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## Pathways 2020-2050 Towards a low-carbon economy in France



Report of the Committee chaired by  
**Christian de Perthuis**





# Pathways 2020-2050

## Towards a low-carbon economy in France

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**October 2011**





**Vincent Chriqui,**  
directeur général  
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**A** leading figure in the fight against climate change, Europe has set itself the objective of reducing its greenhouse gas emissions by 20% by 2020. It has even stated that it is ready to increase this to 30%, provided that the international community could reach an agreement on climate change to match such an ambition. The last major United Nations Climate Change Conference, held in Durban at the end of 2011, showed that it would be somewhat unrealistic to expect this target to be achieved in the near future: although the countries that took part did agree to work on a global climate agreement, it is unlikely that emission reduction objectives will be revised until 2015 at the earliest, to come into effect in 2020. Climatologists point out that the current objectives do not go far enough to be able to stabilise the rise in the average global temperature below 2°C, believed to be the crucial threshold for mitigating the effects of global warming. According to the United Nations Environment Programme, current objectives to reduce emissions targeted by the signatory States could result in a global temperature rise of 4°C.

In that case, what should Europe do? Should it take the initiative to revise its 2020 objective on its own, and plan for a 25% or even 30% reduction in emissions? The latest available statistics might suggest to move in this direction: to date, Europe has already reduced emissions by nearly 15%, making 20% look much more achievable. There are several reasons, described in this report, for such positive results: tighter regulations and the creation of economic regulation instruments, such as the Emission Trading System, have done their part, as did the economic slowdown.

In 2011, the European Commission issued a roadmap, recalling that the long-term objective was to reach a 80% to 95% reduction in emissions by 2050 and that, to achieve this at the lowest possible cost, the mid-term 2020 objective should be raised. This revision could be speeded up by a drastic drop in the price of emission trading on the European market – the ETS. This would put a brake on industry's environment-friendly strategies. Apart from increasing Europe's commitment

for 2020, adopting an objective for 2030 would probably help spur growth on this market and revalue the trading price. This would provide long-term visibility to the economic players... without losing sight of the fact that tougher constraints – whatever their nature – relative to regulating greenhouse gas emissions must neither exacerbate the current recession, nor penalise France's industrial sector which has been affected by the recession.

In this context, Nathalie Kosciusko-Morizet, the Minister for Environment, asked the Centre d'analyse stratégique to look at the implications of increasing the objective by 20% by 2020, for Europe but above all, for France. Chaired by Professor Christian de Perthuis, the *Trajectoires 2020-2050* Committee (*aka. Pathways 2020-2050*) brought together trade union organisations, officials, experts, researchers and non-governmental organisations. I would like to thank everyone for his involvement in this study, which has been completed quickly, in three stages. To begin with, the committee analysed the climate strategies pursued by our European neighbours – especially Germany, the United Kingdom and Sweden – to identify new concepts and the most effective tools. Then, based on experts' opinions and modelling studies, the potential emissions reduction, and the means to achieve this, were estimated for each sector in France. Lastly, several modelling teams worked on identifying the most effective economic instruments to support an increase in our climate change objectives – mainly in terms of growth and jobs, and this, again, in the case of France. The report upholds and substantiates the view that combating climate change is not the enemy of economic growth. Thanks to the development of certain economic instruments, standards and support for transition, it can be a new driving force for growth, stimulating innovation and industrialisation.

In this period of recession, climate policy, as important as it may be for our future, must be analysed in economic terms, the key variables of which are cost, growth, jobs and competitiveness of businesses. As well as being convincing with regard to the urgent need to adopt it, climate change policy thus needs to demonstrate that it is both compatible with economic recovery, and a driving force for recovery.

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## Acknowledgment

Having had the opportunity to be responsible for the work of the Committee "Pathways 2020-2050 – Towards a low-carbon economy in France", it is now a great pleasure to introduce the corresponding report which explores how to intensify what must be done to cope with climate change.

First of all, I must emphasise the professionalism of the team of rapporteurs who, in record time, assembled the huge volume of information which structured this report. It was all the more efficient thanks to the support and co-ordination provided by the Centre d'analyse stratégique. This efficiency was increased by the contributions from experts who were heard by the group members. We would like to warmly thank all the participants.

This work reflects the quality of the discussions which were conducted within the Committee. By construction, this Committee reflects the various points of view which were expressed in a spirit of constructive dialogue. I was impressed by the strong commitment of the various stakeholders to our work and I am happy that the points of convergence largely prevailed over those of disagreement. I very sincerely thank all the members of the group for the time and energy they devoted to this work.

I am sure that this report will give full and impartial information and help its readers to get an overall picture on the interests at stake for a collective action on global warming.

Finally, I hope that it will help our decision-makers to select the best options to combine climate ambition with economic and social development, both in France and in Europe.

Christian de Perthuis  
Visiting Professor of Economics at Paris-Dauphine University  
Chairman of the Committee



## Executive summary

Science is calling for a rapid change in the global GHG emissions trajectories to avoid average warming of the planet of more than 2°C: according to the scenarios of the Intergovernmental Panel on Climate Change (IPCC), this would entail halving global emissions by 2050, and a reduction from 80 to 95% in developed countries. The Committee's work explored the best ways for France to contribute to achieve this goal.

Future decision-making should consider two aspects. First, at the international level, the UN-led negotiations, despite technical advances, have little chance of delivering an ambitious international agreement any time soon. On the other hand, the real economy has not experienced a strong recovery, following the violent recession of 2008-2009, the financial situation of governments has even weakened and cast doubt about the sustainability of sovereign debt within the eurozone.

In this context, the Committee's work pursued the following approach: finding ways to conduct a climate policy that combines high ambitions in terms of reducing GHG emissions with positive impacts on economic growth, industrial competitiveness and employment. Ambitious action on climate change will contribute to the recovery of our economy and to the creation of new comparative advantages in international competition, provided two conditions are met:

- integrating, much more directly than in the past, climate policy to a strategy that combines a policy of developing industrial clusters, research and development, and diffusion of innovation within the economic system;
- lending increased credibility to public policy by building the kind of governance that makes the targets and economic incentives that will help achieve those targets predictable to economic players on the long term, including through a generalization of carbon pricing in the economy;
- these general guidelines subdivide into four areas: analysis of the European context, construction of French sector trajectories, diagnosis of possible scenarios and identification of instruments to be implemented.

1. The European context is currently marked by discussions on achieving the EU's objective, i.e. a reduction of at least 80% of GHG emissions between 1990 and 2050. Since this objective has not been broken down by Member State, the Committee first examined the position of France within the European context. Given the structure of its emissions and, in particular, the low level of its industrial and energy-related emissions (the areas on which the largest reductions are being sought in the Union), it appears that the national target of "Factor 4 " (which would bring our country to an emission level of less than two tons of CO<sub>2</sub> per capita in 2050) is in line with European

long-term objectives. This national target must not be affected by the changing state of play in international climate negotiations. It is to be achieved through means that simultaneously enhance economic growth, employment and the various industrial sectors.

When the Committee's work was carried out, there was no consensus within the European Union as to the best course of action for achieving the long-term objective, in particular, the need to go beyond the EU's objective of a 20% reduction in greenhouse gas emissions by 2020, compared to 1990. Hearings conducted with representatives of three countries that are in favor of such a move beyond 20%, pointed out some interesting innovations in climate policy: in Germany, strong links with the industrial strategies for production and export of new technologies; in the UK, the establishment of a specialized governance together with several financial innovations; in Sweden, the domestically use of a carbon taxation. This suggests that beyond measures already introduced, following the France's *Environment Round Table*<sup>1</sup>, our country must continue to innovate in terms of governmental action to achieve ambitious climate targets.

2. The potential for reducing emissions. Since 1990, French GHG emissions have been partially decoupled from economic growth. This trend seemed to accelerate after 2005, not just due to the mechanical effect of the economic recession. This decoupling creates certainty that France's Kyoto Protocol commitments will be kept and a strong likelihood that our current 2020 Climate and Energy Package target will be achieved, provided the implementation of measures adopted according to the French *Environment Round Table* is not thwarted by public finance constraints. However, just pursuing this incremental progress will not be enough to put us on the path to "factor 4" by 2050. For that to happen, we will need transformative technological and/or organizational changes, so as to achieve the reduction potential identified in each sector. To reach "factor 4", five overall conditions will have to be met:

- act on both demand (by encouraging energy efficiency and more generally lowering consumption of goods and services with a high carbon footprint) and supply (by encouraging low-carbon production). This condition is essential in particular to make sure that non-emitting primary sources of energy can cover needs on the medium to long term;
- all sectors, whether or not subject to the European Trading Scheme for CO<sub>2</sub>, will have to accelerate their emissions reductions. Particular attention must be paid to the "diffuse" sectors, where multiple emission sources make it more difficult to establish the appropriate incentives: transportation, construction industry and agriculture. Agriculture and forestry deserve special attention because of their ability to produce renewable carbon and store atmospheric carbon. This ability could be greatly reduced with respect to the forest in the coming decades, unless new investment is made. Rapid action should also be taken to reduce the pressure to replace natural soil by artificial soil due to suburban expansion;
- economic actors in each sector will need to have a set of predictable long-term incentives which, through public action, will lead them to initiate rapid investment and innovation efforts required to achieve the proposed carbon emissions reduction targets by 2050. In this regard, a variety of conditions prevail in the

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(1) Also called the *Grenelle Environment Round Table*.

various industries, with various challenges and opportunities as regards technological and organizational innovation;

- funding sources will have to be mobilized to achieve the additional investment and cover the conversion costs needed to move towards a low carbon economy without destabilizing public finances, whose consolidation will remain the priority in the coming years. R&D actions, but also technological innovation and diffusion can both enhance the competitiveness of our businesses, but also the growth of our economy in the long term: financing these developments will be particularly important;
- to create the conditions for social acceptance of these changes, the transition to a low carbon economy will have to quickly demonstrate its beneficial effects on business activity and employment, and efforts will have to be equitably shared.

**3. The various possible scenarios.** To respect the limited time available for its study, the Committee did not multiply scenarios but rather focused on three possible paths, which have been broken down by sectors and will lead to a 75% reduction in GHG emissions in 2050. These three paths differ since they go through three different points in 2020, corresponding to three options at the EU level (-20, -25 or -30% reduction targets) that lead to national reductions of 33 to 41% in 2030 (see table 2 at the end of the summary). Though the issue of going beyond the current EU target has not given rise to consensus within the Committee, the modeling and analysis done as part of this study shed light on the parameters that would have to be considered in making such a decision:

- first of all, raising the target to a reduction of -25% or -30% would lead to an additional climate benefit, with cumulative emissions reduced by 8% in 2050. Simulations under different models all illustrate the benefits of an early action: with an enhanced target, reductions are more evenly distributed over time, which avoids sharply increasing constraints towards the end of the period. Such a raise would also be instrumental in raising the price of CO<sub>2</sub> quotas on the EU ETS, which is a widely shared goal today. If supported by adequate measures, it could be conducive to building a competitive advantage in a number new low-carbon economic sectors;
- members of the Committee argued that the timeframe for investment in industry is such, that the 2020 target is too close at hand to change the rules of the European CO<sub>2</sub> trading scheme. Other have expressed concern that achieving further reductions by 2020 in sectors not covered by EU ETS would entail a heavy burden for governments since many incentives in these industries are based on the use of public money. Finally, some have pointed out that EU action would benefit from high leverage if the European system was linked to a global carbon market;
- because of the reservations expressed above, the Committee sought to highlight the right conditions for raising the current -20% target. One essential precondition would be to strengthen the system of economic incentives by expanding the pricing of energy-related CO<sub>2</sub> to areas not covered by the EU quota system. Such scope extension should ideally take place through European channels, but action at the domestic level might also be taken if progress remains slow at EU level;
- the use of funds from national or European carbon pricing can promote growth and employment in the short term as well as in the medium term. The Committee recommends that such use be part of a multi-year vision that incorporates the

following five priorities: lower costs for employers to promote employment and enhance competitiveness; compensation targeted at poor households; funding of R&D and low-carbon innovative technology diffusion in France and as part of international cooperation; funding for new training schemes and retraining support schemes; support for fighting climate change in least developed countries.

4. Instruments to be implemented. One prerequisite for a successful transition to a low carbon economy is that the signals sent by both European and French authorities should be credible and predictable. For every country, the Committee favors renewed governance of climate policy with, as is the case in the UK, an independent committee bringing together the required expertise, and open to businesses as well as to the civil society. We also advocate establishing intermediate targets at both national and European levels:

- at the domestic level, the Committee would recommend a system of intermediate targets for greenhouse gas emissions (every three or five years) to be seriously explored. These targets would not be binding and would be broken down by sector, so as to strengthen national steering capacities for trajectories and assess the adequacy between means of implementation and results;
- at the EU level, once decisions have been made on 2020 targets, it is desirable that a 2030 EU target reduction should be quickly adopted, in line with the 2050 objective. This target figure, which should be in the range of -40 to -45% at EU level as estimated for the European roadmap, should be specifically broken down between Member States and adhere to the rules that cover changes in the EU quota ceiling, because ETS should remain a powerful and effective instrument for controlling industrial emission reductions. In this regard, the Committee wishes that proposals to strengthen regulation of the carbon market under the aegis of an independent European authority, based on the Prada Report, be implemented at short notice.
- at the international level and in order to increase the flexibility of climate policies, the continued use of project mechanisms established under the Kyoto Protocol could be a useful source of external flexibility. It should target least developed countries or those that are making demonstrable efforts to cut their emissions, and it should focus on programs-based approaches. The extension of these mechanisms, if harmonized within Europe, would also facilitate the achievement of reduction targets in sectors not covered by the European quota system.

Financially, the Committee supports the introduction of innovative mechanisms for using the future value of emission reductions and energy savings with a view to financing emissions-saving investment through loans or equity. Such a scheme, if implemented on a large scale, could help remove one of the major obstacles to accelerate upgrades in the housing stock.

Readers are referred to Chapter 5 for details of the Committee's proposals to facilitate a successful transition to a low carbon economy. In addition, the annex #4 to the report brings together miscellaneous proposals that individual Committee members wished to make on their own behalf.



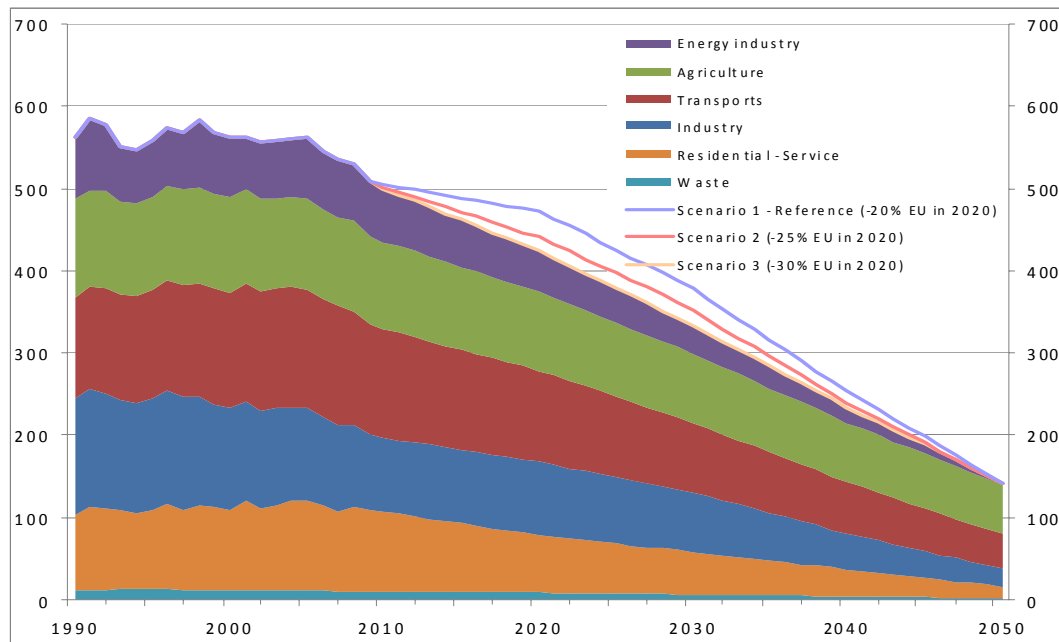
## The report's 9 proposals

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- 1) Strengthen industrial policies aimed at promoting the transition towards a low carbon economy.
- 2) Promote strengthened R&D and dissemination of technological innovations enabling the transition to a low carbon economy.
- 3) Extend the predictability of climate policy by defining binding European targets for 2030 and strengthen its credibility by renovating its governance.
- 4) Strengthen the carbon price signal by making it economy-wide and improve regulation of the European CO<sub>2</sub> trading system.
- 5) Improve and implement the flexibility mechanisms at the international level and promote their use within the European Union.
- 6) Ensure fully transparent management of auction proceeds and future climate-energy contributions, with the aim to promote economic growth, social equity, the development of low carbon innovation and international solidarity.
- 7) Anticipate changes in the job market and plan for achieving successful job transitions.
- 8) Develop innovative financing schemes that combine public and private equity and use of carbon value as leverage.
- 9) Integrate effectively climate policy objectives into urban and rural planning policies.

## Charts and tables highlighting the executive summary

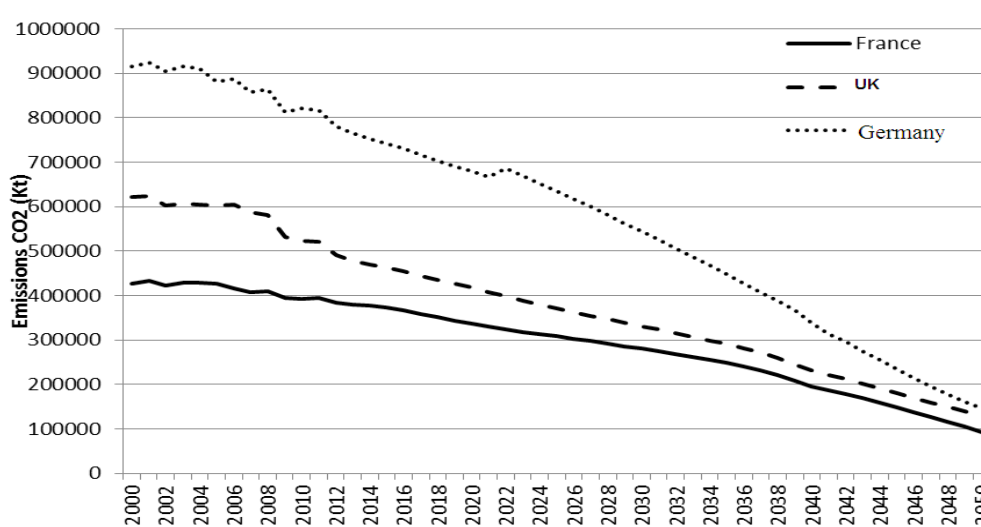
**Chart 1: Pathways of greenhouse gas emissions by sector  
to achieve the objective of 75% in 2050 in France  
(MtCO<sub>2</sub>e)**



*Source: the Committee's work*

Chart 1 shows the greenhouse gas emissions paths in France deriving from the Committee's scenarios. Each of them reach a 75% cut in greenhouse gas emissions by 2050 compared with 1990, but going through three different points in 2020, corresponding to three possible options at EU level (reduction targets of -20%, -25% or -30% compared with 1990). The sectoral distribution of the emissions corresponds to the -30% target at EU level in 2020, compared with 1990. For France, the emissions correspond to the greenhouse gases covered by the Kyoto Protocol, for metropolitan France and the overseas departments. They do not include the emissions or carbon storage linked to soil management and land use changes (in the majority, forests and agriculture).

**Chart 2: Distribution of an emission pathway between France, Germany and the United Kingdom aiming at –80% by 2050 (energy CO<sub>2</sub> only)**



Source: POLES model

Chart 2 shows the emissions pathways for a 80% reduction by 2050 in France, the United Kingdom and Germany, as calculated by the POLES<sup>1</sup> model. Emission reductions are higher in Germany than in France, with the United Kingdom in between. This can be explained by cheaper reduction potential in these countries, mainly in the energy production sector.

**Table 1: Greenhouse gas emissions by sector to achieve the target of 75% by 2050 in France**

	1990		2005		2050		
	(MtCO <sub>2</sub> e)	Share of total (%)	(MtCO <sub>2</sub> e)	Share of total (%)	(MtCO <sub>2</sub> e)	Share of total (%)	Variation/1990 (%)
Total	562	100	561	100	140	100	- 75
Residential -Tertiary	91	16	108	19	13	9	- 85
Manufacturing industry	143	25	112	20	21	15	- 85
Transport	120	21	144	26	41	29	- 66
Agriculture	120	21	110	20	59	42	- 51
Energy industry	76	14	74	13	3	2	- 96
Waste processing	13	2	13	2	3	2	- 76

Source: the Committee's calculation

Table 1 shows the greenhouse gas emissions by sectors, in France (metropolitan France and the overseas departments), in 1990, 2005 and by 2050 on the basis of an adjustment path leading to a 75% reduction in greenhouse gas emissions by 2050 compared with 1990. These figures do not include the emissions of carbon storage linked to soil management and land use changes (in the majority, forests and agriculture).

(1) Prospective Outlook on Long-Term Energy Systems.

Table 2: Comparison of developments in France and in the EU-27

	As a percentage of the total (%)		Variations/1990 (%)							
	2005		2005		2020		2030		2050	
	Fr	EU	France	EU	Fr	EU	Fr	EU	Fr	EU
Total (all GHG)	100	100	0	-7	-16 to -25	-23 to -26	-33 to -41	-40 to -44	-75	-79 to -82
Energy industry (CO <sub>2</sub> )	13	31	3	-7	-25 to -32	-30 to -34	-49 to -53	-54 to -68	-96	-93 to -99
Manufacturing industry (CO <sub>2</sub> )	18	18	-8	-20	-24 to -36	-31 to -32	-32 to -48	-34 to -40	-84	-83 to -87
Transport (excluding international air and maritime) (CO <sub>2</sub> )	25	18	18	25	+ 3 to -8	+ 15 to +27	-22 to -29	+ 8 to -17	-65	-61 to -74
Residential-tertiary (CO <sub>2</sub> )	17	13	16	-12	-11 to -20	-21 to -25	-33 to -42	-37 to -53	-85	-88 to -91
Agriculture (non CO <sub>2</sub> )	17	10	-10	-20	-14 to -19	-	-26 to -29	-36 to -37	-49	-42 to -49
Others (non-CO <sub>2</sub> )*	8	8	-30	-30	-41 to -47	-	-48 to -58	-71.5 to -72.5	-86	-70 to -78

For the greenhouse gases specified in the heading, this table compares the sectoral passing points in 2020, 2030 and 2050 for the three greenhouse gas emissions pathways in France deriving from the Committee's scenarios with the sectoral milestones proposed by the European Commission for EU-27 in its "Roadmap for a competitive economy with a low-carbon level by 2050" published on 8 March 2011.

Source: the Committee's calculation

(\*)This line covers the non-CO<sub>2</sub> GHG in the energy industry, manufacturing industry, transport (excluding international air and sea), the residential-tertiary and waste sectors.

-For the sectors, this comparison only concerns the gases included in the European Commission's roadmap, and do not enable the whole inventory to be covered; the CO<sub>2</sub> emissions in agriculture and waste are not integrated, i.e. about 2% of total emissions excluding LULUCF; furthermore, the LULUCF sector is not dealt with in the Commission's 2050 climate roadmap.

### Climate policy and economic crisis

In his famous *Review* published in 2006 at the request of the British Treasury, the economist Nicholas Stern popularised a reasoning previously confined to the relatively narrow circles of climate economists: when the decision-makers' time-frame is extended, then the costs of failing to take action against global warming are much higher than those incurred by immediate action. Up to 20% of GDP over the next 50 years for the former, against 1 to 2% of GDP for the latter. Could then any responsible decision-maker decide not to take action? However, during an economic and financial crisis, how many decision-makers take decisions going beyond a few months?

Since 2006, the scientific community argues in favour of an increased assessment of the potential damage associated with our greenhouse gas emissions. The fourth IPCC evaluation report, published in 2007, fully documented the risks associated with pursuing the current emission pathways world-wide. Based on this work, the international community maintained the goal of limiting average global warming to 2°C. Quite a wide consensus prevails over the fact that halving greenhouse gas emissions by 2050 would give us every chance of succeeding, which involves going considerably farther in developed countries. From the climate scientists' point of view, Stern's reasoning has never been so relevant.

Nevertheless, very little progress was made on the international level since the EU "Energy-Climate package" adopted in December 2008. International climate negotiations were confined to technical elements, which move away from the prospect of a credible international agreement on emission cuts. Constrained by the crisis, both public and private players take decisions with the eyes fixed on the short term: they do not accept any additional burden on the economy today, even if, tomorrow, this is repaid tenfold.

The mission of the Committee "Pathways 2020-2050 - Towards a low-carbon economy" was specifically to consider the options available for the various and desirable timeframes of climate policy. Its work was organised in order to identify options combining cuts in greenhouse gas emissions with economic and social progress. Different approaches were developed: the comparative analysis of European experiences (Chapter 2), building predictive sectoral pathways (Chapter 3) and assessing the economic and social impacts in using the economist's tools (Chapter 4). It concludes with the proposals (Chapter 5) aimed at identifying the instruments, the simultaneous implementation of which would enable the transition to

a low-carbon economy to be accelerated while invigorating the economy and employment in the short term.

Are these channels realistic in times of crisis, the sceptics ask? Even if they induce players to shortening their timeframe, economic crisis may also become catalysts for change. As Jean Monnet said: "*Men only accept change when it is a necessity, and they only see necessity during a crisis*". If the climate issue no longer weighs down the economy's ability to rebound, but on the contrary is seen as a leverage to enable more wealth and jobs to be created, there is no doubt that it will be integrated into our collective choices at a faster pace. The members of the Committee agree that change is a necessity.

## Chapter 1

# The context and the outstanding issues

Linking up the various timeframes is one of the key questions raised by the initiative to combat climate change. There is a general consensus on the need to massively reduce greenhouse gas emissions by 2050. This consensus tends to crack when we get close to intermediary targets closer to us: 2030, 2020. It may lead to opposing views on the type of action (or inaction) to be undertaken, here and now. As a Mayor of a city engaged in action against climate change likes to say: "at the Town Council, it is child's play to obtain unanimity on 2050; but the consensus breaks up on 2020; however the real debate is when the budget for the next year goes to the vote". Locally, as nationally, this debate must be backed by the best available information and raise the right questions. The Committee's first task was to gather such information while agreeing on the key questions to address.

### 1. The three commitments already made by France

With regard to reducing greenhouse gas emissions, France is already bound by three additional commitments in the short, medium and long term:

- **the short term concerns** the 2008-2012 period. Under the Kyoto Protocol, France is committed, between 1990 and the average of the 2008-2012 period, to stabilising emissions of the six greenhouse gases covered by the protocol<sup>1</sup>, of which carbon dioxide being the main one. This committee is the outcome of the decision taken by the Environmental Council of the EU on 17 and 18 June 1998, when the ministers agreed on dividing up the European commitment on a reduction of 8% over the same period among Member States;
- **the medium-term commitment** concerns 2020. At the European Council of Heads of State and Government on 8-9 March 2007, the European Union decided on a target reduction of 20% of its emissions by 2020, compared with 1990 (i.e. 14% compared with 2005). This target was then broken down by country, under the Energy-Climate Package which, in December 2008, was agreed on, assigning binding targets to France (see *infra* for further details). It was stated that the Commission would propose additional measures to the Parliament and the Council to achieve a target of -30% "if a satisfactory international agreement is reached". The discussion on the suitability of a change to -30% remains however open in Europe, as the Commission and some Member States wish to raise the target to -20% for domestic reasons, independently of the further development of

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(1) The "Kyoto Basket" is made up of six greenhouse gases (CO<sub>2</sub> carbon dioxide, CH<sub>4</sub>, nitrogen oxide N<sub>2</sub>O, HFC hydrofluorocarbon, PFC perfluorocarbon and SF sulphur hexafluoride).

climate negotiations. At the moment, France has not taken any official position on this point, keeping to the classic approach of raising the reduction rate in 2020 depending on how these negotiations develop;

- **with "factor 4"**, France was one of the first European countries to adopt targets to reduce its emissions by 2050, compatible with halving world-wide greenhouse gas emissions as aimed at in the scenarios promoted by the Intergovernmental Panel (IPCC). The objective of reducing greenhouse gas emissions by four, compared with 1990, was incorporated into the Law passed on 13 July 2005 that fixed energy policy guidelines. It was confirmed by the Law of 3 August 2009 that specified the rules for the implementation of the *Grenelle Environment Round Table*. However, these enactments leave some ambiguities on the exact scope of the emissions covered and the reference period selected.

What picture emerges when these three targets are compared with the initial situation? An analysis of the observed emissions shows that France will have reduced its emissions over the period 2008-2012 well beyond the Kyoto target, the two unknown factors being 2020 and, above all, 2050.

## 2. A partial disconnection between emissions and economic growth, quite insufficient to reach the "Factor 4" objective

The first stage in any forward-looking approach is to get a proper grasp of the starting point and to try to detect development trends at work, any breaks with them, weak signals likely to announce greater breaks in the future. The annex #2 at the end of the report (see French version) gives the elements which were analysed both for France and for Europe on this topic. Three main ideas were drawn from it to provide material for the Committee's work.

First, over the past 20 years greenhouse gas emissions in France<sup>1</sup> partially decoupled from economic growth. Between 1990 and 2008, the increase in GDP came close to 40% while the total emissions slightly regressed. During the economic crisis, greenhouse gas emissions continued to decline, compared with GDP (see chart 3). This partial disconnection between emissions and economic growth is not specific to France: this trend can also be seen in all EU countries, but with very marked domestic specificities (see annex #2).

