%
26	2A1 Cement Production	CO <sub>2</sub>	10,937	8,065	0.004	0.87%	82.9%
27	6A Solid Waste Disposal on Land	CH <sub>4</sub>	8,493	8,878	0.003	0.79%	83.7%

7									%
2									84.5
8	2E1	By-product Emissions	HFC	1,663	55	0.003	0.79%		%
2									85.3
9	2F2	Foam Blowing	HFC	0	1,397	0.003	0.78%		%
3									86.0
0	1A2d	Pulp, Paper and Print / oil	CO <sup>2</sup>	1,669	110	0.003	0.76%		%
3									86.8
1	1A1b	Petroleum Refining / gas	CO <sup>2</sup>	37	1,384	0.003	0.76%		%
3									87.5
2	1A2f	Manufacturing Industries / Other / coal	CO <sup>2</sup>	5,136	3,190	0.003	0.74%		%
3									88.2
3	4A	Enteric Fermentation	CH <sub>4</sub>	30,783	28,265	0.003	0.69%		%
3									88.8
4	1A4c	Agriculture/Forestry/Fisheries / oil	CO <sup>2</sup>	10,473	10,252	0.002	0.59%		%
3									89.4
5	1A3a	Civil Aviation	CO <sup>2</sup>	4,298	4,824	0.002	0.59%		%
3									90.0
6	1A2b	Non-Ferrous Metals / coal	CO <sup>2</sup>	1,191	4	0.002	0.58%		%
3									90.5
7	1A2a	Iron and Steel / oil	CO <sup>2</sup>	1,365	210	0.002	0.55%		%
3									91.0
8	2B1	Ammonia Production	CO <sup>2</sup>	2,205	1,083	0.002	0.48%		%
3									91.4
9	4B	Manure Management	N <sub>2</sub> O	6,191	4,726	0.002	0.40%		%
4									91.8
0	1A2d	Pulp, Paper and Print / coal	CO <sup>2</sup>	922	104	0.002	0.40%		%
4									92.2
1	1A1b	Petroleum Refining / oil	CO <sup>2</sup>	11,393	9,365	0.001	0.36%		%
4									92.5
2	1A4a	Commercial/Institutional / coal	CO <sup>2</sup>	868	162	0.001	0.34%		%
4									92.8
3	1A3b	Road Transportation	CH <sub>4</sub>	831	169	0.001	0.31%		%
4		Manufacture of Solid Fuels and Other Energy							93.1
4	1A1c	Industries / gas	CO <sup>2</sup>	643	17	0.001	0.31%		%
4									93.4
5	1A3b	Road Transportation	N <sub>2</sub> O	937	1,342	0.001	0.29%		%
4									93.7
6	1B2b	Fugitive Emissions from Fuels / Natural Gas	CO <sup>2</sup>	816	201	0.001	0.29%		%
4		SF <sub>6</sub> Used in Aluminium and Magnesium Foundries							94.0
7	2C4		SF <sub>6</sub>	809	205	0.001	0.28%		%
4									94.3
8	6B	Waste Water Handling	CH <sub>4</sub>	847	1,210	0.001	0.26%		%
4									94.5
9	6B	Waste Water Handling	N <sub>2</sub> O	1,402	767	0.001	0.26%		%
5									94.8
0	1A3c	Railways	CO <sup>2</sup>	1,070	482	0.001	0.26%		%
5									95.0
1	2F8	Electrical Equipment	SF <sub>6</sub>	898	337	0.001	0.25%		%
...	...		...	...	...	...	...	...	...
<b>Total (*)</b>				<b>559,492</b>	<b>491,497</b>				

(\*) Analysis excluding LULUCF (Land use, land use change and forestry)

(\*\*) Analysis of change according to IPCC good practice (cf. "IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories", equation 7.2, p.7.9, chap.7)

