EXECUTIVE SUMMARY

FRENCH STRATEGY FOR ENERGY AND CLIMATE

MULTI ANNUAL ENERGY PLAN

2019-2023

2024-2028

MINISTÈRE
DE LA TRANSITION
ÉCOLOGIQUE
ET SOLIDAIRE

Global warming is a real and immediate danger for our civilisation and is caused by the production of greenhouse gases, of which about 70% result from our consumption of fossil fuels. Our use of coal, oil and gas leads to unsustainable growth and for that reason countries worldwide have committed to drastically reducing their greenhouse gas emissions as part of the Paris agree+ment.

The National Low Carbon Strategy (*Stratégie Nationale Bas-Carbone* (SNBC) outlines the French roadmap for reducing greenhouse gas emissions by 2050.

In order to reach carbon neutrality, it is necessary to reduce energy consumption, by prioritising a reduction in consumption of the most carbon-rich energies, by prioritising the reduction of the most carbon intensive energy and replacing them by carbon free energy. New technologies such as electric vehicles must be rolled out in the transport sector, but behaviours must also change: we must collectively adopt active mobility and car sharing and provide alternatives to individual car use when it is possible. We must also pull the technological and behavioural levers to control the energy consumption of buildings. In industry, the energy transition must preserve competitiveness at the same time as ensuring that activities on national soil are sustainable.

Energy production will also change: it will be more renewable and decentralised, it will move closer to citizens and become more and more environmentally friendly. The share of nuclear in the electricity mix will be progressively reduced in order to diversify our sources of electricity production. The biomass production will have to be sustainable to satisfy the needs of the whole value chain of bioeconomy (food, material, energy…), and will be optimally used to produce biofuels. Renewable electricity will be produced throughout the regions, managed by smart grids.

A reduction in consumption and a progression towards more sustainable energies will improve air quality and reduce the overall environmental and health impact of the energy sector. This also provides economic benefits, by reducing our dependence on imports and therefore on global fossil fuel prices.

These changes must of course be achieved while continuing to guarantee the level of security of supply that French people expect and with controlled collective cost, necessary for the acceptability of the energy transition. Therefore, they must be done carefully and progressively by building on the successes.

This vast movement should be supported socially, in order to guarantee that it benefits everyone, including households with the lowest incomes who often bear the brunt of air pollution and energy costs. It will also require preparation and support for professional transfers to adapt to new jobs, and anticipation of and support for the reconversion of the impacted businesses and regions.

The French energy transition is part of a much wider movement to create a European internal market and European energy transition. The European countries have collectively set ambitious energy and climate goals which will be achieved by means of the PPE. Furthermore, strengthening interconnections and exchanges with neighbouring countries contributes to transforming and reinforcing the security of our electricity and gas supply. For certain topics, such as batteries, it is the creation of a European industry that will enable our companies to compete worldwide. More broadly, rolling out a wide European market for carbon-free energy solutions offers better prospects for lowering costs as well as for growth and employment in every country and its implementation should rely on support of research and development.

This transition must be done without disruption, by creating a clear, justified pathway to move irreversibly towards respecting the environment and the climate, while ensuring inclusivity. This Multi-Annual Energy Plan (PPE) maps out the route that the government will take in the course of the next 10 years and further topics.

A project prepared in consultation with others

The Multi-Annual Energy Plan has been in preparation since June 2017 with the participation of a great number of stakeholders:

- June 2017: preparation to develop a revised PPE for 2018, involving many stakeholders (monitoring committee made up of the National Council for Ecological Transition and the Higher Council for Energy);
- From October 2017 to January 2018: 24 workshops were organised in order to develop a revised PPE;
- From March to June 2018: a public debate was organised by the Commission Nationale du Débat Public (National Public Debate Commission).

1. Multi-Annual Energy Plan: a coherent action strategy for the energy transition

The PPE sets out priorities for public authority action in the energy domain in order to meet the targets set in the Energy Transition for Green Growth Act. All the pillars of the energy policy and all the energies are addressed in one single strategy: control energy demand, encourage renewable energies, guarantee security of supply, control energy costs and self consuming energy etc. This enables us to build a consistent and complete picture of the role of each energy and its desired progression in French society.

The PPE is a binding operational tool for the public authorities. It describes the measures which will enable France to decarbonise its energy in order to become carbon neutral by 2050. In the next 10 years we must turn a corner in order to will make this necessary goal feasible. The energy scenario for the PPE is the same as that for the SNBC (National Low Carbon Strategy, *Stratégie Nationale Bas Carbone*) for the period that it covers.

The PPE in a few figures

Final energy consumption	7% decrease in 2023 and 14% in 2028 compared to 2012
Primary consumption of fossil fuels	20% decrease in the primary consumption of fossil fuels in 2023 and 35% decrease in 2028 compared to 2012
Greenhouse gas emissions from energy combustion	277 $MtCO_2$ in 2023 227 $MtCO_2$ in 2028 I.e. a reduction of 14% in 2023 and of 30% in 2028 compared to 2016 (322$MtCO_2$)
Consumption of renewable heat	196 TWh consumption in 2023 Between 218 and 247 TWh in 2028 I.e. an increase of 25% in 2023 and between 40 and 60% in 2028 of the 2016 renewable heat consumption (155TWh)
Renewable gas production	Injected biogas production of 14 to 22TWh in 2028 based on the assumption that costs will fall considerably (35 to 55 times the 2017 production)
Installed capacity for renewable electricity production	74 GW in 2023, i.e. +50% compared to 2017 102 to 113 GW in 2028, double the 2017 amount

Capacity for nuclear electricity production	4 to 6 nuclear reactors will be shut down by 2028 including the Fessenheim ones. Closure of 14 nuclear reactors by 2035, the date set for achieving a 50% share of nuclear electricity in the electricity mix.
Economic growth	1.3-point rise in GDP in 2023 compared to the business-as-usual scenario, and 1.9 point in 2028
Employment	Creation of about 246,000 jobs in 2023 compared to the business-as-usual scenario and about 413,000 jobs in 2028
Household disposable income	Rise in purchasing power of households by 1.1 points in 2023, compared to the business-as-usual scenario and 2.2 points in 2028

In order to take uncertainties into account and to guarantee France's energy supply, the Multi-Annual Energy Plan envisages two energy need scenarios, mainly based on two different hypotheses for the progression in demography, economic situation and energy efficiency. The results presented here are those of the baseline scenario, considered to be the most probable.

For citizens, the PPE in 2023 will mean:

- 2.5 million dwellings renovated (highly efficient or very highly efficient renovations);
- The replacement of 10,000 coal-fired heating systems (half of those remaining) and 1 million oil-fired boilers (out of 3.5 million remaining) by renewable heat production means or gas boilers with very high energy efficiency specifications;
- 9.5 million dwellings heated with efficient wood burners;
- 1.2 million private electric cars on the roads (electric and rechargeable hybrid) and 100,000 public charging points;
- 1 million French people having received help to change their vehicle;
- 20,000 gas trucks on the roads;
- The whole of French territory covered by an organising authority for mobility in order to design solutions that meet the needs of citizens;
- 3.4 million of dwelling equivalents connected to a heat network
- All electric power plants running solely on coal to be shut down;
- 2 nuclear reactors shut down (Fessenheim);
- 65,000 to 100,000 self-consumption photovoltaics sites.

2. Reducing consumption in all sectors is the key to meeting the Paris agreement goals, in all sectors

Keeping warm, getting about, manufacturing... all these actions consume energy We shall not succeed in fighting global warming if we do not seek to decrease the energy needs of human activities. The National Low-Carbon Strategy has shown that in order to achieve carbon neutrality by 2050 we must halve our energy consumption on the 2050 horizon. It is now necessary to develop technologies and actions with less primary energy consumption. From this point of view, the French economy is on the right path because its energy intensity has been dropping by 1.4% per year these last few years. This means that we are producing the same amount with less energy.

However, it is not dropping fast enough. In 2017, the final energy consumption level was in the order of 1,643 TWh. In the baseline scenario, it goes down by 7% in 2023 and by 14 % in 2028 compared to 2012, to reach 1,420 TWh.