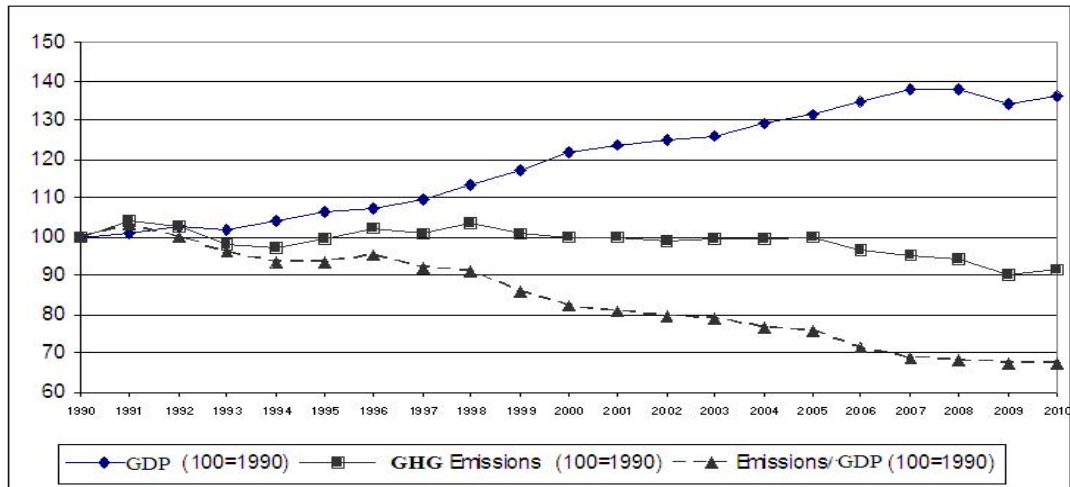
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(1) In this report, the figures on greenhouse gas emissions used correspond to the agreement adopted under the Kyoto Protocol. The inventory encompasses all the emissions produced nationally (metropolitan France + overseas departments) whether they derive from the combustion of carbon-bearing energy products or industrial processes using carbon-bearing products as a raw material. The emissions from "domestic" air, sea and river transport, including those relating to traffic between Metropolitan France and the overseas departments, are included in the inventory. Emissions linked to international sea and air transport are excluded. It should be noted that we are studying 2011 French inventory which does not include preliminary corrections on the methane emitted by landfills requested by the secretariat of the United Nations Framework Convention on Climate Change.



**Chart 3: Economic growth and greenhouse gas emissions in France**

(change in volume of GDP, GHG emissions and GHG intensity – 100 = 1990)



N.B.: GHG emissions for 2010 are preliminary estimates

Source: INSEE, inventory of emissions in the Kyoto scope, CITEPA, submission April 2011

Where did these incremental gains come from? The implementation of climate policies having preceded them, these policies cannot be held responsible for them. They express a complex combination of efficiency gains (in energy, but not only) and a change in the structure of the domestic production with, in particular, the decline of the industry. In this way, some members of the Committee pointed out that embedded emissions from the total households' demand for goods and services no doubt increased more rapidly than the emissions measured domestically. In the present state of statistical knowledge (box 1), it is impossible to have an exact measurement of this phenomenon. The Committee thus requests a statistical follow-up enabling a better monitoring of this phenomenon in the future, under a reformed governance of climate policy (Chapter 5).

The key issue is that simply extending these gains make it in no way possible to split by four greenhouse gas emissions in France by 2050, even if pessimistic outlooks for economic growth are maintained for the coming decades. One of the Committee's priorities was therefore to seek the conditions for enabling changes to emerge (technologies, behaviour, organisations), making thus possible to go beyond these trends of incremental gains.

**Box 1****Assessing emissions on the basis of demand?**

Traditionally, greenhouse gas emissions (GHG) are accounted for on a country basis, according to the quantities emitted on a particular territory within one year. The statistical support used is the domestic inventories whose rules are internationally harmonised in accordance with the guidelines based on the work of the IPCC. The reference data and objectives of the Kyoto Protocol are calculated according to these inventories, internationally audited. In France, the CITEPA (Technical Interprofessional Centre for

Atmospheric Pollution Studies) is responsible for this emissions inventory, in accordance with domestic obligations and guidelines.

For some years now, this calculation method has changed, as requested, to take into account total emissions embedded in our consumption: behind this demand, the developing countries who often argue that a high share of their production of goods is for developed countries. Thus, they see their emissions being reduced to the benefit of emitting countries among which Europe and the United States.

A study published in March 2010 in the American magazine PNAS (*Proceedings of the National Academy of Sciences*) even shows that, on this basis, European countries record more imported emissions than the United States<sup>1</sup>. Another exercise was carried out by the OECD, using bilateral trade data and CO<sub>2</sub> emissions for 41 countries/regions and 17 activity branches<sup>2</sup>. This study highlighted a carbon deficit for OECD countries (France: 134 MtCO<sub>2</sub> in 2000, i.e. 35% additional emissions) which, for most of them, had increased since the previous version, result in line with the existing delocalisation process. Finally, we might mention a study that assessed France's CO<sub>2</sub> imports at 260 MtCO<sub>2</sub> and exports at 178 MtCO<sub>2</sub><sup>3</sup>. Therefore, 82 MtCO<sub>2</sub> were added to French CO<sub>2</sub> emissions, raising them to a total of 499 MtCO<sub>2</sub> for 2005.

These studies provide valuable additions to the emissions' distribution supplied by the domestic inventories and feed very useful research on the links between international trade, greenhouse gas emissions and potential carbon leaks. However, they raise methodological and statistical problems and rebuilding the system for measuring emissions on the basis of demand would, on the one hand, be very uncertain and no doubt very costly. Hence, no doubt that this way is not the best to strengthen the mechanism for calculating and verifying emissions, moreover essential to achieve a credible and binding climate agreement on an international scale.

Moreover, a change occurred in the development of France's emissions in the mid-2000s. Up to 2005, these emissions fluctuated around a stable average value. Since 2005, they seem to have declined by a little more than an average of 1.5% per annum (with a strong acceleration due to the recession in 2009, not followed by a "rebound effect" in 2010<sup>4</sup>). How can this drop be interpreted? Any hasty conclusion is ruled out because of its complexity. However, several factors may be mentioned: economic deterioration, soaring energy prices, as well as the initial results of the implementation of the national and EU climate measures. The next analyses will corroborate this latter point, analyses which result in a substantial outcome for the trade-offs to be made by 2020: if one assumes that the measures already taken on a European scale regarding the climate policy are strictly applied in compliance with the ETS rules in force, and also those already decided within the national scope of the *Grenelle Environment Round Table*, then France will by 2020 achieve its European commitments on greenhouse gas emissions, given the reduction already achieved. This result depends on maintaining the incentives provided for, over the whole period, and the effective implementation of the public investment programmes, within an uncertain budgetary context.

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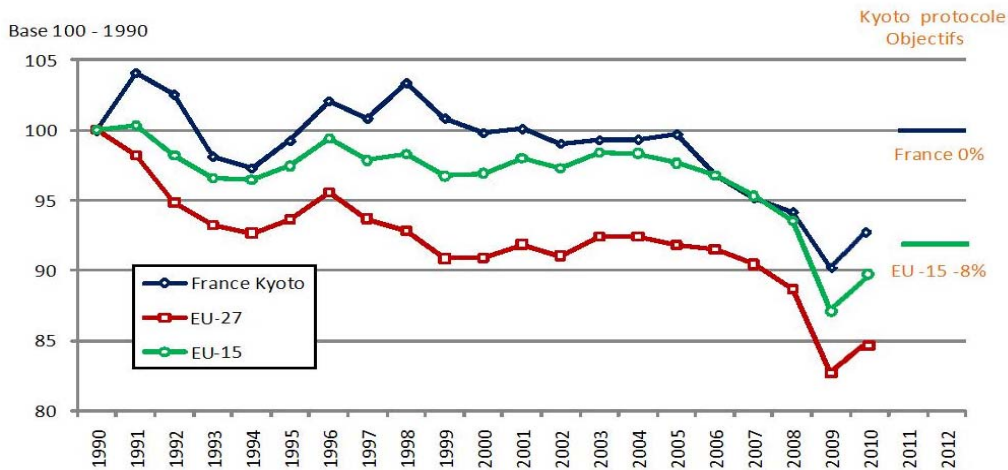
(1) Davis S. J. and Caldeira K. (2010), "Consumption-based accounting of CO<sub>2</sub> emission", *PNAS*, vol. 107, No. 12, March, p. 5687-5692.

(2) Nakano S. *et al.*, (2009), "The measurement of CO<sub>2</sub> Embodiments in International Trade: Evidence from the Harmonised Input-Output and Bilateral Trade Database", DSTI/DOC(2009)3, OECD Working papers.

(3) Pasquier J.-L., (2010), "The environment's physical accounts, a basis for new indicators in the economy-environment interface. The case of CO<sub>2</sub> emissions in France", in Pappalardo M., (2010), *The sustainable development indicators, La Revue du CGDD* (general commissariat for sustainable development), p. 75-83.

(4) In 2010, CO<sub>2</sub> emissions linked to energy in France increased by 2.2% compared to 2009. But the year 2010 was a particularly cold one so that they decreased by 0.6% after climate correction.

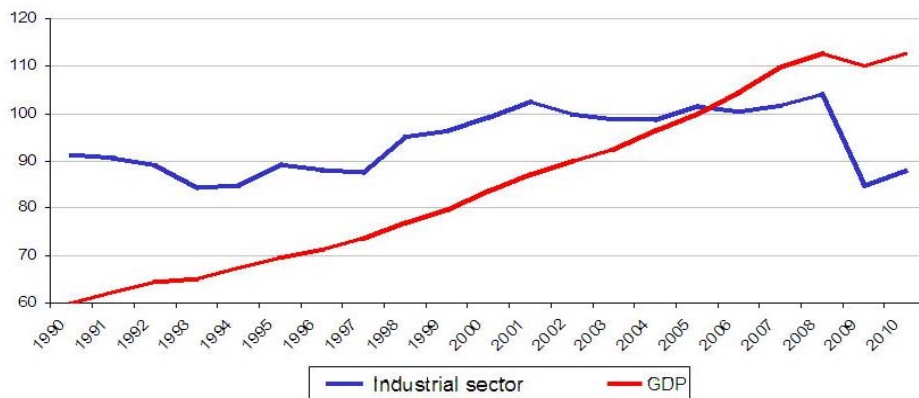
**Chart 4: Changes in greenhouse gas emissions between 1990 and 2009, in France and the European Union**  
(base 100, 1990)



Sources: CITEPA and EEA (provisional estimate for 2010)

The third main idea suggested by the retrospective analysis concerns the link between economic activity, employment and greenhouse gas emissions. The changes to be made to achieve the "factor 4" must go beyond the previously described incremental progress. Thoughts should be given to the pathways towards a low-carbon economy in terms of structural changes, because certain activities, certain jobs, certain types of consumption are likely to disappear while others appear. All the Committee members were in favour of setting an ambitious goal for the EU and France climate policy which would go hand-in-hand with a revitalisation of the economy, including industry. This is why the last section of its report makes proposals to make the decarbonisation of the economy no longer a constraint, as it has too often been presented, but a true leverage for economic growth, expanding employment and reviving industry.

**Chart 5: Changes in industrial manufacturing and GDP**  
(Indexes, base 2005)



Source: Insee, presentation by Vincent Mages to the Committee

### 3. Are the French "factor 4" and the European "factor 5" compatible?

Due to the inertia of the climate system, decisions taken today on greenhouse gas emissions will have consequences in the very long term. The warming effect of one tonne of CO<sub>2</sub> released today into the atmosphere will be felt for 100 years. Choosing whether or not to emit this tonne will therefore have an impact on the average atmospheric concentration of CO<sub>2</sub> for a century with effects on the climate lasting much longer. Since they started, climate negotiations conducted under the United Nations seek to incorporate this long-term perspective into an international framework (see box 2). The French and EU goals for 2050 lie within this framework with explicit references to the climatologists' work summarised in the IPCC evaluation reports.

The "factor 4" was measured according to the work stemming from the IPCC evaluation report whose flagship scenario aims at halving all greenhouse gas emissions world-wide. To achieve the emission goals in this scenario by 2050, developed countries must divide their own emissions by four. France was one of the rare countries to transpose this factor 4 into domestic law.

#### Box 2

##### The IPCC, the target of 2°C and factor 4-5

Anthropogenic greenhouse gases are responsible for an increase in the quantity of greenhouse gas in the atmosphere contributing to global warming. This observation was confirmed and refined by the Intergovernmental Panel on Climate Change (IPCC)<sup>1</sup> in its fourth report published in 2007. This particularly stated that the average global warming observed on the earth's surface in the course of the past century was +0.74°C, and that the current rate of increases in greenhouse gas concentrations will bring about an average warming of +0.2°C per decade during the next 30 years. In this way, by 2100, temperatures may increase, by 1.1°C to 6.4°C, depending on the various scenarios.

At the same time, the IPCC produced a table of the possible consequences (availability of water, food, risks of extreme weather events, sanitary conditions, sea level, etc.) in accordance with the average temperature.

Stabilising the emissions concentration at 450 ppm would be compatible with an average rise in the temperature of +2°C, a level for which the consequences would still be acceptable. According to the IPCC, this goal corresponds to halving emissions world-wide by 2050. The range of emission decreases for all the countries listed in Appendix 1 lies between 25% and 40% in 2020 compared with 1990 and between 80% and 95% in 2050, i.e. at the least factor 5.

At the Cancun conference, the goal of limiting the increase in global temperature to a maximum of 2°C above the pre-industrial temperature was enshrined in the United Nations framework convention under the auspices of the UNFCCC. It was also planned to review this goal by 2015, in the light of the next IPCC assessment report.

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(1) The work of the IPCC is carried out by three working groups: Group I assesses the scientific aspects of climate change; Group II deals with questions on the impact of climate change and adaptation to it; Group III assesses the solutions which may be implemented to limit greenhouse gas emissions or to alleviate the effects of climate changes, including from the economic standpoint.

In October 2009, The European Council committed itself to reducing GHG emissions by a minimum of 80%<sup>1</sup>, which could go up to 95% in 2050, compared with the 1990 level, a goal reaffirmed in February 2011. We can therefore talk about a "factor 5". This range refers to the targets that the fourth IPCC assessment report calculated for all developed countries in order to achieve a halving of world-wide emissions by 2050. However, for the moment, neither the Council of Europe nor the Commission has discussed or specified how this common target for 2050 should be divided up among the various Member States.

The information gathered by the Committee shows a high degree of compatibility between the French factor 4 and the European factor 5. First achieving factor 4 would bring French emissions to less than the equivalent of two tonnes of CO<sub>2</sub> per capita in 2050 (1.94, see Table 3). This level is less than the 2.18 (on average) required to achieve the factor 5 over Europe as a whole. This result is mainly due to the initially lower level of emissions per capita in France, compared with our European neighbours, resulting from the nuclear component in the French energy mix.

**Table 3: Targets for reducing emissions of greenhouse gases by 2020 and 2050**

(six greenhouse gases in the Kyoto Protocol, excluding impacts from changes in soil use)

		Europe (EU-27)	France
<b>Total emissions (MtCO<sub>2</sub>e)</b>	1990	5,567	563
	2009	4,600	517.2
	2020	4,454•	475•
	2050	1,113••	140**
<b>Emissions per capita (t/iper capita)</b>	1990	11.84	9.93
	2009	9.24	8.28
	2020	8.74•	7.2•
	2050	2.18••	1.94••

\* a 20% European-wide reduction compared with 1990 and converted into the French programme according to the existing effort-sharing allocation.

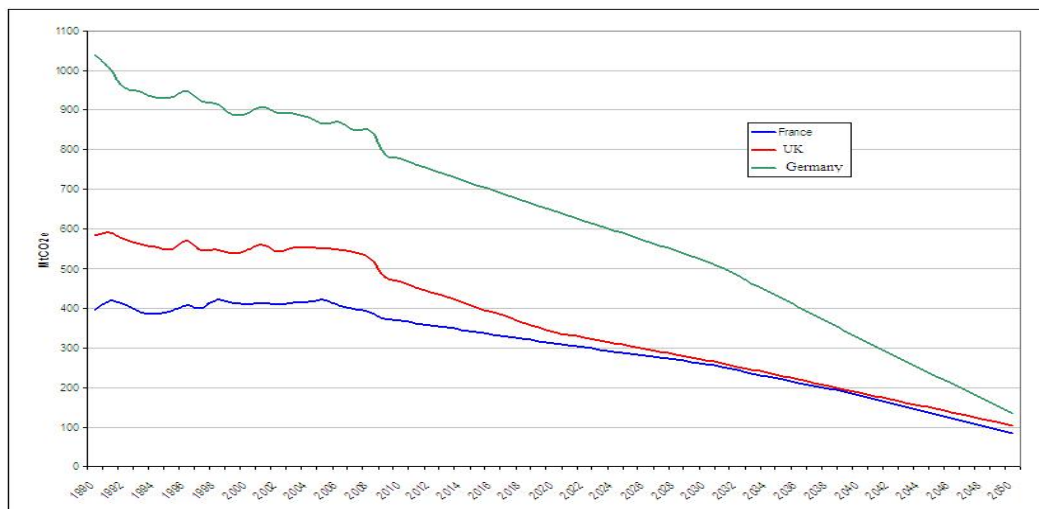
\*\* European Factor 5 and French factor 4.

Source: CAS calculations using the UNO demographic data (2011), World Population Prospect

Besides, it is the specific nature of this energy mix which leads to an interesting result in terms of forecasting. At the Committee's request, a simulation was made with the *POLES* model to effectively divide up the objective to reduce the European emissions by -80%. Its results are given in chart 6. It would mean a target of reduction of -77% for France, close to "factor 4", against -81% for the United Kingdom and -86% for Germany, two countries where there is a larger reduction potential at a low cost, by gradually reconverting coal-fired power stations and other high emitting facilities.

(1) Extract from the Council's conclusions in October 2009: "It supports an EU objective, in the context of necessary reductions according to the IPCC by developed countries as a group, to reduce emissions by 80-95% by 2050 compared to 1990 levels".

**Chart 6: Efficient pathways for CO<sub>2</sub> energy emissions by 2050 in the case of a milestone at – 30% below 1990 level for the European Union**



Source: Patrick Criqui (POLES simulation)

All these data and results shows that there is a substantial compatibility between the French "factor 4" and the European "factor 5" which are two expressions of the same objective: a sufficiently ambitious way of reducing greenhouse gas emissions by 2050 to limit the risk of global warming exceeding 2°C. Consequently, the scenarios selected for the Committee's work are based on a domestic target of splitting by four the emissions by 2050.

#### 4. How do European and French objectives fit into the international climate negotiation?

Whether it concerns the European factor 5 or the French factor 4, it is important to connect these objectives with the climate negotiations that take place at the international level. Europe is responsible for a little more than 10% of world-wide discharges of greenhouse gases into the atmosphere and its relative contribution is diminishing. Consequently, achieving its objective by 2050 would make decisive progress towards the 2°C target only under two conditions, well identified by the IPCC and corroborated by the global scenarios that the International Energy Agency presented to the Committee:

- all industrialised countries should adopt the same reduction in their emissions from 80% to 95% by 2050;
- the emerging countries should achieve a substantial deviation below the currently predicted emissions growth rate, in the range of 15 to 30% by 2020.

At the time of this report, none of these conditions has been met yet, which is a real limit to the impact of Europe's action on global warming: in the case of a scenario where Europe acts alone, the *POLES* model results give an average increase in temperature of around 4°C by the end of the century. Should it then be concluded that unilateral action is not in Europe's own interest?

Several benefits which could result from maintaining Europe's climate ambition would though be neglected: by implementing the factor 5, which imply structural changes towards a low-carbon economy, the European Union can create new competitive advantages on the very promising green economy. A strengthened ambition would also enable to reduce the vulnerability to energy price as well as to contribute to the European objective of improving energy security. Finally, this could strengthen European credibility in international negotiations; even encourage other countries to set off on comparable paths given the competitiveness stakes. So there are many reasons which militate in favour of strengthening France's unilateral climate ambition.

## 5. Which pathway to 2050?

As regard global warming and once the target is determined, the most interesting trajectory to take is the one which would make it possible to reach the final point as fast as possible, as it minimises cumulated emissions, which is the real parameter influencing the rate of global warming. For instance, achieving factor 5 in Europe by reducing emissions by 30% from 2020 would lead, between 2010 and 2050, to a total of emissions one-fifth lower than the one resulting from a trajectory remaining on the current objective of -20% in 2020.

Nevertheless, the scenarios aiming at halving emissions in developed countries by 2050 generally maintains pathways in which emissions are reduced more slowly at the beginning than at the end of the period. This is the case in the International Energy Agency's scenarios or in the one designed by the European Commission. In both cases, this profile derives from financial constraints, the rates at which low-carbon technologies are disseminated and the timeframes required to make the investments in low-carbon energy, buildings or means of transport.

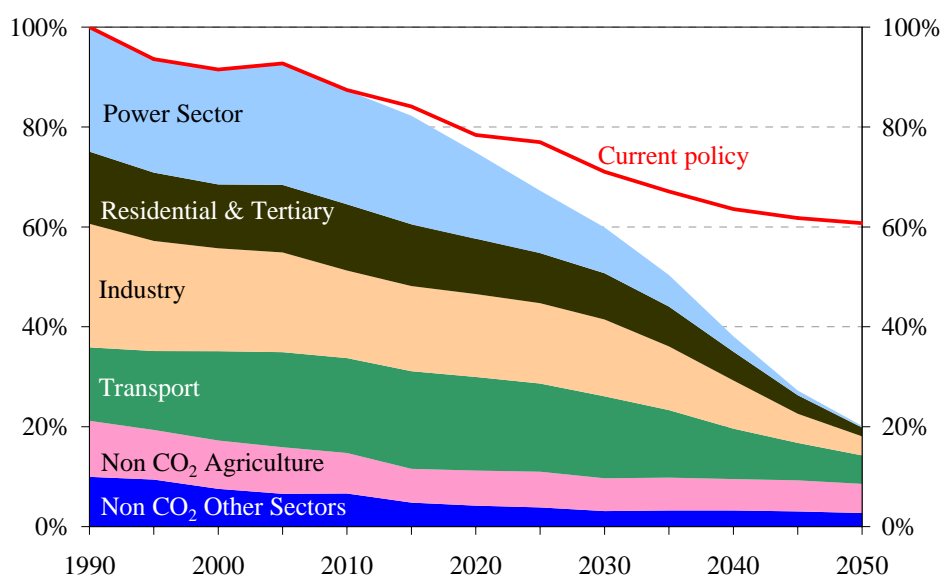
The document published by the European Commission in 2011, *A roadmap for moving to a low-carbon economy in 2050*, gives forecasts for emissions in 2050 in order to assess, under constrained investment, the cost of technologies, the technical progress needed, and thus the milestone in 2020, 2030 and 2040 which would minimise the total cost for reaching the long-term objective of 80% in 2050. According to the model used by the European Commission, the cost-effective path would be a 25% reduction target in 2020 and a 40% one in 2030.

This trajectory is broken down into major economic sectors, as given in chart 7. At the European level, all the sectors are concerned to achieve factor 5, but neither in the same proportions, nor at the same rate. The decarbonisation of electricity production would represent about half of the emission reductions for 2020 and 2030. Emissions in the transport sector will reduce slowly up to 2030, and then speed up, while emission reductions in agriculture will be greater between 2010 and 2030 than between 2030 and 2050 which is based on an assumption that reduced emissions of gases other than CO<sub>2</sub> may be obtained by changing methods of cultivation and livestock breeding. Emission gains obtained in buildings tend to accelerate quite regularly with the gradual provision of new, and more effective, buildings and a renovation rate which is gradually improving the performance of old buildings.

The construction of French pathways to achieve factor 4 relies on these two levels of analysis used in the European exercise. Chapter 3 presents what the Committee undertook from a sectoral point of view, by identifying the constraints specific to each

sector and diagnosing technological or organisational innovations likely to accelerate emission reductions in the future and the conditions for economic and social acceptability. In chapter 4, the authors use modelling results gathered by the Committee to ensure cross-sectoral consistency and to identify the costly and socially most efficient pathway. However, it appears that these economic impacts depend on the type of instruments used to achieve them. Now, at least up to 2020, the sectors commonly called "ETS sectors" (for *Emission Trading Scheme*) are under the European regulations on the CO<sub>2</sub> quota trading scheme, for which the reduction objectives are directly fixed at the EU level, while the others, called "non-ETS", are given as a general EU objective and depend on domestic policies. This distinction between the ETS and non-ETS sectors is particularly important to understand the choices to be made on the 2020 objective.

**Chart 7: European Union emission reduction to achieve the objective of -80% by 2050, under a cost-effective pathway**



Source: *Climate roadmap for 2050, Presentation by Stefaan Vergote (European Commission)*

### Box 3

#### The European Commission's climate roadmap

The Commission's roadmap for a low-carbon economy in 2050, called the "2050 climate roadmap", published in early March 2011, highlights key actions for the European Union's move towards a low-carbon economy in 2050.

This analysis based on models shows that the objective to reduce emissions in 2050 to 80% of domestic emissions<sup>1</sup> may be achieved effectively by reducing domestic emissions by 25% in 2020, 40% in 2030 and 60% in 2040. The measures put in place in Europe would enable the 20% reduction objectives to be achieved in 2020 but they should be supplemented by new measures to fit this cost efficient pathway. In particular, achieving the objective for energy efficiency under the Council of Europe's "20-20-20 by 2020" commitments of March 2007 and the Europe 2020 strategy adopted by the Council of

(1) The EU's objective is to reduce GHG emission by 80 to 95% in 2050 compared with 1990. If the EU reduces its domestic emissions by 80%, the 95% reduction may be achieved through using flexibility mechanisms.



Europe in June 2010, would make it possible to reach a domestic reduction of 25% in 2020.

In a longer term, the roadmap gives details of the emission pathways for the various sectors by identifying the main technological and organisational changes involved and by emphasising that early actions must be strengthened to achieve the objectives for 2030 then 2050.

These actions will require an additional investment of approximately EUR 270 billion per annum, i.e. 1.5% of European GDP, bringing investment in Europe up to 20.5% of GDP (its level prior to the crisis). The major issue is how to fund these investments. Furthermore, R&D should be funded to a larger degree (an additional EUR 50 billion over the next 10 years) to favour a substantial penetration of clean technologies.

These changes will provide a certain number of co-benefits: reduction of the energy bill (savings of EUR 175 to 320 billion per annum), reduction of air quality and health problems due to pollution. However, they would have a negative effect on European GDP (-0.1 to -1.0 GDP point in 2020, -0.7 to -2.0 GDP point in 2030, according to the Commission's impact study, depending whether or not the price of the carbon is extended to the whole economy and the how the corresponding revenues are used) and an undetermined effect on employment (-0. à + 0.7 point in 2020, -0.6 to + 0.4 point in 2030).

## 6. The 2020 milestone and political choices to be made in Europe: should we go beyond the 20%?

The European Union is already committed to achieve a 20% reduction in its greenhouse gas emissions by 2020, compared with 1990, as part of its strategy of "3 times 20"<sup>1</sup> endorsed by the Council of Europe in March 2007, according to which an improvement of 20% in its energy efficiency should be envisaged by 2020, raising the share of renewable energies in energy consumption to 20%, and decreasing its GHG emissions by 20%, compared to the 1990 level. The existence of three targets, of which only the last two are legally binding, is somewhat complex and is likely to generate economic inefficiencies if certain precautions are not taken.

### Box 4

#### The objectives and the practical plan to implement the Energy-Climate package

The climate component of the "3 times 20" resulted in the communication of 23 January 2008 and the adoption of the energy-climate legislative package, based on the distinction between two objectives:

**1) At EU level, a 21% reduction in emissions from installations subject to the ETS system between 2005 and 2020.** The ETS system, which covers the 27 Member States, as well as Norway, Iceland and Lichtenstein, encompasses CO<sub>2</sub> emissions from energy intensive sectors such as combustion plants, power stations, refineries, as well as the cement, metallurgy, glass, tiles and bricks, ceramics, paper pulp and paper/cardboard industries, i.e. 12,000 industrial sites responsible for about 50% of CO<sub>2</sub> emissions and 40% of European greenhouse gas emissions.

(1) Communication by the Commission on 10 January 2007 (COM (2007)2) "To limit global warming to 2 degrees Celsius – Path to be taken by 2020 and beyond".

The European objective of 21% on the ETS cannot be directly transposed at national level since it does not set national *ex ante* reductions. Member States containing plants with potentials for low-cost reductions will be aware of greater reductions in the ETS sector. Currently, industries under ETS receive quotas for the 2008-2012 periods free of charge.

To achieve their objective, plants under ETS may buy permits, implement reduction initiatives or again buy credits stemming from flexibility mechanisms (Clean Development Mechanisms –CDM or Joint Implementation – JI<sup>1</sup>).

Starting in 2013, three major modifications will be introduced: 1) almost the whole quota allocation in the electricity sector will be auctioned as from 2013; the other sectors should buy an increasing share of quotas by auction, except if they are considered to be exposed to a risk of carbon leakage. In this case, their allocation remains free of charge but limited to the proportion of a reference calculated on the most outstanding plants (benchmarks); 2) unused quotas may be kept for later (system called banking), and 3) carbon credit stemming from Kyoto projects' mechanisms may be used up to an amount corresponding to 13.5% of the average allocation. Starting with 2012, the ETS systems will also cover international aviation (i.e. airlines' emissions from and to Europe) and, starting with 2013, also encompasses N<sub>2</sub>O and fluorinated gases from some industrial processes.

**2) At EU level, a 10% reduction between 2005 and 2020 of emissions in sectors outside the ETS, i.e. mainly the building, transport, waste and agriculture sectors, as well as small industrial installations.** This EU objective was broken down into binding national objectives. In this context, France must accordingly reduce its non ETS emissions by 14%<sup>2</sup> between 2005 and 2020. In concrete terms, Member States should abide by a linear emissions reduction trajectory between 2013 and 2020 which the Commission will check every year. In the case where a Member State does not fulfil its objective, it must submit a report presenting corrective actions; otherwise, the Commission may initiate an infringement procedure against the Member State in question. Emissions beyond the annual target should be offset the following year with a penalisation factor of 1.08. To achieve their objectives, apart from domestic initiatives, several flexibility mechanisms are available to the Member States.