# Appendix IV. Evaluation of key sources and related analysis including LULUCF

## EVALUATION OF KEY SOURCES - Tier 1 - ANALYSIS OF LEVEL OF EMISSIONS INCLUDING LULUCF (\*)

source CITEPA /UNFCCC format - March 2013		Secteurs_s_cle_avec_UTCF.xls/s_cle_niv					
Row	Classification Source/Fuel	Direct green-house gas effect	CO <sub>2</sub> equivalent (Gg)	CO <sub>2</sub> equivalent (Gg)	contribution (%)	total (%)	
	CRF		1990	2011	2011	2011	
1	1A3b	Road Transportation	CO <sup>2</sup>	113,458	124,624	20.71%	20.7%
2	5A1	Forest Land remaining Forest Land	CO <sup>2</sup>	33,633	58,537	9.73%	30.4%
3	1A4b	Residential / gas	CO <sup>2</sup>	20,831	32,722	5.44%	35.9%
4	4A	Enteric Fermentation	CH <sub>4</sub>	30,783	28,265	4.70%	40.6%
5	4D1	Direct Soil Emissions	N <sub>2</sub> O	24,808	21,715	3.61%	44.2%
6	4D3	Indirect Emissions	N <sub>2</sub> O	20,140	17,985	2.99%	47.2%
7	1A1a	Public Electricity and Heat Production / coal	CO <sup>2</sup>	36,159	17,962	2.98%	50.2%
8	1A4b	Residential / oil	CO <sup>2</sup>	31,043	17,315	2.88%	53.0%
9	1A4a	Commercial/Institutional / oil	CO <sub>2</sub> eq.	19,006	14,720	2.45%	55.5%
10	5E	Settlements	CO <sup>2</sup>	10,349	14,229	2.36%	57.8%
11	5B2	Land converted to Cropland	CO <sup>2</sup>	15,985	14,214	2.36%	60.2%
12	2F1	Refrigeration and Air Conditioning Equipment	HFC	85	11,718	1.95%	62.1%
13	1A4a	Commercial/Institutional / gas	CO <sup>2</sup>	8,939	11,633	1.93%	64.1%
14	1A2a	Iron and Steel / coal	CO <sup>2</sup>	18,779	10,944	1.82%	65.9%
15	1A2f	Manufacturing Industries / Other / oil	CO <sup>2</sup>	14,558	10,606	1.76%	67.7%
16	1A4c	Agriculture/Forestry/Fisheries / oil	CO <sup>2</sup>	10,473	10,252	1.70%	69.4%
17	4B	Manure Management	CH <sub>4</sub>	8,366	10,006	1.66%	71.0%
18	1A1a	Public Electricity and Heat Production / gas	CO <sup>2</sup>	983	9,541	1.59%	72.6%
19	1A1b	Petroleum Refining / oil	CO <sup>2</sup>	11,393	9,365	1.56%	74.2%
20	6A	Solid Waste Disposal on Land	CH <sub>4</sub>	8,493	8,878	1.48%	75.6%
21	4D2	Animal Production	N <sub>2</sub> O	9,636	8,744	1.45%	77.1%
22	1A2c	Chemicals / oil	CO <sup>2</sup>	7,650	8,345	1.39%	78.5%
23	1A2c	Chemicals / gas	CO <sup>2</sup>	7,146	8,155	1.36%	79.8%
24	2A1	Cement Production	CO <sup>2</sup>	10,937	8,065	1.34%	81.2%
25	1A2f	Manufacturing Industries / Other / gas	CO <sup>2</sup>	8,884	7,875	1.31%	82.5%
26	5C2	Land converted to Grassland	CO <sup>2</sup>	12,362	7,618	1.27%	83.8%
27	5A2	Land converted to Forest Land	CO <sup>2</sup>	4,427	7,099	1.18%	84.9%
28	1A2e	Food Processing, Beverages and Tobacco / gas	CO <sup>2</sup>	3,688	6,410	1.07%	86.0%
29	1A1a	Public Electricity and Heat Production / oil	CO <sup>2</sup>	8,081	5,497	0.91%	86.9%
30	1A1a	Public Electricity and Heat Production / other fuels	CO <sup>2</sup>	1,792	5,488	0.91%	87.8%
31	1A3a	Civil Aviation	CO <sup>2</sup>	4,298	4,824	0.80%	88.6%
32	4B	Manure Management	N <sub>2</sub> O	6,191	4,726	0.79%	89.4%
33	5D2	2. Land converted to Wetlands	CO <sup>2</sup>	2,016	3,522	0.59%	90.0%
34	1A1c	Manufacture of Solid Fuels and Other Energy Industries / coal	CO <sup>2</sup>	4,034	3,193	0.53%	90.5%
35	1A2f	Manufacturing Industries / Other / coal	CO <sup>2</sup>	5,136	3,190	0.53%	91.1%
36	2C1	Iron and Steel Production	CO <sup>2</sup>	3,298	3,053	0.51%	91.6%
37	1A2c	Chemicals / other fuels	CO <sup>2</sup>	2,941	2,375	0.39%	92.0%
38	1B2a	Fugitive Emissions from Fuels / Oil	CO <sup>2</sup>	2,795	2,374	0.39%	92.4%
39	1A2d	Pulp, Paper and Print / gas	CO <sup>2</sup>	2,351	2,158	0.36%	92.7%
40	2F4	Aerosols/ Metered Dose Inhalers	HFC	0	2,106	0.35%	93.1%
41	2A2	Lime Production	CO <sup>2</sup>	2,587	2,106	0.35%	93.4%
42	1A2a	Iron and Steel / gas	CO <sup>2</sup>	2,097	1,714	0.28%	93.7%
43	1A2c	Chemicals / coal	CO <sup>2</sup>	1,918	1,671	0.28%	94.0%
44	1A3d	Navigation	CO <sup>2</sup>	1,263	1,402	0.23%	94.2%
45	2F2	Foam Blowing	HFC	0	1,397	0.23%	94.4%
46	1A1b	Petroleum Refining / gas	CO <sup>2</sup>	37	1,384	0.23%	94.7%
47	6C	Waste Incineration	CO <sup>2</sup>	1,737	1,369	0.23%	94.9%
48	5B2	Land converted to Cropland	N <sub>2</sub> O	1,652	1,359	0.23%	95.1%
...	...	...	...	...	...	...	
<b>Total (*)</b>			<b>642,890</b>	<b>601,785</b>			

