



# National Low-Carbon Strategy Project

*The ecological and solidary transition  
towards carbon neutrality*

# THE ECOLOGICAL AND SOLIDARY TRANSITION TOWARDS CARBON NEUTRALITY

## The National Low-Carbon Strategy

Implemented via the law of 17 August 2015 relating to energy transition for green growth, **the National Low-Carbon Strategy (NLCS) serves as France's policymaking road map in terms of climate change reduction.** It is one of the two prongs of French climate policy, along with the National Adaptation to Climate Change Plan:

- It sets greenhouse gas reduction targets for France over the short and medium term, referred to as “carbon budgets”. Carbon budgets are greenhouse gas limits which may not be exceeded on a national level over five-year periods, expressed in millions of tonnes of CO<sub>2</sub> equivalent<sup>1</sup>.
- This plan puts into action the Government's ambition, presented in July 2017 via the Climate Plan, to accelerate the implementation of the Paris Agreement by setting a target of achieving carbon neutrality by 2050 within French territories, this being understood as achieving a balance between anthropogenic emissions and anthropogenic absorption of greenhouse gas, i.e. that which is absorbed by the natural environment managed by man (forest, prairie, agricultural soil, humid areas, etc.) and certain industrial procedures (carbon capture, storage and reuse).
- It is consistent with France's commitments to the European Union under the Paris Agreement, as well as national commitments including the 40% reduction in greenhouse gas emissions by 2030 compared to 1990.

It provides public policy guidelines for implementing the transition to a low-carbon economy, in which the consumption of energy and materials occurs at a soberer pace, with circular economics applied in all activity sectors.

This strategy is the result of wide-ranging consultations with:

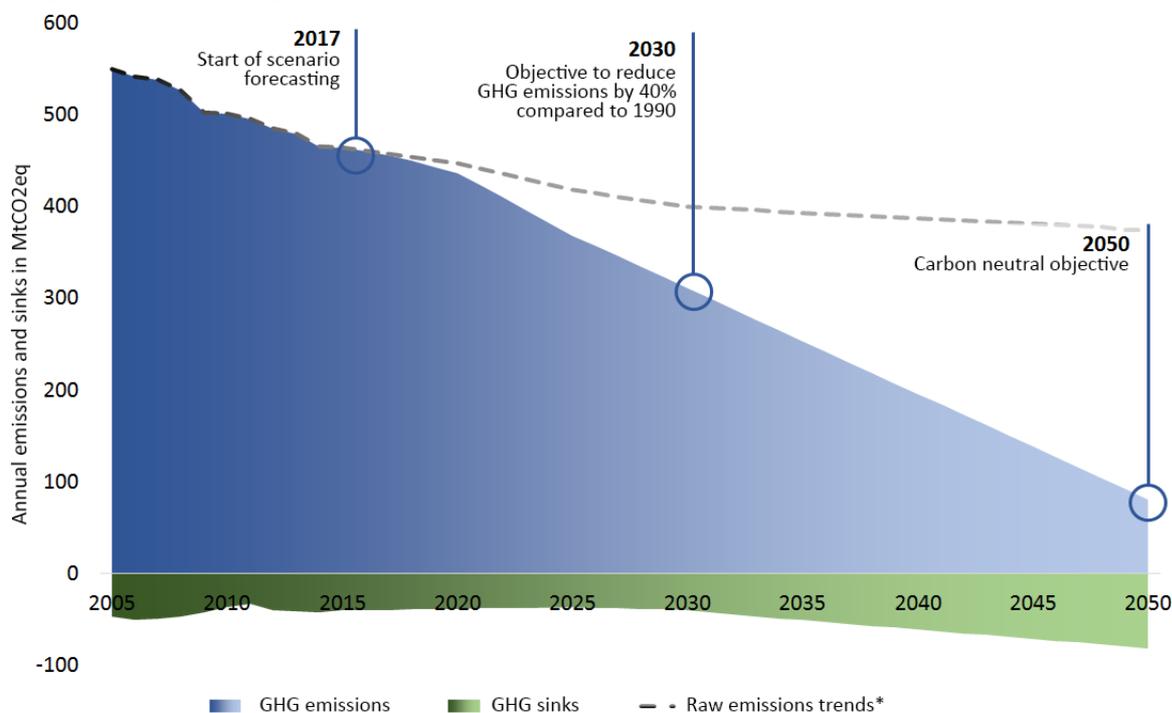
- stakeholders (businesses, NGOs, trade unions, consumer representatives, MPs, local authorities), thirty or so meetings with the Information and Orientation Committee (ICO) and seven themed working groups.
- the public, via a prior consultation under the supervision of a guarantor, in which a questionnaire issued in November and December 2017 received more than 13,000 responses from citizens. Public debating workshops ahead of the Multi-Annual Energy Program, which took place from March to June 2018, have also led to changes to the NLCS.

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<sup>1</sup> The carbon budgets correspond to the emissions recorded in Metropolitan France, Guadeloupe, French Guiana, Martinique, Réunion, Saint Martin, and Mayotte, as well as emissions associated with transport between these geographical areas. Emissions from international air and maritime links are not included in these readings.

This strategy will also take into account the opinions of the Committee of Experts on the implementation of the NLCS in 2015, and compliance with the first carbon budget. The opinions of the Environmental Authority, the National Energy Transition Council, the High Council for the climate, the Corsican Assembly, Overseas authorities and the public consultation shall also be taken into account during the first quarter of 2019.

**Figure 1 - Changes in greenhouse gas emissions and sinks in the national territory between 2005 and 2050**



*\*Trend-based emissions are calculated using a so-called “With Existing Measures” scenario, which takes into account policies already implemented or enacted.*

## Where are we now?

Since the beginning of the 1990s, greenhouse gas emissions have fallen by 16% in France (excluding the forestry and land sectors), and their level per inhabitant is one of the lowest in the developed world (6.9 tCO<sub>2</sub>eq/inhab). Since 2000, France has implemented climate policies to reduce its emissions through the National Climate Change Action Plan (2000) and successive Climate Plans. Following a national debate on energy transition in 2013 and the introduction of the energy transition plan for green growth in 2015, an initial National Low-Carbon Strategy was published in 2015. This aimed to reduce greenhouse gas emissions four-fold in France by 2050, compared to 1990 levels. It was the first road map for the reduction of greenhouse gas emissions, and set the first carbon budgets up to 2028 to achieve its targets.

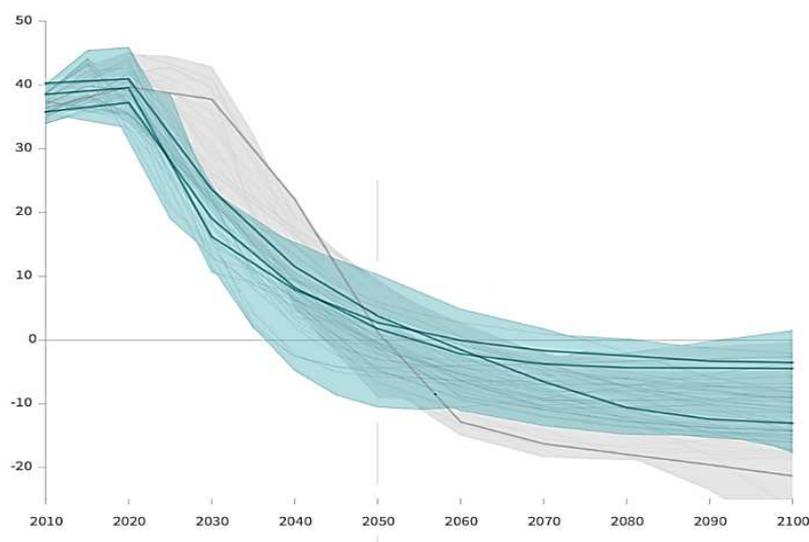
In December 2015, the adoption of the Paris Agreement marked a turning point by establishing a **sustainable and ambitious international framework for cooperation on climate change**, which:

- sets an objective **to limit global warming “to less than 2 °C, and then to limit it to 1.5 °C”**, and to achieve a global balance between emissions and absorption of greenhouse gas in the second half of the 21st century;
- **introduces an idea of fairness to climate action:** those countries that have contributed the most to climate change (due to their past and current greenhouse gas emissions) and which are in a position to do so (capacity and potential to reduce emissions) must play a more active role in global climate action<sup>2</sup>.

## Where do we want to go?

**The Climate Plan put forward in July 2017 has renewed France’s long-term ambition by setting a target to achieve carbon neutrality in French territories by 2050.** Carbon neutrality is an ambitious target, but its achievement is, as evidenced by the recent work carried out by the IPCC, essential on a global level as soon as possible in order to keep global warming down to 1.5°C.