With regard to the objective to reduce greenhouse gas emissions, it is important to understand that a drop of -20% between 1990 and 2020 at the EU level and its possible raising to -25% or -30% require two different types of involvement, depending on the sectors concerned:

- energy production plants and heavy industrial facilities with large emissions output such as cement factories, steel plants, glass factories, paper manufacturers, etc. which represent about half of the EU's emissions of CO<sub>2</sub>, are integrated into the cap-and-trade system for CO<sub>2</sub> allowances directly managed at EU level. For these sectors, the 2020 objective is translated into a binding target for the third phase of the ETS market, an emission cap of -21% below 2005 emissions. This cap applies to all the 12,000 European facilities subject to the system;

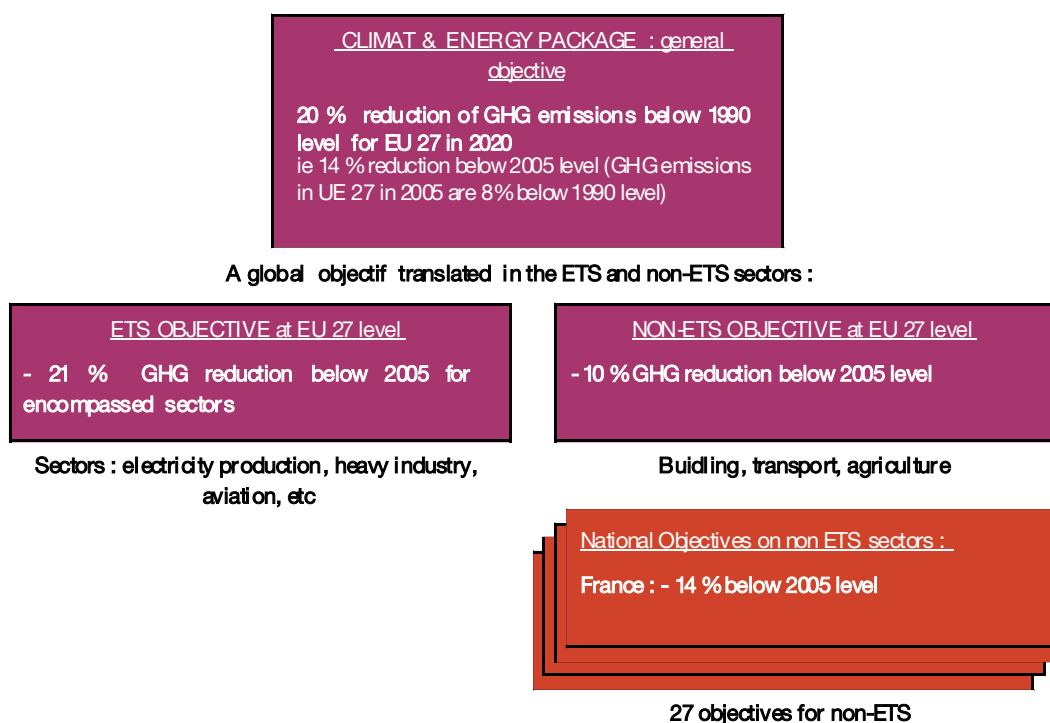
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(1) The MDP and JI are the flexibility mechanisms provided for in the Kyoto Protocol: reducing emissions in countries non Annex I (MDP) or Annex I (JI) gives the right to carbon quotas, which may then be traded on the European market or included in the States' national emissions. To limit their inflow on the quota market, their use is limited to 50% of all the European reductions, i.e. some 1,600 million quotas over the 2008–2020 periods.

(2) The objectives were fixed taking into account the Member States' per capita GDP.

- transport, agriculture, construction industry, waste management and small industrial facilities are not integrated into the European system for CO<sub>2</sub> allowances. For these activities, called "non-ETS", the overall objective of the Energy-Climate Package was expressed by a binding European target of -10% compared with 2005 level (against -21% for the ETS sector). This -10% target was then broken down into domestic objectives (see Chart 8). In this context, France has made an undertaking on a reduction of its non-ETS emissions by -14% between 2005 and 2020. The expression of this undertaking in terms of objectives and sectoral measures was mainly reflected in the *Grenelle Environment Round Table*.

**Chart 8: The different objectives to reduce emissions by 20%**



Source: European Commission

Finally, there are two types of domestic impacts stemming from the ETS rules:

- on the one hand, starting with 2013, Member States will auction the quotas that are not allocated free of charge, according to a fixed key for distribution among Member States determined by the EU Directive (5.3% of the total quantity of quotas to be auctioned belongs to France). Under the carbon price assumptions provided by the Climate Economics Chair at the Paris-Dauphine University, this may represent average annual revenues ranging from EUR 0.7 billion to EUR 1.8 billion for France over the whole 2013-2020 period. This work shows that any additional lowering of the emissions cap would lead, all things being equal, to a raising of the CO<sub>2</sub> quota price and therefore an increase in revenues for France, deriving from the levy on companies subject to allowances;
- on the other hand, following the example of other European countries such as Germany, Sweden or Spain, France has chosen to set up a so-called "domestic

projects" mechanism. This will enable emission reductions to be credited, would they have been made on the French soil in the non-ETS sector. If such a system is maintained, even extended, in the third period, it would give an incentive to reduce emissions in the non-ETS sector that would follow the CO<sub>2</sub> quota price increases.

Thus, a co-existence of the European and national regulations with regard to reducing greenhouse gas emissions means that each government in the European Union needs to take several parameters into account when defining the impact of raising the reduction goal by 20 to 25 or 30%: how the goal is shared between ETS sector and non-ETS sector, the effort-sharing rule in the non-ETS between the 27 Member States, the expected implications on carbon prices and the revenue from the auctions; whether or not it is necessary to implement additional domestic measures and to fund them rapidly; the integration of the 2020 target in "cost effective" pathways which may be aimed at in the country if there is a national target by 2050.

At EU level, the outcome of the roadmap may be interpreted as follows: a -25% emission reduction target for 2020 would be a "cost effective" pathway toward our 2050 objective. Though, the precise means to reach it are not explained in detail. Going further, for instance towards a -30% objective, would involve either using external flexibility mechanisms (consistent with crediting emission reductions achieved outside the European Union), or setting up new instruments.

To document the impacts of the French position on a -25% or -30% objective, the Committee used the following approach: to achieve a factor 4 reduction, three additional scenarios were designed, based on a more ambitious goal for 2020. The analysis of their feasibility was discussed especially taking into consideration the analysis of the measures already adopted. This work is presented in Chapter 3 of this report. The diagnosis of the economic and social effects of these various scenarios was drawn up by the existing modelling teams and is presented in Chapter 4. But before that, the Committee carried out a detailed analysis of the choices for France's European partners. Its main results are given in Chapter 2.

## 7. Should other intermediary milestones be introduced and proposed on a European basis?

Among our European partners, some of them have set up systems for intermediary targets which, in some cases, may slip over time, and may generally be revised according to how the context evolves. These targets seem to meet two requirements, often put forwards by industrialists, but which are difficult to make fully compatible: on the one hand, the requirement for greater flexibility so as to be able to adapt along the way and to address the various shocks which will not fail to occur by 2050 and that no forward-looking exercise saw coming; on the other hand, the necessity for greater predictability in the institutional context. Stable public policies enable companies to timely determine their investment strategy which often goes up to 2030.

In an increasingly uncertain world, it seems difficult to fully reconcile this need for predictability with the ability to adapt to the unforeseen. From this point of view, our Committee, no more than any others, does not have the means to achieve the impossible. On the other hand, we think it was useful to study the role which a 20-

year target could play (a 2030 objective in this exercise) in forming players' expectations. Furthermore, we also questioned the relevance of maintaining 2050 as the long-term target: a 50-year sliding target would in fact require the long-term target to be anchored to 2060.

These considerations may seem trivial when predictive work is not concerned. But climate economists know to what degree the choice of dates and the accuracy of the scopes covered by the commitments are important as soon as it wishes to incorporate a carbon value into economic life to guide our decisions in the short and long term.



## Chapter 2

# What our European partners are doing

Even though they are bound by common targets on climate policy, the European countries face very different situations, both with regard to the evolution of their emissions and the policy instruments put in place. For this reason, the Committee wanted to have a better understanding of our European partners' policies, by collecting comparative information and by questioning the representatives of certain Member States. The detailed results are given in the annex #3 to the report. After having recalled the basic data, this chapter will analyse successively the innovative approaches set up by our European partners with regard to the governance and organisation of the electricity sector, the R&D, the incentives disseminated for the sector and the financing instruments.

### 1. GHG emissions in Europe: developments “on a variable-geometry” basis

First of all, the scope of the European Union changed, with 15 members in 1990 but 27 members in 2011. This led to an initial distinction between the twelve new Member States (EU-12) and the "historic" members, the EU-15.

EU-12 adopted most of the European climate policy instruments (and especially the ETS) on the basis of the "acquis communautaire".<sup>1</sup> They were adopted at the start of the 2000s, while the majority of these countries had experienced very sharp reductions in their emissions, due to the restructuring of their economies as a result of their abandon of the planned economic system. Accordingly, emissions in the EU-12 between 1990 and 2000 were cut by almost 30%, putting these countries perfectly on track to achieve their Kyoto targets and, for most countries, even on track to achieve those for 2020 (under the Energy-Climate package). A new economic growth period started from 2000 in these countries, resulting in an increase in their emissions between 2000 and 2008. These contextual elements partly explain the generally quite reticent positions taken by the EU-12 on the raising of targets according to the European climate policy.

Within the EU-15, overall, the aggregated emissions stagnated, declining from 2003, the phenomenon speeding up with the current economic crisis. Within EU-15, countries have experienced a wide variety of individual trajectories which are

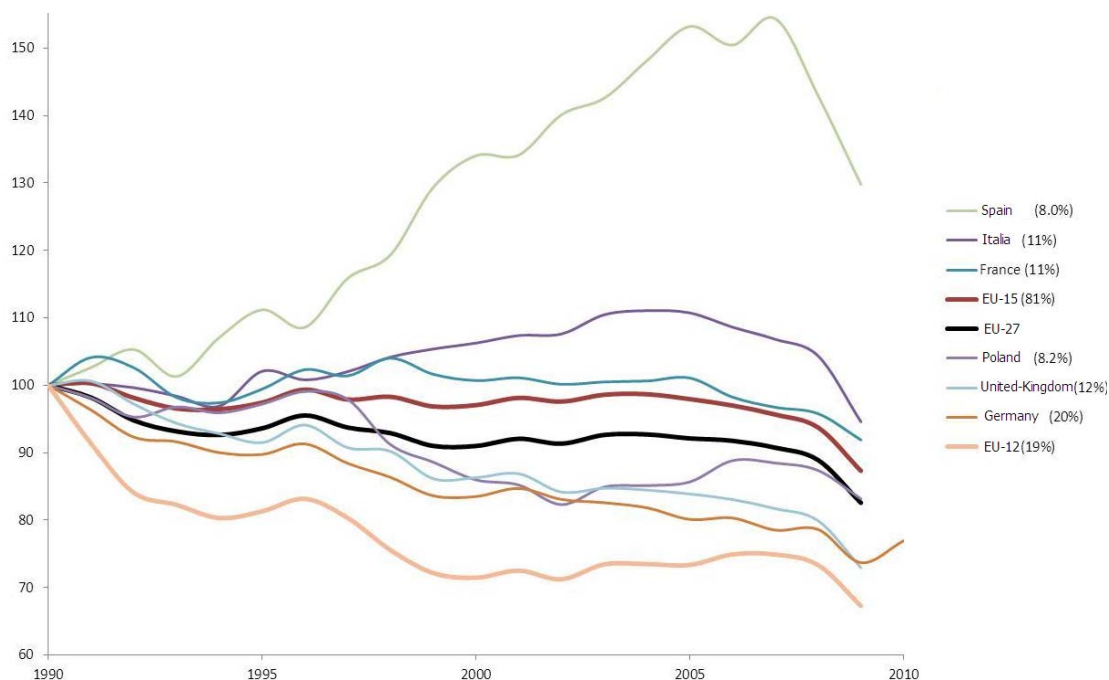
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(1) When a country joins the European Union, it has to bring its domestic legislation in line with EU rules. It is then said that it takes on the "acquis communautaire". With respect to climate policy, the twelve candidate countries had not yet joined the Union at the time of the Kyoto Protocol and the Directive setting up the European carbon trading scheme.

described in more detail in annex #2 and 3 to the report (only in French). For the moment, the economic crisis has not been followed by a very marked rebound effect, as already mentioned in Chapter I.

**Chart 9: Comparison of developments of GHG emission in the EU-15 and the EU-12 between 1990 and 2009**

(Base 100 = 1990)



Source: EEA

Germany and the United Kingdom have both seen substantial decreases in their emissions during the 1990s, due to a lesser use of coal in electricity production, industrial restructuring in the new *Länder* in Germany and the decline in non-carbon gas emissions mainly in the chemical industry. France experienced a development similar to the EU average. Most of the Mediterranean countries recorded more significant increases in their emissions, as in Spain or Italy whose emissions respectively grew by +50% and +10% between 1990 and 2005.

These figures (table 4) are complementary to chart 9. Germany is a good example: it is still one of the EU country with the highest levels of per capita emissions per GDP point, despite the substantial reduction recorded between 1990 and 2009 (-26%). The energy choices, generally linked to the available resources, have led some countries, such as Germany or Poland, to continue using coal predominantly in their electricity generation, partly for securing their energy supply. The *per capita* emission differences may be generally explained by these choices involving the electricity, giving to France an advantageous position below the EU average due to its electricity sources (mainly nuclear and hydraulic). As for Sweden, it decided very early to reduce its energy dependence, by using nuclear and renewable resources (mainly hydraulic and biomass), and also by substantially reducing its energy demand by introducing innovative measures on energy efficiency, based on a carbon tax (unique in Europe). It is by far the European country which has achieved the lowest greenhouse gas emissions per capita or per GDP unit.



**Table 4: Overview of greenhouse gas emissions in seven European countries – Greenhouse gas emissions indicators**

Emissions	Germany	United Kingdom	Italy	France	Spain	Sweden
1990-2007	-21.5%	-18.3%	+ 6.8%	-3.3%	+ 54%	-9.2%
Emissions 1990-2010	-23.5%	-24.8%	-4.8%	-6.8%	+ 26.0%	-11.1%
Emissions per capita*	11.9 tCO <sub>2eq</sub>	10.4 tCO <sub>2eq</sub>	9.3 tCO <sub>2eq</sub>	8.8 tCO <sub>2eq</sub>	9.8 tCO <sub>2eq</sub>	6.4 tCO <sub>2eq</sub>
Emissions per GDP (ppp)*	345 gCO <sub>2eq</sub> /\$	293 gCO <sub>2eq</sub> /\$	308 gCO <sub>2eq</sub> /\$	262 gCO <sub>2eq</sub> /\$	322 gCO <sub>2eq</sub> /\$	191 gCO <sub>2eq</sub> /\$
Target in 2020	-40% compared with 1990	-34% compared with 1990	Unquantified	Unquantified	Unquantified	-40% compared with 1990
Target in 2050	-80% compared with 1990	-80% compared with 1990	Unquantified	Factor 4	Unquantified	0 emission
Energy-Climate package target on non-ETS	-14%	-16%	-13%	-14%	-10%	-17%
Sectoral emissions * (tCO <sub>2eq</sub> /per capita)						
Energy	4.70	3.48	2.72	1.05	2.76	1.1
Transport	1.87	2.12	2.16	2.24	2.40	2.32
Industry	2.50	1.82	1.93	1.89	2.36	1.99
Res/Tert	1.56	1.66	1.38	1.61	0.85	0.46
Others	1.24	1.33	1.13	2.02	1.44	1.31

\* Values for 2007, to avoid including the "crisis effect"

Source: CAS, according to EEA, IMF, UNFCC

When the Energy-Climate package and, more recently, the European roadmap were set up, the Member States' adopted plans and programmes at a faster rate that aimed at reducing emissions. The information gathered in this overview shows a wide diversity in the countries' situation with regard to the targets under the Kyoto Protocol when compared with those of the Energy-Climate package. It helps to explain the positions taken by the various countries with regard to the 2050 target and the intermediary milestones, particularly the 2020 one.

## 2. The positions expressed by the various countries on the 2020 and 2050 targets

The positions in relation to the climate targets should initially be examined in the light of the historic development described in the previous paragraph. As shown in table 6, for the 12 countries which recently joined the European Union and for countries such as Germany or the United Kingdom, achieving the emission reduction targets, compared with 1990, is made easier by the existence of emission trajectories which strongly declined between 1990 and 2005, for reasons outside any consideration of climate policy. This is the reason why Germany and the United Kingdom committed themselves to more ambitious domestic reductions than the EU average (see Table 5). Conversely, in countries such as Spain or Italy, emissions continued to increase between 1990 and 2005, which made it even more difficult to achieve targets, compared with 1990. France is in an intermediate situation, close to the EU-15 average, for which a target fixed compared to 1990 makes almost no change in relation to the target fixed for 2005.

These considerations regarding figures may seem technical. However, they are crucial when expressing the European Union's reduction targets for its Member States, and to understand some countries' position with regard to the question of a possible raising of the emission reduction targets for 2020.

**Table 5: 2020 and 2050 targets**  
(base 2005)

	Emissions 1990	Emissions 2005		Emission variations in 2005 to achieve		
	MTCO <sub>2</sub> equ	MTCO <sub>2</sub> equ	%/1990	-20% in 2020	-30% in 2020	-80% in 2050
EU-15	4,265	4,178	-2%	-18%	-29%	-80%
EU-12	1,324	971	-27%	9%	-5%	-73%
Germany	1,248	1,000	-20%	0%	-13%	-75%
United Kingdom	776	651	-16%	-5%	-17%	-76%
Italy	519	575	11%	-28%	-37%	-82%
Sweden	72	68	-7%	-14%	-25%	-79%
France	563	569	1%	-21%	-31%	-80%
Spain	283	434	53%	-48%	-54%	-87%

Source: Committee calculations on the basis of data from the European Environmental Agency

Debates on raising the European target for reducing its emissions in 2020 are based on the group of countries that perform the best with regard to climate change (Sweden, Germany, United Kingdom, Denmark), and on the group made up of the new Member States and Italy, very reluctant to any change. Obviously, there are contrasting positions within these groups (see Table 6): Hungary, when it took over the presidency of the EU showed itself to be rather constructive, while Poland seemed to wish to return to the status quo under the Energy-Climate package. Member States, such as France, have not taken any clear position and try to avoid a polarised debate by seeking intermediate positions.

So far, the United Kingdom is the only country where the whole government has argued in favour of moving to a 30% target by 2020. The country has adopted ambitious targets introduced in domestic laws. Finally, the United Kingdom was at the origin of a column published in March 2011, just before the 2050 roadmap was released, which commits the EU to considering changing to – 30%. This column was co-signed by six Ministers of other member States in charge of environmental policy. But none of these countries has yet taken up a clearly defined position at the European level. For instance, in Germany, disagreement seems to persist between the Ministry for Environment, clearly in favour of adopting a – 30% target, and the Ministry of Finance, more reluctant, according to the interview given to the Committee by the representative of the Ministry for Environment.

**Table 6: Positions expressed by the European countries in relation to the 2050 and 2020 targets**

	Position relating to targets for 2020	Position on the European roadmap for 2050
France	To be determined	Positive response: the right approach, interest of a long-term view
Germany	Support from the Ministry for the Environment	Positive response: emphasis on energy efficiency
UK	Active support from the government	Favourable: discussions on the instruments making it possible to advance towards more ambitious targets, domestic targets
Sweden	Favourable	Favourable: proposes that the "milestones" should become binding targets
Denmark	Favourable	Positive response
Spain	Favourable: announced at Cancun	Positive response
Portugal	Favourable: conditionality does not work	Positive response
Belgium	Favourable	Positive response
Greece	Favourable (signatory of the UK forum)	Positive response
Netherlands	Unfavourable: remains bound to the developments in international negotiations	Wishes to keep the possibility of revising the milestones, emphasises the uncertainty in long-term modelling
Austria	Unfavourable: linked to international developments Will not keep to its Kyoto target	
Italy	Unfavourable: penalises industrial competitiveness; international context link	Also wishes to link the 25% to the international situation
Poland	Unfavourable: risks losing competitiveness; strong influence by the electricity/coal sector	Hard position; no mention of figure for 2020; emphasises uncertainties
Rumania	Unfavourable	Hostile to the mention of a milestone for 2020

Source: DAEI

For reluctant countries, the EU climate policy is synonymous with substantial costs and loss of competitiveness for their companies, and more ambitious targets could only be achieved in a favourable international context, where competitors of the EU would also adopt measures. Most of the new Member States, if they are somewhat

reluctant in principle, are above all watchful on the bases for dividing up any additional effort, and the application of European solidarity. In this way, Poland's position seems to be particularly hard, not hesitating to block the Council's conclusion on the 2050 roadmap being adopted, by refusing any mention of a target for 2020 on the cost-effective trajectory, even though its conclusions state that this figure could be achieved within the Energy-Climate package, if the energy efficiency target is achieved.

National reports that the Commission should submit at the end of November, as well as the supplementary analyses carried out on the second half of 2011 and the energy roadmap to be published on 23 November, should provide new elements for the debate. Current negotiations on the European Union's financial prospects for 2014-2020 are also an element which could play a role – positively or negatively depending on the guidelines which will be established – in the negotiations on the roadmap and any strengthening of the 2020 target.

The countries in favour of an increase have one thing in common: they have set up national programmes intended to better incorporate climate targets with instruments dedicated to economic, industrial and social development. The remainder of this chapter highlights these innovative instruments which were put in place for this purpose by countries, particularly those whose representatives were interviewed by the Committee: Germany, United Kingdom and Sweden.

### 3. Climate policy governance schemes

Three synergies characterise the implementation of the German, British and Swedish climate policies:

- the existence of a considerable political and social consensus on medium and long-term targets with regard to reducing emissions and the related instruments. In this way, the carbon tax in Sweden, the key of the country's climate strategy, was introduced in 1991 by a social-democratic government then consolidated by successive centre-right coalition governments. Similarly, the more recent changeover from labour to conservative parties made no change whatsoever in the orientations of the British climate policy;
- this consensus favours setting up long-term strategies, making the public initiative more visible and predictable for economic and social players;
- finally, it is the opportunity to set up original and climate-specific governance systems, as in Germany where a public fund was set up to manage the revenue from auctioned quotas in the ETS market or again the possibility of a multi-year programming of the changes in the carbon tax in Sweden whose rate increases are now known up to 2015. There is no doubt that it is the United Kingdom which has gone the farthest towards setting up an innovative institutional framework to manage the climate policy.

The *Climate Change Act* passed in 2008 introduced into British law the target to reduce greenhouse gas emissions by at least 80% by 2050. It simultaneously provided for a genuine system of governance in which the climate policy is based on scientific expertise. From this institutional standpoint, this structuring between expertise, evaluation and the political decision-making was expressed when an independent organisation was set up, called the *Committee of Climate Change*, and

composed of well-known scientists and economists. This Committee is in charge with making recommendations on emission targets and also on the instruments and measures to be implemented. It also has a function of independently evaluating the climate policy which particularly documents the Parliament's discussions. Its recommendations and evaluations particularly concern the *Carbon Budgets* which are a second specific feature of the British public initiative stemming from the *Climate Change Act*.

*Carbon Budgets* are emissions targets fixed for five-year periods, voted by the Parliament and therefore considered as being legally-binding. The United Kingdom already has four *Carbon Budgets* which cover the five-year periods of 2008-2012 and 2023-2027, that is, beyond the end of the Climate and Energy Package. This system enables investors to have a medium-term view. The division of the trajectory into several plans brings certain flexibility into the system. The plans are put together gradually, which enables the progress made to be taken into account and in this way to "adjust the target". The European debate around the target for 2020 brings in an additional parameter for the first *Carbon Budgets*, as even if the British target is a domestic one, the cost engendered by the climate policy will be dependent on European decisions. The portion of emissions reduced by British industries subject to the ETS will especially depend on the target on the ETS for 2020, as well as the amount of revenue expected from auctioning the carbon quotas. Accordingly, the government intends to reopen the discussion on the target for the first *Carbon Budgets* in 2014, as the executive branch of government alone cannot decide to change the targets.

#### 4. A range of instruments for a low-carbon electricity sector

For two decades, the EU has been conducting a policy of liberalising the electricity sector, a policy which is expressed by complex and varied domestic situations. The transition to a low-carbon economy requires a radical re-organisation of the electricity generation and distribution which means finding the right incentives. However, the electricity market suffers from numerous imperfections which justify public interventions, including in countries with liberal orientations such as the United Kingdom whose reform of the electricity market is analysed in more detail in the annex #3 (available in the version in French).

In Europe, electricity production is by far the leading economic sector subject to the ETS and therefore confronted with the carbon signal price. If the *ex-post* evaluation studies show that the introduction of the carbon price changed the management of the existing stations (particularly the order in which the power stations are called, the carbon price is unfavourable to those emitting the most CO<sub>2</sub>), up to now this market has not revealed a CO<sub>2</sub> price which sufficiently changes industrialists' expectations and their investment programmes. Therefore it is necessary to add to this EU system a bulk of other measures that encourage the transition to renewable energies and energy efficiency.

The development of renewable energies in European countries is achieved through economic instruments. Certain countries have chosen the quality instrument (*Green Certificates*, still called *Renewable Obligations* granted by the regulator and which may be sold to the producers to abide by their obligation to produce renewable energy) – this is the case with the United Kingdom, Sweden, Italy, and Poland, while others, such as Germany, Spain, Italy (for photovoltaic electricity) or again France,

have opted for a price instrument, i.e. the purchase price (obligation to purchase renewable energy at a pre-determined price), the methods of which vary from one country to another (guaranteed price in Germany or in France, premium in relation to the sale price of electricity in Spain). The United Kingdom, which experimented with the *Green Certificates*, decided to replace them gradually by a purchase price from 2017 onwards.

**Table 7: Share of renewable energies in the production of electricity (%)**

	2000	2010
United Kingdom	2.7	6.7
Germany	6.2	16.5
Sweden	57.2	55.1
Italy	18.8	25.5
Spain	16.1	32.7
Poland	1.6	6.9
France	13.1	13.7

*Source: IEA (2011), Renewable Information 2011. The renewable portion contains: hydraulic, geothermic, solar heating, solar PV, wind-powered, wave, municipal waste, biomass, and biogas*

These systems go hand-in-hand with the ETS by giving an incentive to invest in new low-carbon segments, in addition to the carbon price. As shown by the readjustments of the purchase prices on photovoltaic energy in France and in Spain, the existence of purchase prices is not in itself a guarantee of predictability for industrialists. In this regard, the German decisions to fix decreasing prices over time, which are intended to disappear eventually, are an interesting instrument, similarly to the methods of "differential tariffs" often used in Northern Europe. The long-lasting cumulative effect of two incentive mechanisms acting on the prices nevertheless runs the risk of eventually leading to inefficiencies. Economic theories teach that to avoid such inefficiencies, other leverage must be used, on the supply and technology side, to develop new industrial sectors.

There is a risk that another type of accumulation appears between the ETS and national instruments when a country prices carbon on the domestic market. From this point of view, Sweden and the United Kingdom have quite opposing experiences. Since 2011, Sweden no longer applies its national carbon tax to installations included in the ETS so as not to penalise its industries and energy producers compared with other European players. On the other hand, the United Kingdom feels that a differential national tax could be added to the European carbon price if this remains below a certain level. This national mechanism aims at ensuring a minimum carbon price to be paid by the country's electricity companies. Inefficient perhaps from the strictly national standpoint, this mechanism risks provoking an additional uncertainty and a supply of additional British quotas on the European market, thereby leading to a reduction in the equilibrium price of the CO<sub>2</sub> quota. Furthermore, it introduces a more general risk of "renationalising" the carbon price, at the end very prejudicial for the effectiveness of the trajectory to reduce emissions in the entire European Union.

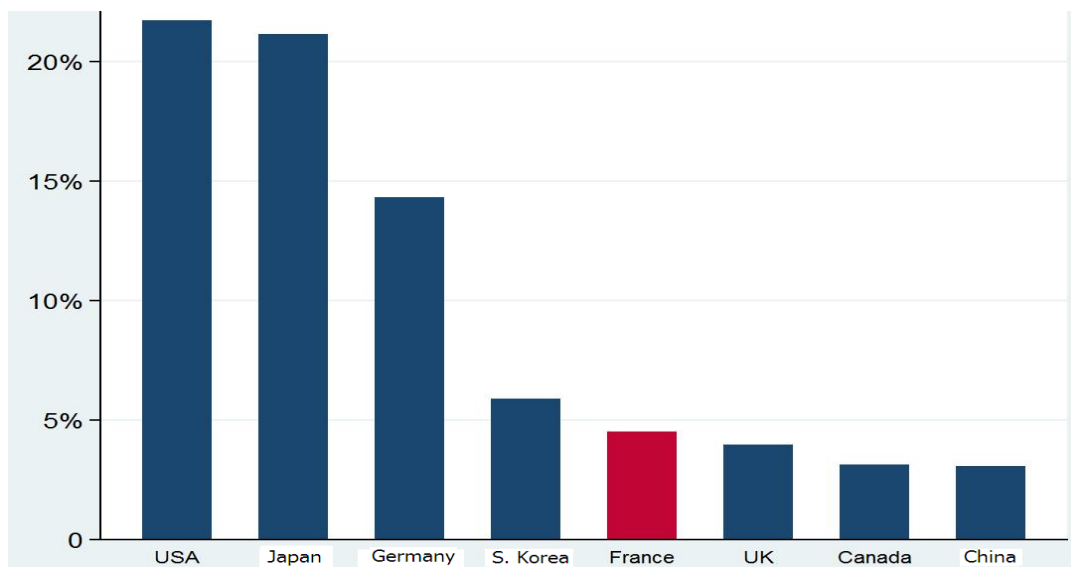
One of the key conditions for the electricity sector's transition being successful is to evaluate the transformations and investments to be made in the transfer and distribution network. The electricity grid raises concerns for many countries, as developing a large proportion of renewable capacities would make the production facilities more rigid. The system is made more flexible by extending the transport

networks and improving interconnections between countries. In Germany, phasing out nuclear generation needs more than just redrawing the connecting lines due to the geographic location of the power stations to be taken out of production. It is for this reason that the country has undertaken a priority funding programme to create new short-term lines and aiming at three objectives decisive for securing supplies in the long term: energy storage (batteries, and also more innovative means of storage such as hydrogen/methane), intelligent networks, particularly on a local scale, and the use of co-generation, which would offset the irregularity of renewable energies. This programme should cost some EUR 3 billion, financed not only by the budget but also be a fund supplemented by auctions on the ETS.

## 5. The link between climate policy, R&D and industrial strategies

At the same time as initiatives on energy efficiency which must limit the growth in energy demand, all the European countries studied have chosen to make low carbon technologies an important element: renewable energies and co-generation which are the choices shared by all countries, nuclear and the use of CCS the social and political acceptability of which vary considerably from one country to another. The question is what is the link between climate policy and R&D when deploying these new energy sectors.

**Chart 10: Percentage of patented climate inventions in the world, 2003-2008 average, international patents**



*Source: Presentation to the Committee by M. Glachant (Mines Paris Tech) on 29 September*

The R&D devoted to carbon-free energies in the United Kingdom, although increasing over several years, is still behind those in Germany or France. On the other hand, its effort seems to be largely divided between the various options, reflecting the government's decision not to favour any particular sector too directly by using economic instruments to allow the economic players to choose the best courses themselves. Nevertheless, the British government seems to give priority to capturing and geologically storing carbon, agrofuels and offshore techniques (wind-power and sea currents).