(\*) Analysis including LULUCF (Land use, land use change and forestry)

## Appendix V. Additional elements required as part of article 7.2 of the Kyoto Protocol

### Information required by article 10 of the Kyoto Protocol

Information brought under article 7.2	Paragraphs of the 6th national communication
National system - article 5.1	III.C
Factors relating to the mechanisms referred to in articles 6, 12, 17	III.D and IV.B.3
Adverse effects of policies and measures	IV.C.10
Regional and domestic plans	IV.B
Information – article 10	
10a	III.C
10b	IV.B and VI.C
10c	VII
10d	VIII
10e	VII and IX

### Information required by article 11 of the Kyoto Protocol

Financial resources coming under public development aid required under article 11 of the Kyoto Protocol are described in paragraph V11.A. Other financial resources meeting article 11 of the Kyoto Protocol are presented in paragraph VII.B.

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## Appendix VI. Plan National d'Adaptation au Changement Climatique (French national plan for adaptation to climate change): Progress status after two year of implementation

### Progress status

The progress status after two years of implementation was drawn up on the basis of contributions from the leaders of each of the twenty thematic files in the course of the second quarter of 2013.

Overall the general factors available at the start of 2013 show that:

- Of the 84 actions specified in the PNACC, 81 have been started (96%)
- Of the 240 measures specified in the PNACC, 194 have been started (i.e.81%).

Distribution of measures started by subject is indicated in the table below. The detailed appendix on the PNACC groups the comments made by the leaders of each subject.

Au 14 juin 2013				
Fiches thématiques	actions		mesures	
	total	taux engagées	total	taux engagées
<b>ACTIONS TRANSVERSALES</b>	5	100%	5	100%
<b>SANTE</b>	5	80%	16	56%
<b>RESSOURCES EN EAU</b>	5	100%	20	80%
<b>BIODIVERSITE</b>	4	100%	22	68%
<b>RISQUES NATURELS</b>	5	100%	28	71%
<b>AGRICULTURE</b>	5	100%	15	93%
<b>FORET</b>	5	80%	16	69%
<b>PECHE AQUACULTURE</b>	1	100%	1	100%
<b>ENERGIE ET INDUSTRIE</b>	5	80%	5	80%
<b>INFRASTRUCTURES SYSTEMES DE TRANSPORT</b>	4	100%	11	73%
<b>URBANISME CADRE BATI</b>	4	100%	10	80%
<b>TOURISME</b>	2	100%	2	100%
<b>INFORMATION</b>	4	100%	12	100%
<b>EDUCATION FORMATION</b>	5	100%	5	100%
<b>RECHERCHE</b>	4	100%	16	94%
<b>FINANCEMENT ASSURANCE</b>	7	100%	13	77%
<b>LITTORAL</b>	4	100%	13	92%
<b>MONTAGNE</b>	4	100%	13	77%
<b>EUROPÉENNE INTERNATIONALE</b>	4	100%	12	100%
<b>GOVERNANCE</b>	2	100%	5	100%
<b>total</b>	<b>84</b>	<b>96%</b>	<b>240</b>	<b>81%</b>

The level of measures started for a given subject should be considered cautiously. In fact some measures required the completion of others before they could be started. The 69% and 73% levels respectively for the subjects "forestry" and "transport systems and infra-structure" reveal undertakings conformed to expectations.

The full document is available on the website of the Ministry responsible for Ecology under the heading *Énergie, Air et Climat / Impacts et adaptation (ONERC) / Plan national d'adaptation 2011-2015*.

### Overall analysis

The PNACC was implemented according to a specific system for each themed file corresponding to the degree of mobilisation of the stakeholders concerned and the existence of concerns about climate change prior to the preparation of the PNACC. 96 % of actions were started. The majority of these actions are broken down into measures which are implemented over several years. As a result, no action can be considered completed at the beginning of 2013.

In spite of a high proportion of measures started (81%), a significant minority of measures suffer credit limitations with the result that the extent of the measure is reduced, its start deferred or in certain cases, its suspension. For some measures the question of their continuation is raised, but for the majority of measures this leads to an adjustment of objectives for the end of 2015. Subject files are variously affected by budgetary constraints.

Beyond these aspects, a real dynamic is set in motion in the majority of subjects under the impulse of their leaders, some of whom have set out to make the working groups from the discussion phase permanent.

### Assessment process

Implementation of the assessment of PNACC is jointly led by the Commissariat général au développement durable (General Commission on sustainable development) and the Direction générale de l'énergie et du climat (General Directorate of Energy and Climate). To do this several methods have been suggested to the leaders. The first stage consists of establishing an initial frame of reference but few assessment results are available at the present time. The Comité national de la transition écologique (National committee on ecology transition) will be requested to examine the assessment factors following the PNACC implementation process.