**Figure 2 – SR15 Report from the IPCC: Projections of net global CO<sub>2</sub> emissions (in billions of tonnes per year) between 2010 and 2100, compatible with global warming limited to 1.5°C**



### The baseline scenario

The National Low-Carbon Strategy is based on a baseline scenario developed through a joint modelling exercise in the Multi-Annual Energy Program. **This baseline scenario highlights public policy measures in addition to those already in place, which will allow France to adhere to its short, medium and long-term climate and energy objectives.**

The baseline scenario aims to be ambitious in its goals but reasonable in its approach to meeting them, without taking major technological gambles. Nevertheless, the scenario

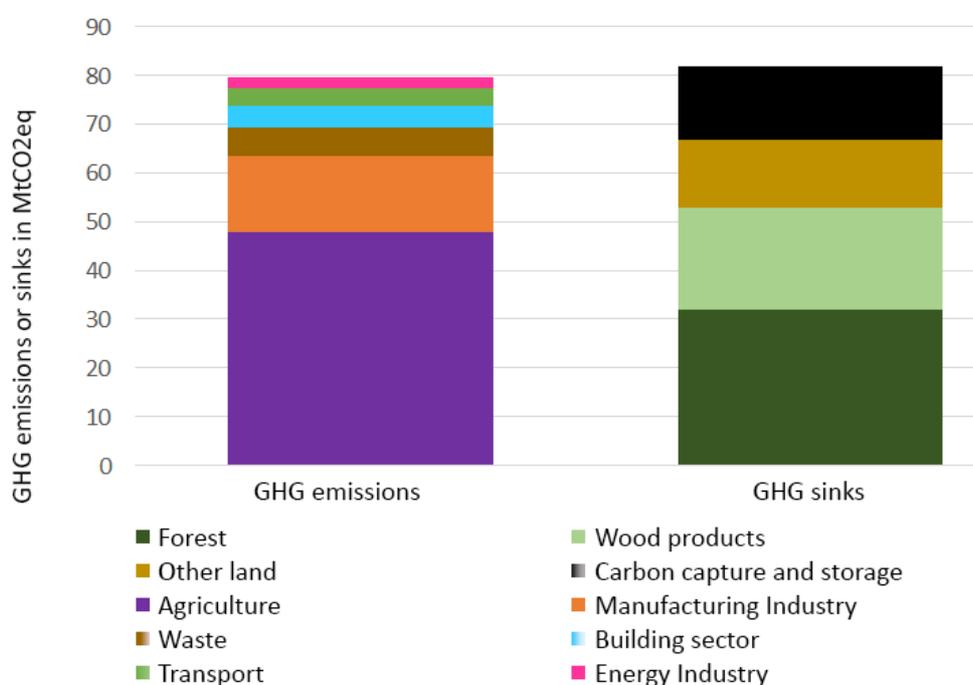
<sup>2</sup> The principles of “fairness and common but differentiated responsibility, and respective capacities in terms of the various national situations in question.”

sensibly relies on a certain number of new technologies: Capture, Storage and Use of Carbon (CSUC), power-to-gas, energy storage, etc.).

### What lessons can be drawn from the scenario?

Looking towards 2050, a certain amount of emissions are impossible to reduce, particularly in the non-energy sectors (agriculture and industrial processes). Achieving carbon neutrality therefore involves compensating for these emissions with carbon sinks. The estimated scale of the land sector sink (forest and agricultural land) at an optimal and sustainable level of performance, coupled with an estimated capture and storage sink, only allows the offsetting of these residual non-energy emissions and the residual emissions from fossil fuels for one part of the transport sector (air transport).

Figure 3- Sinks and greenhouse gas emissions in France in 2050 according to the reference scenario



### To achieve carbon neutrality, it is necessary to:

- **fully decarbonize<sup>3</sup> energy production by 2050** and to rely exclusively on the following energy sources: biomass resources (agricultural and wood product waste, wood energy, etc.), heat from the environment (geothermal, heat pumps etc.) and decarbonized electricity.
- **greatly reduce energy consumption in all sectors**, by substantially improving energy efficiency and by developing sustainability (the scenario is based on the requirements of the slightly declining population in all sectors compared with the trends-based scenario, coupled with a significant change in modes of consumption, with no loss of comfort)

<sup>3</sup> In reality, decarbonization will be “near-total”, as there will remain both residual leaks of renewable gas that cannot be reduced and the partial use of fossil fuels in air transport.

- **reduce emissions not linked to energy consumption emissions** (for example, agriculture or industrial processes)
- **increase carbon sinks (natural and technological)** to absorb incompressible residual emissions by 2050 while developing biomass production. Given the current structure of the economy, which is highly reliant on liquid and gas combustibles, there will be a high demand for biomass resources.

### Macro-economic assessment of the revised NLCS

The results of the macro-economic assessment show that the NLCS increases growth and creates jobs. It would create around 300,000 to 400,000 additional jobs by 2030 and 700,000 to 800,000 jobs by 2050 compared to a trend-based scenario, within a context of international low-carbon transition and effective recycling of carbon taxes.

The low-carbon transition has long-term benefits for household bills, as energy performance improvements will outweigh the rise in energy prices. Over the transition period, the impact on household budgets will vary: cost of investments in renovating housing; rise in energy bills for households heated by gas and oil in badly insulated homes that have not yet undergone renovation; drop in energy bills for households that rapidly adopt the transition. For the investments in energy transition to be profitable over the long term, support should be provided during the transition phase, particularly for households on low incomes.

### Balance of the first carbon budget (2015-2018)

**The provisional balance of the first 2015-2018 carbon budget shows an estimated excess of 72 Mt CO<sub>2</sub>eq over the whole period, or 4% of the first budget<sup>4</sup>. It should be noted that in 2017, estimated emissions will exceed the adjusted carbon budget projected for this year by 7%.**

Nearly one fifth of the excess observed for the first carbon budget is linked to unfavourable situational factors, most significantly the low price of energy and, for the years 2016 and 2017, the unavailability of part of the nuclear power stock (approximately +15 MtCO<sub>2</sub>eq for the whole of the period).

The structural discrepancies (approximately four fifths of the excess) can be explained by worse results than forecasted in the transport and building sectors (approximately + 40 to 45 Mt CO<sub>2</sub>eq over the whole period for these two sectors) as well as agriculture (approximately + 10 Mt CO<sub>2</sub>eq over the whole period). These poor results are partly offset by the above-target results in the first NLCS in the energy production sector<sup>5</sup>, despite the unavailability of part of the nuclear fleet (approximately -20Mt CO<sub>2</sub>eq over the whole period).

<sup>4</sup> The final assessment of the 2015-2018 carbon budget will be published in spring 2019, based on updated inventory data.

<sup>5</sup>The cap for this sector, which includes electricity generation, was set at a conservative level in 2015, pending arbitration on the electricity mix.

Apart from the low price of the energy types already mentioned, the stagnation in emissions in the transport sector can be explained notably by the recovery in road traffic, the weak improvement in the performance of new vehicles, the poor penetration of low emissions vehicles and worse-than-expected results for the modal shift in the freight sector. In the building sector, the discrepancy is mainly down to renovations of insufficient pace and extent.

### The next carbon budgets

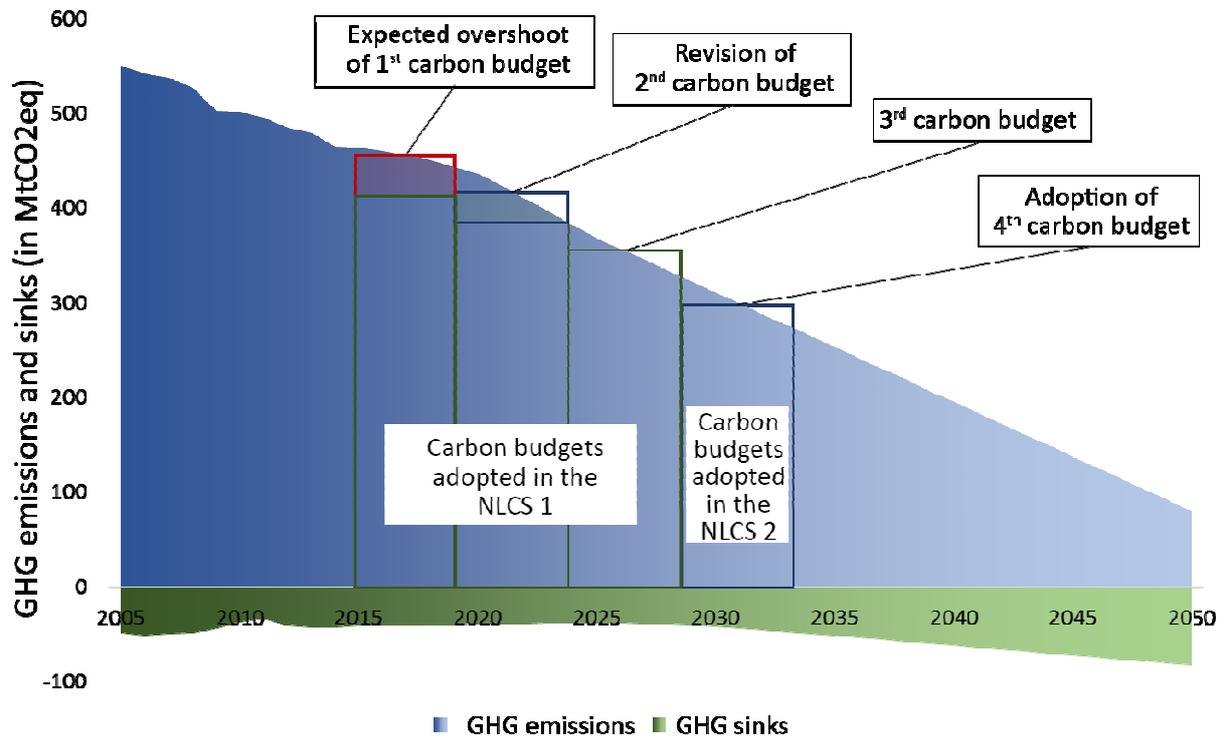
The provisional results of the emissions projections over the 2019-2023 and 2024-2028 periods of the second and third carbon budgets reveal the following:

- an overrun of the second carbon budget set by the first NLCS, which could be around 118 Mt CO<sub>2</sub>eq for the whole of the 2019-2023 period, i.e. 6% of the second budget, closely linked to the shortfalls already recorded in the first budget. The delays in the transport and building sectors for the 2015-2017 period are caused by structural factors that cannot be totally corrected nor offset within the timeframe of the second budget. This leads to a revision of the overall level of the second carbon budget as well as its sectoral distribution, in line with the new benchmark scenario, without calling into question France's capacity to meet its European and international commitments.
- unequivocal adherence to the third carbon budget, on the condition that all the additional measures outlined in the baseline scenario are put in place. **These measures must be implemented fully and effectively, with regular monitoring, in order to return to the budget levels adopted in 2015.**

Figure 4 - next three carbon budgets of the revised strategy

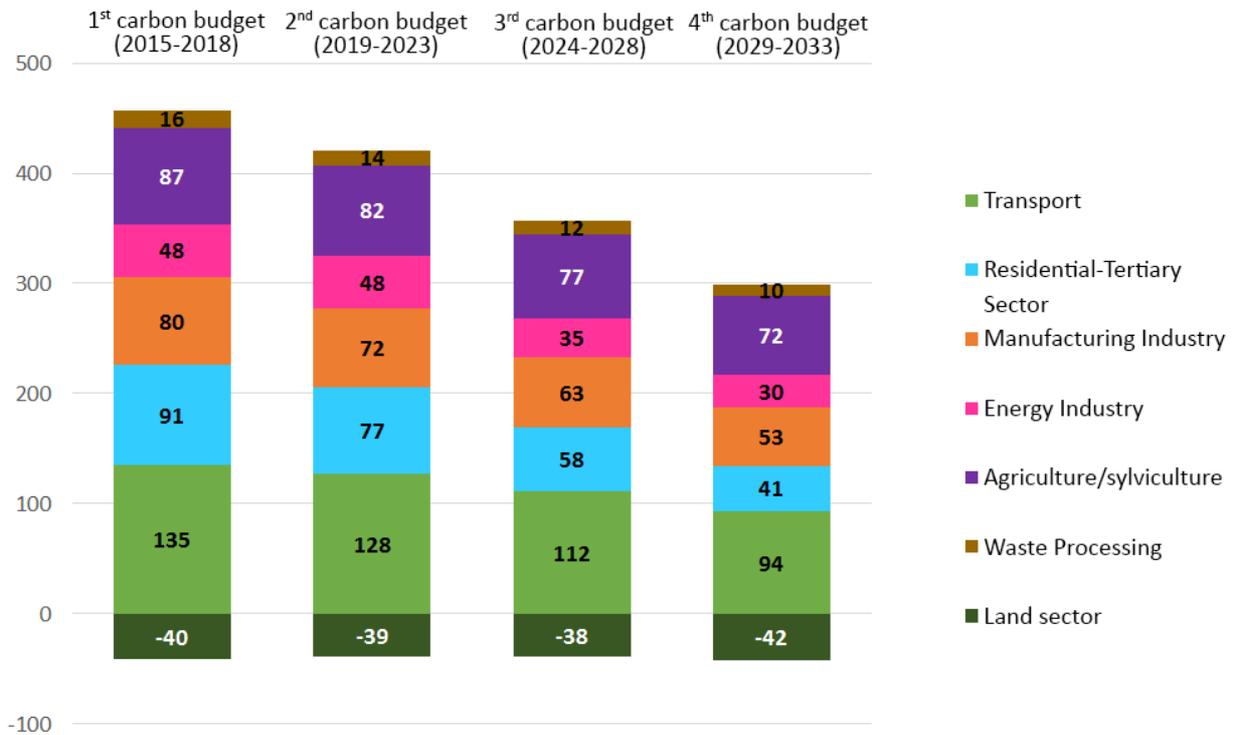
Mean annual emissions (in Mt CO <sub>2</sub> eq)	Baseline years			2 <sup>nd</sup> carbon budget	3 <sup>rd</sup> carbon budget	4 <sup>th</sup> carbon budget
	1990	2005	2015	2019 -2023	2024 -2028	2029 - 2033
<b>Total (not including the forestry and land sectors)</b>	546	553	458	421	357	299
<b>Total (including the forestry and land sectors)</b>	521	505	417	383	319	257
<i>Carbon budgets adopted in 2015 (excluding land) – adjusted in 2018 (for reference)</i>	546	553	458	398	357	

Figure 5 - History and trajectory of net greenhouse gas emissions in France between 1990 and 2050



Source (2005 to 2017 data): CITEPA inventory section - Kyoto Climate Plan format - April 2018

Figure 6 – Sectoral distribution of carbon budgets in MtCO<sub>2</sub>eq



# HOW CAN WE GET THERE? THE APPROACH OF THE NATIONAL LOW-CARBON STRATEGY

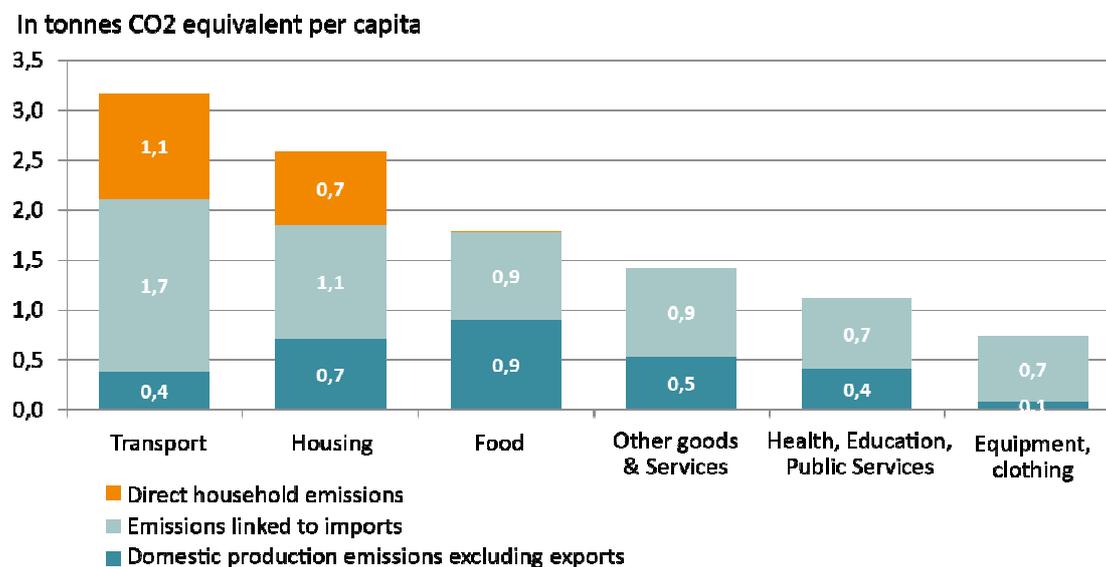
The National low-carbon Strategy formulates 41 public policy orientations. **These orientations are both cross-sectional and sectoral.**

## Cross-sectional orientations

### Decrease emissions related to the consumption of French goods and services

Beyond national emissions, the strategy takes in account **the reduction of the carbon footprint of the French population (11 tCO<sub>2</sub>eq / inhab in 2017 or 1.7 times the territorial emissions)**. This involves reducing emissions linked to the consumption of goods and services, whether these are produced within the national territory or imported, including emissions related to international transport. This amounts to better control of the carbon content of imported products - by producing in France when this reduces GHG emissions, and by consolidating standards at the international level, particularly via carbon pricing. It is also necessary to encourage all operators to mitigate their carbon footprint, for example via the production of more complete product emissions assessments, taking indirect emissions into account.