Germany has decided, from now on, to favour certain energies rather than others and encourage innovation in the sectors where it has comparative advantages. An important element in the German strategy is to set up sectors which export low-carbon technologies and the corresponding equipment. This way of dealing with the technological aspect has proven itself, for instance, in the German wind-power industry which has succeeded in establishing itself on the market, in competition with the Danes, originally the leaders in this segment. The German priorities are current offshore wind power, second generation biomass, photovoltaics in the renewables sector and managing energy efficiency through intelligent networks on the demand side. These German priorities are partially reflected in the R&D budgets but more again in the international patents filed for the low-carbon techniques for which Germany is well in advance, compared with its European partners. Technological progress is expected thanks to research and also to demonstration projects or again to the investment climate (whether or not there is support for certain sectors). To overcome the gradual closure of its nuclear power stations, Germany is relying on improved efficiency in the coal and above all gas-fired stations, and also on offshore wind power, or co-generation. It is interesting to note that views are mixed on certain technologies, particularly the CCS one, which, apart from the costs which slow down its industrial development, suffers from an acceptability problem. In this way, Germany has postponed its decision to pass laws on CCS, considering that private investors, taught a lesson by the population's strong opposition, may not get involved in such projects in the short term.

On its side, Sweden has developed particularly robust and innovative sectors in the use of the biomass and particularly the production and use of the biogas produced from waste. In this field, its policy of supporting the offer was conducted at the same time as economic incentives were set up so that these techniques for heating buildings would be adopted rapidly, and to a lesser degree, transport (use of biogas in the service station network in the south).

## 6. Economic incentives with regard to the non-ETS sectors

In any predictive exercise on emissions, a distinction should be made between the industrial and energy sectors subject to the European ETS regulations on emissions stemming from transport, buildings, agriculture and waste management, normally grouped under the terms "diffused sector". France is the European country where the diffused sector's emissions that are not subject to the European regulations are the highest (three-quarters of its emissions). It is therefore particularly instructive to identify the economic instruments which have proven themselves or our partners' outstanding innovations in these sectors.



**Table 8: Share of domestic emissions covered by the ETS**

	2007	2008	2009
EU-15	41.1%	40.9%	38.9%
EU-27	43%	42.5%	40.3%
United Kingdom	40.1%	42.2%	40.4%
Germany	50.9%	49.3%	48.8%
Sweden	28.8%	31.4%	-
Italy	41%	40.8%	37.3%
Spain	42.5%	40.3%	36.8%
Poland	52.4%	51.6%	-
France	23.9%	23.5%	-

Source: EEA

The studies carried out by the Committee show that few countries have set up economic instruments which delivered large-scale emission reductions in agriculture and transport. The same cannot be said for the building sector where the potential for reduction, even if it is substantial, is difficult to achieve. Three levers can contribute to this: the buildings should be well-insulated, which requires substantial renovation work or excess costs for new buildings; the initiative on the energy sources used in the buildings or the networks supplying them; the behaviour of the buildings' users. Our partners' experience suggests that the most effective instruments here are those which act simultaneously on the three levers.

In Sweden, public initiative achieved a substantial reduction in emissions in the residential/tertiary sector. In fact, 60% of needs in the residential/tertiary sector come from heating and hot water. However, emissions in this sector were reduced by 65% between 1990 and 2007. The price of the carbon (carbon tax, and also support for certain energies, particularly biomass) practised in these countries since 1991 seems to have played a determining role as it affected both demand and supply. It encouraged consumers to replace their means of producing conventional energy (very often old boilers) with electricity or heat supplied by the networks (see annex #3). These emissions, produced then outside the household, were carried over to the centralised heating and electricity production sector, but at the same time the government made the use of the biomass general in this sector, an energy considered as zero-emission.

The Swedish carbon tax, set up in 1991, is combined with other energy pricing instruments (VAT, energy tax). Its initially low level was gradually raised to exceed EUR 100 per tonne today (variable according to the exchange rate for the Swedish kroner) for all uses relating to buildings and means of transport. In the transport sector, the high level of domestic carbon tax led to an experience unique in Europe: the introduction of biogas deriving from processing agricultural and forestry waste in the service station network.

Similarly, Germany undertook a reform of its tax system in 1999, introducing a tax on electricity and fossil fuels. Starting at a rather low level, this tax was nevertheless supposed to increase the price of energy, in order to encourage more energy-saving behaviour. Although it is difficult to measure the impact of this tax, in 1999 it was observed that electricity consumption specific to German households decreased, while the quantity of household equipment increased. On the one hand, the increase in the price of electricity through an ecology tax contributed to rationalising the use of domestic electrical appliances. On the other hand, the decline in their prices, as well

as energy labelling (according to a European directive) led households to buy less-energy intensive appliances. The DENA (German energy agency) can also be mentioned, which set up a co-operation programme with several household electrical appliance distributors with the aim of improving the sales staff's message on the performance of new appliances.

With regard to building insulation, new buildings are normalized, according to thermal standards, France's *Environment Round Table* having made up the ground lost, compared with more effective European countries. The main difficulties concern the set of incentives enabling the large-scale renovation of existing buildings. Several innovative options were undertaken in the United Kingdom. Energy producers are compelled to fund energy efficiency improvements through a system of White Certificates (certified energy savings which can be traded). According to the new reform proposed by the government, they will directly concern the housing occupied by the poorest people. Another British innovation, the *Green Deal*, whose co-ordination with the preceding system is still being studied in the DECC (*Department of Energy and Climate Change*), will help households (and/or businesses) to renovate their building and housing. It includes an audit element (carried out by personnel trained by the government) in which the main reduction potentials are identified, followed by a funding element, in which the household is proposed a plan for funding the measures identified. The golden rule, these measures must be entirely funded out of the savings achieved on the energy bill. The *Green Deal* is not a standard loan, in the meaning where this funding is not linked to a household but to accommodation. It is intended for private individuals, as well as to small and medium-sized businesses. Contrary to the above-mentioned Swedish and German experiences, it is not possible to judge *ex post* the effectiveness of these mechanisms which have not yet been deployed on a large scale in the field.

The United Kingdom's *Green Deal* has its counterpart in Sweden for industry: the idea is to provide financing for the industries' audits (two-year period) and to propose measures that they could render profitable over the coming years (three years at the most), in exchange for a tax exemption on electricity. This programme, which came into force on 1<sup>st</sup> January 2005, is a real success, as more than 100 businesses have taken part to date: some EUR 70 million has been spent on more than 1,200 energy efficiency measures. A large number of jobs have been created under this programme, as the State provides training for qualified audit personnel in the work of real energy efficiency.

## 7. Financial innovations

Even if there are powerful incentives such as feed-in tariffs or the carbon pricing, financial constraints may slow down the development of new industrial sectors or transport networks. These types of investment are often capital-intensive and require a substantial amount of funds to be raised at the beginning: renewable energies generally have a special financing structure with large investment and low operating costs, contrary to the thermal power stations, for instance. In view of this structure, producers of renewable energies borrow to finance them. But the banks see these projects as risky, particularly on start up when the technologies are new, and therefore offer loans at very high rates of interest.

Aware of this difficulty, since the beginning of the 1990s, Germany has been offering financial facilities for wind-power projects through the public bank KfW (*Kreditanstalt*

*für Wiederaufbau*). This bank grants loans at very low rates for private companies (up to 75% of the investment costs up to a maximum of EUR 10 million). Initially devised for wind power, this system was extended to renewable energies and energy efficiency. In fact, the KfW is very active in the renovation of existing buildings, through two programmes (*CO<sub>2</sub>-Minderungsprogramm* and *CO<sub>2</sub>-Gebäudesanierungsprogramm*). The first one enables targeted measures to be financed, through loans at preferential rates. The objective of the second is to renovate housing and it puts together a number of measures, also funded through preferential loans and by cancelling part of the loan (up to 15%) for housing which achieves an energy consumption per square metre equal to or less than laid by construction standards for new buildings. Even if emission reductions do not meet the government's expectations, nevertheless these programmes make it possible to partially or entirely renovate more than 1 million housing units. Not forgetting that they lead to a large number of jobs being created in this sector.

However, the central source of funding for the German climate and energy policy still come from using the revenue from auctioning CO<sub>2</sub> quotas. Over the market's second period (2008-2012), Germany will auction about 9% of its allowances which should bring in revenue of about EUR 300 million in 2011 and EUR 700 million 2012. Between 2013 and 2020, the country will receive one quarter of the European auction proceeds, i.e. a sum in the order of EUR 3,300 million per annum starting with 2013. The proceeds of these auctions will be paid into a public fund, *Energie und Klimafonds*, the governance of which, opened to the Länder and the stakeholders, should enable uses to be found which optimise the energy and climate transition. These funds should help in providing finance for renewable projects, energy efficiency or electromobility projects, forestry investments (mostly domestic but part of which will be used for projects in developing countries) in the form of subsidised loans and direct subsidies. It provides for subsidies for R&D. Part of the funds will also be redistributed to energy-intensive industries to offset the increase in electricity prices brought about by the price of the carbon quotas.

To reduce funding blockages, particularly in the building renovation sector, the United Kingdom intends to launch a public bank in 2012: the *Green Investment Bank*. As the British representatives told the Committee, this institution takes inspiration from organisations of the KfW type in Germany or the Caisse des dépôts in France. At the beginning, with the capital entirely provided by the State, this bank will become an autonomous entity, operating with a public guarantee but which may raise private funds. Its first assignment will be to develop funding revenue to facilitate the renovation of existing buildings, particularly under the *Green Deal* (loans linked to buildings and not to owners). It may also borrow on the financial markets by raising funds to invest in low-carbon projects jointly with private investors (see details in annex #3). It should also be noted that in 2008, similarly to Germany, the United Kingdom has started to auction some of the carbon quotas.

Even if it is premature to judge the effectiveness of the mechanisms which are still mainly in the project stage, we must clearly conclude that, as France's two major partners have opted for ambitious emission reduction targets in 2020 and in 2050, they are currently setting up new financial instruments which make use of the revenue from the auctioned carbon quotas and innovative mechanisms combining public instruments and private resources.



## Chapter 3

# Building French sectoral pathways

Working out the French possible pathways to achieve a factor 4 reduction by 2050 was based on a detailed analysis by sector. A retrospective analysis enables to grasp the major issues for each sector, to identify the time constants and to highlight the emissions' determining factors. They are used as a basis for building emissions pathways in the short and medium terms. For the long term, the forward-looking analysis enables technological or organisational innovations to be diagnosed, which are likely to reduce emissions faster by 2050.

In each sector, the potential reductions are assessed according to technical, economic and acceptability constraints. The pathways proposed correspond to the implementation of certain reduction potentials and are necessarily a compromise between the various possible options. The interest of such approach relies in identifying the constraints specific to each sector and putting forward leverage actions which public policies may use.

An emission trajectory for France by 2050 can be established when the sectoral pathways are stacked, after verifying that the sectors are consistent. This approach, called "*bottom-up*", is complementary to the macro-economic one, addressed in the next section. If the carbon price is not explicitly integrated into the economy, it gives rough ideas of the intensity of efforts to be undertaken and the necessary changes for achieving emission targets.

### 1. Theories and limits of the three scenarios

Given the constraints of time, the Committee was not in a position to build a full scenario for the future. For 2020, it mainly relied on the existing work of the DGEC (*General Directorate for Energy and Climate within the Ministry of Ecology, Sustainable Development, Transport and Housing*), and its assumptions on the macro-economic situation and changes in energy prices. For the following milestones, we combined experts views and forward-looking sector studies, within the scope of common assumptions on international energy and economic conditions. Thus, at this stage, we can not yet test the robustness of our results to macro-economic changes or to possible shocks on energy prices.

The three scenarios built are all based on the assumption that the domestic factor 4 objective will be achieved by 2050. This normative assertion reflects the consensus within the group that it complies with the IPCC's results. Each scenario differs on the

milestone reached in 2020, which corresponds to three possible situations, depending on the choices that will be done at the European level:

- a reference scenario is based on the conventional assumption in this type of exercise, that the public policy steps already taken will be strictly applied. In the ETS sector, this means that companies implement the current rules for the third phase of the carbon quota trading system, with a reduction of emissions of -21% by 2020 compared with the 2005 level. In the non-ETS sector, it is assumed that all the domestic measures already decided will be entirely implemented by 2020, but that no other will come into force. This set of assumptions led to a trajectory of domestic emission reduction compatible with the European objective to reduce emissions by 20% in 2020, compared with 1990;
- a second scenario simulates a situation in which the objective for Europe would change to achieve a -25% reduction; the objective is fully realized by the non-ETS sector. This scenario therefore involves implementing new measures or incentives the functioning modalities of which have already been explored by the Committee;
- in a third scenario, it is assumed that the goal of the European Union is to achieve a reduction of -30%, adding an additional constraint of -5% on the ETS sector in the form of a reduction in the emission cap by 2020 for industries subject to quotas. The main consequence is to raise the price of the CO<sub>2</sub> quota in the European trading system.

The reference scenario corresponds to the results of the scenario called "with additional measures – measures" in the forecasting exercise carried out by the DGEC in 2010. For the non-ETS sector, given the current budgetary context and without real feedback on measures which stem from the *Environment Round Table*, some assumptions of this scenario appear today as proactive.

For example, as far as renovating the public and private building stock is concerned, the scenario assumes that, by 2020, this will be done for the 800,000 least energy-efficient social housing units; the obligation to renovate all tertiary buildings will also be fully implemented. Both targets are considered as very ambitious ones. On the other hand, it would be prudent to take into account that support measures (e.g. interest-free eco-loan, sustainable development tax credit) introduced for the building sector will come to an end after 2012, as there is no enactment guaranteeing that these measures will be extended beyond the 2012 Finance bill. Other commitments stem from the *Environment Round Table* could also not be fully implemented, such as achieving the reduction in energy consumption of existing buildings by 38% in 2020, or the decrease of transport emissions to their 1990 level. Furthermore, the scenario "with existing measures" in the DGEC exercise does not include impacts of the crisis, highlighted by recent statistics, in particular the weakness of the resumption of emissions in industry and road transport.

Thus, the reference scenario is based on a scenario slightly different from the DGEC's "with existing measures" scenario but achieve, overall, the same result in emissions reduction. It is important to remind that these reductions are not taken for granted, but are regarded as fairly achievable, as long as adjustment measures may be implemented rapidly, in addition to the measures already taken if the trajectory obviously deviates from the projected one.

Once the three milestones for 2020 have been determined, the pathway towards 2050 is obtained by a simple linear extrapolation, in crossing the existing forward-looking

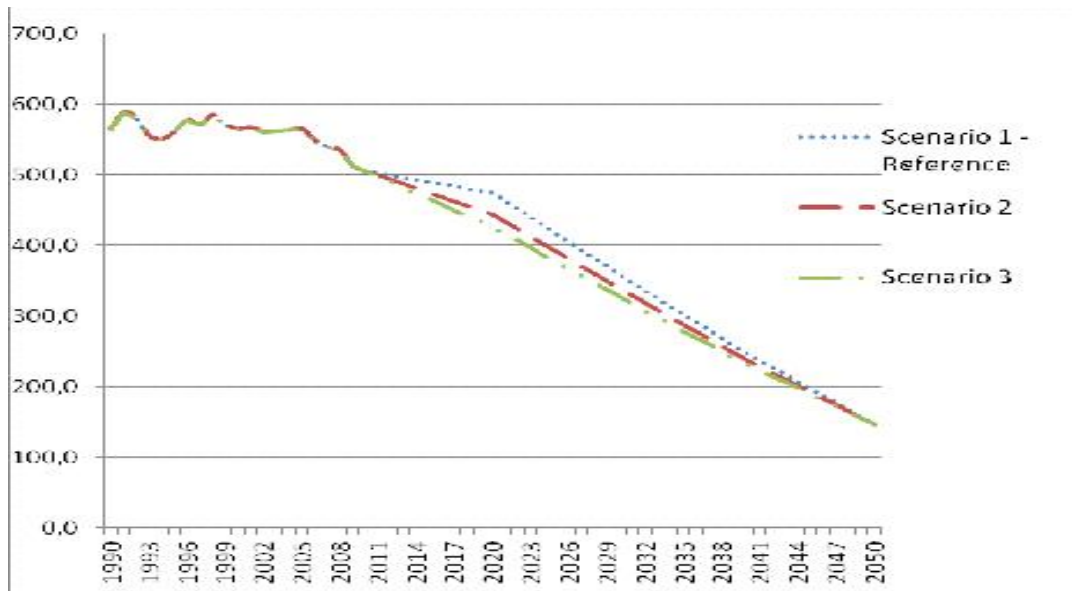
work and the views of the experts. The consistency of the 2030-2050 pathways has been ensured by comparing the results with the sectoral outputs of the POLES, IMACLIM and NEMESIS models (Chapter 4). The summarized results are given in Table 10 and Chart 11 and their sectoral breakdown is the main topic addressed in this Chapter.

**Table 9: Pathways of GHG emissions in France**  
(compared with 1990)

Variation/1990 (%)	2009	2020	2030	2040	2050
Scenario 1-reference	-10%	-16%	-33%	-55%	-75%
Scenario 2	-10%	-22%	-37%	-57%	-75%
Scenario 3	-10%	-25%	-41%	-58%	-75%

Source: Committee's work

**Chart 11: Pathways of GHG emissions in France**  
(in MtCO<sub>2</sub>eq)



Source: Committee's work

In terms of total emissions over the 2010-2050 period, scenarios 2 and 3 lead respectively to a reduction of -5% and -8% in the emissions, compared with the reference scenario.

**Table 10: Pathways of total GHG emissions in France**  
(in GtCO<sub>2</sub>eq)

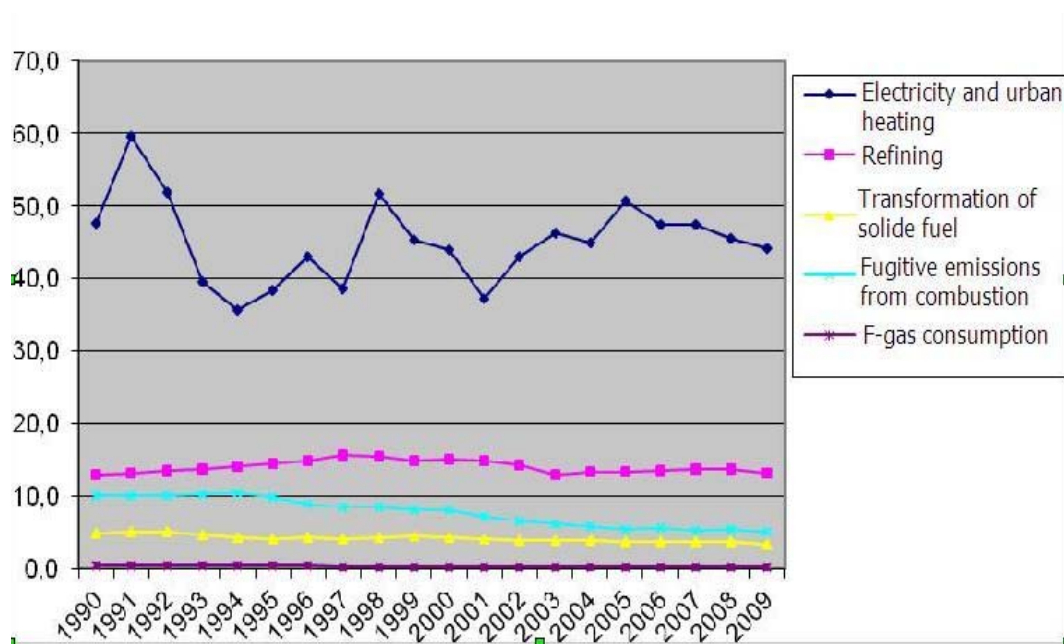
Total emissions of greenhouse gas over the 2010-2050 period	
Scenario 1-Reference	14.6
Scenario 2	13.9
Scenario 3	13.5

Source: Committee's work

## 2. Energy: several paths towards a low-carbon system

The energy sector comprises electricity production, refining and transport of hydrocarbons, and the supply of steam and heat. It represents about 13% of domestic emissions, the two main sources being the production of electricity and heat, and oil refining. The emissions deriving from the consumption of fuels and combustibles are recorded in the consuming sectors, the main ones being construction, transport and manufacturing industries. An important feature of these sectors is that they are subject to the European regulations of the CO<sub>2</sub> quota trading system. Therefore, the momentum depends considerably on how this European mechanism evolves as well as the price of carbon it produces.

**Chart 12: Changes in emissions in the energy industry between 1990 and 2009**  
(in MtCO<sub>2</sub>eq)



Source: IFARE 2011

Compared with other European countries, the French energy production sector emits very little carbon. This is due to the electricity mix, its two main sources being nuclear and hydraulic emitting no carbon. Thus in France, the kWh emits an average of 60 g of CO<sub>2</sub> against an average of 420 g in the European Union. However, a necessary condition to achieve factor 4 is to go further in order to have an energy production system that emits no carbon at all in 2050. The Committee has thus set a target of -96% in 2050, i.e. in the range of 3 MtCO<sub>2</sub>e emitted in 2050. This long-term objective is in line with the European low-carbon pathway, but its implementation has particular implications given the characteristics of the French electricity industry.



**Table 11: Emissions by the energy sector compared with the level in 1990**

Variation 1990 (%)	2009	2020	2030	2040	2050
Scenario 1 -Reference	-14%	-28%	-51%	-74%	-96%
Scenario 2	-14%	-30%	-52%	-74%	-96%
Scenario 3	-14%	-35%	-55%	-76%	-96%

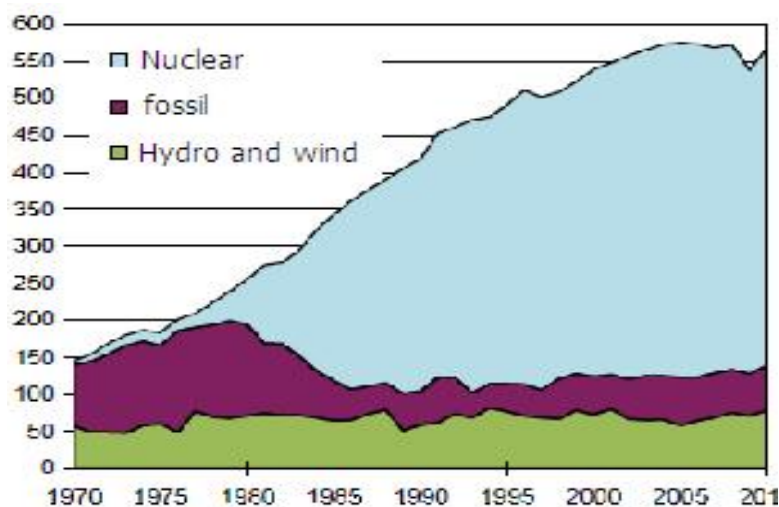
Source: Committee's work

A precondition for achieving the 2050 target is to speed up gains in energy efficiency. In 2050, metropolitan France will have more than 72 million inhabitants, that is, almost 14% more than in 2011. If the current profile of per capita consumption is maintained, the increase in demand will make unrealistic any rapid decline in carbon emitting production means. This is the reason why the pathways discussed by the Committee lie within the context of a substantial acceleration in energy efficiency. In the POLES model, used as the main basis for the Committee's work, the GDP energy intensity is halved between 2010 and 2050. This will enable the electricity system to supply the consumption in 2050 and to cope with the increased use of electricity in other sectors, particularly transport.

To achieve such progress in energy efficiency, initiatives of all kind will have to be mobilised: information for consumers, product eco-design, and incentive system such as energy saving certificates. But studies show that the final consumer price of energy is crucial. Achieving the 2050 target is therefore dependent on an increasing trajectory for the carbon price that the players must anticipate in their investment choice. It also implies that this price provides a strong enough incentive to generate the necessary "say 'no' to waste". Such repercussions are socially acceptable only if powerful mechanisms are simultaneously set up to avoid an increased insecurity in energy supply.

Diversifying supply is the second motto on the energy pathway for 2050. For electricity, it means that the share of the renewable energies will have to speed up substantially and that of the nuclear power to decrease. In the POLES scenario, the nuclear share will decline from more than 75% in 2010, to less than 50% in 2050 while renewable energies (including hydraulic) increase from 12% to 40%. The balance is almost reached by gas power stations, some of which capturing and storing carbon. Simultaneously, a better use of bioenergy (biogas, forest products, advanced biofuels, etc.) contributes to reducing oil consumption. The oil refining activity has to adjust the production tools' dynamic to the change in demand for refined products, both in quantity and in quality (balance between light products and middle distillates, reduction in the demand for sulphur products, etc.). To be compatible with the 2050 target, the refining plants located in France must be able of sequestering most of their emissions of CO<sub>2</sub> by 2050.

Chart 13: Structure of total gross electricity production (in TWh)



Source: SOeS 2011

Heat production is the main tool for reducing energy consumption in the residential-tertiary sector by 2050. The -96% reduction in emissions in the energy sector, compared with 1990, assumes that the methods for producing heat are substantially changed: for households and services, increasing share of electricity use (renewable) and more biomass in individual installations, and increase in the number of heat networks using biomass, and/or even sequestering CO<sub>2</sub>, in dense areas. Fuel will gradually see its share reduced to almost zero, replaced by gas and wood. These changes will become more significant from 2020 onward, in the scenarios 2 and 3.

The use of renewable energies plays a crucial role in the low-carbon scenarios. Their rate of growth depends on how fast their costs decrease, on progress done in managing the networks to cope with intermittence issues and on their social acceptability. Hydraulic production, land-based wind-power and biomass energy have reached, or almost reached, technical and economic maturity and are competitive with classic fossil resources. Other technologies, not yet economically mature, may be rapidly deployed after 2020: offshore wind-power, photovoltaic solar, advanced biofuels and, to a lesser degree, solar concentration. Their current costs are between two and five times higher than those of traditional means of production but should decrease thanks to R&D and the industrialisation of production. Also, extension of the networks and technological changes in their management are levers just as important as those on the production side, above all if they are combined with progress in electricity storage capacity, either by batteries, or in the form of hydrogen. We should add that there is a growing uncertainty about the rate at which carbon capture and storage techniques will be disseminated given to a dual difficulty: the costs of deploying them without any incentive instrument and social acceptability.

The change in the electricity system, whatever it may be, is very much linked to the transport network's capacity to adapt: the time required to build the transport infrastructures, due to administrative constraints and acceptability, are often greater than those of the production means. The network's development capacity is therefore a major issue.

These various technologies can be combined very differently, and the options contrast sharply, particularly according to the choices made in relation to nuclear power. First,

they concern not only the decision on the future of the existing power stations or those under construction, but also the "fourth generation" nuclear stations, corresponding to the breeder mode that will probably not be mature before 2030 even if its development remains a priority. The Committee did not study these questions in details, since they will be addressed by another working group. However, it paid particular attention to the year 2030, the configuration of which largely depends on the choices made today with regard to investment.

In the scenario that the Négawatt association made public, primary energy consumption is almost reduced by two-thirds in 2050 compared with 2010, which makes it possible to build a scenario satisfying both climate requirements and a total phasing-out of nuclear energy. This view which anticipates a total phasing-out of nuclear energy in 2033 is based on the technical calculations which do not include the costs and benefits for the economy. It differs from those provided by the two exercises, carried out by the DGEC and the French Electricity Union, which compared scenarios with the growing contribution from renewable energies with or without faster nuclear decommissioning. Not surprisingly, these two exercises suggest that the scenarios on a rapid nuclear phasing-out have a transition cost corresponding to the decommissioning of a capital not yet depreciated and to the start-up of thermal reserve capacity to cope with the intermittent nature of renewable energies. In all cases, the maximum emission decrease in 2030 is obtained in the scenario without the faster nuclear decommissioning.

Table 12: Comparison of forward-looking scenarios on the electricity mix in 2030

	Scenario	Modelling tool	Average annual GDP growth rate 2010-2030 (%)	Demand in 2030 (TWh)	Export balance in 2030 (TWh)	Nuclear capacity in 2030 (GW)	Total capacity in 2030 (GW)	ENR portion in the electricity mix in 2030 (%)	CO <sub>2</sub> emissions by the electricity sector in 2030 (Mt CO <sub>2</sub> )	Variation in CO <sub>2</sub> by the electricity sector 2030/2010 (%)
RTBP 2011	Reference	RTE simulation	1.75	554	67	65	165	29	16	-53
	Low nuclear		1.75	530	1	40	168	38	23	-32
DGEC	AMS- <i>Grenelle</i> measures decided	MEDPRO/ POLES	1.75	617	100	66		22	28	-24
	AMS- <i>Grenelle</i> Targets Factor 4			616			23	24	-35	
UFE	70% nuclear production	UFE	1.5	570	101	66	145	22	17	-50
	50% nuclear production				5	41	142	34	44	130
	20% nuclear production				1	16	152	40	101	297
Négawatt 2011	Négawatt 2011	Négawatt	•	400	?	13-15		70	?	(factor 2 reduction in CO <sub>2</sub> emissions originating from energy)

Source: according to RTE, UFE, DGEC, Négawatt

For 2020, the reference scenario's target for reducing emissions is based on 65-GW nuclear power stations (including the EPR in Flamanville and Penly), renewable electricity production capacities of about 26 GW (wind-power, photovoltaic and biomass; hydraulic production capacity is unchanged), the closure of the refineries in Flanders, Reichstett and Berre. This objective is to be achieved within the context of current policies, without causing any particular problems.

Scenario 2 differs from the 2020 reference scenario by a reduced demand resulting from greater constraints in the customer sectors: reduced demand for electricity during peak hours, particularly in the residential-tertiary sector and reduced demand for petroleum products for transport and heating. It is more or less this scenario which has been developed on a European scale with new emphasis on energy efficiency whose objectives may become even more restrictive. It led to a lower constraint on the energy supply which resulted in return in a reducing CO<sub>2</sub> quotas price on the carbon market. In scenario 3, the energy sector will reduce its emissions by 35% compared with 1990, as it will be encouraged by the surge in CO<sub>2</sub> quotas on the carbon market, resulting from the lowering of the European emission cap.

Over and above the 2020 reduction target, the greatest difference between the three scenarios will be the kind of investments made by 2020, crucial for achieving the 2030 and 2050 targets. From this perspective, the Committee decided that to determine rapidly a set of legally-binding objectives for 2030 was urgent and that France would then structure these objectives around transparent and credible purposes regarding the future of its nuclear energy policy.