The mid-way assessment planned for the end of 2013 is intended to give an update on the methods and initial results on the basis of a sample of measures on the initiative of subject file leaders. As a result, this first exercise will only be partial and will mainly take the form of a self-assessment. It may nevertheless lead to a reconsideration of certain measures (reinforcement or redeployment of efforts).

The final assessment of the plan, planned for the end of 2015, will be more complete in terms of results and will in particular include recommendations for subsequent planning of the adaptation to climate change. It may take the form of an external assessment.

## Appendix VII. Labex and Equipex

Knowledge of past climates, essential to our understanding of the Earth's system, is increased by palaeoclimate ice-cores and cores in marine and continental sediments. The purpose of the **CLIMCOR** equipex is to set up new means of studying climate archives so as to make high resolution records of climate variations available, particularly those over the last few millennia, in marine sediments, continental sediments and ice. This new core sampling system will be supplemented by the **ASTER-CEREGE** equipex, an isotopic geo-chemistry platform for analysing chemical tracer elements of climate fluctuations and the impact of human activities.

This new equipment should enable France to maintain its level of excellence by advancing knowledge of past climates, also essential for the validation of future climate projections resulting from modelling exercises.

French modelling capacity is provided and reinforced by three labex. The Labex Institut Pierre Simon Laplace (**L-IPSL**) on the Saclay platform aims to understand climate and help anticipate future changes. The main expected results will concern the ability to forecast climate change by a combined analysis of changes caused by human activities and those due to natural fluctuations; the relationship between the total climate change and its consequences on the regional scale; and the ability to anticipate how regional changes could affect our living conditions. This highly specific climate modelling labex will be supplemented by the **OSUG@2020** labex that will develop innovative strategies for observing and modelling natural systems. In particular, the main objectives of the project are to extend the expertise of the Observatoire des Sciences de l'Univers (OSU) (Observatory of Universal Sciences) in Grenoble in the field of interdisciplinary research (applied fluid mechanics, environmental engineering, instru-

mentation, ecology and biodiversity and social vulnerability).

Finally, the **BASC** labex (Biodiversity, Agroecosystems, Society, Climate) proposes to explore how human activities interact with ecosystems and the ways in which human-induced degradation of biodiversity and the environment might be remedied. Supported by the Fondation de Coopération Scientifique (Scientific Cooperation Foundation) of the Paris-Saclay Campus, the BASC project will be manifested by the development of a new research domain, on the borders of social sciences and ecosystems: socio-ecology systems. This should enable France to catch up with the centres that have developed in recent years in Europe and North America.

Knowledge of climate processes, and consequently our short-term forecasting ability (seasonal and ten-year), will be improved by these new sea ice and ocean observation systems. The **IAOOS** equipex, a veritable Arctic sea ice and atmosphere observatory will enable a set of fifteen floating platforms to be set up in the Arctic Ocean for continuous monitoring, with real-time transmission, of vertical profiles of the physical characteristics of the ocean and the atmosphere in order to draw up a radiation balance. The new Argo observation system, NAOS, will provide actual monitoring of all the oceans. The objective of the project is to consolidate French and European participation in the international Argo profiling float network and to anticipate changes in the network for the next decade.

Argo floats are small autonomous robots that measure the temperature and salinity of the upper 2000 m of the oceans in real time. NAOS will enable the next generation of Argo floats to be developed. These floats will be more intelligent and capable of carrying new sensors (particularly for biogeochemistry).

In order to gain a better understanding of the effects of climate change on the future of the planet, the CRITEX Equipex is focused on the critical area of drainage basins at global scale. Its purpose is to describe the hydro-logical, hydrogeological and geochemical functioning of selected drainage basins representing various contexts (rocks, soils, vegetation, climate, human activities, etc.). **CRITEX** will enable measurements to be made at time steps appropriate to the process system studied and over long periods possibly extending to several years. The quality of surface and underground waters could thus be studied in detail in relation to the characteristics of the natural environment and those of neighbouring human activities.

The **VOLTAIRE** labex is involved in the study of GHG flows from natural wet zones and cultivated soils and what becomes of them in the lower and upper atmosphere. It also sets out to characterise the flows of halogen elements emanating from volcanoes in order to improve descriptions of the characteristics of variables linked to anthropic activities.

The following table shows the funding for these Labex and EquipEx.

<b>EquipEx</b>	Allocation (€million)
Aster cerege	3.7
IAOOS	5.3
NAOS	8
CLIMCOR	4.18
CRITEX	7
<b>Total EquipEx</b>	<b>28.18</b>

<b>Labex</b>	Allocation (€million)
L-IPSL	6.5
OSUG@2020	11
VOLTAIRE	11
BASC	5
<b>Total Labex</b>	<b>33.5</b>

## Appendix VIII. AllEnvi working group: “Climat: évolution, atténuation, impact” (Climate: change, mitigation, impact)

The “Climat: évolution, atténuation, impact” thematic group, consisting of some twenty members of various bodies of very different outlooks and cultures (Météo France, IPSL, CEA, BRGM, CEMAGREF, CNRS, IFRE-MER, IFSSTAR, INRA, IRD, MNHN, IPEV, etc.), produced several lines of action for implementation. For representatives of climate sciences, gaining a better understanding of climate and how it works remains a priority for determining the regional impact of climate change, even in the relatively short range 2020-2030. Such an approach requires studies of past climate change as well as monitoring and forecasting climate change and its impacts on biodiversity. For representatives of human and social sciences the priority is to undertake studies to understand how societies work and how they react to global changes, irrespective of their origin. Two different analyses, but a single aim, to learn from the existence of the Alliance in order to make advances in the key climate change fields and ultimately to achieve a shared strategy. This work may be developed as part of targeted geographical projects like the MISTRALS project, which groups the re-search work of several countries in the Mediterranean basin.