The downward movement of consumption will have to be continued and speeded up in order to achieve carbon neutrality, because carbon-free energy resources, in particular biomass, will not suffice as substitutes for current fossil fuel consumption.

Consistent with France's goals for climate, the measures in the PPE will lead to lower final energy consumption but not uniformly across energy vectors: coal and oil consumption is significantly reduced. Gas consumption is reduced but proportionately less. Final electricity consumption is relatively stable and renewable heat consumption grows slightly.

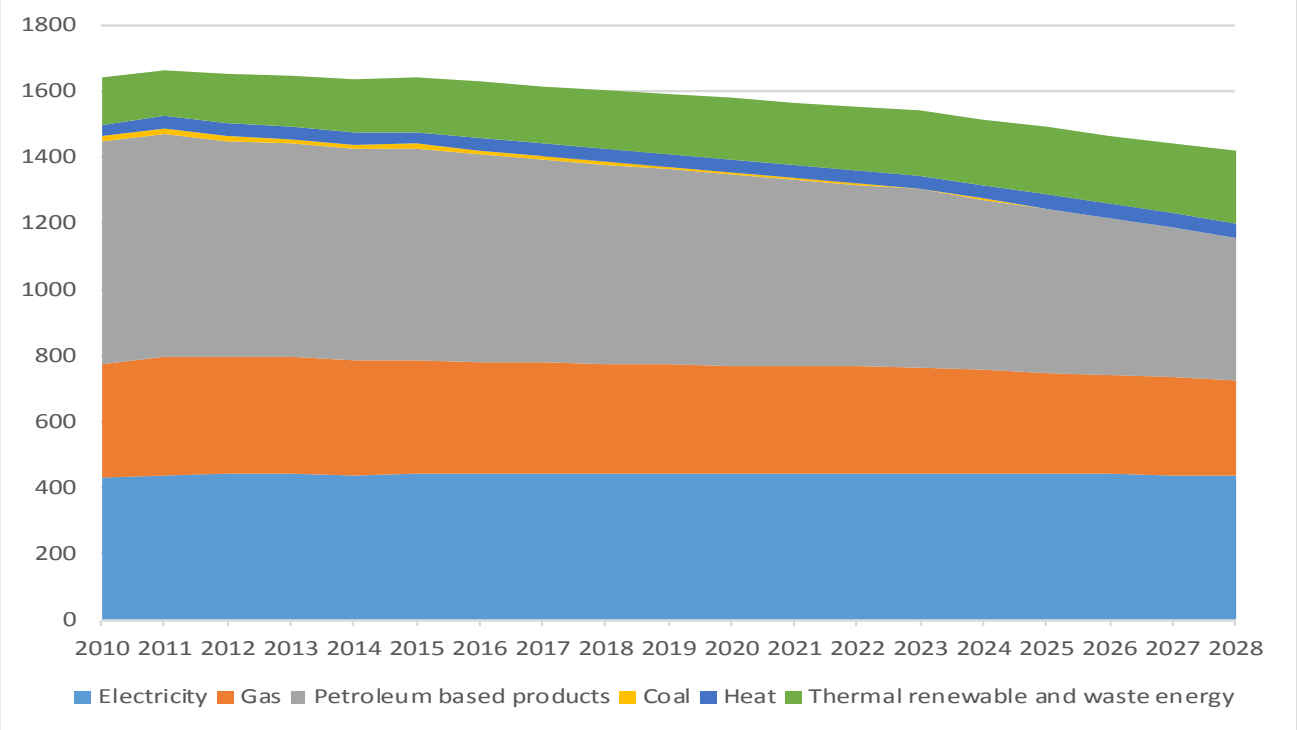


Figure 1: Progression of the real (2010-2016) and projected (2017-2028) energy mix by energy vector

Saying goodbye to fossil fuel

The priority targets for consumption reductions are the most carbon-rich energies. Cutting back the use of fossil fuels in this way enables a reduction in greenhouse gas emissions, but also an improvement in air-quality by reducing the other pollutants emitted through combustion.

In the baseline scenario, the primary consumption of fossil fuels, which was 1,412 TWh in 2017, drops by more than one third in 2028 to reach 940 TWh. There is a bigger contraction for the fossil fuels with a higher carbon content. In this way, the primary consumption in 2028 of:

- coal should decrease by 80 % compared to 2012 to reach 27 TWh;
- petroleum products should decrease by 35 % compared to 2012 to reach 565 TWh;
- natural gas should decrease by 19 % compared to 2012 to reach 349 TWh LHV.

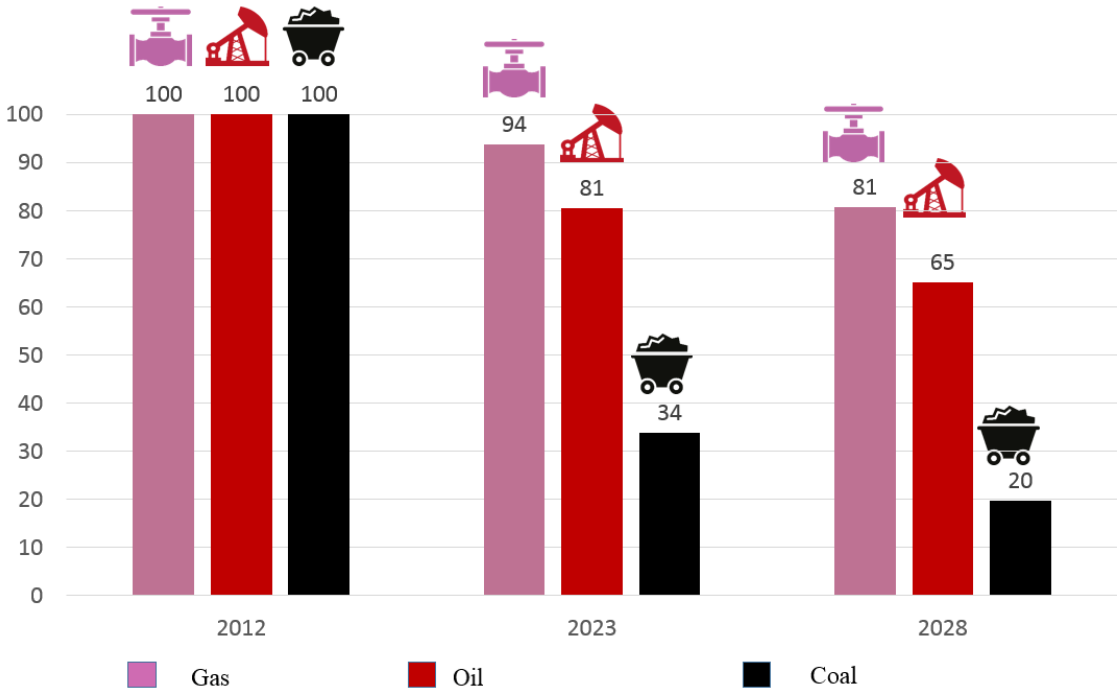


Figure 3: Reduction in the primary consumption of fossil fuel by energy vector

Furthermore, the sectors do not all have the same impact on final energy consumption: the two major consumers are transport and buildings (residential and tertiary), followed by industry. Energy consumption in industry declined in 2008 and has been stable since. Energy consumption in transport and tertiary housing is stable. In the PPE, all sectors are mobilised.