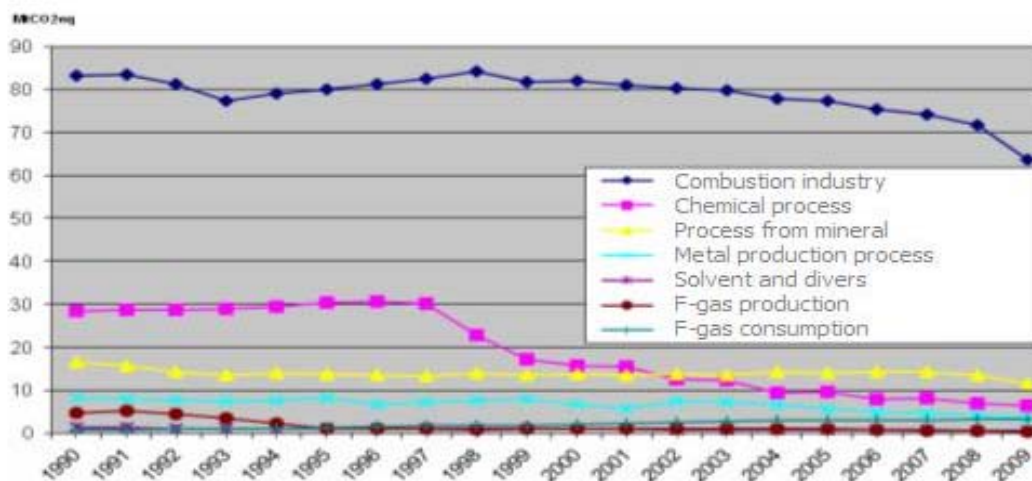
In order to carry out the Committee's work, the cost per tonne of CO<sub>2</sub> saved and the main actions to reduce emissions in the energy sector would deserve to be quantified, and offset against other benefits or losses, on a monetary basis. In this way, cost-efficiency and cost-benefit analyses could be of help, within the scope of a multi-criteria approach, to give priority to the various potentials for reducing the carbon intensity in the energy production sector, together with the other two levers which are downstream substitution and energy efficiency actions. Such an approach would also enable a better understanding of technological lock-in that is potentially counter-productive for the climate.

### **3. Industry: energy efficiency gains to be continued and actions to be taken at a sector level**

In 2009, the manufacturing and construction sectors emitted 18% of total greenhouse gas emissions in France. Their emissions decreased by 38% compared with 1990 (of which 10 points only are due to the 2009 recession). The first leverage was the fourfold N<sub>2</sub>O emissions split in chemicals, given impetus to the Rhodia group which had developed a thermal disposal process in its Chalampé factory. This process is now widely used all over the world. The second is the reduction in CO<sub>2</sub> emissions mainly deriving from energy efficiency gains, reductions artificially amplified by the recession in 2009. For over 82%, the sector's emissions concern installations subject to the European trading system, an important feature given that they are concentrated in less than 30 major installations emitting large quantities, in the steel, cement, paper pulp, glass and other industries. These sectors are moreover exposed to international

competition and they are obliged permanently to ensure that these emissions reductions do not lead to de-industrialisation.

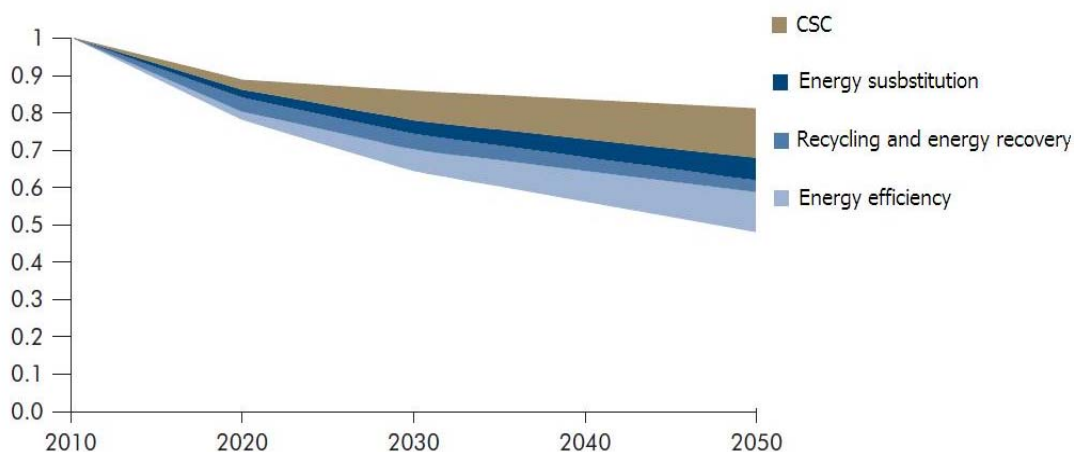
Chart 14: Changes in emissions in the industrial sector



Source: IFARE 2011

For the industrial sector, and after having consulted experts, the Committee adopted a 2050 target for reducing emission of -85% below 1990 level in the whole industry. In view of the reductions achieved between 1990 and 2011, this represents an additional effort of 50% (about 45 MtCO<sub>2</sub>), of which 30% could be achieved by seeking energy efficiency gains, 30% by energy recovery and recycling and 40% by disseminating innovative technologies similar to CO<sub>2</sub> capture and storage.

Chart 15: Options to reduce industry's CO<sub>2</sub> emissions by 2050 (index 1 = CO<sub>2</sub> industry's emissions in 2010)



Source: Committee's work according to IEA

The approach by industrial sector is given in detail in annex #4 (only available in French version).

Four main ideas concern every sector:

- despite the energy efficiency progress already achieved, substantial additional sources could still be mobilised. According to CEREN, net final energy savings in industry come from fuels for 23 TWh (more than 50% of the total fuel consumption in industry) and from electricity for 41 TWh (about 30% of industry's electricity consumption). These savings have the potential for reducing emissions by 8.6 MtCO<sub>2</sub>. More than half of these sources of energy savings are assessed to have a relatively short pay-back time. Furthermore, there are additional potential reductions of emissions in specific processes (cement, iron and steel, etc.) through using the best technologies available;
- energy substitution will mainly concern the increased electrification of some industrial processes and the use of biomass. Its rate will depend on the resource's availability and changes in energy relative prices, with carbon price increases giving an even greater incentive for substitution;
- recycling and re-use may eventually reduce primary production output in some branches. For instance, a study to be published by WWF France suggests that it is possible and relevant to implement the re-use of glass packaging, at a rate that could be increased to 10% in 2020 and up to 80% in the long term. Similarly, a 90% recycling rate is mentioned for steel, in the long term, against an average of 75% at present. Another form of recycling may eventually be that of CO<sub>2</sub> itself of which only 0.5% of emission were re-used as raw material in 2008;

**Table 13: Potential recycling rate in industry**

	2008	2020	Long term
Aluminium	30%	50%	86%
Paper-Cardboard	60%	75%	80%
Plastics	6%	15%	30%

*Source: according to E&E*

- in order to reach -85% in 2050, the first applications of carbon capture and storage technologies (CCS) should start to spread throughout some energy-intensive industrial sectors as early as 2020. This technique seems to be particularly appropriate to industrial units with large emissions outputs and close to electricity power stations. Nowadays, industry seems to have less low-carbon options than the electricity sector. Thus obstacles to introduce this technology should be removed. The emergence of a French export offer is also at stake: even if the French domestic market for CCS remains modest in comparison with other countries, several French players in this field are among the major industries. Research organisations are established in all stages of the CCS value chain. If the right products and the right funding are in place, the premises are there for the start of a new sector with the chance of becoming an engineering centre with an international influence.
- the analysis of intermediary milestones must take into account the inertia and the long lead periods of time before investments may be in operation. In the "trend-based" scenario, industry will only return to its 2009 production level in 2030, which suggests that, during that time, investments intended to speed up the transition towards low-carbon production will not be in operation. With an

increased constraint outside the ETS in 2020, the scenario 2 differs from the reference one thanks to the SMEs and very small enterprises that, reacting to the same signals as households, implement more reduction actions. But this alone does not basically change the global picture. Scenario 3 differs through the tightening of the ETS emission cap which increases the carbon price at the beginning of the period and changes the expectations of companies who accordingly invest massively in reducing emissions.

**Table 14: Emissions in the manufacturing industry and construction sectors, compared with the 1990 level**

Variance/1990 (%)	2009 *	2020	2030	2040	2050
Scenario 1 - Reference	-38%	-27%	-35%	-64%	-85%
Scenario 2	-38%	-29%	-38%	-66%	-85%
Scenario 3	-38%	-38%	-50%	-69%	-85%

\* In 2009, the severe reduction in some manufacturing branch affected industrial emissions. For information, the 2007 emissions only decreased by 26% compared with 1990.

Source: Committee's work

Globally, the two major issues in reducing industry's emissions are, on the one hand, the visibility and predictability of the carbon signal price and, on the other, improved competitiveness. On the first element, industries wish to establish a credible restriction in 2030, combined with an immediate strengthening of the carbon market regulations under the auspices of an independent authority. On the competitiveness side, maintaining a free allowance on the basis of a benchmark system is a satisfactory mechanism but the implementation is unable to avoid useless administrative complications. In the medium term, industry's ability to compete will however depend above all on the public authority's ability to deploy innovative systems for supporting R&D, funding enterprises' development, structuring sectors, training, etc. In a context of a long-term economic recovery, the more credit restriction and reluctance to take risks remain strong, the more public support is needed to stimulate innovation and buoyant industrial markets.

Companies have also a major role to play for decelerating emissions resulting from the use of their products. It means offering products whose full life cycle will emit less (energy-efficient products, recyclable or re-usable products, services instead of products, according to a function-oriented economy).

An approach by sector is therefore interesting and complementary to an approach by enterprise to assess how the emissions can change. The dynamics of innovation must also be sector-oriented, in addition to the improvement of production processes.

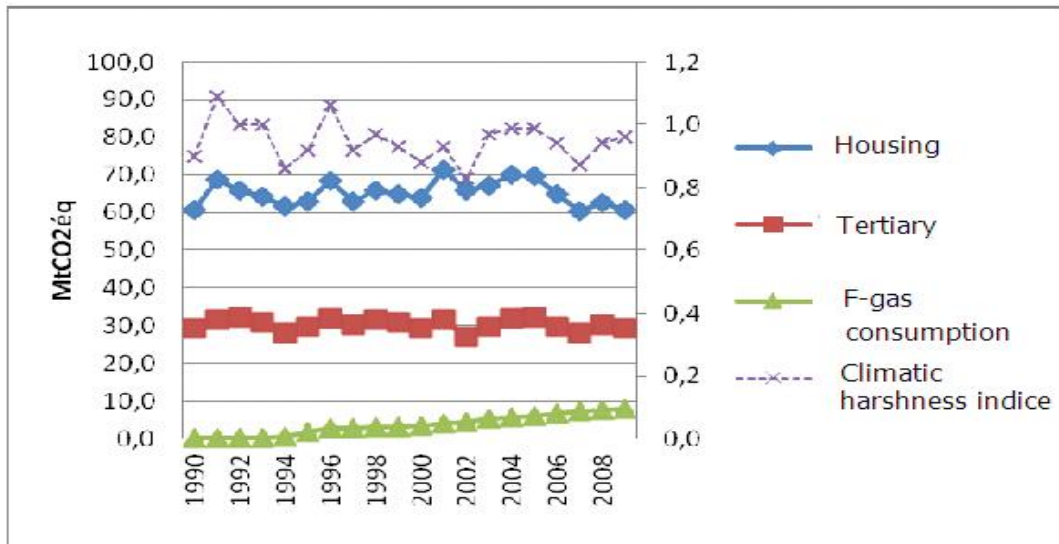
#### 4. Construction industry: the inertia of the building stock and the renovation rate

In 2009, the residential-tertiary sector represented 44% of the final energy consumption in France, but only 19% of direct emissions and 25%, if electricity production and urban heating emissions are added. These emissions increased by 9% between 1990 and 2009. Apart from climate variations, this rise comes from the



constant increase in fluorinated gases linked to the development of air-conditioning and refrigeration. For the remainder, the rise in heating consumption for new buildings (+ 50% of housing units over the 1990-2010 period) was counterbalanced by improved energy efficiency in existing buildings and a gradual substitution toward lower-carbon energies (near disappearance of coal and a decrease in fuel, in favour of gas and electricity).

**Chart 16: GHG Emissions in the residential-tertiary sector**

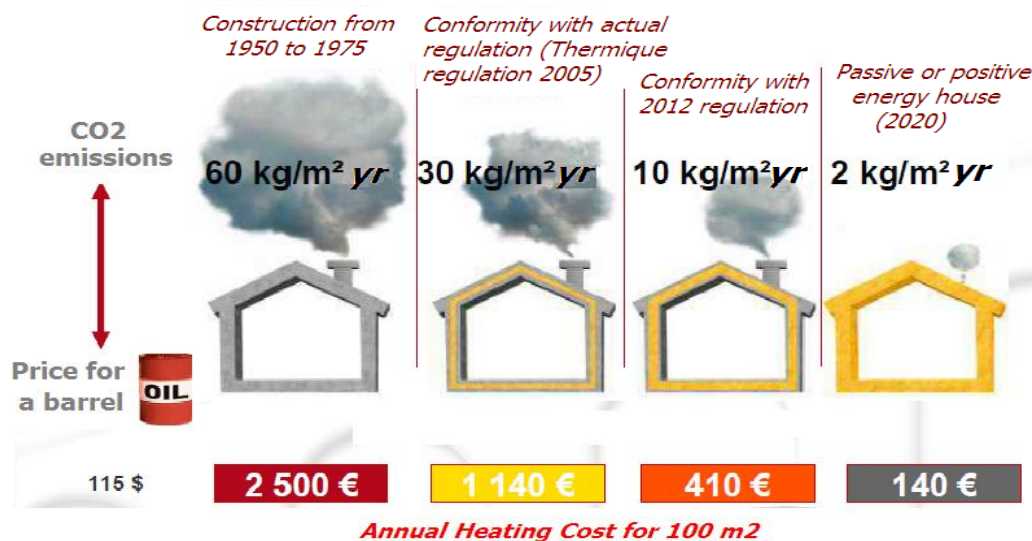


Source: IFARE April 2011

Nevertheless, carrying this type of incremental gains on - by improving boilers' performance or making double-glazing general and low-consumption light bulbs- will not be enough. To reach an 85% reduction in buildings' emissions by 2050, the Committee set up a scenario based on three guidelines : new buildings built as from 2012 consume very little heating energy; over the next 40 years, all existing buildings will be substantially renovated so that consumption per unit will be close to that of new buildings; decarbonised energies (biomass and renewable electricity) win market share, for both new and old buildings, particularly through heating networks.

Tougher standards will be the first incentive for the construction of new housing that consumes very little energy for heating and which will even be able to produce more than it consumes, on an annual basis. But the "rebound effect" must be taken into account: if some calories can be provided by electric heating or a plasma television to heat very well-insulated housing, air-conditioning and particularly the electricity for domestic and office use should not double or triple the emissions from these new efficient buildings. Additional incentives (information, education, steering instrument, even pricing and obligation) should therefore have an effect on uses to supplement actions on the building-offer side, regardless of whether new or renovated buildings are concerned.

Chart 17: Changes in the construction standards in France



NB: CO<sub>2</sub> gains generated by new buildings or by renovating old buildings are of course linked to the energy sources selected.

Source: Saint Gobain.

Because of the low demolition rate, 60% to 70% of existing buildings in 2050 will have been built before 2010. Finding economic solutions and setting up an efficient organisation for the sector, for all existing buildings to be substantially renovated, is a particularly complex economic and social issue. Over the next 40 years, existing buildings will undergo at least one major renovation. This should not just be refurbishment but an opportunity to lower the energy consumption to the level of the most efficient new buildings. On a more macroscopic scale, this could also be an opportunity to review town planning by making certain districts or central areas denser; a positive impact may also be recorded in terms of transport. Our 2050 target assumes that all buildings will achieve per-unit consumption close to that of today's new low-energy buildings<sup>1</sup> and that the renewable energies will have the highest share in the energy mix. Nevertheless, in view of the efficiency gains, the sector's demand for biomass and electricity should not be greater than today's.

In our pathways, the two possible milestones in 2020 depend on the pace at which the renovations are stepped up. The 13% decrease, compared with 1990 (-11% compared with 2010), corresponds to a renovation rate half that of the average rate which must be reached to substantially renovate all buildings (the quality in terms of GHG reduction is also half that of the objective sought), it is more or less the situation prevailing today with the incentives currently in place. The 22% decrease, compared with 1990, assumes that, by 2020, the cruising speed required to renovate all buildings in 40 years will be reached; in this case, the renewable energies' penetration rate (biomass and heat pumps in particular) is also slightly greater. Even in this scenario, the extremely ambitious targets of the *Grenelle Environment Round Table* to reduce the per unit consumption in the existing buildings by 38% are however not likely to be reached.

(1) Bâtiment basse consommation (BBC) in French.

**Table 15: Emissions by the residential-tertiary sector in relation to the 1990 level**

Variation/1990 (%)	2009	2020	2030	2040	2050
Scenario 1 -Reference	9%	-13%	-35%	-62%	-85%
Scenario 2	9%	-22%	-43%	-64%	-85%
Scenario 3	9%	-22%	-43%	-64%	-85%

Source: Committee's work

Achieving these targets presumes that a certain number of restrictions are removed, particularly in funding and in the sector's organisation. The two go hand in hand: if the construction sector improves efficiency, the renovations' profitability will improve. Reciprocally, if powerful economic incentives are set up, the sector will find innovative solutions to meet demand. The *Environment Round Table* and the *Grenelle Building Plan* have set up financial incentives<sup>1</sup> to experiment for the construction of energy-efficient housing, to generalise efficient equipment and to remove the restrictions on funding for substantial energy efficiency renovations. To go beyond the minimum scenario, these mechanisms must be supplemented, both in terms of volume and quality. It will also be needed to incorporate this dimension, as far as possible, into the functioning of the property market: labelling is a first step in this direction. But its impact on property prices is far from being enough to encourage private investors to invest in low-carbon renovations.

To reduce costs, to guarantee quality and to bring appropriate solutions that will secure these investments and reduce their pay-back time, the authorities must strengthen the sector's structure and raise the level of skills. Labelling encourages it; raising the standards for new buildings and performance on equipment and materials is a powerful lever for technological innovation. At last, research is still expected to offer technical solutions even less expensive and more effective.

To remove the economic constraint on building renovation for households, to maximise the leverage effect of public grants and to reduce housing insecurity, the authorities should target renovations on housing whose thermal performances are the worst and for which complete renovation (roof, walls, openings and ventilation) has the best chance of being profitable.

## 5. The urban transport and the transport of goods

With a share of 27% of the total emissions in France, the transport sector is the major source of greenhouse gas emissions. Furthermore, between 1990 and 2009, it increased by 12%. In the long-term and on a worldwide scale, studies show a strong correlation between mobility and economic wealth. Speed creates the link between the two variables as Yves Crozet recalled during his presentation to the Committee: since 1880, a 1% increase in GDP is reflected by an increase of 2.7% in this speed! A substitution by more and more rapid transportation modes (from walking to horses, to

(1) The sustainable development tax credit (CIDD) and interest-free eco loans (eco PTZ) are the main measures intended for households; a conditional improvement in the classic aid instruments such as interest-free loans to households to buy property or loans to the public housing organisations also encourage the constructions standards to be anticipated.

cars and now planes) enables mobility to be considerably increased without increasing the "time budget" used for these journeys. Mobility enables ways of life and consumption to be "intensified". It is intimately linked to productivity and growth, as well as to a way of life.

Because of the mobility's weight in our way of life and our economic system, changes in this sector appear to be restricted in the short term. The leverages for action however differ, depending on the segments:

- urban mobility for which the three priority levers seem to be i) a transfer toward soft modes of mobility, ii) an improvement in public transport and iii) vehicles' electrification;
- long-distance mobility for which the extension of the train high-speed network must be combined with an improved performance in road vehicles and aircraft and the use of advanced biofuels;
- transport of goods, with road transportation which has made the greatest highest contribution to the growth of emissions over the past 20 years, and for which efforts to increase the market shares for alternative modes must be combined with improved performances in road vehicles.

*The Committee 2020-2050 Pathways* suggests reducing greenhouse gas emissions by 65%. It seeks a balance between two types of scenarios: those which are essentially based on significant technological progress without questioning our transport habits; and those involving a radical change in our mobility habits by minimising the use of hypothetical technological progress.

**Table 16: Transport sector emissions compared with the 1990 level**

Variance/1990 (%)	2009	2020	2030	2040	2050
Scenario 1-Reference	12%	3%	-22%	-44%	-65%
Scenario 2	12%	-8%	-29%	-48%	-65%
Scenario 3	12%	-8%	-29%	-48%	-65%

Source: Committee's work

The milestone in 2020 depends on several parameters. The reference pathway (rise of 3% compared with 1990) corresponds to 10% biofuels being incorporated, to a fleet of about one million rechargeable electric and hybrid vehicles (HEV) and a 16% non-road modal part for goods transport. If the post-crisis rebound in goods transport is less than expected, a more ambitious target for 2020 (decrease of 8% compared with 1990) may be achieved if these parameters reach respectively 13%, two million and 18%.

The proposed pathways result in emissions being reduced by about 65% in 2050. Apart from a moderate increase in mobility compared with what was experienced in recent decades, this assumes that the technologies used will be substantially changed: more than half the vehicles would run on electricity, the others, much lighter than today, would consume close to 2 litres per 100 km and almost 40% of the fuel would come from biomass. Urban transport would be widely electrified, with the different complementary modes; the private and "Swiss army knife" car would be replaced by shared vehicles, optimised according to their use.

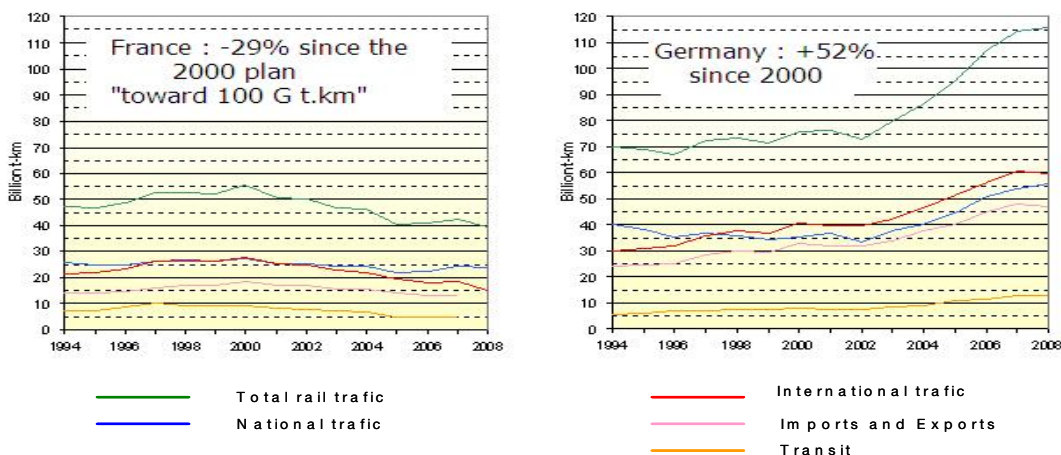
From a technological perspective, these pathways assume that R&D and industry will be in position to provide solutions by 2050. Traditional internal combustion vehicles have seen their unit consumption regularly decreasing, all the more so as the past years benefited from the combination of the bonus-malus system, the European regulations and the economic crisis. According to the experts' opinion, reduction potentials are far from being exhausted, particularly if the vehicles become lighter. Advanced biofuels (extracted from the ligno-cellulosic biomass and micro-algae) do not compete with farm food production and do not have the first generation's disadvantages, but are still very costly and must undergo additional expert assessments. Finally, vehicles' gradual electrification is a substantial source of progress, from the "stop and start" system which made the engine cut out when stopped, to hybrid motorisation, and then finally the all-electric vehicle which runs on a fuel cell.

It should not be neglected that the use of technological innovations in the fleet depends on vehicles' renewal term. The regulations setting a binding overall objective on car manufacturers and, to a greater extent, on road vehicles, seems to have borne fruit at the European level, while leaving technologies open to competition; here again, long-term objectives enable to give visibility to companies and to stimulate the offer.

With regard to the demand for mobility and organised transport, no action should be neglected, as was agreed at the *Environment Round Table*: restricted traffic in major built-up areas, control and possible reduction of speed limits, rapid application of the tax on heavy goods vehicles, improved quality of service in public transport and non-road freight, road taxation, maintenance and development of infrastructures for systems other than roads, etc.

Particular attention should be paid to transport of goods, to foster efficient logistics chains to be set up within a consistent production and consumption system. In France, on several opportunities, experience has shown that the policies implemented so far have been insufficient to achieve a significant move off non-road transport; nevertheless, experience in Germany confirms, if need be, that this is achievable.

**Charts 18: Change in rail freight traffic in France and Germany (in billion t.km)**



Source: Yves Crozet's Presentation to the Committee

In conclusion, international transport, though not addressed here, also deserves special attention since it is growing faster than domestic transport. From this standpoint, including aviation in the ETS as from 2013 would be a significant step forward. The price signal could be extended to international air transport as a whole, on the one hand, and to sea transport, on the other hand, by introducing a market for licences.

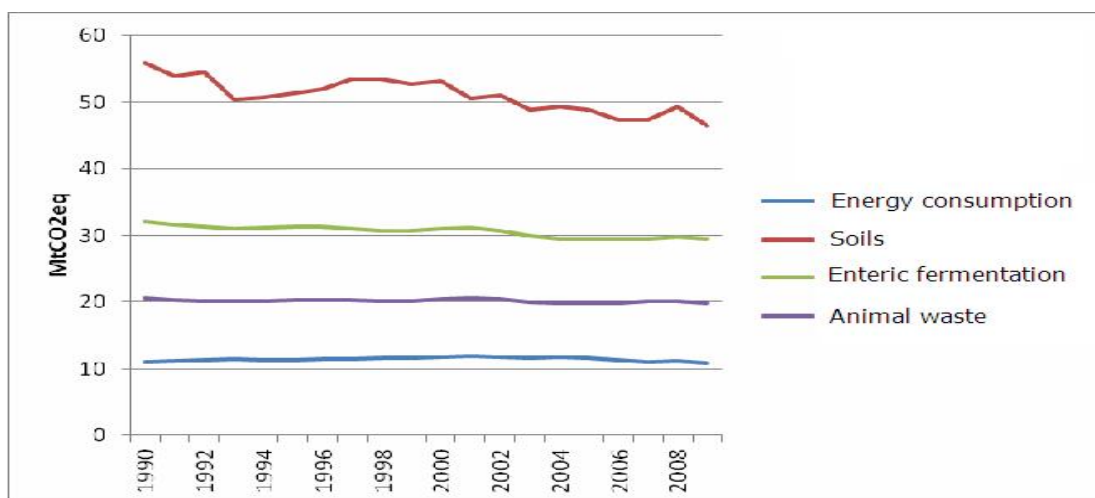
## 6. Towards an “ecologically intensive” agriculture

The agricultural sector is the main source of emissions of methane (CH<sub>4</sub>) and nitrogen oxide (N<sub>2</sub>O) and the fifth largest emitter of national greenhouse gas emissions. Furthermore, agriculture can contribute to stocking or destocking carbon in the land depending on the cultivation and livestock breeding practices used. It contributes to enlarging or reducing this storage capacity according to possible land use changes, particularly with the forest and agricultural cover on the one hand, and the peri-urban areas on the other hand. Finally, (together with the forestry sector), it is one of the main providers of carbon and renewable energy through production deriving from the biomass.

Since 1990, emissions from agriculture decreased by a little more than 10%, due to the 17% reduction in nitrogen oxide emissions linked to fertilisation and the 8% decrease in methane emissions resulting from smaller beef herds. Emissions linked to energy consumption and animal manure were stable. This can be partly explained by the methods of recording emissions based on fixed coefficients (tonnes of fertiliser used and number of heads of cattle) that gives estimates showing a high level of uncertainties.

These developments are quite directly correlated with the changes in farm production and the resulting land use. Therefore one cannot talk about a disconnection between farm production and greenhouse gas emissions. Nevertheless, to respond to the food and environmental stakes, the agricultural sector should increase its productivity while reducing its greenhouse gas emissions.

Chart 19: Changes in agricultural emissions since 1990



Source: IFARE 2011

Forward-looking scenarios consist precisely in wondering, on the basis of a multi-criteria analysis, if agriculture is able in the medium and long term of making such a disconnection. This would enable agriculture to reduce its emissions while coping with other challenges with which it will be faced:

- to maintain the ability to adapt production to cope with both the variations in domestic demand as well as those from international markets which, by 2050, should contribute to ensuring food safety for the planet's 9 billion inhabitants. The production system must also be adapted to new demands linked to the energetic and industrial use of the biomass from agriculture;
- to become integrated into the national areas by valuating ecological legacies and environmental services linked to the climate, biodiversity and water resources. In this field, in particular, one must watch out for the possible effects of transferred pollution if emission reduction is to be considered as the sole target;
- to adapt to the effect of climate change which, by 2050, will result in production systems being displaced, to provide access to water resources in the long term and to require farmers to change a certain number of agricultural practices.

Our forecasts for 2020 are mainly based on the work carried out by the INRA institute<sup>1</sup>, as well as on the results presented to the Committee. The -15% reduction in our reference scenario corresponds to the extension of past gains, but at a slower pace as the assumption made on how production will evolve by 2020 was revised upwards. Achieving a 21% decrease in emissions in a more ambitious scenario involves speeding up gains, thanks to a wider dissemination of already known farming practices: energy diagnoses, reasoned fertilisation, diversification of crop rotation, introduction of pulses into the rotation, cultivation techniques without tillage, improved efficiency in energy consumption and the use of methane produced on the farm.

**Chart 20: Agricultural emissions forecast in the various scenarios**



Source: INRA (2008)

(1) French National Agricultural Research Institute.

**Table 17: Scenarios on agricultural emissions (all greenhouse gases) as a% of change compared with 1990**

Variance/1990 (%)	2009	2020	2030	2040	2050
Scenario 1 -Reference	-11%	-15%	-27%	-39%	-50%
Scenario 2	-11%	-20%	-30%	-40%	-50%
Scenario 3	-11%	-20%	-30%	-40%	-50%

Source: Committee's work

The three scenarios for 2050 were produced thanks to the expertise within the group, without being able yet to use the forward-looking study launched by the ADEME (*French Environment and Energy Management Agency*), but with the participation of the Ministry for Agriculture, the results of which being not available so far. On the other hand, the group had access to the prospective work carried out by Solagro for 2050<sup>1</sup> which is based on the assumption of a dietary change (in particular a decrease in the average portions of meat and dairy products) which would facilitate the emissions' reduction.

Our scenario aims at reducing emissions from agriculture by 50% by 2050. This magnitude corresponds to the reduction potential provided by the modelling work carried out by the European Commission, IIASA<sup>2</sup> and the PIK<sup>3 4</sup>. This target will only be achieved if strong incentives are set up to make farming practices and eating habits change, and if a certain number of technological and organisation barriers are lifted especially by reinforcing the network of advice to farmers.