This group specifies several lines of action:  
**IMPROVING OBSERVATION DATA  
IN ORDER TO IMPROVE CLIMATE  
MODELLING**

It is essential that the French component of the operational observation of the global ocean is consolidated by being organised at international and European level. In particular, by enrolling in the European “Global Monitoring for Environment and Security” programme and its “Ocean” section. Similarly, for terrestrial environments, the observation networks of carbon flows, water and energy between the atmosphere, the biosphere

and soils should be consolidated, by giving a greater place to biodiversity.

### OPTIMISING THE TREATMENT OF OBSERVATION AND MODELLING

An inter-agency funding programme is necessary to bring together all the French teams studying the climate fluctuations of the last millennium, recent climate fluctuations and climate forecasting up to 2020-2030, in order to understand the interactions between natural variability and greenhouse gas forcing. One component of this programme should support the collection and processing of climate-related data, especially data supplied by markers and observations (content in certain isotopes, etc.) offering indirect information on climate (temperature or rainfall).

### ASSESSING AND DESIGNING INNOVATIVE SYSTEMS

It is important that agriculture is assessed according to criteria other than productivity. An essential issue is its ability to limit the production of greenhouse gasses. Such an assessment requires a mass of data, covering different situations (indicators), to be collected over the period. This leads to support for approval of observation systems, which are the SOERs, and their instrumentation.

### GAINING A BETTER UNDERSTANDING OF SOCIETY’S DEMANDS

A specific think tank within AllEnvi identifies the means for gaining a better understanding of the mechanism of forming opinions and changing behaviour in the area of environmental risks. Such work would make it possible to identify changes in behaviour that might occur.

# Appendix IX. GIS Climat-Environnement-Société

The groupement d'intérêt scientifique (GIS) Climat-Environnement-Société (Climate-Environment-Society Scientific Interest Grouping) was created in 2007. In line with the 2006 version of the "Plan Climat 2004-2012" decided by the French government for the purpose of combating climate change, it received an allocation of €8 million over a five-year period (2007-2012), provided by its six founder members (CNRS, CEA, ADEME, the University of Versailles Saint-Quentin-en-Yvelines, the École Polytechnique, the University Pierre et Marie Curie) and support from the Ministry of Research and the Ministry responsible for Ecology. This high-level grouping will set out to develop interdisciplinary research on the impacts of climate change on ecosystems, human health and socio-economic aspects (the programmes are detailed in appendix X).

The GIS Climat-Environnement-Société encourages, supports and coordinates interdisciplinary research on climate change and its impacts on the environment and society. It relies on the expertise of 16 research laboratories in the Ile-de-France working mainly in the climatology, hydrology, ecology, health and human and social science fields. Its founder members are the CNRS, CEA, UVSQ, UPMC, Ecole Polytechnique and ADEME.

Five key areas of research have been defined in order to channel the interdisciplinary initiatives to the various laboratories:

- Climate change, ecosystems, land use and water resources
- Global climate, energy policies and economic development
- Climatic extremes and vulnerable regions

## ■ Impact of climate change on health

Research projects in association with partner laboratories cover a wide range of themes:

### ■ "ADAPTATION TO CLIMATE CHANGE" projects:

★ **MICLIV** = Understanding the link between the effects of climate change on the agri-cultural sector and migratory phenomena in the different countries of Sub-Saharan Africa (2009-2012)

★ **ENVIGLOB** = Debate on the world environment: controversies and images (2011-2013)

★ **AGECCAO** = Cost/benefit assessment of residual damage and the adaptation of agriculture and water management to climate change in West Africa (2011-2013)

★ **CCTV**: Climate Change and Green Areas: Relationship between revegetation of towns and adaptation to climate change (2011-2013)

### ■ SOME "CLIMATE CHANGE, ECOSYSTEMS, LAND USE AND WATER RESOURCES" PROJECTS

★ **ACCACYA**: Attribution of Anthropogenic Causes of Climate Change by the Carbon Cycles: Integrated analysis of carbon flows incorporated in global economic exchanges and geochemical cycles (2011-2013)

★ **PASTEK**: Impact of global changes on the hydrological support of the Mekong (2010-2012)

★ **HUMBOLDT**: Impacts of man on biodiversity and the climate during the Anthropocene (2009-2012)