Figure 7 – Carbon footprint by forms of consumption in 2014



Note: The footprint is based on the three main greenhouse gases (CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O)

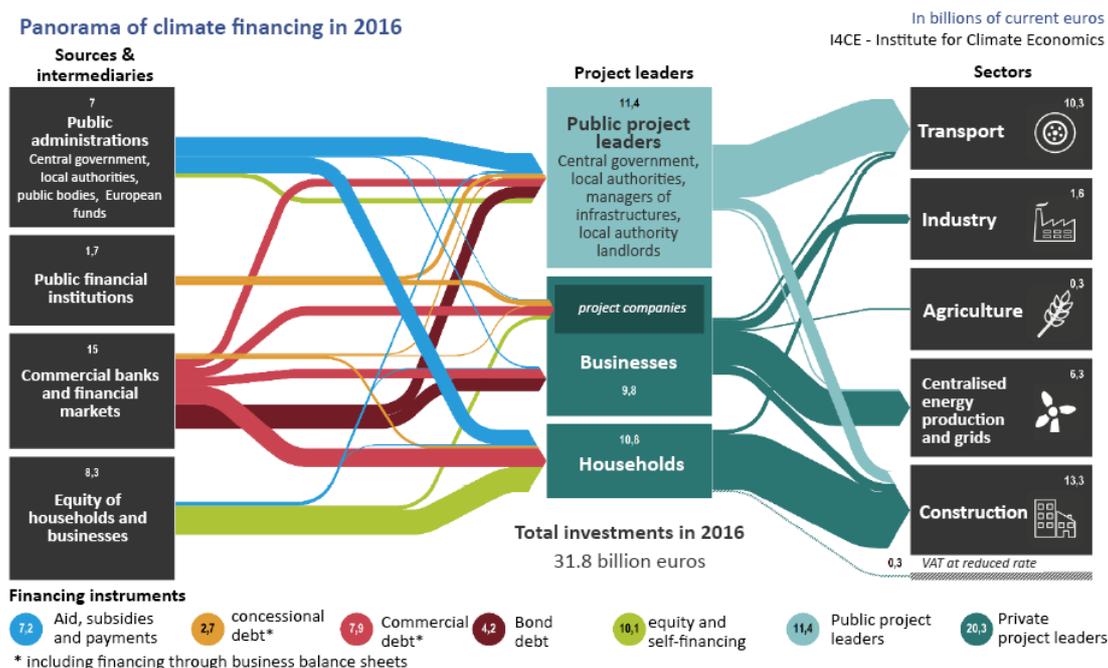
Scope: France + Drom (Kyoto perimeter)

Source: Citepa, AIE, FAO, Customs, Eurostat, Insee. Processing: SDe5, 2018.

## Reorienting investments for an ecological and solidary transition

The average annual investment **required for the energy and climate transition is around €45 to €85 bn / year for the next three carbon budgets**, i.e. a doubling of current climate financing needs, which stand at around €32 billion (see Figure 8). The required investments include: €14 to €20 billion for buildings (mainly in renovation), €20 to €50 billion for transport (taking into account the full costs of infrastructure and low-emissions vehicles necessary for the transition), and €10 billion for energy and electricity networks.

Figure 8 - overview of climate financing in 2016



Source: Panorama of climate financing, 2017 edition

This does not mean that new resources must be mobilized in every instance. The average annual investment required for the next three carbon budgets can be brought down to between €25 and €40 billion if only incremental costs in relation to investments that do not include the ecological transition goal are considered. Indeed, part of the investments to be made cover spending that would have had to be disbursed in any case, for example building housing and renewing the vehicle fleet. The challenge is to ensure these investments contribute to decarbonizing the economy.

**Achieving carbon neutrality includes the reorientation of public and private financial flows, and their removal from climate-damaging investments.** It is necessary to send the right signals to investors, and to give them the required visibility on climate policies. Tools and criteria must therefore be developed to limit the risks of investments, and to better determine whether or not projects are climate-friendly.

This will involve:

- a strengthening of the carbon price at national level via the carbon component (this will increase from €44.6 / tCO<sub>2</sub>e 2018 to €86.2 / tCO<sub>2</sub>e in 2022, by temporarily

adapting the new increases to changes in international markets, in particular to mitigate the effects for citizens in the event of soaring global prices) and at European level with the European carbon market (a market stability reserve will be put in place from 2019 to limit quota excesses), and strengthening incentives to reduce HFC emissions.<sup>6</sup>

- redirection of climate-damaging subsidies and investments towards those that contribute to achieving the objectives of the Paris Agreement (by developing labels for green financial products and phasing out public subsidies that are harmful to the environment).
- public and private financial operators made to take into account the **climate-related risks** (anticipate the effects of climate change or depreciation of assets caused by climate policies) and the **associated opportunities** (investments becoming profitable through the strengthening of climate policies);

Environmentally beneficial European and international actions in finance and carbon pricing must be strengthened. These must help support the most vulnerable developing countries, promote an international commitment to the development of budgets consistent with the Paris agreement, and harmonize price signals between countries, which are essential for effective reductions in carbon footprints (in particular by setting a carbon floor price for certain sectors subject to the European emissions trading market). The strategy also promotes the introduction of a carbon tax at the borders of the European Union (carbon inclusion mechanism) to ensure that European industry is on an equal footing with competing international industries from regions of the world with less stringent climate rules.

These financial issues raise important justice issues for the ecological transition.<sup>7</sup> The economic and environmental impact of investments, the support for change in the most vulnerable actors, as well as the redistribution of income generated by carbon taxation must be carefully studied.

## **Develop technologies and behaviours that will help reduce France's emissions**

The transition to a low-carbon economy **involves innovation and adaptation of production and consumption patterns**. It requires enhanced action in research and innovation, in order to develop technologies and bring about social and behavioural innovations that will help reduce France's emissions. It is important for France to be better positioned in these technologies, **so that it can be competitive in the markets of tomorrow and offer low-carbon goods and services**.

The strategy advocates the development of low-carbon innovations and their rapid roll-out, by relying on basic and applied research via funding and tools that help guide research in the long term (roadmaps, prospective studies, etc.). It also supports innovative companies

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<sup>6</sup> Hydrofluorocarbons (HFCs) are greenhouse gases with high global warming potential, and are subject to specific regulations that set emissions reduction targets.

<sup>7</sup>In the sense of inequality reduction as defined by the Economic, Social and Environmental Opinion published in September 2016.

and facilitates the adoption and roll-out of large-scale innovations (industrialization phase, communication, tools for measuring emissions avoided, etc.)

The National Research Strategy is built around major challenges that include ecological transition issues. A specific component is dedicated to energy (SNRE) to meet the challenges of low-carbon and efficient technologies, but also the needs of storage, intelligent management and the development of solutions for carbon capture, storage and reuse.

### **Supporting land planning for resilient urban solutions and low-carbon organization by limiting soil artificialisation.**

Planning and development are key factors for the very long term. These decisions have a major direct and indirect effect on greenhouse gas emissions due to their impact on bio-sourced production, carbon storage in soils, habitat typologies, patterns of displacement and vulnerability to climate change. This is a cross-lateral issue affecting many sectors, particularly through infrastructure.

To achieve carbon neutrality, it is particularly necessary put **strict limits on the artificialisation of soils today, by pursuing the objective of stopping net artificialisation in 2050** and by reducing the carbon emissions caused by urbanization. This involves enhancing urban centres (without causing over-density) and optimizing the use of spaces (diversification of uses) while ensuring the promotion of urban solutions that are resilient to the effects of climate change.

Governance and regulatory tools are also needed to structure solidarity between territories.

Regional schemes for spatial planning, sustainable development and equality between regions (SRADDET) and the territorial air and energy climate plan (PCAET) must take the NLCS into account, and thus ensure that these objectives and orientations are implemented at territorial level.

### **Involve citizens in the transition to a low-carbon culture.**

**To achieve the ecological transition to carbon neutrality, it is necessary to take action in the emitting sectors, but also to introduce a new “low-carbon” culture, promoting new ways of living and consuming.** To do this, communication about environmental issues, awareness-raising and education from the earliest age, as well as lifelong learning, are key issues. Mobilisation of citizens through promotional actions, civic service or participation in defining action plans can contribute to enriching and sharing this low-carbon culture. The exemplarity of public institutions must be reinforced, in particular through energy management systems, human resources policies and commuting plans.

In order to support citizens in their transition, it is important to make information tools available, enabling them to be better informed about the challenges and solutions, to calculate their own impact on the climate (calculation of carbon footprint), and to take the decisions necessary to reduce this impact (in particular through labelling).

## **Make the low-carbon transition an opportunity for the economy and employment by supporting occupational transitions.**

The enrichment of skills, improvements in levels of qualifications, incentives to follow new career paths and new gateways between professions are all strategic factors that make the low-carbon transition an opportunity for the economy and employment.