From the incentive standpoint, speeding up new cultivation and livestock breeding practices will be facilitated by a scaling-up of the domestic projects system, experimented with success since 2009, and whose interest the Committee assessed on the basis of a presentation made by the major co-operative group, In Vivo. This system, if it is organised and simplified, provided that any windfall effect is avoided, may in the future become a decisive element for introducing the price signal to reduce non-CO<sub>2</sub> gas of agricultural origin. Simultaneously it would lift a certain number of financial barriers, the carbon credits contributing to funding the required research and development programmes as well as any action enabling greenhouse gas emissions to be reduced (e.g. funding initiatives for sustainable development).

From the technical standpoint, the dissemination of "ecologically intensive" methods requires farmers and their development organisations to reach higher levels of knowledge regarding agriculture and animal husbandry. In that light, public, co-operative and private basic and applied research must be redeployed or increased, particularly in what concerns animal feed, genetics, soil biology and their links with cultivation practices.

Finally, research should provide for a better understanding of carbon soil sequestration, as this is an important stake in conserving this storage (for instance,

(1) It will be noted that the whole agricultural profession has not yet validated this study.

(2) International Institute for Applied Systems Analysis.

(3) See Popp A., Lotze-Campen H. and Bodirsky B. (2010), "Food consumption, diet shifts and associated non-CO (2) greenhouse gases from agricultural production", *Global Environmental Change-Human Policy Dimensions*, vol.20, n°3, p 451-462.

(4) Potsdam Institute for Climate Impact Research.



permanent grasslands would store more carbon in the soil than the forests) and in increasing the carbon content of agricultural land. This will also take place by improving methods for measuring and recording emissions and sinks in the inventories.

## 7. Forest and carbon sinks: the stake for preserving forest sinks

Activities linked to land use, land use changes and forestry (LULUCF<sup>1</sup>) may be carbon sources or sinks, depending on the case. French forests, due to their youth and their extent (except the Guyana forest), have increased their carbon storage capacity in the soil and in the biomass since 1990. The 2009 inventory shows that the LULUCF represents a carbon sink of around 64 MtCO<sub>2</sub>eq, 61% higher than in 1990. This larger sink is only marginally the result of land use changes. Indeed the increase in French metropolitan forest areas was more or less offset by the decrease in those of Guyana. Basically, it is the result of forest management, especially a net growth of trees and a very favourable age pyramid, as French forests benefited from substantial investment made during post-war period.

Nevertheless, there is no guarantee that this carbon sink will continue. In a balanced forest system, the stored carbon mass is constant, it is neither a sink nor a source. French forests are today a sink if they are growing. Apart from continuing deforestation in Guyana, there is a risk that several phenomena will reverse this trend in metropolitan France. First of all, forest investment slowed down during the past two decades, basically turning towards curative actions (reforestation after storms). Furthermore, global warming may lead to a loss of productivity in forests comprising species currently established and, consequently, a lesser capacity for storing CO<sub>2</sub>. For instance, the heat wave and drought that occurred during 2003 summer resulted in less carbon being stored (assessed by the trees' growth), which INRA estimated at 25-40% during the following two to three years. Finally, the growing need of biomass for bioenergy will tend to cut into its storage capacity if forestry investments are not made at the same time.

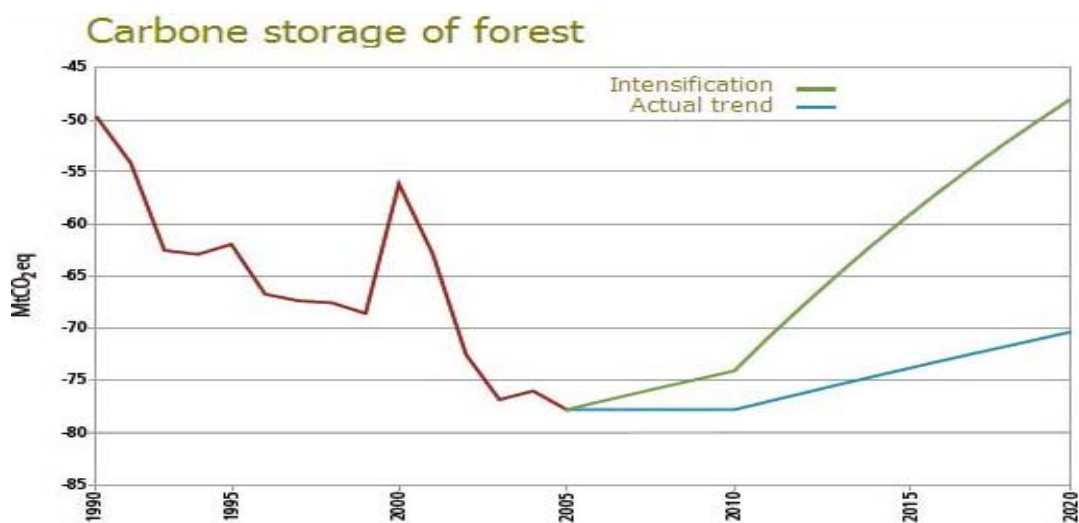
INRA's work for 2020 is already anticipating a decrease in the forest carbon sink by that date. IFN (*French National Forest Inventory*) recently published new data on forests' biological production in metropolitan France and on timber cut, on the basis of a new recording method enabling uncertainties to be reduced.<sup>2</sup> According to the IFARE, this could lead to a substantial decrease in the forest sink observed over the 2005-2008 period and the forest sink forecasts for 2020.

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(1) This sector concerns activities linked to the change in the use of forest land, cultivation, grasslands, wetlands and urbanised areas.

(2) See IFN (2011).

Chart 21: Change in the carbon sink in various scenarios



Comment: the peak in 2000 results from damage caused by storms.

Source: Retrospective data and INRA forecasts (2008)

As an initial approximation, the preliminary baseline scenarios for the forest sector show a sink's linear trajectory ranging from 64 MtCO<sub>2</sub>eq in 2009 to zero in 2040, with the sink disappearing by that date. They would be refined thanks to a simulation model being currently developed in the forest economics laboratory in Nancy. To reverse this trend, action must be taken on three levers:

- an investment boost in forests in order to maintain and increase the carbon storage capacity of French forests, to encourage mobilising the resource and to enhance the use of forest biomass resources. The leverage effect of this investment is currently not well known: there is a risk that public money may be limited and that mobilising private investment requires the sector to be re-organised and adequate incentives;
- an anticipation of the potential impacts of the forthcoming climate change on the forest's storage capacity. This requires both supporting research into the forest stands' vulnerability and resilience, continuing the work carried out by INRA in more depth and taking them into consideration when selecting new tree species for planting;
- a hierarchical organisation of uses between carbon storage and carbon sequestration in wood products (or carbon emissions reduction) by substituting wood for material or for energy. This last point is a complex issue that the Committee could not address within the allocated time. Including the forest in a carbon pricing system, either by inclusion in the ETS like the New Zealand method, or in a specific mechanism (with a distinct decision and target), would be such as to introduce new incentives for long-term forest management.

Let us add that without any doubt, carbon storage by agricultural and forest land offers a large potential by 2050 if cultivation and livestock farming practices develop in this way. At present, the national inventory does little to follow up this storage and one priority of the research and development should be to improve the systems of measurement for CO<sub>2</sub> flows, inventory, modelling and monitoring in this field.

## 8. Comparisons with the results of the European roadmap

Unsurprisingly, the trajectories built for France show many similarities with the exercise carried out on a European scale. Aggregated, the trajectories are quite similar. The European trajectory starts in 2005 from a higher level, resulting thus in greater reductions by 2030 and 2050. Furthermore, it exploits high reduction potentials in energy production which were already used in France. For this reason the French Factor 4 for 2050 is compatible with a European "Factor 5".

It is also important to keep in mind the relative weight of the various sectors. From this point of view, a condition for achieving the targets in 2050 is to use the reduction potential in the agricultural sector which represents a substantially greater share in French emissions than in the European ones. The conservation of the forest carbon sinks is also a considerable advantage for offsetting our greenhouse gas emissions.

If the changes to be made in the transport sector can be compared, the rupture that has to be made in the building sector seems to be particularly substantial in France: emissions in this sector steadily increased between 1990 and 2005, while they significantly decreased in the rest of the European Union. In France, the building sector must achieve a trend reversal in trajectories by 2030, to be on a 2050 trajectory compatible with the Factor 4.

Table 18: Comparison of changes between and France and the EU

	Share of total (%)		Variations/1990 (%)							
	2005		2005		2020		2030		2050	
	Fr	EU	Fr	EU	Fr	EU	Fr	EU	Fr	EU
Total (all GHG)	100	100	0	-7	-16 to -25	-23 to -26	-33 to -41	-40 to -44	-75	-79 to -82
Energy industry (CO <sub>2</sub> )	13	31	3	-7	-25 to -32	-30 to -34	-49 to -53	-54 to -68	-96	-93 to -99
Manufacturing industry (CO <sub>2</sub> )	18	18	-8	-20	-24 to -36	-31 to -32	-32 to -48	-34 to -40	-84	-83 to -87
Transport (excluding air and sea) (CO <sub>2</sub> )	25	18	18	25	+3 to -8	+15 to +27	-22 to -29	+8 to -17	-65	-61 to -74
Residential-tertiary (CO <sub>2</sub> )	17	13	16	-12	-11 to -20	-21 to -25	-33 to -42	-37 to -53	-85	-88 to -91
Agriculture (non-CO <sub>2</sub> )	17	10	-10	-20	-14 to -19	-	-26 to -29	-36 to -37	-49	-42 to -49
Other (non-CO <sub>2</sub> )*	8	8	-30	-30	-41 to -47	-	-48 to -58	-71.5 to -72.5	-86	-70 to -78

Notes:

-\* Non-CO<sub>2</sub> GHG emissions in the energy and manufacturing industries, transport (excluding international air and sea), residential-tertiary and waste sectors.

- For the sectors, this comparison concerns only gas included in the European Commission roadmap, and does not enable the whole inventory to be covered; CO<sub>2</sub> emissions in agriculture and waste are missing, i.e. about 2% of total emissions excluding LULUCF; the LULUCF sector is moreover not dealt with in the Commission's 2050 climate roadmap.

- Annex #4 returns to the assumptions which enabled CO<sub>2</sub>/non-CO<sub>2</sub> emissions to be separated for the various sectors.

Source: Committee's work adapted to take into account  
Only the gases included in the European Commission's roadmap

## 9. How to ensure spatial, industrial and economic consistency

The sector analysis has highlighted a large number of specificities from one sector to another and often within each of them. This diversity requires great adaptability in emission reduction strategies, each time appropriate leverage actions are used. However, simultaneously, it must also be consistent with a spatial, industrial, economic and social viewpoint.

Working on the scenarios showed how the current choice of development and use of space had impacts on future emissions. According to the Institut français de l'environnement (*French Environmental Institute*), 600 km<sup>2</sup> in France become artificial every year, i.e. the equivalent of a French department every ten years. And the increase in "artificialized" areas is four times greater than the population growth. The extension of peri-urban areas makes it much more complex to reduce transport emissions and puts growing pressure on agricultural or forest land.

A better spatial consistency could be obtained by making European, national and local policies more consistent. Urban planning is a good illustration. It is clear that reducing the impact of local mobility, optimising heating needs, conserving agricultural lands and forests in the long term come along with a reasoned urbanisation policy to be implemented immediately. Despite the growing number of climate plans at different scales, for the moment they do not provide the desired consistency between the various documents of urban planning. It would probably be necessary to go further in integration policies at different levels; one way could be to give local authorities more responsibilities and means of action.

The industrial policy is an issue impacting all sectors. The R&D carried out in industry is intended to develop innovations for all sectors. Even within sectors, low-carbon technologies could be used to develop certain segments but, on the contrary, will substantially reduce employment in others. Aside from technological innovation alone, structuring and upgrading skills in some segments is an obligatory milestone. Information, training, labelling are levers in addition to conditional public grants and regulations.

Influenced by these new technologies, the evolution of social structure and ways of life may also eventually modify the balance between the various sectors' needs. If information technologies make a new virtual mobility possible or offer more local services in a post-carbon city, the needs for transport, for example, could be reduced.

Finally, given the resources and funding available, economic consistency requires that the chosen objective criteria give us the priorities of actions, in time and in space. We understand thus our interest in assessing these actions' relevance based on a common criterion, which is the price of a tonne of CO<sub>2</sub> avoided.

The gradual extension of the carbon price to all sectors, whether in the form of quotas or a tax, appears to be a powerful lever for achieving factor 4 by 2050. In all sectors, the players insisted on the necessity of having a credible price signal that is also foreseeable well in advance. Without such a signal, large-scale investments leading to factor 4 risk to be rejected in favour of actions resulting in immediate reductions. Intermediary milestones, for instance at 2030, are such as to make long-term objectives credible. Specific governance, independent of economic and political uncertainties, may also provide predictability.

The detailed sector analysis in the previous paragraphs showed that in each sector, it is possible to aim at more ambitious reduction targets than those in the reference scenario, depending on the implementation of additional actions on both supply and demand side. Rather than repeating all the sectoral measures to move from scenario 1 to scenario 2 or to scenario 3, as the *Environment Round Table* tried to do, this Chapter's conclusion clearly asserts that the higher the carbon price for economic actors will be, the greater the reductions. The analysis of the ZEPHYR model by the economy-climate chair shows, for instance, that, in 2020, the carbon price would increase from EUR 28/tCO<sub>2</sub> to EUR 43/tCO<sub>2</sub> if the ETS reduction objective was brought from -21% to -34% compared with 2005. The models and the technico-economic analysis give the same information for the non-ETS sectors. Here we clearly see the importance of the carbon price or at least the importance of this common yardstick that is the price of the tonne of CO<sub>2</sub> avoided. The existence of a carbon price across sectors does not oppose the implementation of specific sector policies. Actually it will provide more consistency between them and more optimisation.

Another positive effect from scaling-up carbon pricing is that, under certain conditions, it will bring positive effects in terms of economic growth and employment. But we are now departing from field of sector analysis to enter that of macro-economics which is the subject of the next chapter.

# Chapter 4

## The economic impacts

The sector trajectories built in the previous chapter give us the opportunity to assess the emission reduction potentials, sector by sector, and to identify the main constraints that the authorities should remove so that the targeted objectives may be reached. This chapter analyses in more detail the economic and social impacts of these pathways which will be dependent on the instruments chosen and their implementation. It is based on a set of modelling exercises conducted at the behest of the Committee and the results of which are given in more detail in annex # 5 to the report (only in French version). Their results are used as a supplement to the assessment of the economic impacts given in this chapter.

### 1. A French modelling exercise

The Committee co-ordinated a modelling exercise comprising models of partial equilibrium and general equilibrium. Its objective was to determine, on an aggregated basis (i.e. at a macro-economic level), the GHG emissions reduction trajectory which will be consistent with France's objectives for 2020 and 2050 and which will ensure that these objectives are achieved at the least cost while optimising their impacts on growth and employment. Table 19 gives an overview of the models and their contributions to the Committee's work.

**Table 19: Models which contributed to the Committee's work**

Models	Type of model	Cost-effective trajectory	Carbon price trajectory	Macro-economic impacts		Distinction between ETS and non-ETS
				Aggregated	Sector	
POLES	Technico-economic	Yes	Yes	No	No	No
ZEPHYR-FLEX	Technico-economic	No	Yes	No	No	Yes
GEMINI-E3	General balance	No	No	Yes	Yes	Yes
IMACLIM	Hybrid	Yes	Yes	Yes	No	No
MESANGE	Macro-econometric	No	No	Yes	No	No
NEMESIS	Macro-econometric	Yes	Yes	Yes	Yes	Yes
THREEME	Macro-econometric	Yes	Yes	Yes	No	No

Source: Pathways Committee

Modelling is a useful decision-making tool which assesses the various impacts of given policies. The models simplify complex economic relations and give us a picture of what the economy could be at a particular time given a precise set of assumptions.

Hence, the models show the actions that need to be done to reach the long-term objective.

However, the economic reality is very complex and it is difficult to modelize economic interactions as well as the numerous market failures. Therefore, the models resorted to a large number of simplifications so as to be able to provide accurate information (on given assumptions) on other aspects. The results are strongly influenced by these assumptions. Despite this limit, the results of the modelling exercises contribute to the reflection but are only one of the parameters to be included in the decision-making criteria.

The modelling exercises undertaken within the scope of this Committee provide elements on three crucial points for the determination of a roadmap towards a low-carbon economy by 2050 in France. Firstly, a cost-effective emissions reduction trajectory was built for each milestone in 2020.<sup>1</sup> Secondly, the carbon price linked to each trajectory was identified. Thirdly, the macro-economic effects of the three trajectories were assessed, according to different assumptions on how the proceeds of the carbon pricing are used.

## 2. Sharing the emission reductions over time: gains due to early action

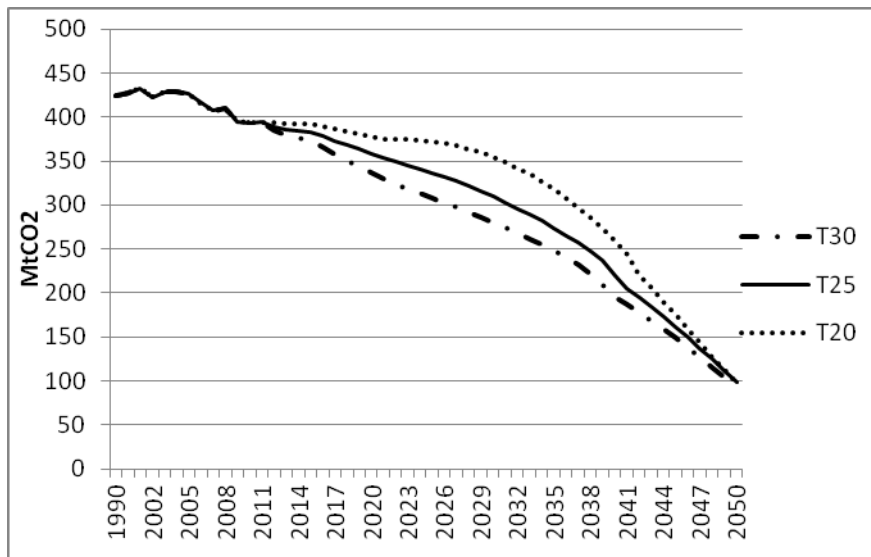
Partial equilibrium models (i.e. without a macro-economic blockade) give the emissions' cost-effective trajectory (described as the emissions trajectory which enables the objective to be reached at the least abatement cost) consistent with the objectives set for 2020 and 2050. This efficiency condition stems from the assumption (made by most models), that is to apply a single carbon price to the whole economy, leading agents to reduce emissions as long as the reduction cost is less than the carbon value. As long as there is no pricing mechanism in the real economy, this carbon price may be taken as a "shadow value", likely to guide the public action's choices if the policies are genuinely assessed.

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(1) Three reduction emission objectives were considered for the year 2020: -20% compared with 1990 (current European objective); -25% compared with 1990 (European roadmap proposal); -30% compared with 1990 (objective initially subject to an international climate agreement being signed that meet European demands for pooling the effort between countries).



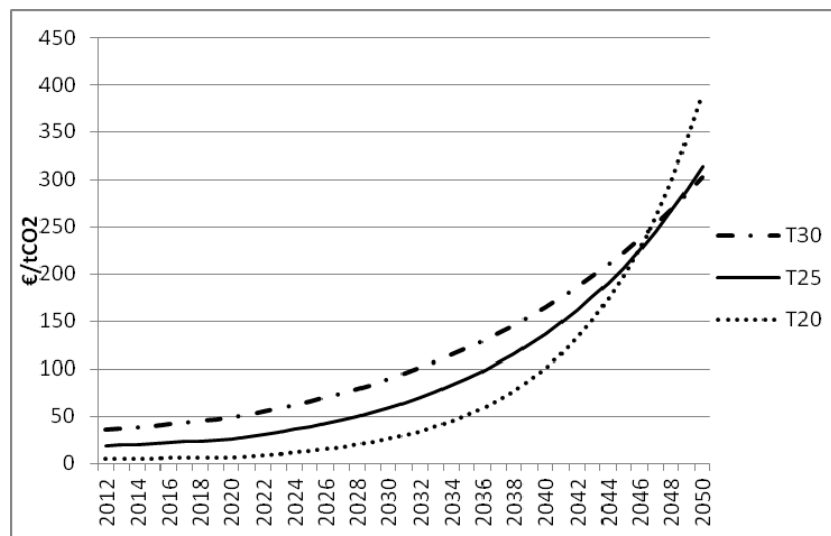
Chart 22: Cost-effective emissions trajectories, France



Source: POLES

The trajectory characterising a reduction target of –20% in 2020, called T20 in the text *infra*, would require greater efforts between 2030 and 2050, than the T30 trajectory which suggests a more linear development, even though it is more restricting between 2010 and 2020 than the other two trajectories. Hence, the T30 trajectory corresponds to an early action scenario (Chart 23). The related carbon value is higher in 2020, compared with scenarios T20 and T25, but in 2050 it would become less than 22% of the value in scenario T20. Scenario T20 corresponds to a late action scenario. The effort is small up to 2020, then, a big effort is necessary to catch up, which is expressed by a big increase in the carbon price.

Chart 23: Carbon price trajectories consistent with climate policies



Source: POLES

When built, the trajectories T20, T25 and T30 are "cost-effective". Three criteria appear to be relevant for assessing their respective advantages and disadvantages:

- from a purely climatic angle, the most relevant trajectory is the one which minimises emissions accumulated between 2010 and 2050. In this case, it corresponds to T30 which, over the whole period, reduces emissions by 8% more than T20;
- an optimality criterion coming from the Hotelling<sup>1</sup> model on the depletion of non-renewable resources recommends choosing a price trajectory that presents the most constant growth rate. From this viewpoint, T30 still appears to be the most relevant;
- a last criterion is to calculate the overall costs relating to each trajectory and to apply them to avoided emissions. In this case, the T25 trajectory is the one which minimises the cost as long as the time preference for the present<sup>2</sup> is less than 1%. For a higher rate, it is T20 which minimises the cost over the whole period.

Hence, the cost-effective approach on which the Committee's modelling work is based suggests that a choice may be made between a target of –25% or –30% in 2020<sup>3</sup>. In fact, a reduction of 20% by 2020 is only justified in a short-term viewpoint where long-term effects are not so important. Given that the impacts of climate change will be fully felt only in the very long term, this viewpoint is not appropriate.

The choice of one or another trajectory will depend on the importance given to the proposed criteria and also on the choice of the time preference rate. Economists have debated this question on numerous occasions especially after the Stern Report's release, even though there is a consensus that a low rate is more appropriate to this field of the economy than a high rate, in particular to be fair to future generations. A preference rate for present of less than 1% would therefore appear to be appropriate. In this case, T25 is preferable to T30.

These results, close to those of the NEMESIS model, were obtained on the basis of the POLES model. To apply them to the real economy, there must be a carbon pricing mechanism in the non-ETS sector. In fact, a single price reveals to all economic sectors the implicit carbon price that the sectors or emitting economic agents have not taken into account because of their nature (i.e. a free publicly-owned asset, non-competing and non-exclusive). It encourages the economic agents to change their behaviours and to focus on low-carbon consumption and production modes. By applying a single carbon value across the economy, carbon pricing enables marginal abatement costs to be levelled out across the sectors and accordingly results in a cost-efficient allocation of the efforts across sectors. Efforts are made wherever they cost the least. Extending the carbon price to non-ETS sectors is therefore crucial. For this reason, introducing such pricing is one of the Committee's first proposals made in Chapter 5.

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(1) This criterion refers to arbitrating across time: the decision-maker must not make any difference between reducing an additional unit of CO<sub>2</sub> now or doing so in the future – these two actions must have exactly the same value, or the same social usefulness from the community's point of view. To do this, the price related to this asset, will increase in time similarly to the interest rate or again the discount rate. See Hotelling H. (1931), "The economics of exhaustible resources", *Journal of Political Economy*, vol. 39, p. 137-175.

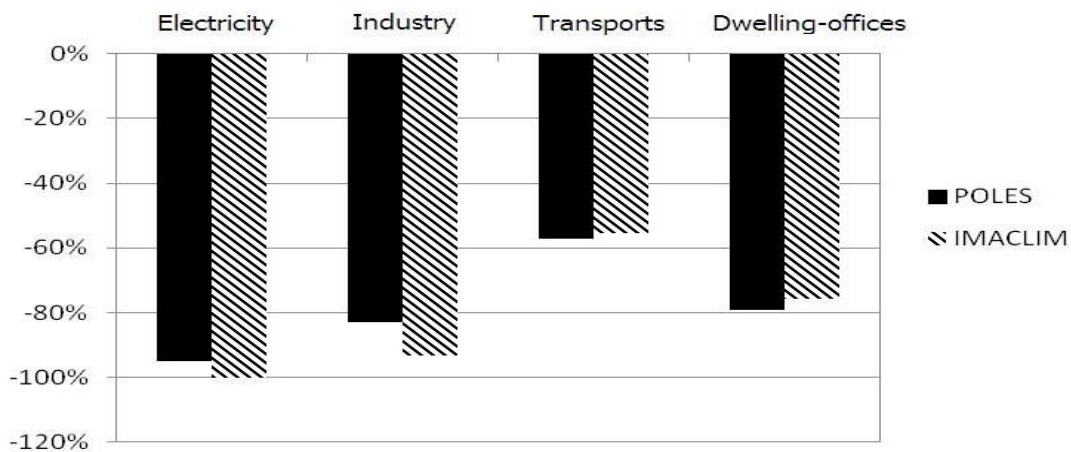
(2) This is a rate which is added to the economy's growth rate implicitly used in the POLES model to take into account specificities linked to climate change. For instance, in the Stern Report, a 0.1% rate was used. See Quinet Report: Centre d'analyse stratégique (2009), *La valeur tutélaire du carbone*, rapport de la commission présidée par Alain Quinet, Paris, La Documentation française, [www.strategie.gouv.fr/content/rapport-de-la-mission-la-valeur-tutelaire-du-carbone](http://www.strategie.gouv.fr/content/rapport-de-la-mission-la-valeur-tutelaire-du-carbone).

(3) It will be noted that the models do not take into consideration the funding conditions required in connection with such an increase in the objective.

### 3. A distribution of the effort which emphasises the sectors' diversity

The models provided an explanation of the breakdown of the emission reduction trajectories between sectors. This sector distribution is given in Chart 24 which only covers energy CO<sub>2</sub> emissions. The agriculture is therefore partially included and is not on the chart.

**Chart 24: Distribution of emission reductions between sectors in 2050 compared with 2005 (energy CO<sub>2</sub> only)**



Source: POLES and IMACLIM

Models' results indicate that all sectors should contribute to emission reductions so that factor 4 may be reached in 2050. But they also suggest that the constraints resulting from the inertia specific to each sector mean that the emission reduction's pace should substantially vary from one sector to another. In this regard, the Committee noted that the models' results and its own analysis made at the sector sessions were very consistent (see Chapter 3): in these two types of approach, the highest reductions occur in the energy sector, then in industry, followed by construction, transport being the sector where reduction takes the most time to achieve.

### 4. Impacts on growth and employment depends on how the carbon value is recycled

Now how can macro-economic interactions be taken into account? To go beyond partial equilibrium models, a macro-economic relationship must be introduced, which several teams did and whose work generally converges (with the exception of the IMACLIM model). In this case, we are mainly using the results of the MESANGE model developed by the department of the Treasury (see Table 20). This model simulated a situation in which France would introduce a domestic carbon tax, the rate of which keeps pace over time with the carbon price for each of the three trajectories described above. The reference scenario assumes that we are on a regular growth path and does not take any future public policies into account. Accordingly, it does

not take into account a single carbon price signal over the whole economy. A policy's impact is measured on the basis of the difference between the *level* of interest variables (in this case, GDP and employment) after the shock and the *level* of these variables in the reference scenario.

Accordingly, there is an implicit assumption of a generalised carbon price which causes a shock on demand, but the effects of which depend on how the tax proceeds:

- the introduction of a price signal through a carbon tax, without recycling the proceeds<sup>1</sup>, would lead to a decline in the economic activity and employment. The more ambitious the reduction objective will be, the higher the decline;
- recycling the tax proceeds only in the form of reducing employers' social contributions is accompanied by a slightly positive effect on the activity and employment, all the more since the objective is restrictive in the short term (i.e. in 2020). This is called the "double-dividend". This result was already highlighted in the preparatory work when setting up the "Climate-energy contribution";
- an optimum effect is obtained from hybrid recycling combining a reduction in employers' social contributions and a support for innovation: support for R&D has a strong impact on competitiveness, growth and employment, and the reduction in employees' contributions reduces the labour costs and encourages increased demand for employment. Their combined effects lead to a substantial rise in growth and employment.

**Table 20: Macro-economic impacts of a carbon price according to various climate scenarios and ways of recycling**

	2020			2030			2050		
	SR*	CS*	CS+CIR*	SR*	CS*	CS+CIR*	SR*	CS*	CS+CIR*
<b>– 30% in 2020</b>									
GDP, in%	-0.45	0.37	0.59	-0.56	0.63	0.97	-0.37	0.82	1.19
Employment, in thousands	-78	106	125	-95	152	155	-55	159	164
<b>– 25% in 2020</b>									
GDP, in%	-0.25	0.21	0.42	-0.41	0.40	0.74	-0.44	0.76	1.13
Employment, in thousands	-44	59	78	-72	104	106	-70	157	162
<b>– 20% in 2020</b>									
GDP, in%	-0.07	0.06	0.28	-0.20	0.15	0.49	-0.58	0.70	1.06
Employment, in thousands	-12	16	38	-37	45	48	-99	163	168

Source: MESANGE

\*: SR: without recycling (the proceeds from the tax are not used to reduce the debt); CS: uniform decrease in employers' social contributions; CS + CIR: uniform decrease in employers' social contributions and reinforcement of the CIR.

These results are confirmed by the work based on the NEMESIS model. Nevertheless, interpreted with caution, modelling does not take into account the

(1) It is presumed here that the proceeds from the tax will go into the State's coffers but has no effect on the economy.

stickiness which, in reality, limits the economy's flexibility and its ability to react to a price signal, together with the best way for recycling the tax. We may wonder about the real functioning of the mechanisms that encourage the innovation diffusion and the right adjustments on the labour market.