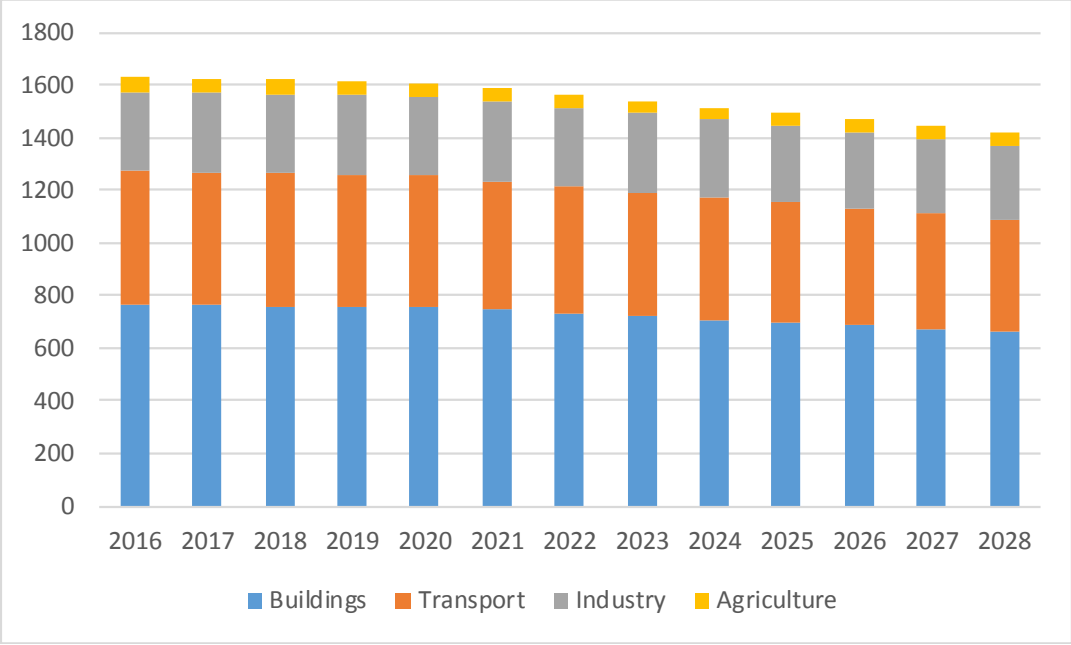


Figure 2: Progression of final energy consumption by sector since 2017 (TWh)

2.1. Actions to reduce final energy consumption in the whole economy

In order to deeply transform investment choices and behaviours across the whole of society, two long-term measures will be pursued and consolidated:

Pricing carbon fairly across the whole economy

The price of carbon must induce changes in the decisions made by energy consumers in their purchases or uses. It must also serve to accelerate the development of efficient technologies by making them more competitive than those using more fossil fuel. The climate plan had set a developmental trajectory for the carbon component of energy taxation, rising to € 86/tCO_2eq in 2022. Following the cancellation of the rise for 2019, a new trajectory will have to be defined, up to 2022, as well as over the second period of the PPE. This taxation has to be coupled with support measures for transition so they appeared to be efficient and equitable.

The current carbon component does not cover energy-intensive industries subject to international competition which fall under the European Emissions Trading System (ETS). The quota market price, however, is not yet sufficient to induce major changes to modes of production. France supports in particular the implementation of a floor price mechanism for the carbon in electricity at European level to speed up the decarbonisation of industry.

A transversal action for energy efficiency: Energy Saving Certificates

Energy efficiency improvements rely principally on a market device: the Energy Saving Certificates (Certificats D'Économie D'Énergie, CEE). They put the supplier under the obligation to carry out energy efficiency actions, directly or indirectly. Each energy-saving action triggered as a result of the CEE scheme is credited with certificates which can then be exchanged to meet the obligation. This system enables discounted cumulative savings of about 530 TWh of energy per year by generating investments of between € 2 and 3 Bn. The industry, local authorities and citizens benefit from it in addition of other targeted public policies incentives.

The PPE plans to extend the CEE scheme over the whole period covered, progressively increasing the goal based on estimated savings potential.

Transversal measures encouraging the reduction of energy consumption:

- Define between now and the start of 2020 the goal and methods of the next two periods of the Energy Saving Certificates (CEE) scheme based on an analysis of energy saving potentials;
- Support an ambitious and effective European policy on the eco-design of energy-related products and energy labelling for these products;
- Define a new carbon price trajectory (carbon component of the energy tax) that takes into account feedback from the big national debate of the 1st quarter of 2019;
- Push for a floor price mechanism for the carbon in electricity at European level, as well as setting a price for carbon for all sectors that fall outside of the European carbon trading scheme.

2.2. Highly efficient, renovated buildings which integrate renewable energy

Buildings are the highest consumers of energy at the national level. Therefore, reducing consumption in this sector is a central issue. There are 3 principles underpinning the action:

1. **Highly efficient new buildings**: in 2020 the new environmental regulation for new buildings will set more ambitious goals than the previous one in terms of units consumed per m^2 of building. These regulations will take into account the building's overall results in terms of energy and greenhouse gas emissions, ensuring the use of the most carbon rich materials and energies is limited;
2. **Renovated existing buildings**: the energy renovation plan for buildings sets a goal of 500,000 highly efficient home renovations per year. It stipulates a 20% reduction in energy consumption in the public

building stock and the draft regulations on renovation in the tertiary sector stipulate a decrease in consumption for all buildings over 1,000 m² in 2030;

3. **Renewable energies in buildings:** as a result of the support of the tax credit for energy transition, of the CEE and the financial support of ANAH to widespread renewable heat. Renewable heating in buildings can be provided by biomass boilers, air/water or water/water pumps, solar combined systems or connection to a renewable heating network. New buildings, including in the collective and tertiary sectors, should produce a minimum amount of renewable heat.

The actions for buildings are that much more important because heat sieves[1] bring about fuel poverty situations for households, whose restricted resources become increasingly consecrated to their heating bills. Particular attention will be paid to energy efficiency in the rented building stock. When conceiving, building, and renovating buildings, a specific attention will also be paid on potential negative impacts on health and environment, that means on indoor air quality and noise.

During the first PPE period, the incentives will be linked to improvements in information to property owners and tenants: energy audits will be 100 % funded for lower income households owning heat sieve dwellings. This audit will be made mandatory by 2021 for all transfers or rental of F or G dwellings, after consultation and work with professionals to make the audit reliable and competitive.

Furthermore, specific measures will be set up to encourage households to replace coal-fired heating, oil-fired boilers and old gas boilers with renewable heating systems2 or gas boilers with very high energy efficiency specifications. The aim is to no longer use coal or home heating oil by the end of the PPE in 2028. The first PPE period will enable a more detailed analysis of the composition of the housing stock and a better identification of the owners of the heat sieves. In light of these studies and the results obtained during the incentives phase, the government will decide in 2023 whether to employ coercive measures to reach goals for reducing consumption and greenhouse gas emissions by 2030. These coercive measures could include prohibiting the letting of heat sieves, as well as the introduction of a deposit system, during property transfers, for the sums required for the work to renovate class F and G dwellings in order to make them more energy efficient.

Measures to reduce energy consumption and greenhouse gas emissions in buildings:

- Implement the energy renovation plan for buildings (Plan de rénovation énergétique des bâtiments, PREB).

For professionals:

- Work with building and real estate professionals, NGOs, local authorities and energy companies, under the FAIRE banner to better identify the relevant renovation solutions for households, to trigger more action by enhancing household knowledge and confidence, and to better coordinate the existing grants and financing;
- Finalise and implement the new environmental regulations for buildings, in particular by:
  - Making a minimum renewable heating rate mandatory for all new buildings (individual, collective, tertiary) by 2020;
  - Updating the conversion factors in primary energy for electricity used in the regulation of new buildings (RT 2012, E+C- Label, RE 2020) to take account of the projected electricity mix in 2035 in the PPE. The calculation method used will be the method selected by the European Union as part of the revision of Directive 2012/27 / EU on energy efficiency.
  - Incorporating a criterion on greenhouse gas emissions over the entire life cycle of the building.
- For tertiary buildings, applying energy efficiency obligations to 40 % of the consumption of existing tertiary buildings in 2030 by targeting all business sectors and limiting exemptions to only cover buildings of less than 1,000 m².

[1] Dwellings with energy performance certificate ratings of F or G.
[2] Renewable heating provides heat by heat pumps, biomass boilers, solar combined systems, or connection to a renewable heating network.