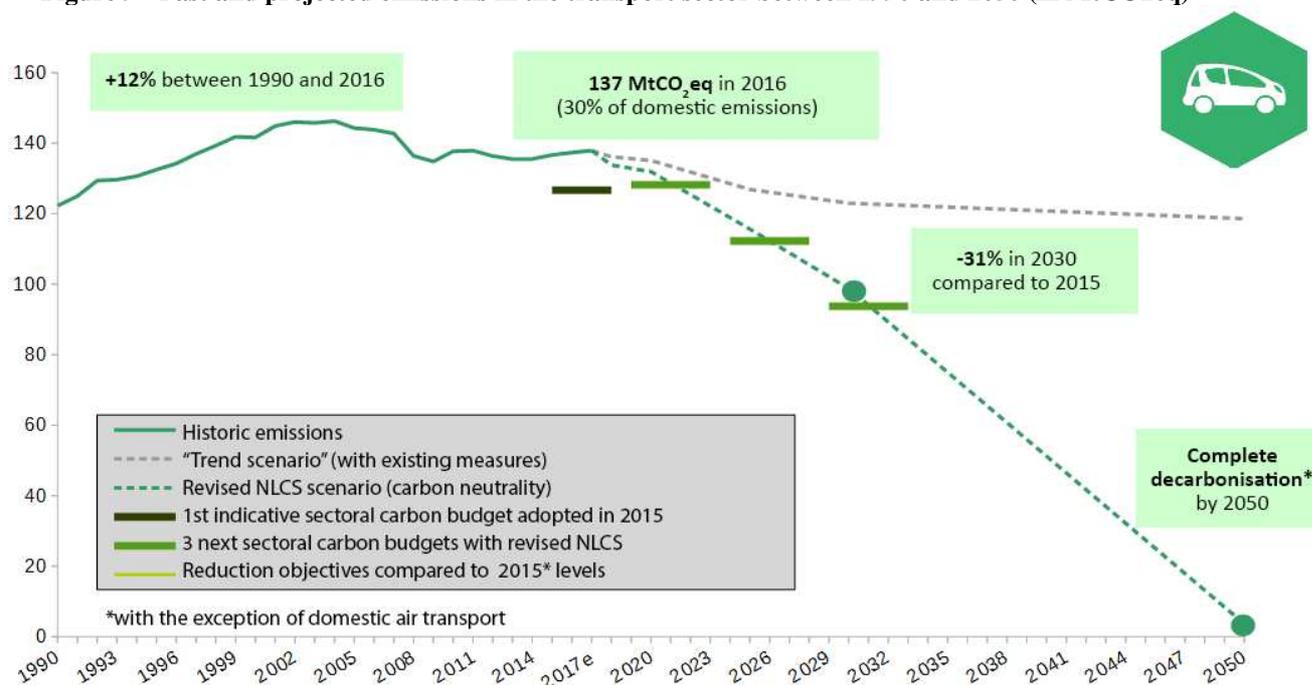
Better integration of the low-carbon challenges by industrial sectors, businesses and territories must be encouraged to facilitate occupational transitions and conversions. However, a comprehensive and profound transition will inevitably bring with it certain risks. It follows that occupational conversions and the nature of the new jobs (geographical location, durability, quality) are major challenges for the sectors affected by the low-carbon transition, which must be anticipated. Tools must analyse the changes in jobs and skills brought about by the transition (programming plan for jobs and skills, ecological transition contracts) and make it possible to implement actions to support various sectors and renew skill sets.

Initial education and in-service training schemes must be adapted to support the transformation of activities and territories. This transformation of the training landscape relates not only to the programs, which must adapt to the needs of business, but also to the knowledge of teachers and trainers who must be supported throughout the process of curriculum change.

## Sectoral Orientations

### Low-carbon transport

Figure 9 - Past and projected emissions in the transport sector between 1990 and 2050 (in MtCO<sub>2</sub>eq)



#### What are the main avenues for action?

- **Decarbonise the energy consumed** by vehicles and adapt infrastructures (for supply of organic NVG and electrical charging). By 2040, 100% of vehicles sold must produce zero or very low emissions.
- **Improve energy performance** of vehicles, with ambitious objectives both for private vehicles (4L/100km in 2030<sup>8</sup>) and heavy goods vehicles.
- **Control the growth in demand for passenger and goods transport**, in particular by facilitating working from home, carpooling and short supply chains. This requires optimisation of vehicle use.
- Spur a **modal shift to modes of transport that consume the least energy and produce the lowest emissions**, such as rail or public transport, and **support active modes**, such as cycling (with an objective of 12% of the modal share by 2030), which can also improve health through regular physical exercise.
- For domestic maritime transport, in addition to gains in energy efficiency, carbon neutrality must be an objective by providing a **supply of low-carbon fuel** in all French ports and by facilitating **conversion to other low-carbon technologies** (batteries, biofuels, hydrogen, sails, etc.).
- For air transport, it will be necessary to achieve **substantial gains in energy efficiency** and a **very high level of replacement with biofuels** (50% share in 2050)

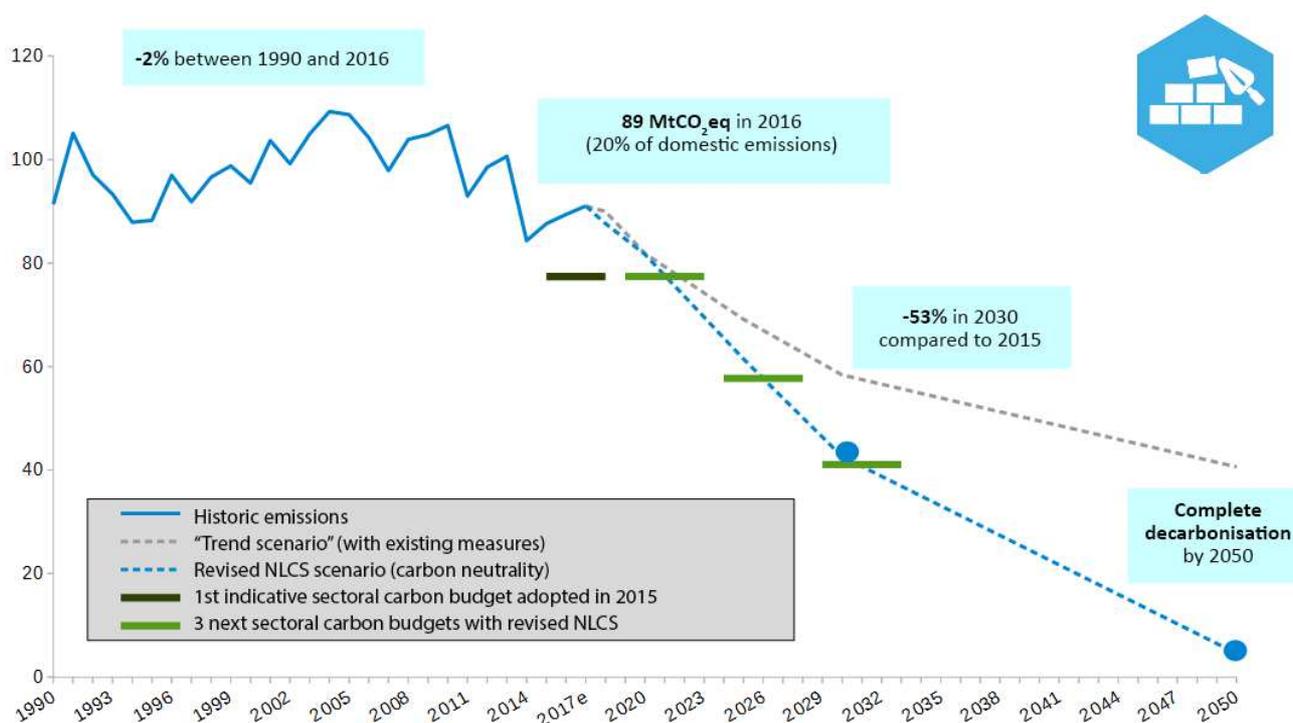
8 Energy efficiency objectives are also set for vehicles powered by natural gas and electricity.

instead of fossil fuels. It is also important to **strengthen the market mechanisms in place** (European Emissions Trading System - ETS, Carbon Offsetting and Reduction Scheme for International Aviation - CORSIA), in order to accelerate the decarbonisation of air transport.

Transition in this sector must be upscaled quickly, while taking account of air quality issues - an area in which major co-benefits should be obtained. The transition should also make it possible to reduce artificialisation of soils by limiting construction of new infrastructures. In this transition, it is necessary to support local authorities and businesses in their implementation of innovative initiatives, and to involve them in clean mobility policies. This takes the form of deployment of low emissions zones, and the definition of action plans to reduce emissions and renew vehicle fleets. It is also necessary to support low-income households, for example with the vehicle conversion subsidy.