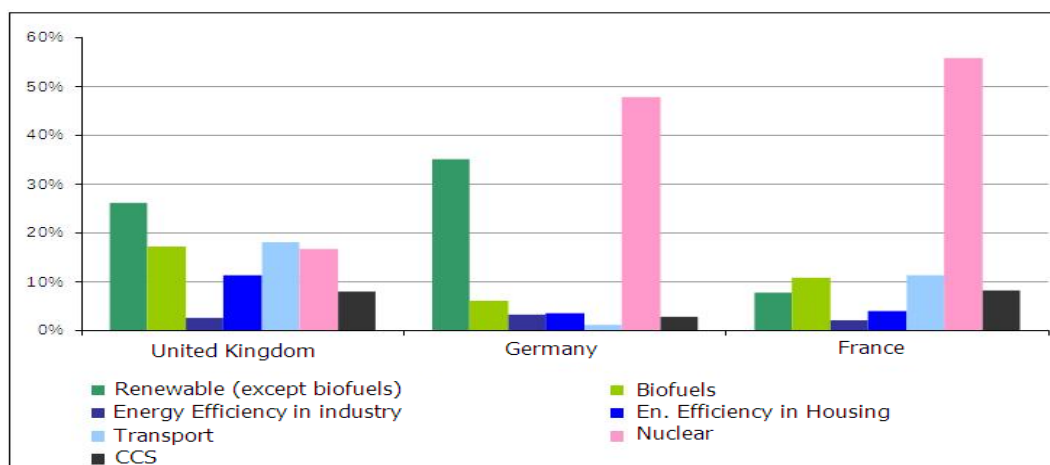
## 5. Technological changes require specific instruments

Regarding the increasingly high constraints caused by energy resources depletion and climate change, technological innovation is one of the key actions to reach the climate objectives.

The first issue is the transfer of clean technologies. Despite their many benefits, these technologies do not spontaneously spread, especially because of the presence of numerous economic and non-economic barriers. Government intervention is therefore desirable to correct these failures, incentives for instance helping companies to invest in these technologies. Extending the carbon price to non-ETS sectors is one way for doing so.

The second issue is that the currently-existing technologies are not sufficient to reach the objective. Technological breakthroughs within all sectors are therefore necessary, and this requires an increasing funding to R&D. The various sectors must adjust to technological changes and, doing so, supposes an increase in support for R&D. Currently, the R&D effort in France is substantial, but more important for nuclear energy than for other energy sources (see chart 25). Nevertheless, major French companies have substantial R&D capacity in some specific fields (*e.g.* Alstom in CCS, St Gobain in related materials and technologies, Air Liquide in industrial gases, EDF and AREVA – among others – in energy, the CEA, etc.). The key here is to find a way to transfer this knowledge, this "positive spin-off" to small and medium-sized companies since, as the models showed, this would eventually generate growth and employment on a long-term horizon. Clusters will therefore have a key role to play.

**Chart 25: Allocation of government expenditures in R&D in 2009**  
(as % of total expenditures for these seven items)



Source: IEA data base on R&D

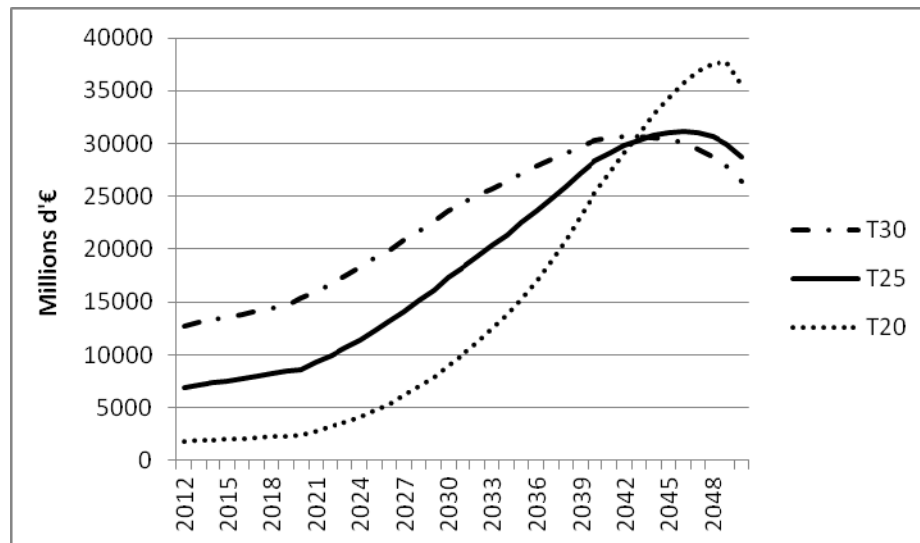
One should design climate policies carefully, not favouring one sector over another, leaving all choices open and using economic instruments to identify the best orientations. Crowding-out effects should also be limited through a global approach, by encouraging the export of national technologies and knowledge.

## 6. The financing issue and its link with the carbon price

A single carbon price will not be set across all sectors spontaneously and it will include a certain cost for the economy. The POLES model can assess the total abatement cost (i.e. the cumulated cost over the period 2010-2050) for each cost-effective trajectory. The indicative cumulated cost over the whole period given by the POLES model ranges from EUR 256 billion to EUR 437 billion. It covers both extra investment costs against a reference scenario without any climate policy, and all the transition costs. With respect to GDP, this cost is at its lowest level at the start of the period in scenario T20, and suddenly rises after 2030. It is more evenly spread over time in scenarios T25 and T30. However in every case, the problem is to find the corresponding funding for investments that have to be made from the beginning of the period.

The Committee's analysis suggests using an economic instrument (i.e. carbon tax or emission permits market) to reach these objectives at the lowest cost while raising financial resources (tax proceeds or revenue from auctioning emissions quotas). Chart 26 shows the revenues expected from a carbon tax consistent with the three cost-effective emissions reduction trajectories.

Chart 26: Potential revenues from the carbon tax



Source: MESANGE

Two observations can be seen from chart 26:

- 1) the introduction of a carbon tax could be combined with substantial financial resources (the total may range from EUR 578 billion to EUR 891 billion, depending on the trajectory);
- 2) these revenues will be short-lived: they will start to decrease when paying the tax will become more expensive than the cost of reducing emissions. On the one hand, this feature will prove the effectiveness of the instrument. But on the other hand, it implies that new revenues will have to be found in the very long term to safeguard the Government balance sheet.

In fact, there are three ways to use carbon tax revenues: consolidating the budget, designing a transfer of taxation, funding additional expenditure. For example, it may be decided to reduce the debt; to support economic growth; to finance public policies, for instance those related to climate, which could make the reduction objective easier to reach (in France or in developing countries). Classic macro-economic models suggest that the optimum revenue-recycling scheme consists in i) reducing social security contributions ii) and supporting innovation. The latter corresponds to additional investments during a transition period funding by the government budget. As certain members of the Committee noted, the former – the labour cost reduction through a reduction of social contributions by the employers – supposes to find new sources to finance the social protection in the long term.

Finally, each revenue-recycling scheme produces specific socio-economic effects. The transition's social conditions should also be taken into account when choosing the revenue-recycling mode.

## 7. Social conditions in the transition towards a low-carbon economy

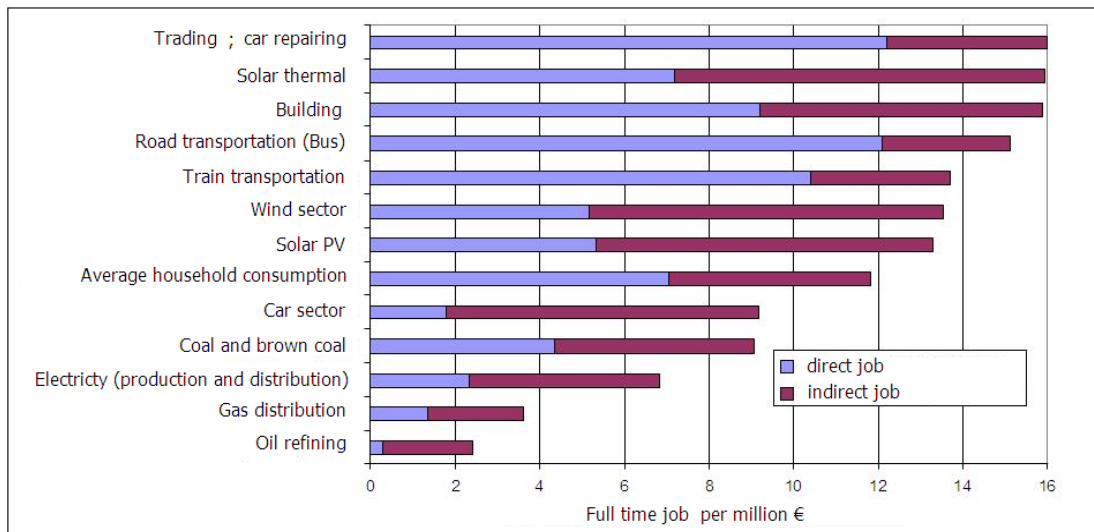
For the transition towards a low-carbon economy to succeed, one of the key conditions is its "social acceptability". Those who live close to an investment likely to damage the immediate environment use frequently the term in its narrow sense of acceptability. It is very important to take this feature into consideration, when deploying any new investment, whether it concerns a wind farm or a CCS installation, two technologies likely to lead to strong local opposition.

The Committee's analysis tried to make a broad assessment of the social conditions required for a successful transition towards a low-carbon economy. It encompasses not only the acceptability of a specific installation, but also a broad-based "social support" to this transition. Without this support, everyone will be reluctant to work for a low-carbon economy. This support first requires that information and knowledge are circulated through the educational system. But it will be all the more acceptable if the implemented policies create employment, anticipate retraining and correct the recessive effects likely to be generated by extending the carbon price to the whole economy.

The Committee studied the possible impacts of climate policies on employment in detail. The simplest method consists in comparing the direct and indirect labour content in the various sectors. Net jobs' creations appear as the difference between creations in the low-carbon sectors and jobs' destructions in the large emitting sectors (or processes).

For several reasons, the labour content differs quite considerably from one sector to another: variable import elements, differences in profit rates, differences in salaries, income from natural resources, ground rents, etc. In France, the traditional energy sectors tend to be less labour-intensive than those of building, public transport and service sectors (see chart 27). Renewable energies have an above-average labour content, but it is difficult to distinguish transitional jobs linked to their initial deployment (construction work and installation) from those with a long-term effect. In France, the labour content in the fossil branch is low, since fossil energies are imported and jobs linked to this oil production are created abroad. Hence, the labour content will depend on the ability of the public authorities to develop new industrial sectors which can ensure that new equipment is supplied and installed, and also ensure that they are produced upstream as well as the related R&D activities.



**Chart 27: Job content in full-time equivalent for French sectors**

Source: Philippe Quirion's presentation to the Committee

If we want the positive impacts on employment to be effective, retraining schemes has to be carried out under good conditions. Some sectors or businesses will decline, while others will generate new jobs. Macro-economic modelling shows that recycling the carbon value towards reducing charges and additional expenditures on R&D is likely to show a positive balance rapidly. Given the inertias and the stickiness of the labour market, one of the major conditions is that the transitions should be anticipated and prepared in advance. This means both adapting initial and on-going training to respond to new requirements and to support employees in their career plans. In Chapter 5, the Committee puts forward some proposals to improve this employment and skills management policy.

The last condition for social acceptance: to prevent the possible negative effects of extending carbon pricing to the whole economy, particularly those that may affect the most vulnerable households. Studies show that one household out of five is concerned by “fuel poverty”. If a generalized redistribution of carbon tax revenues to households would compromise the objective of reducing charges on employment, the lack of any compensation runs the risk of increasing the inequalities among individuals. A revenue-recycling, combining a decrease in social contributions and differentiated compensation for households that are the most vulnerable to energy prices rise, should therefore be considered. Hence, social equality should be reconciled with economic efficiency.

## 8. The impacts for France of a more ambitious European objective to reduce emissions by 2020

Elements are now available to make a more in-depth analysis of the impacts that an increase in the European emission reduction for 2020 will have in France. Even though not all of the Committee members share the same view on the opportunity for such an increase, its work makes it possible to identify the parameters that the authorities should take into consideration when making such a decision.

- 1) A first criterion when deciding whether or not to increase the objective is the resulting additional cost. In its 2010 communication<sup>1</sup>, the Commission outlined that moving beyond a 20% reduction target and stepping up to a 30% (with the possibility of using international flexibility mechanisms) would cost an additional EUR 10 billion by 2020. This cost is clearly lower than initially estimated because of the economic recession. For France, the modelling exercises estimate the additional cost between EUR 4 and 9 billion (i.e. between 0.2 and 0.4% of GDP), depending on the models.

If the criterion is to minimise the cost per tonne of CO<sub>2</sub> avoided over the whole period, the trajectory through a –25% in 2020 must be given priority if a low discount rate is used, which is customary in climate policy. If a rate which rapidly depreciates the future is used, the trajectory through a –20% may be accepted, but achieving factor 4 at the end of the period would become very costly, even unlikely.

- 2) The modelling analysis suggests that a cost-benefit analysis should be done to take the right decision. Even if considering only climate-related benefit or having a regular carbon price increase over time, the objective of –30% in 2020 must be given priority. However, to guarantee that this trajectory is effective, the assumption must be made that a carbon value is introduced into the whole economy from the start of the period.

Taking into account these macro-economic retroactions linked to the introduction of the carbon value suggests that a revenue-recycling scheme would result in positive effects on growth and employment rapidly if it combines three elements: the reduction in labour costs, a targeted compensation for the households in “fuel poverty”, and additional funds for R&D and innovation. However, its effects imply that the economy shows the flexibility and adaptation that the models are hardly able to assess.

- 3) From an institutional standpoint, the decision to increase the European climate objective by 2020 does not only depend on France but also supposes to reach a political agreement within the EU. If such a decision is taken, the commitments must be made by EU members, as well as the share of the additional reduction must materialise in the ETS and non-ETS sectors.

The Committee's work shows France's very specific position since most of its emissions are non-ETS ones for which there are few flexibility mechanisms among European countries. To make it easier to reach ambitious targets in the non-ETS sector, our country may wisely suggest to our European partners that the flexibility mechanisms in Europe be extended to the non-ETS sectors.

- 4) A 5% increase in the objective for the non-ETS sector could not be reached only by implementing the existing policies and measures. Consequently, additional measures must be rapidly taken, that comply with the constraints of every sector. The analysis in Chapter 3 highlights that existing measures are a combination of regulatory measures, the costs of which for the economy are poorly identified, and of a tax incentive system that is costly for public finances.

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(1) European Commission (2010).

Accordingly, extending them could weigh on the State's budget. Funding them would be largely facilitated by extending carbon pricing across the economy since it provides incentives to reduce emissions while simultaneously procuring additional revenue to the government. For this reason, most of the Committee's members expressed themselves in favour of the extension of the carbon price signal to the non-ETS sector, if possible at the European level which may take time and, if not, on a national scale rapidly.

- 5) A 5% increase in the objective concerning the ETS sector would result in lowering the carbon market's emission cap by a little more than 10% in 2020, according to the Committee's assumptions on the division between ETS and non-ETS. Its first effect would be a rise in the price of the CO<sub>2</sub> quota which the ZEPHYR model estimated at a little more than EUR 40 per tonne. Such a rise in the carbon price is desirable with regard to carbon's reference value and is sought by the Committee's members; but companies consider that an increase in the 2020 target is not the most suitable way as it does not take into account the time limits required for investment and highlights the credibility of the previously enacted rules.

They recommend a rapid change in the regulatory framework which takes into account the recommendations in the Prada report for setting up stricter regulations specific to the carbon market. Simultaneously, introducing a mandatory and ambitious target to reduce emissions by 2030 would enable the carbon market's mechanisms to be addressed in a long-term perspective by increasing the price of the CO<sub>2</sub> quota.

- 6) An increase in the emission reduction objective could finally be an opportunity to maintain the requirement to extend the flexibility instruments set up by the Kyoto Protocol and to selectively invest in project mechanisms, particularly in less advanced countries up to now too far removed from this type of investment.

Finally, a wide consensus prevails within the Committee to create a tighter link between the transition towards a low-carbon economy, the development of new industrial sectors and an improvement in the competitiveness of restructuring sectors. This is the vision that inspired most of the proposals detailed in Chapter 5.



## Chapter 5

# Propositions for a successful transition towards a low-carbon society

By crossing the comparative approaches (Chapter 2), the sector analysis made in Chapter 3 and the results of the modelling exercises (Chapter 4), the Committee attempted to make a series of propositions which should enable France to combine an ambitious reduction in greenhouse gas emissions with economic growth and employment. Each proposal is broken down into elementary measures for their implementation. This chapter does not include the Committee's sectoral measures which are grouped together in Chapter 3 of this report.

The aim of these proposals is to produce a consistent set of measures which could be implemented within a relatively short time, the monitoring of which incidentally should be repeatedly assessed under a renewed climate policy governance. Furthermore, the reader will find in annex #4 (see French version of the report) all the contributions from the various Committee's stakeholders reflecting all its diversity and creativity.

### 1. Strengthen industrial policies aimed at promoting the transition towards a low carbon economy

On numerous occasions, the Committee recommended the strengthening of an industrial policy that promotes the transition towards a low-carbon society. In line with the propositions made in the recent report released by the *French Economic Analysis Council*<sup>(1)</sup>, devoted to the required conditions for a sustained growth in France, it means improving competitiveness of French companies by introducing horizontal policies and, together with the plan "Investments for the future", to support the most promising research and development projects submitted by industries.

The aim of current industrial policies is to improve the country's growth potential by responding to major long-term structural challenges. One of the best examples is the transition towards a low-carbon society that will need several decades. Apart from so-called horizontal actions intended to improve the competitiveness of an economy and its companies (improved training, reduced costs for the enterprises, etc.), an industrial policy promoting this transition will try: i) to encourage technological breakthroughs; ii) to focus on applied research and pre-production experiments (pilots, preliminary runs, etc.) that have benefited from poor funding up to now; iii) to design long-lasting mechanisms for implementing the plan "Investments for the future", in selecting the best initiatives; iv) to give priority to European approaches in the support mechanisms to

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(1) Conseil d'analyse économique.

create European-sized or even world-sized companies; v) to encourage the setting up of technological centres and clusters specialized in innovation; vi) to co-ordinate French enterprises that belong to the same export sector.

The aim of such a policy would be the same as if it would be carried out at a European level: in fact, it will lead to the emergence of European-sized projects with the ambition to be exported all over the world.

The first measure, mentioned in the previous paragraph, consists in using part of the revenues from CO<sub>2</sub> quotas for the most promising R&D projects submitted by the industries and the relevant public organisations.

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#### PROPOSAL 1a

Promote competitiveness centres, "clusters" and so-called "green growth" sectors which will develop projects intended to reduce greenhouse gas emissions, without however dispersing the research credits. In particular, take into account the criteria of the transition towards a low-carbon economy for the evaluation of "competitiveness centres" (to be set up in 2012).

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#### PROPOSAL 1b

Fully use the domestic or European grants for R&D and innovation in order to fund the setting up of demonstrators and pilots. Within the scope of a consultation with the Commission and all the Member States, assess the adjustments to be undertaken when determining these grants so that funding which is the closest possible to pre-commercial phases is provided, so that the EU's economic actors have the same room for manoeuvring as their competitors in other geographic areas, particularly the United State, Japan, China, etc.

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#### PROPOSAL 1c

Implement an "export plan" for French low-carbon technologies, closely co-ordinated by the government and the companies, and based on a voluntary co-ordination of French companies in the same sector.

## 2. Promote strengthened R&D and dissemination of technological innovations enabling the transition to a low carbon economy

This proposal is made up of three sections: international, European and national.

The intellectual property law appears to be compatible with disseminating innovations in the low-carbon technologies' field. In the specific case of less advanced countries, it would be relevant to study the cases where certain measures would slow down the dissemination of innovations and to assess solutions compatible with the international law on intellectual property.

One solution could be the set up of an observatory for technology intended to identify not only good practices for disseminating technologies but also deadlock or monopoly situations requiring specific measures, under international laws. As a priority, these solutions could benefit the less advanced countries (for instance, those emitting less than 2 tCO<sub>2</sub>eq per capita) as well as those which comply not only with intellectual property rights, but also with procurement codes, other international market regulations and elementary social rules (decent work, child labour, etc.).

Technological breakthroughs are absolutely necessary in the 2050 energy sphere. R&D will play a key role in going that way. At the national and European levels, reaching the roadmap's objectives depends on the development of new technologies whose dissemination is held back by the rate at which costs are reduced and society's frequently low acceptance. Setting up demonstrators with the aim of running laboratory tests on industrial prototypes makes it easier to disseminate new technologies. Their additional cost is now high and appropriate financial support will have to be provided.

The mechanism called NER 300, launched under the Climate-Energy Package at the end of 2007 and characterised by an initial invitation to tender, still in progress, initiated at the end of 2010, is a practical and a priori attracting illustration of the government's intervention. Its aim is to fund at least eight carbon capture and storage projects and about thirty others for developing renewable energies. It also seeks to speed up the introduction of innovative technologies on the market for renewable energies and carbon capture and storage. It would be wise to build on this initial experience in using the proceeds from auctions to disseminate innovation to replicate it on a larger scale in the future.

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#### **PROPOSAL 2a**

Set up an observatory in the Climate Technologies Centre, initiated in Cancun, in order to promote good practices for disseminating low-carbon technologies and to identify the situations causing deadlocks and monopolies justifying, for countries complying with international intellectual property law, setting up specific solutions compatible with the international law, particularly those available in the WTO agreements on the trade-related aspects of intellectual property rights (TRIPS).

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#### **PROPOSAL 2b**

Reach the primary objective of transferring low-carbon technologies to developing countries while abiding by the principles of sustainable development, and while taking particular care to avoid any opportunistic use of social or environmental dumping:

- make aids for technology transfers, that help tackle climate change, conditional on complying with a certain number of social rules (decent work, child labour, other ILO rules, etc.);
- study the possible conditionalities to avoid offshore.

## PROPOSAL 2c

Recycle a share of carbon revenues from auctioning to continue to fund research and development projects, as well as demonstrators for low-carbon technologies (renewable energies, carbon capture and storage, advanced biomass, smart grids, etc.). Focus on applied research and pre-industrial experiments (technological platforms, pilots, demonstrators, preliminary runs, etc.).

### 3. Extend the predictability of climate policy by defining binding European targets for 2030 and strengthen its credibility by renovating its governance

Industrial players have strongly expressed their need for a long-term visibility of the efforts to be made. In this regard, 2050 appears to be too far away to reduce uncertainties about the public policy and 2020 too close for investment decisions to be oriented towards the long-term. It is for this reason that, apart from the necessary explanation of the 2020 objective, the Committee recommends setting credible objectives for 2030 both at European and domestic levels:

- at the EU level, it recommends that France rapidly suggests to its European partners that a global emission cap on the ETS market should be determined up to 2030, consistent with reaching the 2050 objectives determined by the European Union's Climate Roadmap. Such a decision would give a carbon price signal in line with the long-term climate policy objectives;
- at the same time, the regulatory standards systems, be they national or EU, should rapidly anticipate the change in the thresholds required for that date. For instance, this concerns the emissions thresholds per kilometre for cars and heavy goods vehicles, efficiency of energy equipment, construction standards and building renovations, etc.

Given our country's very substantial share of emissions from non-ETS sectors, the Committee moreover proposes to follow the British example (see Chapter 2) by introducing a system of domestic reduction objectives set up over a specific period of time. This indicative system could be a five-year, even a three-year, carbon budget which may be revised to adjust the objective to the external conditions if necessary. It should be broken down by major non-ETS sector to enable monitoring over time the consistency between resources used and the achievement of the emission reduction trajectories.

It would be better if this mechanism is set up under a renewed governance of the climate policy with the establishment of an independent Committee, composed of all the stakeholders, and including scientists and economists, the aim of which would be to assist the authorities in ensuring that the institutional mechanism is consistent and predictable over time. Such stability seems a necessity to activate the investments required for the transition towards a low-carbon economy.



### PROPOSAL 3a

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Besides the necessary clarification of the 2020 objective, define immediately an ambitious objective for reducing European emissions for 2030, compatible with the 2050 European roadmap which recommends a 40 to 45% emission reduction by 2050. Break down this objective between ETS and non-ETS sectors, and between Member States, to give a clear view of the efforts to be provided by the various actors in the long term.

### PROPOSAL 3b

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Set regulatory standards for 2030, be they European or French, for emissions by cars and heavy goods vehicles, energy equipment performance, construction standards and building renovations, etc.

### PROPOSAL 3c

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Determine French non-binding intermediary targets for multi-year periods, broken down by sector and consistent with the European framework in order to strengthen the trajectories' guidance. The adequacy between the financial resources needed to reach these targets and the results should be regularly monitored by the governance structure envisaged in the next proposal before the Parliament examines them.

### PROPOSAL 3d

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Set up an independent national governance structure which groups together the required scientific and economic expert knowledge and brings in the various stakeholders to discuss the climate policy's orientations upstream, to assure their continuity and ensure they are monitored so that, if needed, they may be re-oriented.

## 4. Strengthen the carbon price signal by making it economy-wide and improve regulation of the European CO<sub>2</sub> trading system

The modelling work showed that extending the carbon price signal to non-ETS sectors would constitute a priority for France's climate policy. This price signal would benefit from being established on a European scale. France ought to push in this direction every time it has the opportunity of doing so. At the beginning of 2010, the Commission agreed to a proposal to revise the Directive on energy taxation, which would change the European framework setting the minimum taxation on fuels by introducing a component based on the carbon content to be added to a first term, already in existence, on the energy content. However, all the Member States would have to vote unanimously on the proposal. An alternative solution would be to extend the ETS to all CO<sub>2</sub> emissions from fuels and fossil fuels on the market. In fact, it would

just require a simple qualified majority. Increased co-operation could also result from the introduction of this price signal in volunteering countries.

Even if the carbon price signal cannot be extended all over Europe, many Committee's members would like to have it introduced on a country basis, in a form preventing from adding distortion into the intra-European trade. The analyses carried out in Chapter 4 showed that the carbon revenue-recycling is of great importance. Not properly designed, it could impede economic growth and lead to inequalities among households. Well-designed, on the contrary, it would cut our GHG emissions while, to a certain extent, fostering employment as well as growth in the short and long term, without however penalising the most disadvantaged households.

It would be easier to introduce the carbon price signal in non-ETS sectors if the European trading system of CO<sub>2</sub> quotas is made more secure and subject to a stringent regulation. The Michel Prada's report, published at the beginning of 2010, outlines the characteristics of a specific regulation of the carbon market which would guarantee its integrity and predictability under the auspices of an independent European authority. However, there is a risk that the European Commission will follow these conclusions as it envisaged simply applying financial regulations to the carbon market. Many of the Committee members would like France to continue to act vigorously so that an *ad hoc* regulation is applied to the carbon market as the prototype of the new conformity markets which, in the future, could develop to protect rare environmental resources.

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#### PROPOSAL 4a

Introduce the carbon value into the non-ETS sector for all CO<sub>2</sub> emissions from energy use, ideally at a European level but at least at a national level (if it becomes impossible to meet the appropriate deadlines for implementation).

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#### PROPOSAL 4b

Revitalise the European emission trading system through new rules determining the cap's evolution between 2020 and 2030 consistent with the roadmap's objectives for 2050.

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#### PROPOSAL 4c

In accordance with the recommendations of the Prada's report, increase the European market's security by rapidly implementing specific emission trading regulations which guarantee integrity and predictability under the auspices of an independent European authority.

## 5. Improve and implement the flexibility mechanisms at the international level and promote their use within the European Union

By the end of the first commitment period of the Kyoto Protocol in 2012, an ambitious and comprehensive agreement will never be ratified. Current negotiations are making progress on certain technical points, on which France must insist at the upcoming climate meetings in December in Durban. Reliable systems for monitoring, reporting and verifying emissions (MRV) are therefore essential if comparisons can be made on greenhouse gas emissions, particularly on forests or agriculture.

One of the important issues to be addressed at the Durban Conference lies in extending, beyond 2012, certain instruments deriving from the Kyoto Protocol. This is the case with the flexibility mechanisms and, in particular, the clean development mechanisms, which should however be improved to enable programmatic approaches to be funded. The latter are already included in the ETS of the Energy-Climate Package which however plans to dedicate them to the least advanced countries or to those entered in a bilateral agreement, while nowadays the major emerging countries are the first beneficiaries of these mechanisms. Maintaining these instruments under the United Nations would enable information on projects to be centralised and to avoid a double counting.

The Committee also favours an extension of the domestic project mechanisms in Europe. It recommends France to ask the Commission for an in-depth analysis of the article 24 bis of the directive on the ETS system which offers an interesting prospect in this regard. It particularly recommends applying this system for reducing methane and nitrous oxide emissions caused by farmers; current economic incentives are not sufficient.

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### PROPOSAL 5a

Obtain the maintaining and improvement of project mechanisms deriving from the Kyoto Protocol, if possible within the scope of a wider agreement incorporating a new commitment period and including the main emitting countries.

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### PROPOSAL 5b

Negotiate bilateral agreements with States or regional blocks that are effectively making a commitment, the least advanced countries (LDCs), and the Mediterranean countries, and programmatic approaches.

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### PROPOSAL 5c

Use experiments made in France, Germany, Sweden and Spain as a basis to set up a "domestic" project mechanism on a European scale in the non-ETS sectors, in application of article 24 bis of the ETS directive. Ensure that the system avoids any double counting, limits

windfall effects and, as a priority, is applied to sectors, such as agriculture, in which there are currently insufficient incentives to reduce their emissions of other gases such as CO<sub>2</sub>.

## 6. Ensure fully transparent management of auction proceeds and future climate-energy contributions, with a view to promoting economic growth, social equity, the development of low carbon innovation and international solidarity

The modelling exercise has highlighted the importance of the carbon revenue-recycling scheme for the economy. This section concerns both the proceeds from the auctions that France will receive as from 2013 on the basis of its participation in the EU CO<sub>2</sub> quota system and the proceeds deriving from extending the carbon pricing that the Committee moreover recommended.

Accordingly to the European system, the Member States decide on the allocation of the carbon auction proceeds. However the European institutions have recommended using at least 50% of the revenues for climate policies' funding. The models suggest that, in the current economic context, the adequate carbon revenue-recycling option consists in optimising, within the budget constraints aiming at reducing the deficit, between:

- the reduction in the labour cost for companies in order to create jobs,
- the long term expenditures encouraging innovation or R&D in particular, whether this is strictly in the energy field or in a certain number of key technologies;
- redistributive actions with regard to the most disadvantaged households and potentially disadvantaged players;
- the funding of new training courses and grants for retraining schemes;
- the support for tackling climate change in the least advanced countries.

According to the prospective exercises, the forests, that absorb 14% of domestic emissions, could flip from sink to source and become a net emission source by 2050. Its sustainability is therefore a priority within the scope of a low-carbon strategy. Its funding should be studied.

Similarly to the funds that the German government has envisaged, a French public structure combining the various stakeholders as well as experts and economists, could be set up to manage the auction proceeds and a carbon price signal's revenue. It would guarantee that these funds are properly and transparently used.