### ■ SOME "GLOBAL CLIMATE, ENERGY POLICY AND ECONOMIC DEVELOPMENT" PROJECTS:

★ **PEPER**: Experimental approaches applied to the forecasting of extreme regional weather (2010-2012)

★ **EPI-C3**: Chemistry of the atmosphere and climate

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change: scientific, epistemological and political aspects. Study of geo-engineering projects. (2009-2012)

■ SOME "EXTREME WEATHER AND VULNERABLE REGIONS" PROJECTS

★ **ERIC:** Assessment of climate risk in the development of coastal areas of West Africa (2009-2010)

★ **RENASEC:** Study of characteristics and frequency of extreme events in France since 1500 (2008-2012)

■ SOME "IMPACT OF CLIMATE CHANGE ON HEALTH" PROJECTS

★ **ADCEM:** Impact of desert aerosols and climate on Meningitis epidemics in the Sahel (2009-2012)

★ **EREBUS:** Assessment of risks and benefits of exposure to ultra-violet radiation (2011-2013)

★ **ACHIA:** Impact of air pollution and climate change on health (2011-2013)

## Appendix X. Major international programmes

Under the aegis of a unique framework known as the Earth System Sustainability Initiative (ESSI) for international research on global environmental change, four international programmes have been grouped together to form an integrated strategy for re-search on environmental change.

■ **WCRP:** The World Climate Research Programme  
The WCRP was created in 1980 at the initiative of the International Council for Science (ICSU) and the World Meteorological Organisation (WMO). It has also received support from the Intergovernmental Oceanographic Commission (IOC) and UNESCO since 1993. The programme has set the objective of increasing fundamental knowledge about the physical climate system and climate processes, with a view to determining the degree to which climate can be forecasted and the extent of human influence on climate.

The World Climate Research Programme aims to determine the forecastability of climate and the effect exerted by human activities. Several projects result from this programme: CliC, CLIVAR, GEWEX, SPARC.

■ **IGBP:** The International Geosphere Biosphere Programme

This programme, created in 1987, is focused on the acquisition of basic scientific knowledge on global change, and in particular the biological and chemical processes interacting within the Earth System. The initial objective of the programme is to describe and understand the interacting physical, chemical and biological processes that regulate the Earth System, the unique environment that permits life, the changes that affect this system and the manner in which they are influenced by the action of man.

■ **DIVERSITAS:** The international programme on sciences and biodiversity

Created in 2002 under the auspices of the ICSU, IUBS, SCOPE and UNESCO, for which the FRB (Fondation pour la Recherche sur la Biodiversité -Foundation for Research on Biodiversity) is the French national committee, DIVERSITAS fills a dual mission:

★ Promoting an integrated scientific approach to biodiversity, by linking biological, ecological and social disciplines in order to produce relevant new knowledge for society.

★ Supplying scientific bases for the conservation and sustainable use of biodiversity.

The scientific landscape, in conjunction with biodiversity issues, is organised around four interconnected spheres: research, observations, scientific assessments and policy development. DIVERSITAS is situated at the intersection of these four spheres, and encourages the study of biodiversity at a global level through four projects: bioGENESIS (providing a conceptual framework that changes with biodiversity sciences), bioDISCOVERY (monitoring, understanding and predicting biodiversity changes), ecoSERVICES (studying the consequences of biodiversity changes on the functioning of ecosystems and ecosystem changes), and bioSUSTAINABILITY (guiding the development of policies and decisions which support the conservation and sustainable use of biodiversity as a whole).

■ **IHDP:** The International Human Dimensions Programme on Global Environmental Change

The IHDP was launched in 1990, created officially in 1995 together with the ICSU and the ICSS (International Council for Social Sciences) and then finally set up in its current form in 1997. This programme is concerned with the social and socio-economic aspects of global change.

# Appendix XI. Summary tables of variables monitored by France in respect of observation

## 1) Observation of essential climate variables (ECV) of the atmosphere (surface)

Contribution to networks implemented by GCOS	ECVs	Number of stations or platforms currently in operation	Number of operational stations or platforms conforming to GCMPs	Number of stations or platforms that should be operational in 2010	Number of stations or platforms supplying data to international centres	Number of stations or platforms with archiving available in the international centres
The GCOS surface network (GSN)	Air temperature	25 (6/19)*	25	25	25	The 25
Global Observing System (GOS) surface network	Air temperature and pressure, wind speed and direction, water vapour	84 (46/38)* - RBSN: (44/38)* - RBCN: (42/27)*	84	84	84	84
	Precipitation	84	84	84	84	84
BSRN surface network	Radiation	1 (1)*	1	1	1	1
Solar radiation and sampling data	Surface (global) radiation	274 (223/47)*	274	274	274	274
Floating buoys	Air temperature and pressure	60 Atlant. (30) Indian (30)	60	60	60	60
Moored buoys	Air temperature and pressure (5/1)*	6	6	6	6	
VOSclim project	Air temperature and pressure, wind speed and direction, water vapour	51	51	51	51	51
Mooring network and sites situated on small remote islands	Air temperature, wind speed and direction, water vapour, precipitation	0	0	0	0	0

\* (x/y): x: number of stations in mainland France, y: number of Overseas stations.