For private individuals:

- Make the Energy Transition Tax Credit (Crédit d'impôt pour la transition énergétique, CITE) more efficient via a new fixed rate scale in 2020, which will take into account the energy efficiency of the actions and will be defined after wide consultation with players in the sector;
- Extend the CITE to **landlords** in 2020.
- From 2019, extend the CITE for lower income households to cover the **installation of renewable heat equipment** and the disposal of **oil tanks**;
- Make the CITE payments through the French National Housing Agency (Agence nationale de l'habitat, ANAH) at the time of the work, for the households in the first four deciles (current scope of ANAH aid). The rate of aid will be increased for these households, so that public aid is a real catalyst of building work to escape fuel poverty;
- Maintaining the VAT rate at 5.5% for energy renovation works eligible for the CITE and related works;
- Enable the ecoPTZ (interest-free loan) to be applied at a fixed rate for single initiative work, without a work package (e.g.: installation of central heating powered by renewable energies);
- 100% funding of an energy audit for lower income households who own heat sieves (performance certificates F or G). Make this audit mandatory prior to letting a private category F or G dwelling and during transfer of a dwelling classified F or G between now and 2021, to encourage homeowners to initiate building work;
- To get out the coal for heating households by 2028;
- Continue and boost the CEE helping hand for halting the use of fuel-oil boilers in favour of heat pumps, biomass boilers, solar combined systems, gas boilers with very high energy efficiency specifications or connection to a renewable heating network.

2.3. Towards zero-emission mobility and vehicles

In transport, the public authorities must take resolute action: access to mobility is often the foremost factor for integrating populations living far from their place of work, and transport costs weigh heavily on household budgets. This action will take many forms: we must change vehicles, modes of transport and the way we plan our living areas. Reducing consumption in transport also means rolling out public transport and increasing the average vehicle load, whether through car sharing for passengers or by optimising goods transportation. Urban space planning should encourage these changes in use, chiefly by boosting bike use and setting up low-emission zones, which will lead to a switch to less polluting means.

Measures to reduce energy consumption and greenhouse gas emissions in transport:

- Comply with the European objective for greenhouse gas emissions of 95gCO_2/km on average for new cars by 2021;
- Comply in the most efficien way with the European objective of 37.5% decrease of CO_2 emissions of new vehicles sold in 2030 compared to 2021 for personal vehicles;
- End sales of new vehicles emitting greenhouse gases in 2040;
- Remove barriers to the development of electric vehicles: total extra cost of ownership (including nominal extra cost at purchase), key usage constraints (battery autonomy, charging infrastructure);
- Balance the total cost of ownership: maintain subsidy and/or tax mechanisms;
- Put in place regulatory measures (development of low-emission zones, benefits of use such as dedicated lanes or parking spaces);
- Support the investment in clean heavy vehicles by an enhanced extra depreciation scheme: extend the extra depreciation scheme for NGV heavy goods vehicles until 2021; consolidate the system for heavy vehicles under 16t and establish technological neutrality (extension to hydrogen and electricity), expanding it to other modes, principally maritime;
- Support car sharing and all mobility solutions alternative to individual car use;
- Deploy a network of charging infrastructures able to support the targeted growth in the number of electric vehicles: mobilise financing tools (PIA (Future investments programme), CITE, CEE ADVENIR program; increase funding of connection costs through network tariffs); lift the barriers to the installation (changes to the law on co-ownership, charge points to meet demand); facilitate recharging at the workplace (reform of the benefit in kind).

Clean mobility development strategy

For the production of these scenarios, the main guidelines and courses of action are notably derived from the national Consultative Meetings on Mobility. The draft Mobility Law (LOM) will be the main implementation process.

Enabling all areas to benefit from clean mobility and freeing up innovation

- Make clean mobility accessible to all by providing each area with a Mobility Organisation Authority (AOM) and extending the role of the AOMs to active or shared mobility and mobility services of a social nature. The objective is to ensure that anyone can choose its mobility within a range of services of mobility more diversified, more efficient, more connected, more shared in any area.
- Facilitate experimentation and implementation in new mobility solutions, including driverless vehicles travelling on public roads through a dedicated legislative and regulatory framework.

Managing mobility demand

- Optimising travels by implementing incentives procedures, enhancing the role of employers and the coordination of local public authorities and giving incentives to companies to adopt action plans to reduce emissions on the whole logistic chain;
- Promote more virtuous behaviours by implementing low-emission areas in conurbations and valleys affected by air pollution issues.

Developing low-emissions vehicles (included river, sea and air ones) and improving fleet efficiency by building on the alternative fuels market

- Set ambitious growth targets for the market share of low-emission (light and heavy) vehicles and using purchase and tax incentives to achieve these targets (bonus-malus, grants to switch vehicle), accompanying all people;
- Support this development through the deployment of alternative fuel distribution infrastructures by increasing funding for electric charging stations, simplifying the right to install charging facilities, and creating new gas stations (CNG) and hydrogen stations;
- Speed up the energy transition of fleet, for companies, state and local public authorities;
- Support this development through the deployment of alternative fuel distribution infrastructure, by supporting and facilitating the installation of electric charging points (right to plug) and of gas stations (NGV and hydrogen);
- Promote energy efficiency of river and sea domestic transport and reach the carbon neutrality, allowing the distribution in low carbon energy in every French harbour and facilitating the switch to other low carbon technologies (battery, biofuels, hydrogen, sail…);
- Limit air transport greenhouse gas emissions with huge energy efficiency improvement and an important switch from fossil fuels to biofuels (50%).

Favouring modal shift for passenger transport

- Developing multi-modal mobility as a result of the accelerated opening of the data and the possibility for the actors to offer a journey planning and ticket payment service integrating all links for the same journey;
- Boost the share of active modes in daily mobility by creating a national fund of €350M to make cycling safer (secure parking, anti-theft tagging of bicyclcles, bike box at traffic lights…) and creating incentives (grant for sustainable mobility) and more accessible (cycling proficiency);
- Develop public, shared and collaborative modes of transport by investing in rail infrastructures, in collective transports, in clean mobility through calls for tender and by encouraging the use of shared transport thanks to a sustainable mobility grant and dedicated ways.

Promoting modals shift and freight transport towards river routes and railways and improving efficiency

- Streamline urban logistics by taking them into account in planning documents and by overseeing the activity of digital platforms.
- Develop mass modes for freight by increasing investments in mass transport infrastructures (railways, river routes and ports).

2.4. For an industry that is both high-performing and carbon-free

Increased control of the demand for electricity and the development of renewable energies will enable the decarbonisation of electricity production by shutting down the last 4 coal-fired electrical power stations on mainland France between now and 2022. The simulations conducted by RTE as part of its provisional forecasts show that the system will indeed have enough of a margin to all of them to be shut down progressively between 2020 and 2022, notwithstanding unforeseen exceptional conditions. The continuous updating of the forecasts by RTE will allow, if necessary, to adapt the park to the context.

Decarbonising industry is more difficult because great efforts have already been made and many industrial processes require huge provision of low-cost heat, gas or electricity in a highly competitive international context. Furthermore, coal is still in use in certain applications.

In terms of coal-fired industrial heat production, it is already possible to use waste or biomass for industrial needs. This will be prioritised as part of the Heat Fund. Reducing or eliminating coal within the steel industry will necessitate technological breakthroughs whose development continues to be encouraged.

For all these industries, the recovery of waste heat is also to be integrated at the point of coal substitution.

Measures to reduce industrial energy consumption and greenhouse gas emissions in industry and energy sector

- Testing a managed release of the first energy saving certificates for energy saving operations carried out in facilities covered by the European carbon trading system;
- Including a technical-economic evaluation of solar or geothermal heat production in the energy audits of large and medium-sized companies;
- Continuing to increase applications for the eco-energy loans (PEE) made available by BPI France, for SMEs and micro-companies engaged in work qualifying for energy saving certificates. Prolonging the PEE scheme until 2025.
- Promoting the deployment of energy management systems (ISO 50 001 type) and energy benchmarks in industry.
- 75 % reduction in coal consumption in industrial sectors, excluding steel between now and 2028. To do this:
    - As part of the Heat Fund, prioritise the substitution of biomass for coal and continue the Waste Fund's call for Refuse-Derived Fuel projects to make the necessary adaptations (about € 400m in grants over 20 years would make it possible to remove coal from the agri-food and paper/cardboard industries, and € 20m for the other industries);
    - For heat networks, in the Heat Fund, prioritising the substitution of renewable and recovery energies for coal and increasing the heat fund's means.
- In the iron and steel sector:
    - Continue experiments to set up processes that emit less CO_2 in blast furnaces through the use of loans from the future investments programme;
    - Over the period covered by the PPE, establish demonstrators of innovative processes enabling the complete replacement of coal;
    - Continue the Heat Fund support for actions to recover industrial residual heat.
- In the energy sector:
    - shut down the last electric power stations running solely on coal between now and 2022. In conformity with the guidelines that prioritise projects to develop biomass in heat form, the State will not grant any financial support for those focusing on producing electricity using biomass;
    - No new authorisations for power stations producing electricity exclusively from fossil fuel.