### PROPOSAL 6a

Determine a strategy for using the funds stemming from the national and European carbon pricing, which takes budget constraints into account and lies within a multi-year view, by integrating the five priorities highlighted by the Committee's work: reduced charges to enhance productivity; targeted compensation for households in “fuel poverty”; funding R&D and dissemination of low-carbon innovations in France and within the scope of international co-operation; funding new training courses and grants for retraining schemes; support for tackling climate change in the least advanced countries.

### PROPOSAL 6b

Associate manufacturers, experts and economists and all the stakeholders in managing the auction proceeds passing through the existing trading account in a multi-year strategy facilitating the transition of industry towards a low-carbon economy.

### PROPOSAL 6c

Establish a public structure in the form of a fund to transparently manage and assess the use of the revenues from the carbon price signal in the non-ETS sectors to optimise economic, social and climate spin-offs.

## 7. Anticipate changes in the job market and plan for achieving successful job transitions

The potential economic growth together with the transition towards a low-carbon economy will emerge insofar as the required changes in job, occupations and qualifications as well as the development of professional mobility, even new job creations, will enable demand to be met. Here we see all the interest in knowing how to anticipate changes in qualification needs and the labour market to set up training courses and tools for indicating the corresponding skills in the various sectors concerned, particularly in the building sector where a marked increase in skilled jobs is expected. A specific committee focused on the building sector should be set up in order to study the questions related to initial and on-going training, retraining, supporting employees and firms. Furthermore, prospective studies (sectoral and/or regional) undertaken by the social partners should contribute to a better analysis of recruitments as well as training and skills.

The models produced by the Committee showed that the climate policies may have an effect, moderate but positive, both on growth and employment. Their acceptability depends on it. This effect will be depends on the concerned sectors, some of which should restructure, those currently working with a high carbon footprint. Similarly, new jobs should be created in the sectors contributing most to the emergence of low-carbon technologies: renewable energies, substantial building renovations, public transport. However, here again, the number of jobs created will depend on the industrial strategy (which affects the technologies' labour content) and support in

terms of initial vocational training and on-going training which could be given impetus by the government action together with the social partners.

Organising the discussions on these issues would be desirable both within the various national commissions and sectoral committees, and also at a regional level. Finally, the clusters should enable future technologies and occupations to be anticipated. Implementing a social dialogue intended to integrate reflection and monitoring training (initial and on-going), human resources, disseminating the scientific and technical culture is entirely appropriate here.

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#### PROPOSAL 7a

Ask each national joint Commission for employment and training (CPNEFP), as well as the sectoral Committees set up by the National Industry Conference, to study the possible consequences of the transition towards a low-carbon economy in order to anticipate qualifications, skills and training needs and the retraining stakes, both from the quality and quantity standpoints. Organise this same study on a local scale (together with the European breakdown of strategic workforce planning).

*Comment: this study could also be carried out on employment areas taking inspiration from the experience gained by 33 employment centres, even to entrust it to them.*

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#### PROPOSAL 7b

Encourage social dialogue within competitiveness clusters to integrate reflection and monitoring training (initial and on-going), human resources, disseminating the scientific and technical culture.

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#### PROPOSAL 7-3

In view of the efforts to be made by all the professionals not only in renovating existing housing but also for new buildings, set up a building sectoral committee to examine initial and on-going training courses, retraining and support for employees and enterprises. With the transition towards a low-carbon society in view, other sectoral committees should probably be set up, particularly in the agri-food and automotive industry sectors.

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#### PROPOSAL 7c

By means of the European social funds in particular, encourage and support the social partners to establish forward-looking study contracts (sectoral and/or regional) to identify the recruitment needs as well as those for training and skills.

## 8. Develop innovative financing schemes that combine public and private equity and use of carbon value as leverage

On an international scale (the promised North-South funding of USD 100 billion per annum by 2020 made at the Copenhagen summit), and on a national and European scale, the funding of climate policies is the core question. This issue arises in a context that is doubly penalising:

- budget consolidation will take time because of the size of the public deficits in developed countries and the doubt in Europe on the quality of sovereign debts;
- the economic and financial players re-evaluation of risks led them to be very cautious in making new investments. This shortage of investment is one of the parameters which slows down recovery and increases the risk of falling back into recession. It has been very strong for the past two years in a number of niches in the low-carbon economy (severe decrease in new CDM projects, investors' reluctance towards carbon funds, investment in renewable energies diminished, etc.).

The Committee's work highlighted a certain number of innovative mechanisms that our European partners have implemented or are developing (Chapter 2). In general, these mechanisms have two characteristics: they combine private and public capital with the idea that this type of partnership enables a leverage effect to be exercised in relation to public money. They seek to use the future value of energy savings or carbon emissions avoided for immediate funding as loans or as equity (mechanism called "third-party investors").

It is relatively easy to draw a diagram of such funding mechanisms on paper, but it is much more difficult to establish on a large scale as the various partners have to agree to share the risks. In the allocated time, the Committee was unable to further develop its views. Nevertheless, it felt that studies should be carried out to analyse which conditions are required to develop this type of instrument on a large scale. The intuition underlying these innovative instruments is that a sustainable climate policy would eventually lead to a high valuation of the carbon avoided and that there must be a way to capture part of this valuation today, or finding the appropriate means of transferring this future valuation over time.

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### PROPOSAL 8a

**Set up a working group whose mission would be to study the practical conditions for developing innovative financial mechanisms on a large scale combining public instruments, re-orienting savings, calling on private resources and using the carbon value leverage. The objective is to speed up housing renovation, energy-efficiency investments (particularly small enterprises) and to develop industrial projects at the cutting edge of technology.**

## 9. Integrate effectively climate policy objectives into urban and rural planning policies

The Committee's work raised the question of the spatial consistency of the sector trajectories. In concrete terms, the local authorities will play a significant role in implementing policies that tackle climate change, particularly in land planning and use. By using urban planning documents in the right way (local urban planning, development plan, etc.) and land use authorisations, and also through their land development skills (urban planning, rural planning, urban and rural regrouping, renovation and protection operations, etc.), the local authorities may have a decisive impact on how objectives to reduce greenhouse gas emissions will be reached. Land use that does not pay attention to the link between housing and activity, unsuitable land development and poor location of state-owned equipment may compromise the success of other policies or wipe out the expected effects of the most restrictive standards.

Since the *Grenelle Environment Round Table* (Act 2), even if the SCOTs and the PLUs "determine the conditions making it possible to ensure, in compliance with sustainable development objectives, a reduction in greenhouse gas emissions", it must however be stated that the field of application of these various schemes and plans must be compatible with the objectives to reduce emissions decided at a national level.

The local authorities must be persuaded to review their urban planning documents. In fact, implementing a genuine policy for conserving farmland in France is urgent, by setting an objective to halve the rate at which farmland is taken out of use by 2020, according to the explanatory note attached to the Law passed on July 2010 on the modernisation of Agriculture and Fishing. An agricultural land policy must be comprehensive. Existing measures should be used as a basis, particularly those which apply at an intercommunal level, such as regional cohesion schemes. This scale seems to be the most relevant: in fact it enables local specific features to be taken into account, while being wide enough to avoid actions that are too dispersed. Priority should therefore be given to land management on an intercommunal scale.

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### PROPOSAL 9a

Make it legally binding that urban planning documents (SCOT and PLU) should be compatible with national objectives on combating climate change.

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### PROPOSAL 9b

Implement a genuine policy to conserve farmland in France by setting an objective to halve the rate at which farmland is taken out of use by 2020 and by using the SCOTs and PLUs as a basis to rapidly contain trends towards building on land and to urban sprawl.



### Four avenues worth exploring in more detail

This report explored the ways in which collective action may be intensified when faced with climate change in a very tense economic and financial context. In the introduction, it was noted how the economic crisis environment made it desirable to implement climate policies which rapidly stimulate economic growth and social progress. The Committee's work identified two major series of conditions to achieve this:

- to closely associate public action on climate change with a supply policy combining strategies to develop competitive industrial sectors, increasing research and development and disseminating low-carbon innovation in the economic fabric;
- to make the scope of the public action reliable, with the objectives set for the economic agents predictable in the long term, and with the economic incentives which will help them succeed, particularly by ensuring a widespread carbon pricing in the economy.

The sectoral scenarios analysed, sector by sector, the required changes in technology and organisation to reach the objectives set. The economic assessments emphasised the importance of implementing powerful economic instruments to speed up the transition to a low-carbon economy. Their social acceptability depends on a dual condition: maximising the positive impacts on employment and countering the socially regressive effects of the carbon pricing.

However, it was impossible to review all the subjects in depth. Hence, a number of fields remain to be further explored. Four avenues require attention as a priority:

- forward-looking scenarios in the report are not sufficiently connected to the assumption which, all together, concern the economic and energy environment and the choice of climate policy instruments implemented under the national and European plan. It would therefore be desirable to make a deeper study of these scenarios, together with the other forward-looking exercises carried out to 2050 in Europe and in France. In the future, it would enable a better *ex ante* assessment to be made of the effects of the various possible choices for public action and to test the scenarios' sensitivity to various economic and energy crises;
- an analysis of the cost of the climate policy scenarios is still too simplistic. It is based on economic models which are unable to break down these costs by standard economic category. A deeper investigation should identify at least three economic categories: investment costs, the amount of which must be balanced against the expected returns; apprenticeship and transition costs; social costs in

terms of jobs or standard of living. Furthermore, the analysis should clearly identify where these costs are shared by the public finances and the private sector;

- from the deepening of the cost concept, one moves directly to the question of funding methods and particularly innovative funding. The report stressed how extending a carbon value in the economy may change the funding prospects, both for the public authorities and for private players. Accordingly, any possibility of using the future carbon value as a leverage to widen current funding for the transition to a low-carbon economy should be used. Implementing such mechanisms involves a detailed analysis of risk sharing which could not be carried out within the time the Committee was allocated;
- if the carbon pricing is extended, the scale of related prices and costs in the economy will be deformed, with the price of high carbon-footprint goods and services increasing, particularly energies of fossil origin. To avoid undesirable regressive effects, the distributive impacts of climate policies must be assessed with great accuracy, which requires a lot of new investigations, in view of the weakness of our current knowledge of the matter in France.

If attention is paid to these avenues for an in-depth exploration, they should be carried out within a framework ensuring that knowledge is capitalised over time and that the public debate is well informed.

# Appendix 1

## Mission statement



MINISTÈRE DE L'ÉCOLOGIE, DU DÉVELOPPEMENT DURABLE,  
DES TRANSPORTS ET DU LOGEMENT

La ministre

Paris, le 21 JUIN 2011

Monsieur le Professeur,

La lutte contre le changement climatique est une priorité de la France. Dans le cadre de la loi de programme fixant les orientations de la politique énergétique du 13 juillet 2005, la France s'est dotée d'un objectif de long terme de division par quatre de ses émissions de gaz à effet de serre à l'horizon 2050, réaffirmé par la loi du 3 août 2009 relative à la mise en œuvre du Grenelle de l'environnement.

Au niveau international, l'Union Européenne (UE) s'est également fixée des objectifs ambitieux à moyen et long terme, en s'engageant à diminuer ses émissions de 20% d'ici 2020 et de 80 à 95 % d'ici 2050 par rapport à 1990.

A l'horizon 2020, le paquet énergie-climat européen adopté sous présidence française est construit autour d'un objectif minimum de réduction de 20 % des émissions de gaz à effet de serre de l'UE entre 1990 et 2020. Le Conseil européen de décembre 2008 a engagé l'UE à relever cet objectif à -30 % entre 1990 et 2020 dans le cadre d'un accord global sur le climat post-2012, à condition que les autres pays développés s'engagent à réaliser des réductions d'émissions comparables et que les pays émergents contribuent au regard de leurs responsabilités et capacités respectives.

La Commission européenne a publié le 8 mars dernier une feuille de route pour une économie bas-carbone en 2050 proposant une trajectoire coût-efficace de réduction domestique des émissions de gaz à effet de serre en 2020, 2030, 2040 et 2050. Le point de passage prévu pour 2020 se situe à -25% par rapport à 1990 et pourrait être atteint, d'après la Commission, par le simple respect des engagements déjà pris, grâce notamment à l'amélioration de l'efficacité énergétique. Plusieurs Etats membres, ainsi que des ONG et des entreprises, plaident dans ce contexte pour un relèvement à 30 % de l'engagement de l'Union européenne qui ne soit pas conditionné à des efforts comparables d'autres pays, en invoquant trois motifs :

- le premier est d'ordre environnemental et scientifique : le niveau global d'ambition actuellement affiché par les engagements de l'ensemble des pays n'est pas suffisant pour limiter l'augmentation de la température à 2°C en 2050 ;

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- le second est d'ordre économique : repousser à l'après 2020 une trop grande partie de l'effort risquerait de rendre bien plus coûteux l'atteinte de l'objectif de réduction de 2050 ; accélérer l'effort d'ici 2020 augmenterait les ressources tirées des enchères carbone susceptibles de financer une partie de l'effort ;
- le troisième est d'ordre politique : l'UE réaffirmerait ses ambitions et sa posture à la veille d'échéances internationales cruciales.

Pour prendre position dans ce débat qui concerne tout le monde, il importe de considérer l'ensemble des conséquences d'une telle évolution et en particulier ses impacts environnementaux, économiques, sociaux et juridiques à court et moyen terme ce qui passe par l'identification des scénarios les plus pertinents pour la réduction des émissions de gaz à effet de serre d'ici 2050.

C'est pourquoi j'ai décidé d'installer un comité, composé de représentants des entreprises, des syndicats, des ONG et des ministères concernés ainsi que d'experts, pour partager les analyses sur les scénarios les plus pertinents. Je souhaite que vous présidiez ce comité dont l'animation sera conduite avec l'assistance des équipes du Centre d'Analyse Stratégique et le soutien technique des services de l'Etat.

Ce comité devra réaliser une synthèse des travaux existants sur les cibles et les trajectoires de réduction d'émission de gaz à effet de serre à long terme. Il pourra organiser des auditions en tant que de besoin, chacun des grands secteurs devant être auditionné. Le rythme de ses travaux devra être articulé avec le calendrier des discussions au niveau européen.

J'attire en particulier votre attention sur la nécessité de traiter les questions suivantes :

- Quelles sont, dans le cadre de la feuille de route de l'Europe, les orientations prises par nos partenaires européens et de quels éléments précis dispose-t-on sur la comparabilité des efforts respectifs ?
- Quels seraient les potentiels de réduction d'émissions des différents secteurs (énergie et industrie, bâtiment, transports, agriculture et forêt) dans le temps (d'ici 2020 puis entre 2020 et 2050) ?
- Quels sont les différents scénarios envisageables, leurs avantages et inconvénients, notamment en termes de faisabilité technique, d'impacts sur l'économie et sa compétitivité (au niveau macroéconomique et sectoriel), et de retombée sur l'environnement ?
- Quelle part accorder aux instruments économiques domestiques et internationaux (par exemple marché de permis, taxe carbone, mécanismes de projet) pour atteindre les objectifs et quels critères pour assurer leur intégrité environnementale ?

Compte tenu des prochaines échéances communautaires et internationales, et notamment des Conseils européens, je souhaite que soit produite une note d'étape pour le 20 juillet et un rapport final pour le 15 octobre. La note d'étape inclura une synthèse des premiers échanges avec les parties prenantes et des travaux existants. Le rapport final récapitulera l'ensemble des analyses et permettra d'alimenter le débat européen sur le relèvement de l'ambition de réduction des émissions de gaz à effet de serre. Il devra permettre au gouvernement, à l'issue de ce travail collectif, de se positionner, grâce à une meilleure connaissance des impacts, sur la question du relèvement des objectifs de réduction des émissions.

Je vous prie de croire, Monsieur le Professeur, à l'assurance de ma considération distinguée.

Bonne nuit



Nathalie KOSCIUSKO-MORIZET

## Translation of the mission statement

Dear Professor,

Tackling climate change is a priority in France. Accordingly to the Law of 13 July 2005 related to its energy policy's orientations, France set a long-term objective to divide its greenhouse gas emissions by four by 2050, confirmed by the Law of 3 August 2009 on the implementation of the *Grenelle Environment Round Table*.

At an international level, the European Union (EU) has also set ambitious objectives for the medium and long term, undertaking to decrease its emissions by 20% by 2020 and 80 to 95% by 2050, compared with 1990.

The European energy-climate package for 2020, adopted under the French presidency, is built around a minimum objective of a 20% reduction in EU greenhouse gas emissions between 1990 and 2020. In December 2008, the European Council undertook to raise this objective to -30% between 1990 and 2020 under a global agreement on the post-2012 climate, provided that the other developed countries commit to comparable emission reduction objectives and that the emerging countries contribute as regard their respective responsibilities and capabilities.

On 8 March 2011, the European Commission published a roadmap for a low-carbon economy in 2050 working on a cost-effective trajectory to reduce domestic greenhouse gas emissions in 2020, 2030, 2040 and 2050. The first milestone planned for 2020 is -25% compared to 1990 and, according to the Commission, may be reached simply by abiding by the commitments already made, in particular owing to improved energy efficiency. In this context, several Member States, as well as NGOs and enterprises, argue in favour of the European Union's commitment being increased to 30% which is not conditional on comparable efforts by other countries, putting forward three reasons:

- the first one is environmental and scientific: the current overall ambition level evidenced by the commitments made by all countries is not sufficient to limit the temperature increase to 2°C in 2050;
- the second is economic: if too much of the effort is postponed to post-2020, there would be a risk that reaching the 2050 reduction effort would turn out much more costly; speeding up the effort by 2020 would increase resources raised through carbon auctioning and would in return fund today part of the effort;
- the third is political: the EU reconfirmed its ambitions and its position on the eve of crucial international events.

All the consequences of such a development should be taken into consideration when taking a stance in this debate which is of concern to everyone. In particular, environmental, economic, social and legal impacts in the short and medium terms should be considered by identifying which scenarios are the most relevant for reducing greenhouse gas emissions by 2050.

It is for this reason that I have decided to set up a committee, made up of representatives of enterprises, trade unions, NGOs and ministries concerned as well as experts, to share the analyses of the most relevant scenarios. I hope that you will chair this committee which will be organised with the support of the Centre d'analyse stratégique and technical support from the State's services.

This committee should make a summary of existing studies on the targets and pathways to reduce greenhouse gas emissions in the long term. If need be, it could hold hearings, and representatives of the major sectors should be heard. The tempo of the work should be organised around the discussions' timetable at European level.

I would particularly draw your attention to the need to deal with the following questions:

Within the scope of the European roadmap, what orientations have our European partners decided on and what exact elements do we have on the comparability of respective efforts?

What are the potentials for reducing emissions over time in the various sectors (energy and industry, construction, transport, agriculture and forestry) (by 2020 then from 2020 to 2050)?

What are the various possible scenarios, their advantages and disadvantages, particularly in terms of technical feasibility, impacts on the economy and its competitiveness (at a macro-economic and sector level), and the implications for the environment?

What share should be given to domestic and international economic instruments (for instance, permits market, carbon tax, project mechanisms) to reach the objectives and what criteria to ensure their environmental integrity?

In view of the forthcoming EU and international deadlines, and particularly the European Council meetings, I hope that a preliminary paper will be produced for 20 July and a final report for 15 October. This preliminary paper will include a summary of the initial discussions with the stakeholders and of the existing studies. The final report will summarise all the analyses and will facilitate the European discussion conducted on the greenhouse gas emissions and whether or not the target should be increased.

This joint effort will provide a better understanding on the potential impacts, helping thus the government to take position on this issue of raising the ambition of our GHG reduction commitment.

Yours sincerely,

Nathalie KOSCIUSKO-MORIZET

## Appendix 2

# Composition of the committee

### Chairman

**Christian de Perthuis**

Climate Economics Chair, Paris Dauphine University

### Rapporteurs

**Johanne Buba**

Centre d'analyse stratégique – Sustainable Development Department

**Aurélien Million**

Ministry of Ecology, Sustainable Development, Transport and Housing - General Directorate for Energy and Climate

**Pascale Scapecchi**

Ministry of the Economy, Finance and Industry - General Directorate of the Treasury

**Olivier Teissier**

Ministry of Ecology, Sustainable Development, Transport and Housing, General commission for sustainable development then Centre for Scientific and Technical Building Studies

### Co-ordinator

**Dominique Auverlot**

Centre d'analyse stratégique - Sustainable Development Department

### Assistant

**Elise Martinez**

Centre d'analyse stratégique – Sustainable Development Department

## Members

**Jacques Andrieu**

Ministry of Agriculture, Food, Sea Fisheries, Rural Development and Regional Planning

**Olivier Appert**

National Association for the Co-ordination of Research for Energy

**Matthieu Autret**

General Secretariat for European Affairs

**Richard Baron**

International Energy Agency

**Jean-Baptiste Baroni**

MEDEF (Movement of French Enterprises)

**Jean-Jacques Becker**

Ministry of Ecology, Sustainable Development, Transport and Housing, General Commission for Sustainable Development

**Étienne Beeker**

Centre d'analyse stratégique - Sustainable Development Department

**Sophie Blainville-Wellburn**

Ministry of Agriculture, Food, Sea Fisheries, Rural Development and Regional Planning

**Sébastien Blavier**

Climate Action Network-France

**Baptiste Boitier**

École centrale, Paris

**Xavier Bonnet**

Ministry of the Economy, Finance and Industry, General Directorate of the Treasury

**Nicolas Boquet**

French Association of Private Enterprises

**Sandrine Bourgogne**

General Employers' Confederation for Small and Medium Enterprises

**Jean-Paul Bouttes**

Électricité de France

**Dominique Bureau**

Ministry of Ecology, Sustainable Development, Transport and Housing, Economic Council for Sustainable Development

**Alain Capmas**

MEDEF (Movement of French Enterprises)

**Hélène Charpentier**

General Secretariat for European Affairs



**Christophe Chassande**

Ministry of Agriculture, Food, Sea Fisheries, Rural Development and Regional Planning, General Directorate for Agricultural, Agrifood and Regional Policies.

**Pierre-Franck Chevet**

Ministry of Ecology, Sustainable Development, Transport and Housing, General Commission for Sustainable Development, General Directorate for Energy and Climate

**Raphaël Claustre**

Liaison Committee for Renewable Energies

**Raymond Cointe**

Ministry of Ecology, Sustainable Development, Transport and Housing, Department of European and International Affairs

**Stéphanie Combes**

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**Morgane Creach**

Climate Action Network-France

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UPFM-Grenoble (EDDEN-LEPII) (Sustainable Development and Energy Economics-Production and International Integration Economics Laboratory

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**Sophie Gaudeul**

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**Daniel Geneste**

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**Matthieu Glachant**

Mines ParisTech Academy

**Jean-François Gruson**

National Association for the Co-ordination of Research for Energy

**Jean-Luc Haas**

French management confederation, General Managers Confederation

**Franck Jésus**

Environment and Energy Management Agency

**Jean Jouzel**

Intergovernmental Panel on Climate Change

**Pascal Labet**

General Employers' Confederation for Small and Medium Enterprises

**Ludovic Larbodière**

Ministry of Agriculture, Food, Sea Fisheries, Rural Development and Regional Planning

**Christiane Lambert**

French National Federation of Farmers' Unions

**Henri Lamotte**

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**Rémy Lauranson**

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**Richard Lavergne**

Ministry of Ecology, Sustainable Development, Transport and Housing, General Commission for Sustainable Development, General Directorate for Energy and Climate

**Sandrine Mathy**

International Centre for Research on the Environment and Development

**Emmanuel Mermet**  
French Democratic Confederation of Labour

**Bernard Merten**  
French Confederation of Christian Workers

**Céline Mesquida**  
France Nature Environnement

**Laurent Meunier**  
French Environment and Energy Management Agency

**Hervé Mignon**  
Réseau de Transport d'Electricité

**Estelle Panier**  
National Association of Food Industries

**Nathanaël Pingault**  
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**Philippe Quirion**  
Climate Action Network-France

**Philippe Rosier**  
MEDEF (Movement of French Enterprises)

**Nathalie Roy**  
Professional Union of Craftspeople

**Raphaël Trotignon**  
Climate Economics Chair, Paris Dauphine University

**Murielle Trouillet**  
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**Claire Tutenuit**  
Enterprise for the environment

**Diane Vandaele**  
Climate Action Network-France

**Éric Vidalenc**  
French Environment and Energy Management Agency

**Paul Zagamé**  
Centre d'analyse stratégique

## Appendix 3

# List of speakers

### Meeting of 7 July 2011

**Jean-Pierre Fontelle** – The French-German Institute for Environmental Research  
*"Changes in French greenhouse gas emissions since 1990"*

**Richard Lavergne** – Ministry of Ecology, Sustainable Development, Transport and Housing, General Directorate for Energy and Climate/General Commission for Sustainable Development

**Pascale Scapecchi** – General Directorate of the Treasury  
*"Overview of modelling instruments used in France and national forward-looking studies"*

**Daniel Delalande** – Ministry of Ecology, Sustainable Development, Transport and Housing, General Directorate For Energy And Climate

**Nicolas Brizard** – Enerdata  
*"Forward-looking energy-climate-air scenarios from 2020-2030 of the General Directorate for Energy and Climate"*

### Meeting of 1st September 2011

**Renaud Crassous** – EDF  
*"Dissemination of low-carbon technologies and the stake in CCS (France and EU)"*

**Raphaël Claustre** – Renewable Energies Liaison Committee  
*"Scenarios for disseminating renewable energies by 2050"*

**Audrey Zermati** – UFE  
*"Electricity in France 2015-2030: scenarios and impacts CO<sub>2</sub>"*

**Vincent Mages** – LAFARGE  
*"Energy-intensive industries under ETS"*

**Pascal Labet** – CGPME (General Confederation of Small and Medium-sized Enterprises)  
*"Industrial enterprises not subject to the ETS system"*

**Diane Simiu** – Ministry of Ecology, Sustainable Development, Transport and Housing, General Directorate for Energy and Climate

*"Main changes in the functioning of phase III of the EU-ETS and the effect of tightening of the restriction to 25% or 30% in the EU"*

**Raphaël Trotignon** – Climate Economics Chair, Paris Dauphine University

*"The effect of tighter restrictions on the market price equilibrium analysed on the basis of the ZEPHYR model. Effect on the expected proceeds from the auctions"*

## Meeting on 7 September 2011

**David Kennedy** – Chief Executive, Committee for Climate Change

**Phil Wynn Owen** – Ministry of Ecology, Sustainable Development, Transport and Housing, General Directorate for Climate and Energy

*"The orientations of the climate policy in the United Kingdom"*

## Meeting on 8 September 2011

**Damien Joliton** – Énergies Demain, Marie-Hélène Laurent – EDF

*"Assessment of the emissions, prospects for 2020, scenarios for 2050: GHG emissions in the residential-tertiary sector"*

**David Molho and Pascal Eveillard** – Saint-Gobain

*"Energy efficiency in buildings: substantial opportunities"*

**Yves Crozet** – Transport Economics Laboratory

*"Assessment of emissions, prospects for 2020, scenarios for 2050: GHG emissions in the transport sector"*

**Jean-Luc di Paola Galloni** – VALEO

*"Prospects for technological changes by 2050"*

## Meeting on 14 September 2011

**Patrick Criqui** – Production and International Integration Economics Laboratory

*"Cost-effective trajectory"*

**Paul Zagamé** – ERASME

**Christophe Cassen** – International Centre for Environmental Research and Development

**Gaël Callonnec** – Environment and Energy Management Agency

**Hugo Pillu** – General Directorate of the Treasury

*"Macro-economic impacts of the various climate policy scenarios"*

## Meeting on 15 September 2011

**Christophe Chassande** – Ministry of Agriculture, Food, Sea Fisheries, Rural Development and Regional Planning

*"Assessment of public policies on reducing greenhouse gas emissions"*

**Stéphane de Cara** – National Institute for Agronomic Research

*"Scenarios on forecasts and potentials for projections and mitigation potentials in the agricultural sector"*

**Antoine Poupart** – InVivo

**Jean-Baptiste Dollé** – Livestock Institute

*"Agricultural practices and innovative approaches for reducing GHG emissions"*

**Jérôme Mousset and Antoine Bispo** – Environment and Energy Management Agency

*"Carbon sequestration in agricultural land"*

**Valentin Bellassen** – CDC Climat

*Julien Jimenez and Béatrice Gendreau – Aquitaine Carbon Association  
"Carbon storage in the forest"*

## Meeting on 22 September 2011

**Philippe Quirion** – National Centre for Scientific Research – International Research Centre on Environment and Development

*"Quantitative impact on the use of energy and climate policies"*

**Alain Mestre** – Cabinet Syndex

**Jacky Fayolle** – Cabinet Alpha

*"A sectoral approach: Europe and France"*

**Fabrice Cytermann** – MEDDTL-SG/DAEI (Ministry for Ecology, Sustainable Development and Housing-General Secretariat/ Department of Economic and International Affairs)

**Johanne Buba** – Centre d'analyse stratégique

*"Overview of European strategies"*

**Franzjosef Schafhausen** – Ministerialdirektor für Klimaschutz, Umwelt und Energie, BMU

*"The German climate policy: Das Energiekonzept"*

## Meeting on 29 September 2011

**Denis Ferrand** – Coe-Rexecode

*"What is learnt from macro-economic impacts for France"*

**Suzanne Akerfeldt** – Ministry of Finance (Sweden)

*"Carbon tax experience: the case in Sweden"*

**Sébastien Blavier** – RAC, François-Nicolas Boquet – French Association of Private Enterprises

**Alain Capmas** – Technical Association of Industries of Hydraulic Binders, Jean-Guy Devezeaux – Atomic Energy Commission

**Benoît Faraco** – FNH, Pierre Franc – General Directorate of Infrastructures, Transport and the Sea

**Daniel Geneste** – General Labour Confederation, Matthieu Glachant – Mines ParisTech

**Jean-François Gruson** – French Petroleum Institute, Benoît Leguet – CDC Climat

**Emmanuel Mermet** – French Democratic Confederation of Labour, Jean-François Soussana – National Agronomic Research Institute

**Eric Vidalenc** – Environment and Energy Management Agency

*"Support measures to reconcile climate ambition and economic, industrial and social development"*



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The report “Pathways 2020-2050 - Towards a low-carbon economy in France” results from discussions held within the Committee established by the Minister in charge of Ecology in June 2011 and chaired by Professor Christian de Perthuis. It was composed of companies’ representatives, trade unions, NGOs, dedicated ministries, and various experts and was supported by the analysts of the Centre d'analyse stratégique. This Committee contributes to the discussions on climate-related policies by 2050 held within Europe, by exploring the possibility to move beyond the 20% reduction of greenhouse gases emissions by 2020. It identifies the options that maximize the economic and social benefits of a climate-related policy. When climate preservation is no more perceived as a major impediment to faster economic growth, but rather as a powerful lever to foster employment and value added, it will surely be integrated into decision-making and policies.