## 2) Observation of essential climate variables of the atmosphere (altitude)

Contribution to networks implemented by GCOS	ECVs	Number of stations or plat-forms currently in operation	Number of operational stations or platforms conforming to GCMPs	Number of stations or plat-forms that should be operational in 2010	Number of stations or platforms supplying data to international centres	Number of stations or platforms with archiving available in the international centres
GUAN altitude network	Air temperature and pressure, wind speed and direction, water vapour	9	9	9	9	9
Full WWW/ GOS Upper Air network	Air temperature and pressure, wind speed and direction, water vapour	18 RBCN (5/13)	18	18	18	18

## 3) Ozone measurement sites belonging to the NDACC / GAW network

Stations	Country	Place	Start	Instruments	Measurements
ScoresbySund	Greenland	70 N, 2 W	Nov 91	SAOZ	O3, NO2 col-umns
Zhigansk	Siberia (East)	67 N, 123 W	Dec. 91	SAOZ	O3, NO2 col-umns
Sodankyla	Finland	67 N, 27 E	Mar. 90	SAOZ	O3, NO2 col-umns
Salekhard	Siberia (West)	67 N, 67 E	Nov 98	SAOZ	O3, NO2 col-umns
OHP	France	44 N, 6 E	Jun. 92 1986	SAOZ Lidar	O3, NO2 col-umns O3 profiles
Réunion	Ile de la Réunion	21 S, 55 E	Feb 94 2000	SAOZ Lidar	O3, NO2 col-umns O3 profiles
Bauru	Brazil	22 S, 48 W	Nov 95	SAOZ	O3, NO2 col-umns
Kerguelen Islands	Kerguelen Is-lands	49 S, 70 E	Dec 95	SAOZ	O3, NO2 col-umns
Rio Gallegos	Kerguelen Is-lands	49 S, 70 E	Mar. 08	SAOZ	O3, NO2 col-umns
Dumont	Adélie land	67 S, 142 E	Jan 88 1991	SAOZ Lidar	O3, NO2 col-umns O3 profiles
Concordia	Antarctica	75 S, 123 E	Jan 07	SAOZ	O3, NO2 col-umns

#### 4) Observation of the composition of the atmosphere

Contribution to networks implemented by GCOS	ECVs	Number of stations or platforms currently in operation	Number of operational stations or platforms complying with GCMPs	Number of stations or platforms that should be operational in 2020	Number of stations or platforms supplying data to international centres	Number of stations or platforms with archiving available in the international centres
GAW network, monitoring of CO <sub>2</sub> & CH <sub>4</sub>	Carbon dioxide	9/22	9/22	9/22		
	Methane	1/19	1/19	1/19		
	Other GHGs	1/19	1/19	1/19		

(x/y): x: number of continuous measurements, y: number of selective measurements.

Contribution to networks implemented by GCOS	ECVs	Number of stations or platforms currently in operation	Number of operational stations or platforms complying with GCMPs	Number of stations or platforms that should be operational in 2020	Number of stations or platforms supplying data to international centres	Number of stations or platforms with archiving available in the international centres
GAW network, ozone probe <sup>a</sup>	Ozone	3	3	3		
GAW network ozone column <sup>a</sup>	Ozone	11	11	11		
GAW network, ACTRIS infrastructure	Depth insitu: number, size, optical properties; composition, vertical profile	8	8	10	8	1

a SHADOZ, NDACC, including remote measuring probes.

b Filter stations, including Dobson and Brewer.

## 5) RAMCES measuring and sampling sites and measured components

Site	Country	Latitude	Longitude	Alt (m asl)	Alt (m agl)	Start	In-situ measurements	Intermittent measurements
<i>ICOS-France OBSERVATORIES</i>								
Saclay	France	48°43'N	2°09'E	165	10, 50, 100	2001	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO, Radon, Weather	-
Trainou	France	47°58'N	2°06'E	131	5, 50, 100, 180	2006	CO <sub>2</sub> , CH <sub>4</sub> , CO, Radon, Weather	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO, CO <sub>2</sub> isotopes(4 / month)
Puy de Dôme	France	45°45'N	3°00'E	1465	10	2001	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO, Radon, Weather	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO, CO <sub>2</sub> isotopes(4 / month)
Biscarosse	France	44°22'N	1°13'W	120	47	2005	CO <sub>2</sub> , CH <sub>4</sub>	-
OHP	France	43°56'N	5°43'E	640	10, 50, 100	2013	CO <sub>2</sub> , CH <sub>4</sub> , CO, Weather	-
OPE	France	48°33'N	5°30'E	390	10, 50, 120	2011	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, CO, Radon, Weather	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO, CO <sub>2</sub> isotopes(4 / month)
Cap Corse	France	42°55'N	9°21'E	533	40	2013	CO <sub>2</sub> , CH <sub>4</sub> , CO, Weather	-
Pic du Midi	France	42°56'N	0°08'E	2877	10	2014	CO <sub>2</sub> , CH <sub>4</sub> , CO, Weather	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO (4 / month)
Roc Tredudon	France	48°24'N	3°53'W	360	10, 50, 100, 200	2014	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, CO, Weather	-
Amsterdam Island	France - French Southern and Antarctic Lands	37°57'S	77°32'E	55	20	1980	CO <sub>2</sub> , Radon, Weather	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO, CO <sub>2</sub> isotopes(4 / month)
OPAR	France - Réunion	21°05'S	55°23'E	2200	5	2013	CO <sub>2</sub> , CH <sub>4</sub> , CO	-
Guyaflox	France-Guyana	5°17'N	52°54'W	97	57	2009	CO <sub>2</sub> , CH <sub>4</sub>	-
Mace Head	Ireland	53°20'N	9°54'W	25	15	1992	CO <sub>2</sub> , CH <sub>4</sub> , Radon, Weather	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO, CO <sub>2</sub> isotopes(4 / month)
Finokalia	Greece	35°19'N	25°40'E	150	2	2014	CO <sub>2</sub> , CH <sub>4</sub> , CO	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO (2 / month)
Ivittuut	Greenland	61°12'N	48°10'W	10	5	2007	CO <sub>2</sub> , CH <sub>4</sub> , O <sub>2</sub> , Weather	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO, CO <sub>2</sub> isotopes(3 / month)
Lamto	Côte d'Ivoire	6°13'N	5°01'W	155	50	2008	CO <sub>2</sub> , CH <sub>4</sub>	-