3. Diversifying energy mixes by encouraging the penetration of renewable and recovered energies

The PPE sets the year 2028 for the goal of a marked acceleration in the development rate for renewable energies. The energy system will then have the capacity to meet the law's objectives for 2030. In particular, the goals of the PPE will enable:

- a twofold rise in the installed capacity for renewable electricity in 2028 compared to 2017 with an installed capacity of 102 to 113 GW in 2028 and 36 % renewables in electricity production for 2028 (upper range). Installed capacity will be increased by 50% between now and 2023;
- an increase in production of renewable heat from 40 to 60% compared to 2016, with production between 218 and 247 TWh in 2028, i.e. between 35% and 39 % of total heat consumption;
- an increase in the volume of injected biogas of 14 to 22 TWh in 2028, against 0.4 TWh in 2017. Biogas (injected or directly used) will account for 6 to 8% of gas consumption in 2028;
- an increase in the biofuel share of liquid fuel to 348 TWh in 2028 by stabilising the first-generation biofuels at 7% incorporation and by multiplying the share of advanced biofuels by 12 for petrol and by 9 for diesel compared to 2017;
- achieve a quantity of renewable and recovered heating and cooling delivered by the networks of between 31 and 36 TWh in 2028, which is 2.4 to 2.8 times the 2016 amount.

3.1 Renewable heat is an essential decarbonisation vector

Heating represented 42% of final energy consumption in 2016, i.e. 741 TWh. The main production source is gas at 40%, followed by renewable energies (biomass, heat pumps, geothermal, biogas, solar thermal) at 21%, electricity and petrol at 18% and 16% respectively, and only marginal amounts of coal at 5%. Achieving decarbonisation in heating is therefore a priority.

The tertiary residential sector accounts for 65 % of final heat consumption, while industry accounts for 30 %; the share for agriculture is low. As a result of the measures to control energy demand, heating needs should be at 690 TWh in 2023 and 631 TWh in 2028.

The PPE intends to accelerate the growth rate of the share of renewable heat by an average of 1.2% per year, i.e. 1.5 times faster than that recorded between 2010 and 2016. In 2028, renewable heat production should be somewhere between 218 and 247 TWh.

Transversal measures to develop renewable heat:

- Make mandatory a minimum level of renewable heat to be installed in all new buildings (individual, collective and tertiary) starting from 2020 (future environmental regulation for new buildings);
- Give feedback on the calculation engine in the RT2012 and on the E+C- experiments to give more added-value to thermal REs, in particular thermal solar, in the upcoming 2020 environmental regulation;
- Build up the Heat Fund from 2018 with a Heat Fund budget of € 255m in 2018 and € 307m in 2019 then € 350m in 2020;

	2018	2019	2020	2021	2022
Commitments authorised Heat Fund (M€)	255	307	350	350	339

- Simplify the heat fund rules: remove the requirement for refundable advances for heat fund projects and replace them with subsidies (and therefore adapt the COP ADEME objective concerning refundable advances), get closer to European guidelines by becoming aligned on maximum levels of support for heat networks and by applying the most advantageous European framework as soon as possible for non-economic activities; develop regional contracts for renewable energy development, which will allow clusters of small projects to be subsidised;
- Including a technical-economic evaluation of solar or geothermal heat production in the energy audits of large and medium-sized companies;
- Build labour costs for the installation of renewable heat for lower income households into the CITE in 2019, then make changes to this tax credit in 2020 to make it fixed rate, differentiated according to technology and take particular account of the production of renewable heat provided by each type of equipment;
- Maintain VAT at 5.5% for renewable heat equipment eligible for the CITE and related works (e.g.: smoke flue, pellet silo);
- Starting from mid-2019, enable the zero-rate eco-loan to be applied at a fixed rate for all work eligible for the CITE (e.g.: loan of up to 18,000 Euros to install a geothermal heat pump), instead of requiring at least two types of work (e.g.: heat pump plus wall insulation) to benefit from these advantageous loans.

	2016	2023	2028 low case	2028 high case
Biomass	123	145	157	169
Aerothermal Heat Pumps	22	35	39	45
Geothermal Heat Pumps	3	4	5	7
Deep geothermal energy	2	3	4	5
Solar thermal energy	1	2	2	3
Biogas (including injected biogas)	3	7	12	18
Total	154	196	218	247

Table 1: Goals for final energy consumption of sectors of renewable heat (TWh)

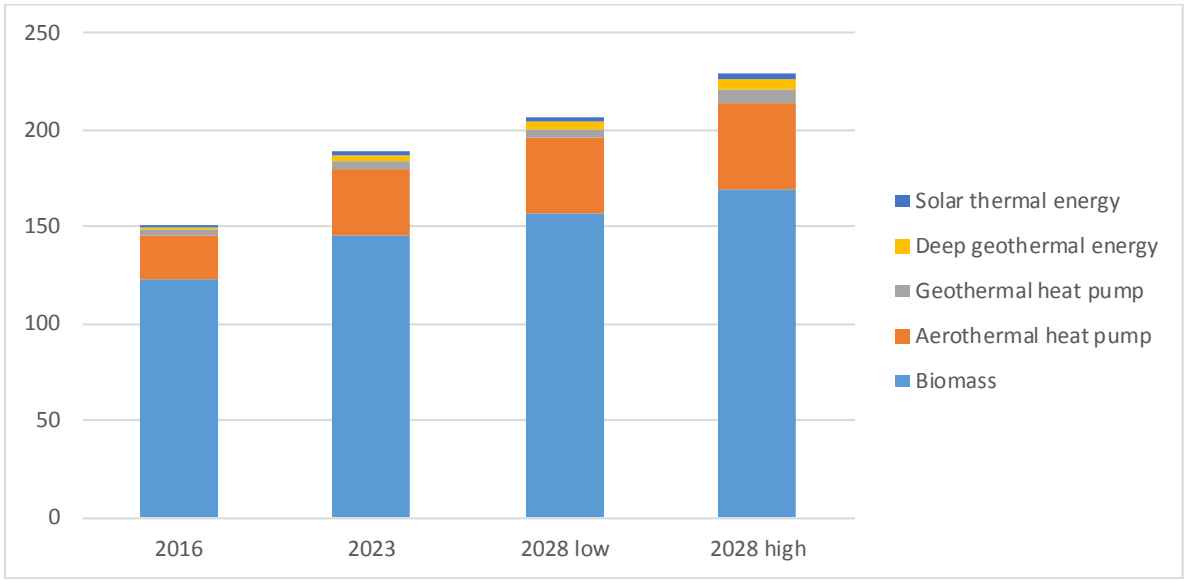


Figure 4: Progression of final energy consumption of heat by sector (TWh)

Measures specific to the promotion of solar thermal energy:

- For individuals: increase State support for solar thermal devices (solar combined systems, individual solar water heaters etc.) in the context of re-centring the CITE on the most efficient work;
- In the collective, tertiary and industrial sectors:
  - Extend the Heat Fund's call for projects for large solar thermal surface areas for a minimum of 3 years;
  - Allow Heat Fund grants for the reconditioning of faulty equipment (size audit, performance instrumentation, skills upgrading, conditional grant for example if no support has already been granted for installation or if an AFC is envisaged);

    Diversify the role of wood energy coordinators towards solar and geothermal.