### Low-carbon buildings

Figure 10- Past and projected emissions in the construction sector between 1990 and 2050 (in MtCO<sub>2</sub>eq)



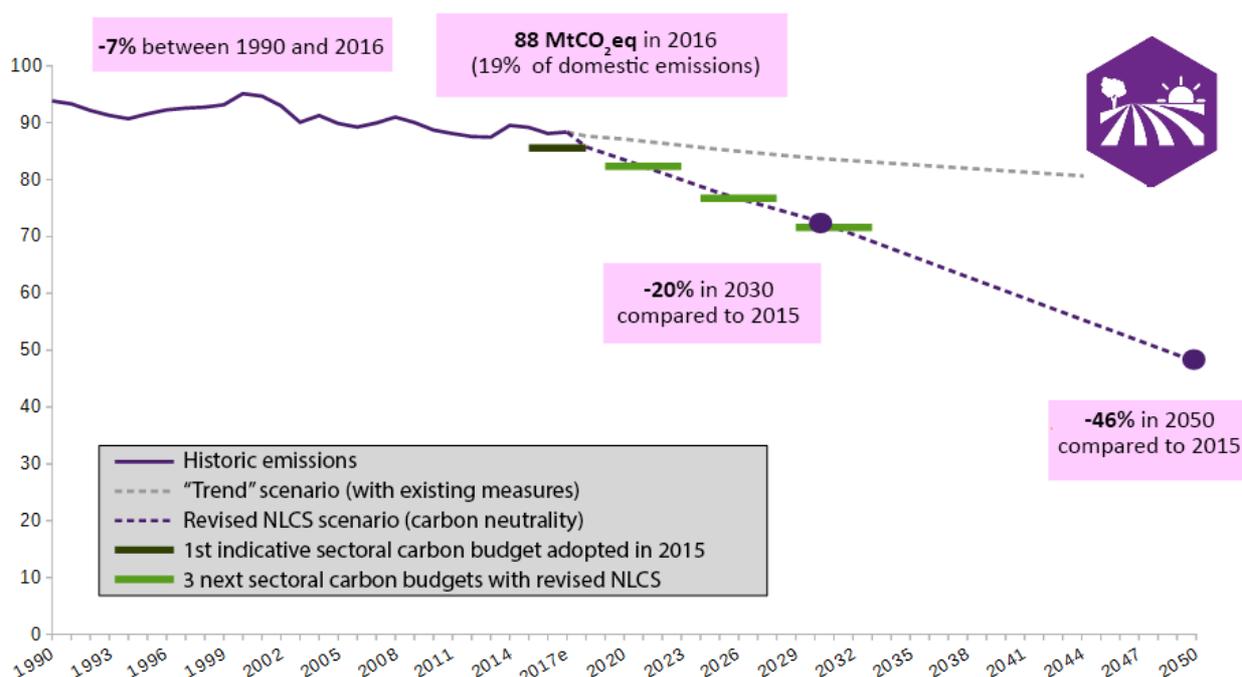
### **What are the main avenues for action?**

- **Make use of decarbonised energies and maximise their production** by placing the priority on solutions best suited to each type of building, and by taking account of the changes in the energy mix and local potential (in particular for heating networks), including self-consumption, and eliminate fuel oil heating within ten years.
- **Improve energy efficiency of buildings** the rate of renovation will have to accelerate considerably to reach 500,000 renovations per year in the residential and tertiary sectors in the short term. In the longer term, 700,000 complete high-performance renovations per year will have to be carried out in the residential sector alone, in order to radically renovate the whole of the existing housing stock by 2050. In the short and medium term, target in particular buildings that lose a tremendous amount of energy, as this is where the greatest gains can be achieved.
- **Increase levels of energy and carbon performance in new buildings** in future environmental regulations by placing an emphasis on integrated approaches with life cycle analysis. Future regulations must take into account hot-weather comfort levels, making it possible to systematically achieve very high-performance insulation of the building's structure, and to develop use of renewable energy sources as well as materials that have a small carbon footprint, in particular those capable of storing carbon from the atmosphere. Renovate all of the tertiary building stock, and set an example by implementing very high-performance renovations in public buildings.
- Aim for **better energy efficiency of equipment and more reasonable levels of use**
- Promote the **use of construction and renovation products and equipment that are low-carbon** (originating from the circular economy or bio-sourced) with objectives for the buildings' carbon footprints.

A sharp acceleration is required in the speed of transition in this sector, which will necessitate mobilization of financing to make the required investments. Behavioural changes are also necessary to reduce energy consumption. For this sector, **training of professionals and transformation of businesses are crucially important**. It is vital to support low-income households for insulation work in dwellings, and to change heating systems. This can be carried out through investment aid (energy transition tax credits, energy saving certificates, etc).

## Low-carbon agriculture

Figure 11- Past and projected emissions in the agriculture sector between 1990 and 2050 (in MtCO<sub>2</sub>eq)



Emissions linked to energy consumption in the sector only represent 13% of the total. Most of the emissions consist of methane (CH<sub>4</sub> – 45 %), mainly linked to livestock, and nitrous oxide (N<sub>2</sub>O – 41 %), mainly linked to nitrogen-based fertilization.

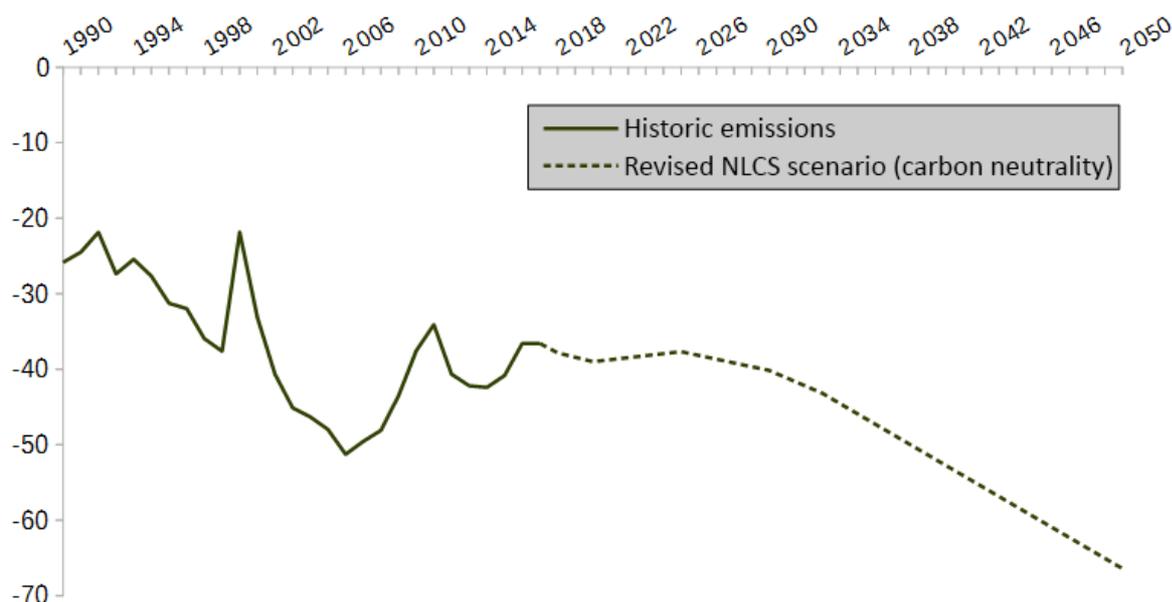
### What are the main avenues for action?

- Reduce emissions in the agricultural sector by developing **agro-ecology, agroforestry, and precision agriculture**, and increase storage of carbon in soils via **changes in practices and a decrease in soil artificialisation**.
  - For N<sub>2</sub>O emissions, in particular by optimising the nitrogen cycle, by reducing excessive protein intake in animal feed, and by developing self-sufficiency in plant proteins.
  - For CH<sub>4</sub> emissions, by improving management of livestock effluent, by optimising control of herds, and by limiting enteric fermentation.
  - For CO<sub>2</sub> emissions, by decreasing energy consumption and by making widespread use of renewable energy sources.
- Develop **the bioeconomy to supply energy and materials that emit less GHG** within the French economy (methanisation, wood-energy, liquid or second-generation biofuels, etc.), which will make a positive contribution to the sector's added value.
- Bring about **changes in food demand**, to favour of products of **better quality** and develop organic farming, **in compliance with the latest nutritional recommendations and reduce food waste**.

The sector is faced with other major challenges: feeding the population, ensuring sustainability of landscapes and biodiversity, meeting increasing demands regarding the health-related aspects of production, dealing with the pressures on land use and the impact of climate change. In the long term, **the movement towards decarbonisation could bring with it a relocation of production activities in France.** This movement is backed by a strong demand from French consumers for local high-quality produce.