AIRBORNE MEASUREMENTS								
Orleans	France	48°50'N	2°30'E	150	100-3000	1996	CO <sub>2</sub> , Weather	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO, CO <sub>2</sub> isotopes(3 / month)
YAK-Aerosib	Russia	-	-	-	100-7000	2006	CO <sub>2</sub> , CH <sub>4</sub> , O <sub>3</sub> , CO	-
INTERNATIONAL COLLABORATION								
Hanle	India	32°46'N	78°57'E	4517	5	2004	CO <sub>2</sub> , CH <sub>4</sub> , Weather	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO (2 / month)
Pondicherry	India	12°00'N	79°51'E	20	30	2011	CO <sub>2</sub> , CH <sub>4</sub> , Weather	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO (2 / month)
Port-Blair	India	11°39'N	92°45'E	20	30	2012	CO <sub>2</sub> , CH <sub>4</sub> , CO, N <sub>2</sub> O, Weather	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO (2 / month)
Cape Grim	Australia	40°41'S	144°41'E	94	70	1998	-	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO, CO <sub>2</sub> isotopes(1 / month)
Cape Point	South Africa	34°21'S	18°29'E	230	30	2004	-	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO, CO <sub>2</sub> isotopes(2 / month)
Begur	Spain	41°58'N	3°13'E	13	3.5	2000	-	CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, SF <sub>6</sub> , CO, CO <sub>2</sub> isotopes(4 / month)
Chacaltaya	Bolivia	16°21'S	68°08'W	5200	5	2011	CO <sub>2</sub>	-

## 6) Observation of essential climate variables of the oceanic domain

### Surface

Contribution to networks implemented by GCOS	ECVs	Number of stations or platforms currently in operation	Number of operational stations or platforms complying with GCMPs	Number of stations or platforms that should be operational in 2010 in 2020	Number of stations or platforms supplying data to international centres	Number of stations or platforms with archiving available in the international centres
Deployment of free floating buoys, at a resolution of 5°x5°	Sea temperature, sea pressure, current					
GLOSS network	Ocean level	15	15	15	15	15
VOS ships	Any possible surface ECV	80	80	80		
Ships of opportunity	Any possible surface ECV	17	17	17	17	17

### Water column

Contribution to networks implemented by GCOS	ECVs	Number of stations or platforms currently in operation	Number of operational stations or platforms complying with GCMPs	Number of stations or platforms that should be operational in 2010 in 2020	Number of stations or platforms supplying data to international centres	Number of stations or platforms with archiving available in the international centres
Reference global mooring network	Any possible surface ECV					
Tropical global moored buoy network	Any possible surface ECV	17	17	17		
Argo network	Temperature, salinity	250	250	250	250	250
Carbon inventory along the route (ship)	Temperature, salinity, oceanic tracers, biogeochemical variables	1	1	1		

## 7) Observation of essential climate variables of the terrestrial domain

Contribution to networks implemented by GCOS	ECVs	Number of stations or platforms currently in operation	Number of operational stations or platforms complying with GCMPs	Number of stations or platforms that should be operational in 2010 in 2020	Number of stations or platforms supplying data to international centres	Number of stations or platforms with archiving available in the international centres
GCOS flow monitoring network (GTN-R)	River flow	~100	~100	~100		
GCOS network, levels of lakes/ zone/ temperature GTN-L	Level/ zone/ temperature					
WWW/GOS synoptic network	Snow coverage	403	403	403		
GCOS glacier monitoring network GTN-G	Mass balance and length of glaciers	9	9	9	6	6
GCOS permafrost monitoring network GTN-P	Temperature and depth of permafrost					

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