Specific measures for solid biomass:

- Promote the recovery of biomass heat before high-yield cogeneration. Heat will be clearly prioritised to obtain added energy value from biomass, with a goal of 38 % of renewable heat in final heat consumption in 2030;
- Rapidly replace low-performance independent wood fired heating devices (hearths, stoves, inserts) with better performing equipment in terms of returns and air quality (green flame, pellets etc.);
- Organisation of an awareness raising campaign on the proper domestic use of wood
- Support for boilers in collective and industrial heating via the Heat Fund.

Measures specific to heat pumps:

- Supporting heat pump-assisted geothermal energy and renewable cold projects through geothermal energy via the Heat Fund.

Measures specific to deep geothermal energy:

- Support investment in geothermal energy, geothermal cooling networks, geothermal heat storage solutions, through the Heat Fund;
- Continue the Auxiliary Finance Company (Société Auxiliaire de Financement, SAF) guarantee fund and adapt it, if necessary, in order to develop the potential of new little-known aquifers based on the conclusions of the sizing study which will be conducted by ADEME in 2019.

Improvements in energy recovery from waste

Recovery from organic waste should increase (see 2nd generation biogas and biofuels). The policy of promoting the circular economy by improving the recovery of waste that could not have been avoided and is not recoverable in material form, will increase energy production from waste.

The PPE sets a goal of delivering recovered heat (industrial, data centres and waste) through heating and cooling networks. These objectives correspond to a 5-6-fold increase in the amount of industrial heat recovered by 2028, improved recovery of residual heat from household waste treatment units, and heat recovery from the combustion of other wastes such as refuse-derived fuel. The best-case scenario for 2028 is an increase in the average rate of recovery in networks of 0.8% per year over the period 2016-2028.

- Industrial residual heat will represent a contribution of 0.84 TWh in 2023 (i.e. twice the 2016 baseline situation) and of between 2.3 TWh and 2.95 TWh in 2028 (i.e. a 5 to 6-fold increase compared to the 2016 situation).

- Improved recovery of waste heat from household waste treatment units, and heat recovery from the combustion of other waste such as recovered solids will contribute 3.6TWh in 2023 and between 5.3TWh and 6, 9TWh in 2028.

	2016	2023	2028
Goal (TWh) including R&R energy from household waste incinerators	3.7	4.4	7.6 to 9.9

	Heat	Electricity
Thermal recovery from waste (Household Waste Incinerators, RDF, etc.)	15 to 18 TWh	2.3TWh
RDF Cogeneration		0.04 GW

Table 7: Prospects for heat and electricity production from household waste incineration plants and RDF in 2028

Principal measures

- Make mandatory the recovery of biogas trapped from waste landfills;
- Further develop the improvement in energy efficiency of household waste energy recovery units, have a specific action for the 10 incinerators without energy recovery and go beyond the minimum energy efficiency criteria for existing units;
- Maintain the aid paid under the Waste Fund for improving the energy efficiency of the household waste incineration plants (HWIP) and under the Heat Fund for connection to the heat recovery networks;
- Rerun the ADEME call for Refuse-Derived Fuel projects.

3.2. Fuels should be bio-sourced without negative impact on the environment

Liquid fuels, petroleum derivatives, represent a significant share of French CO_2 emissions in uses that are often difficult to substitute: transport in particular is heavily dependent on oil. The 10 years of the PPE are key to developing alternative energies to petroleum products in transport. The drop in consumption and the substitution of liquid fuels by other energy vectors (electricity, gas) will be the main lever, but it is neither sufficient in the short-term nor for certain specific uses like air or long-distance maritime transport: as such more environmentally friendly biofuels also need to be developed.

The consumption of liquid fuel should be about 432 TWh in 2028, driven by energy control measures. The goal of incorporating 1st generation biofuels will not exceed 7% of the energy contained in fuel, by 2023 and 2028. Increasing the share of bio-sourced materials in fuel will thus be done exclusively by developing advanced biofuels, that is to say, those made from waste, residue or non-food primary materials.

There will be a major focus on meeting sustainability criteria and on the traceability of the raw materials to achieve the goals set. In conformity with the European framework, biofuels produced from materials with a high risk of impacting changes in land use will be capped and then reduced to zero.

	2017	2023	2028
Petrol channel objective (%)	0.3	1.8	3.8
Diesel channel objective (%)	0.35	0.85	3.2

Table 2: Incorporation rate of advanced biofuels in fuels released for consumption

Measures for biofuel development:

- Continue national support for the development of biofuels through incentives for incorporation for the operators who release the fuels for consumption;
- Beyond the existing threshold for conventional biofuels, limit the incorporation of biofuels made from primary materials presenting a high risk of causing indirect changes in land use (e.g.: certain palm or soya oils) as stipulated in the new European directive relating to renewables energy.

3.3. Natural gas should be progressively replaced by biogas or synthetic gas

Natural gas is today crucial to the French energy system. Its storage capacity is vital to meet the demand during heat and electricity spikes in winter. Besides, natural gas is the least carbon-rich fossil fuel and therefore enables us to reduce CO_2 emissions and atmospheric pollutants when it substitutes petroleum, for example in transport. However, natural gas is no less a fossil fuel and therefore needs to be replaced in the long term by biogas or new synthetic gas produced with renewable energy: hydrogen or power-to-gas (manufacture of synthetic gas, principally methane, by using renewable electricity).

In 2017, natural gas consumption was in the region of 493 TWh HHV. By 2023, measures to control energy demand will result in a gas consumption of 470 TWh, and 420 TWh in 2028.

Biogas has many advantages which justify significant public funding, at the same time as structuring the sector and lowering support costs.

The advantages of biogas are already evident today, it's a renewable that:

- can be stored easily;
- can be produced by farmers, offering them the opportunity to earn some extra income;
- allows waste to be used as fertilizers that would necessary be safe for health and environment;
- allows the use of an energy network already in existence over a large part of the territory which serves industry and transport.

Production costs for renewable gas are today about four times that of natural gas, but prospects of a lower cost have been indicated by players in these channels. Developing a higher production capacity should enable costs to come down, principally by means of economies of scale. The PPE provides for an adaptation of the pace of construction of new production capacity based on real time observations of the costs coming down.

NGV (Natural Gas for Vehicles) is an alternative solution to fossil fuel which enables atmospheric emissions to be limited. Furthermore, through the use of bioNGV, it could become a completely carbon-free fuel. This new use is being developed for heavy vehicles and is destined to grow. It seems sensible for the markets to direct biogas production mainly towards the means of transport that are difficult to make carbon-free rather than towards uses in buildings where other low-carbon alternatives exist.

The objective of the PPE is for biogas to reach 7 % of gas consumption in 2030 if the lower costs targeted in the baseline trajectory indeed come about, and up to 10 % if there is an even greater drop in costs.

2016	2023	2028
5.4 TWh HHV Including 0.4 TWh injected	14 TWh HHV Including 6 TWh injected	24 to 32 TWh HHV Including 14 to 22 TWh injected

Table 3: Biogas production goal (in TWh HHV)

Measures for the promotion of renewable gas:

- Create a higher profile by adopting a timeframe for calls to tender for injected bio methane: two calls to tender, for an annual production objective of 350 GWh HHV/year each, will be launched each year;
- Cement the biogas purchasing obligation at a regulated price and launch calls to tender allowing the production goals to be met at low cost thanks to big drops in costs:
  - The calls to tender will be built on a baseline purchase price trajectory, used to determine the size of the funding envelope with the aim of achieving an average of € 67/MWh HHV for the injected bio methane projects selected in 2023 and € 60/MWh HHV in 2028. If this average price is not reached, the total quantities will be reduced not to exceed the public expenditure level targeted. A maximum purchase price trajectory reaching an average of 87 €/MWh HHV for injected bio methane in 2023 and 80 €/MWh HHV in 2028 will also be put in place.
  - The volume of calls to tender will be adjusted upward if the average prices asked for in the tender framework are less than the baseline purchase price trajectory. The threshold price for calls to tender will be determined based on the maximum price trajectory. The "open window" feed-in tariff for small installations will be adjusted downwards if the contractualisation of biogas production capacity is higher than the goal of 800 GWh HHV per year over all the recovery sectors.
- Put appropriate support provisions in place for biomethane not injected in the natural gas networks (in particular biomethane used directly for bioNGV vehicles);
- Foster NGV and bioNGV mainly through an extra depreciation for purchases of compatible vehicles.