## Forests and carbon sinks

Figure 12 - Past and projected national carbon sinks between 1990 and 2050 (in MtCO<sub>2</sub>eq)



The forest-wood-biomass sector is a strategically important sector in achieving carbon neutrality, because it enables carbon sequestration and the production of bio-sourced renewable materials capable of replacing fossil-based products. With 31% of the metropolitan territory and 96% of the territory of French Guyana covered by forest, the sector represents the largest proportion of the French carbon sink (along with agriculture) and makes it possible to offset part of the emissions from other sectors.

### What are the main avenues for action?

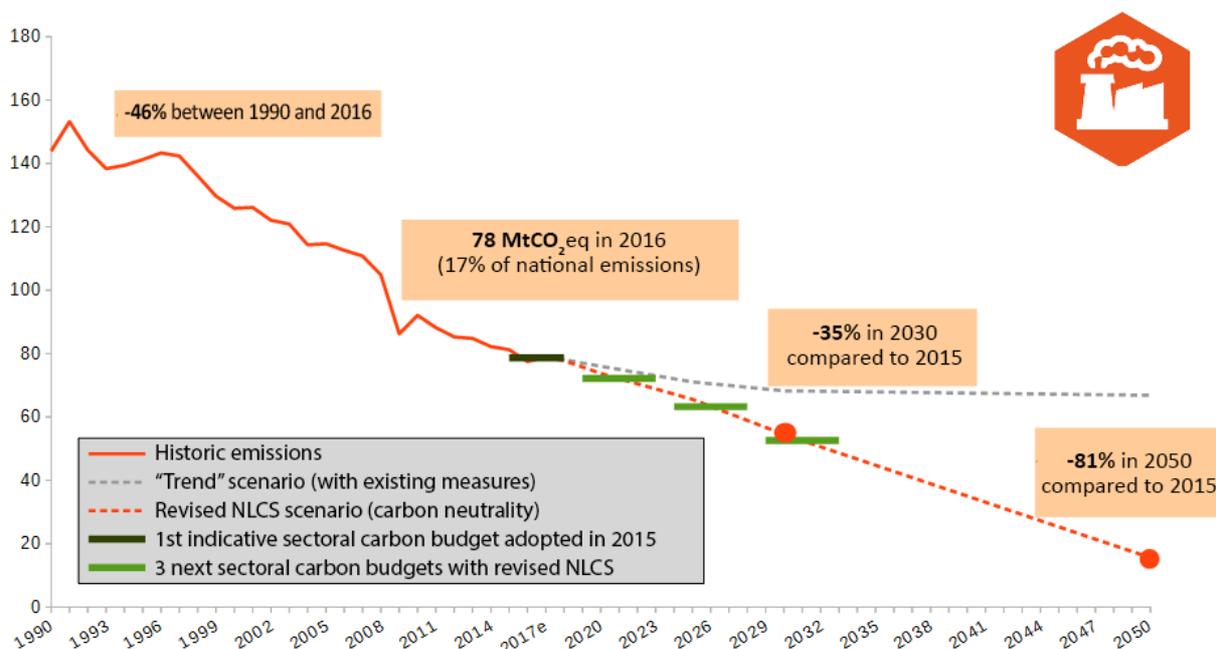
- Improve the carbon pump through better forestry management, which will make it possible to adapt the forest to climate change and to preserve carbon stored in the soils. Observation and statistical monitoring of this carbon stored in soils must be guaranteed and improved. Strengthening of the carbon sink in the forest-wood sector will also require the development of forestation initiatives and a reduction in forest clearance.
- Maximise the effects of substitution and carbon storage in wood products, via:
  - increased harvesting of wood (with, in particular, an objective to increase wood commercialisation set by the French national programme for forests and wood, or PNFB, for the period 2016-2026) while ensuring that biodiversity is preserved;

- an orientation towards uses that have a long-life cycle (in particular an increase in the volume of wood used in construction), and development of recycling and energy recovery from products at the end of their life cycle.
- Assess implementation of the resulting policies, and regularly adjust them accordingly so as to guarantee the results are achieved, in particular concerning biodiversity.

These policies are combined with the French national programme for forests and wood (PNFB) which is supervising forestry policy for the period 2016-2026 and sets an objective for additional mobilisation of wood as part of sustainable and multifunctional forest management (involving challenges in terms of protecting biodiversity, soils, water resources and landscapes). One of the specificities of the sector is its integration into a particularly long time frame: it is necessary to combine actions to mitigate and adapt to climate change and to manage risks linked to natural hazards in forests in order to meet the various challenges, while at the same time preserving the high economic value of the sector.

## Low-carbon industry

Figure 13 - Past and projected emissions in the industrial sector between 1990 and 2050 (in MtCO<sub>2</sub>eq)



80% of GHG emissions from the sector are covered by the Euro Emissions Trading System for greenhouse gases (EU ETS).

### What are the main avenues for action?

- Support businesses and sectors of activity in drafting **roadmaps to a carbon-neutral economy, and support them via investments** in their transition to low-carbon production systems in order to preserve their competitiveness.
- **Intensify research and development for technologies** to reduce residual emissions and for low-carbon manufacturing processes, and support deployment of

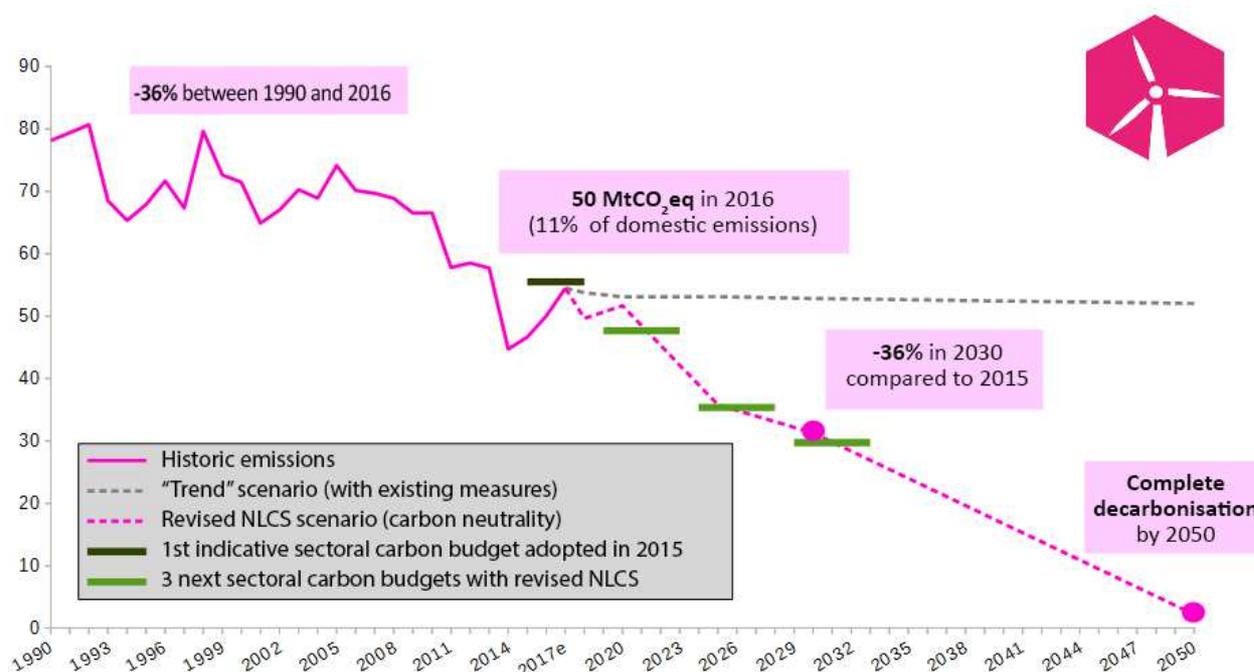
these technologies. Development of technologies to capture and store or use carbon will play a particularly important role in achieving carbon neutrality.

- **Define a framework giving incentives to control demand for energy** and materials, by prioritising decarbonised energy (in particular electricity) and **the circular economy** to allow development of recycling, re-use and recovery of energy. This can be achieved through widespread use of greenhouse gas, energy and material balances, and by developing eco-design of products. A strengthened carbon price signal at the international level is necessary to influence this transition to products compatible with carbon neutrality, whether for industrial production or for the consumption choices that citizens make.

A transition to industry as close as possible to zero carbon by 2050 will require a profound transformation of the sector. For this reason, the most efficient measures must be envisaged today, and it is important to avoid being locked in to using ineffective technologies leading to failed investments.

## Decarbonised energy production

Figure 14 - Past and projected emissions in the energy production sector between 1990 and 2050 (in MtCO<sub>2</sub>eq)



77.6% of the sector's GHG emissions are covered by the Euro Emissions Trading System (EU ETS).

### What are the main avenues for action?

- Control demand and round off the electricity demand curve by mitigating the seasonal and daily peaks in consumption. This can be achieved via:
  - energy efficiency, through implementation of effective technologies that must be supported by public policies providing incentives to optimise resources. A

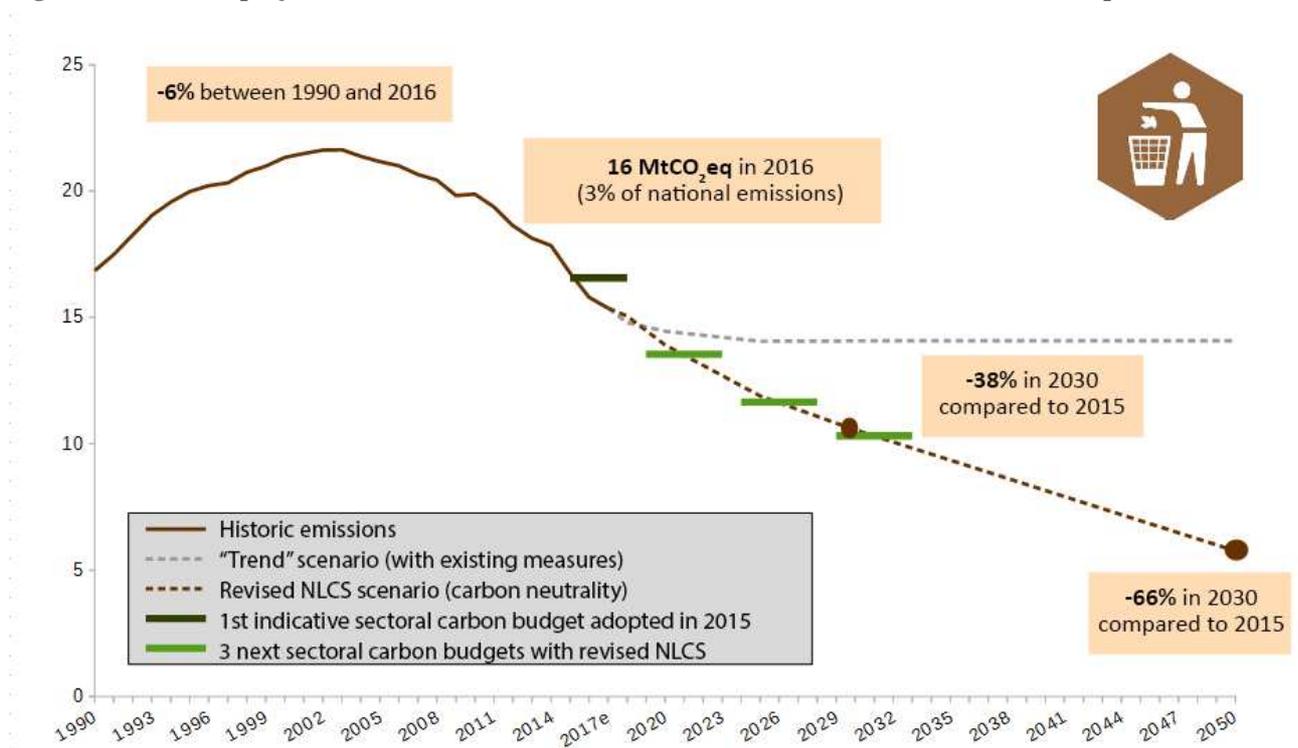
decisive role will be played by research and development in energy efficiency and storage.

- By promoting careful uses and behaviour relating to energy consumption. Deployment of intelligent devices and awareness-raising concerning best practices will make it possible to introduce and facilitate this careful attitude.
- Decarbonise and diversify the energy mix, in particular by developing renewable energy resources (decarbonised heating, biomass and decarbonised electricity). Actions in favour of renewable energy resources and recovery must continue, in particular by identifying the sources of waste heat and by massively mobilising biomass resources, while bearing in mind the underlying challenges (biodiversity, resources, economic and environmental conditions).

The challenges in the energy production sector will require long-term structural choices to be made, particularly concerning the fate of gas and heating networks. The energy efficiency objectives and changes to the energy mix are determined within the framework of the multi-annual energy plan (PPE). The PPE is based on the same reference scenario as the NLCS and is compatible with its orientations.

### Waste processing for a circular economy

Figure 15- Past and projected emissions in the waste sector between 1990 and 2050 (in MtCO<sub>2</sub>eq)



### What are the main avenues for action?

- Reduce the quantity of waste (including food wastage):
  - by preventing waste at the source on production sites

- by promoting the circular economy, as well as re-use and repair of products among consumers;
- Improve collection and management of waste by developing recovery (materials and energy) options, and increase the efficiency of processing sectors. This will be made possible by developing sorting of waste at the source, and through improved waste categorization. Special attention must be paid to organic waste, the collection of which must become systematic (including remains of agricultural and forestry biomass), and also to the collection and treatment of waste water.

For this sector, the strategy is essentially the 2018 circular economy roadmap strategy, which aims to improve production (eco-design, incorporation of recycled materials), consumption habits (development of re-use and repair facilities, extension of products' life cycle), and waste management (optimisation of waste sorting, development of recycling and recovery), and to mobilise all relevant stakeholders.

## MONITORING, ASSESSMENT AND REVISION OF THE STRATEGY

### Regular monitoring of the Strategy using a set of indicators

Monitoring of the national low-carbon strategy is based on a set of indicators, consisting of:

- indicators regarding the implementation of each cross-lateral and sectoral orientation (indicators or results, context and pilots).
- indicators of the level of integration of the strategy's orientations into public policies.
- additional environmental indicators provided as part of the strategic environmental assessment.

The results indicators are updated every year following publication of the greenhouse gas emission inventories. This annual monitoring process makes it possible to gradually ascertain whether the carbon budget for the ongoing period has been respected.

A thorough monitoring of all the indicators is performed every two years, starting from the adoption of the strategy and its future revisions.

All of the stakeholders will be included in the NLCS monitoring process.

### A regular review process

Every five years, the National low-carbon strategy (NLCS) undergoes a complete revision cycle. This includes revision of the strategy's reference scenario, revision of the strategy and its orientations (a phase in which stakeholders are also closely involved), and organisation of regulatory consultations. In particular, revision of the strategy makes it possible to adapt the reference scenario to circumstances or changes (technical, economic, social and geopolitical).

This revision is based on a retrospective assessment of the implementation of the national low-carbon strategy. It examines compliance with the indicative annual periods of the carbon budget, compliance with the trajectories of the strategy's reference scenario, and the level of integration of the orientations into public policies. This assessment makes it possible to identify any deviations from the trajectory and the target objectives, and to analyse their causes, providing valuable feedback in order to draw up a realistic revision of the Strategy.

### Strengthened governance

The *Haut Conseil pour le Climat* (HCC - High council for climate change) has its own dedicated resources. It will participate in regular monitoring and assessment of the strategy, in particular regarding implementation of operational actions resulting from the strategy, and adherence to the trajectory for reducing greenhouse gas emissions.

## Strategic Environmental Assessment of the NLCS

The strategic environmental assessment of the NLCS highlights notable probable positive effects on the following environmental challenges:

- **Limiting of greenhouse gas emissions** (the primary objective of the strategy) via the orientations defined for all of the emitting sectors or sectors with storage potential;
- **Strengthening of territories' resilience in the face of climate change and limiting of natural risks**, through the orientations concerning land use planning and the construction sector;
- **Limiting of resource depletion and development of the circular economy**, via the orientations concerning waste prevention and management, recovery of local resources and promotion of bio-sourced materials.
- **Preservation soil and water quality and improved spatial management**, via the orientations in the agriculture and forest-wood sectors, aiming to reduce pollution in soils and to increase their carbon storage. The strategy also proposes orientations aiming specifically to limit soil artificialisation. Nevertheless, the development of low-carbon processes and technologies, and the installation of new infrastructures, must be carefully examined in order to avoid any impacts in terms of soil and water pollution. The multi-annual energy plan (PPE) contains environmental recommendations on this topic.

The strategic environmental assessment also raises some other points of interest, in particular concerning:

- **The preservation of biodiversity and the loss of natural, agricultural and forest spaces.** Increased use of biomass may have indirect impacts due to the intensification and extension of agricultural and forestry production systems. The environmental recommendations of the National Biomass Mobilisation Strategy aim specifically to limit this type of impact;
- **Management of non-energy mineral resources** associated with development of renewable energy sources, electrification of transport systems (production of batteries, photovoltaic panels, grids, etc.), and renovation of energy systems in buildings. These challenges are taken into account in a more operational manner in the Multi-annual Energy Plans (PPE), the National Plan for Energy Renovation, and the Resources Plan for France;
- **Air quality**, which could potentially be affected by the use of biomass and its combustion, and by the energy renovation operations in buildings (maintenance of indoor air quality by means of ventilation systems). This challenge is included in the orientations of the NLCS, and taken into account on an operational level in the National Plan for Reduction of Atmospheric Pollutants, and in the Plan for Energy Renovation of Housing. Probable positive impacts of the NLCS should also be noted regarding the quality of outdoor air, notably associated with the orientations concerning energy decarbonisation and widespread electrification of transport.