Hydrogen and "power-to-gas" represent medium-/long-term solutions for decarbonisation

As an energy vector, hydrogen produced by renewable electricity electrolysis is a strategic solution for decarbonisation in the long-term. It can replace fossil hydrogen used in industry immediately. In the medium-term, it can be one of the decarbonisation vectors in the transport sector. Beyond 2030 or 2035, it could contribute to integrating renewable energies into the electricity system: it is currently the most promising mass storage medium for inter-seasonal intermittent renewable energy.

The hydrogen plan announced in June 2018 is divided in the PPE into the following goals:

	2023	2028
Power-to-gas demonstrator (MW)	1 to 10	10 to 100
Incorporation rate of decarbonised hydrogen in industrial hydrogen nationally (%)	10%	20 to 40%
Light hydrogen vehicles (number)	5000	20,000 to 50,000
Heavy hydrogen vehicles (number)	200	800 to 2,000

Table 4: Goals for increased hydrogen consumption

Measures for promoting hydrogen:

- Put a € 100m support fund for hydrogen in place and launch calls to tender for projects on mobility and hydrogen production using electrolysers;
- Establish a traceability system for decarbonised hydrogen by 2020;
- Extend the extra depreciation measure on the purchase of hydrogen vehicles under *at least* the same conditions as for NGV (heavy vehicles>3.5t);
- Mobilise financial institutions (private and public financing, including the Deposit and Consignment Office (Caisse de Dépôts et Consignations, CDC), Banque Patrimoine & Immobilier (BPI)) and standardise co-financing models for ecosystem deployment projects in the regions;
- Conduct discussions with all players on simplifying and harmonising the licensing and certification procedures for boats and associated hydrogen fuelling solutions.

3.4. Electricity is a lever for decarbonising numerous uses, and the renewal of its production modes should make our electricity system more resilient

On the 2050 horizon, carbon neutrality will require the electrification of many applications. In the shorter term, efforts to control demand should be higher than or equal to these first transfers, which will lead to a stable or slightly lower electricity consumption.

The diversification of the mix and decentralisation of production will be continued during the whole PPE while gathering speed over the 2nd period

France is engaged in diversifying its electricity mix in order to make it more sustainable, increase its resilience and foster technological progress. This development of renewables should enable us to produce more energy from sources present on French territory and progressively reduce the share of nuclear.

The development of renewables is a global movement and particularly present in Europe, a continent which is at the cutting-edge of the fight against climate change. The European union has therefore set a goal of 32% renewable energy across Europe for 2030 (on all energies: electricity, gas, heat). This dynamic has contributed to a sharp drop in the production costs of electricity from renewable energy, making ground-based solar or wind the most competitive sources today, as long as the electricity systems do not need the addition of storage to manage the intermittent nature of these electricity sources.

The government is committed to an unprecedented development of its renewable electricity production while paying careful attention to environmental issues, local feasibility, conflicting uses

The Energy Transition for Green Growth Act set a target of 40% electricity from renewable sources in national production in 2030. In 2017, renewables accounted for 17 % of national production (2017 RTE electricity balance). The main channels that can enable this goal to be met are hydroelectricity, photovoltaic solar (PV) and onshore wind power, then progressively offshore wind power whose production will increase during the second PPE period. These are the most competitive channels: the sharp drops in costs observed in these channels make it possible to develop significant capacity with less public support compared to previous projects (for which we are currently paying because the support to electric renewables is granted during 15 to 20 years after the beginning of production). The pace of their rollout is intended to increase compared to the objectives of previous PPE, which are at 3 GW/year for PV and 2 GW/year for onshore wind.

Photovoltaic solar will be proportionately more developed in big solar power stations than it is nowadays, because it is the most competitive channel and big projects (>50MW) will progressively be developed without subsidy which will increase the average size of the systems. The government will ensure that these projects respect biodiversity and agricultural land, by prioritising the use of industrial wasteland, neglected motorway space, military areas or even the solarisation of big roof areas which will gradually become mandatory.

Wind power will be developed partly through renovation of existing systems that have reached the end of their life, which will enable us to increase the energy produced while keeping an identical or smaller number of masts. In total, the transition from 15 GW in 2018 to 34.1 GW in 2028 will lead to a progression in the wind farm capacity from 8,000-masts at the end of 2018 to approximately 14,500 in 2028, i.e. an increase of 6,500 masts.

Marine energies will provide a significant complement, all the more so because their level of availability (>4000hrs/year) will enable the electricity network to be stabilised, particularly in the Brittany peninsula. The first 6 offshore wind projects, which were subject to renegotiation, will all be operational at the start of the 2nd period of the PPE. In order to capitalise on the industrial channel created in this way, 3 calls for tender for fixed equipment and 3 calls for tender for floating equipment, totalling 3.25 GW, will be launched in the first period of the PPE. The floating farms in Brittany and in the Mediterranean will be world firsts, and will ensure France becomes a leader in these technologies with a very big market potential.

Hydroelectricity still accounts for the biggest part of the renewable electricity produced in France. Its development is however limited by physical capacity. During the period of the PPE, the return to tender for franchises that have passed their deadline and work connected with the extension of the Rhône franchise will enable the installed power to be pushed up by developing new capacity without new damming of water. Furthermore, research into optimising the existing sites will be carried out and some new projects will be developed.

Considering the costs of producing geothermal and biomass electricity, support for these sectors will be reserved for heat production in order to optimise the overall cost of meeting the renewable energy goals and encourage the most energy efficient solutions. Innovative projects, where appropriate, may be supported within the framework of provisions for R&D. Equally, tidal power technologies do not appear sufficiently mature to stimulate commercial development in sustainable economic conditions before the end of the PPE.

Principal transversal measures for promoting electricity renewables

Set the following goals for renewable electricity channels in order to raise installed capacity from 48.6 GW at the end of 2017 to 74 GW in 2023 and to between 102 and 113 GW in 2028:

	2023	2028
Hydroelectricity (GW)	25.7	26.4-26.7
Onshore wind (GW)	24.6	34.1-35.6
Offshore wind (GW)	2.4	4.7-5.2
Photovoltaics (GW)	20.6	35.6-44.5
Wood biomass	0.8	0.8
Biogas-Methanisation	0.27	0.34-0.41
Geothermal energy	0.024	0.024
Total	**74**	**102 to 113**

Table 5: PPE goals for electricity production from renewables by channel

In order to achieve these goals, adopt a call for tender timeframe providing for an annual launch of about 10 calls for tender with the following projected timeframe:

Projected timeframe (launch date for procedures)	2019				2020				2021				2022				2023				2024			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Hydro-electricity	35 MW				35 MW				35 MW				35 MW				35 MW				35 MW			
Terrestrial wind turbines		0.5 GW	0.5 GW	0.6 GW		0.8 GW		1 GW		1 GW		1 GW		1 GW		1 GW		1 GW		1 GW		1 GW		1 GW
Solar energy (ground level)		0.8 GW		1 GW		1 GW		1 GW		1 GW		1 GW		1 GW		1 GW		1 GW		1 GW		1 GW		1 GW
Solar (Buildings)	300 MW	300 MW	300 MW		300 MW	300 MW	300 MW		300 MW	300 MW	300 MW		300 MW	300 MW	300 MW		300 MW	300 MW	300 MW		300 MW	300 MW	300 MW	

Table 6: Timeframe for calls for tender to develop renewable electricity

Grant date for the call for tenders	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**>2025**
Floating wind turbine			250 MW *Bretagne (€120/MWh)*	250 MW *Méditerranée (€110/MWh)*		250-500 MW depending on prices	1 project of 500 MW per year, fixed or floating depending on prices and resources
Fixed wind	500 MW *Dunkirk (<€70/MWh)*	1000 MW *English Channel (€65/MWh)*			1000 – 1500 MW *(€60/MWh)*		

Table 7: Calls for tender for offshore wind (the dates indicated are the dates on which a winner will be selected, following a pitch procedure; prices indicated are the target prices for the calls for tender on the basis of which the maximum prices will be fixed)

Speed up project development while paying careful attention to environmental issues, local feasibility, conflicting uses:

- Continue the steps taken to simplify administration in order to shorten development time and reduce costs;
- Support the development of participatory investment in projects by citizens and local authorities;
- Prepare for large-scale recycling of end-of-life facilities for the sectors in which this has not already been done.

Measure specific to the promotion of hydroelectricity:

- Optimise the production and flexibility of the hydroelectric stock, paying particular attention to over-equipment and the installation of hydroelectric power plants on existing non-equipped dams

Measures specific to the promotion of onshore wind turbines:

- During the dismantling stage, make recycling of wind farm materials mandatory by 2023;
- Encourage the re-use of end-of-life wind power sites in order to reinstall higher performing machines there.

Measures specific to the promotion of photovoltaics:

- Prioritise the development of ground level photovoltaics which are less costly, preferably on artificialised land, waste ground and car parks and keeping attention that projects are careful with biodiversity protection and agriculture lands;
- Support innovation in the photovoltaics sector via calls for tender, to encourage new solar solutions on the ground (agro-voltaics, floating power stations etc.) and on buildings.

Self-consumption and local energy production

There is a strong trend which will dramatically restructure the French energy landscape in years to come: the decentralisation of energy production is set to gain ground at regional and individual level in particular through the massive development of photovoltaic solar. This renewable and increasingly competitive source (even if small PV is still expensive) will lead to self-consumption and self-production. The networks will be used less but will be more intelligent, and will require a new spacial planning as well as a rethinking of energy system governance. To ensure the development of self-consumption, the players need, in particular, a clear view of the context applicable to them and of the various factors that may have an influence on profitability levels of self-consumption operations.

Measures:

- Clarifying the framework applicable to the third-party investor model, in which the consumer does not own the installation but still benefits from production, in order to align it with the framework of individual self-consumption;
- Open up new possibilities for collective self-consumption and facilitate their funding;
- Increase the maximum size for the facilities eligible for self-consumption call for tenders to 1 MW;
- Widen the scope of self-consumption to allow for collective self-consumption projects of greater scope (large development projects / eco-neighbourhoods).

The government is defining a credible and realistic program for reducing the share of nuclear energy in electricity production with a goal of 50 % in 2035.

The Fessenheim nuclear power station should be shut down with effect from spring 2020, by applying a cap to installed electronuclear power and to enable the commissioning of the Flamanville EPR.

Beyond this first stage, the government is pursuing a goal of **diversifying the electricity mix to reach 50 % electricity production from nuclear.** This diversification policy is a response to several different issues:

- **A more diversified electricity system**, if it succeeds in integrating an increased volume of variable renewable energies, can be **an electricity system that is more resilient** to external impacts such as, for example, a drop in the production capacity of reactors following an incident or a generic failing leading to the non-availability of several reactors;
- The vast majority of the nuclear electricity power station system was built over a short period of time, about 15 years. We should therefore **anticipate the shutdown of certain reactors in the existing system to avoid a "cliff edge" effect** which would not be sustainable, neither in terms of social impact nor for the electricity system. This anticipation is also necessary to spread out investment in new electricity production capacity;
- Several channels for electricity production from renewable sources have shown their ability to compete and will make up a significant part of the long-term electricity mix, at least until a massive electricity storage need appears;
- Diversification on this scale towards renewable energy should be smoothed out over the course of time because the new renewable capacity will be installed in a diffuse and decentralised way by means of small projects and channels requiring a gradual stepping up in power.

It seems impossible to reach the goal of 50% of electricity in production being sourced from nuclear by 2025, except by risking disruptions to France's energy supply or by restarting the construction of combustion power plants which would run contrary to our goals to fighting climate change.

Therefore, the government has set the achievement of 50 % electricity from nuclear in the mix as an objective for 2035. Such a progression is consistent with our climate commitments: it will be completed without building any new fossil fuel thermal power plants, it will not lead to an increase in greenhouse gas emissions from our electricity production and it is compatible with the closure of all our coal-fired power plants between now and 2022. It is also consistent with the challenges of maintaining a closed cycle for fuel and sustaining the cycle facilities and will enable the regions and employees to prepare better, to undertake their reconversion well in advance and to structure the dismantling channel.

The government has chosen to show a clear programming for the changes to nuclear capacity, including beyond the term of the PPE (2028), so as not to task our successors with designing the modalities for putting this diversification into action. Therefore, to achieve this 50 % electricity production goal in 2035, the government sets the following guidelines:

- **14 nuclear reactors will be shut down between now and 2035, including those at the Fessenheim plant;**
- **The final version of the PPE will identify the sites for which these closures will be prioritised.** During the PPE consultation period, EDF should send the government a list of the nuclear sites concerned, **by prioritising reactor shutdowns that do not lead to the complete shutdown of any site in order to minimise the social and economic impact of these closures.** The State's preliminary analysis, based on the age of the sites, the dates of their ten-year inspections, and the industrial and economic vision described by EDF in its contribution to the public debate on the PPE, steers us towards a prioritised closure of 12 reactors from amongst those at the sites of Tricastin, Bugey, Gravelines, Dampierre, Blayais, Cruas, Chinon and Saint-Laurent;
- **The general principle will be the shutdown of the 12 reactors (excluding Fessenheim) with a deadline falling at the latest at their 5th ten-year inspection.** The shutdowns at the 5th ten-year inspection enable a scenario that is industrially consistent and economically beneficial as long as openings exist and there is no overcapacity leading to important shut down of electricity price market, and that allows the French and European electricity mix to benefit from carbon-free electricity production. Because EDF will amortise the accounts of the 900 MW reactors over a period of 50 years, the Government considers that these shutdowns will not give rise to compensation.
- Nonetheless, in order to smooth reactor shutdown to facilitate the implementation socially, technically and politically, **2 reactors will be shut down in advance of their 5th ten-year inspections in 2027 and 2028**, except in cases of non-compliance with security of supply criteria or sudden shutdown of other reactors for safety reasons;
- **2 reactors could also be shut down in the next five-year presidency, in 2025-2026**, under two conditions: security of supply is assured and if our European neighbours speed up their energy transition, reduce their production capacity from coal and massively develop renewable energy, which would lead to low electricity prices on European markets that could lower the profitability of the extension of existing reactors. These conditions presuppose coordination with our neighbours on the evolution of European electricity systems. The analysis of these conditions will be the subject of a report submitted by the Commission for Energy Regulation (Commission de régulation de l'énergie, CRE) to the government before 1st December 2022 and based on RTE expertise.

The early closures will be confirmed 3 years before their implementation based on data available at that time, in order to ensure that the above-mentioned criteria are complied with. This will begin after the coal-fired power plants have been shut down, since the priority is to decarbonise electricity production. These closures will be systematically supported by the state, principally by means of establishing **ecological transition contracts** in order to enable the regions to participate in new development dynamics.

Furthermore, the strategy for treating-recycling nuclear fuel will remain over the PPE period and beyond, until the 2040s, when a large portion of the facilities and workshops of the Hague plant will reach the end of their

life. To this end, and to compensate for the closures of the MOX fuelled 900 MW reactors over this period, the moxing of a sufficient number of 1300-MW reactors will be undertaken in order to maintain the French cycle sustainable.

Beyond this timeline, the government, in association with the channel, should assess the strategic direction it desires for its fuel cycle policy, based on R&D efforts which will be pursued over the term of the PPE in the field of closing the fuel cycle.

Measures:

- The government has set a goal of achieving a maximum 50 % nuclear share in the electricity mix in 2035. The goal stipulated in the Energy Code will be modified as a result;
- To meet this goal, fourteen 900MW nuclear reactors must close, including the two reactors at Fessenheim;
- The timeframe for closure of the power plants will comply with the dates of the 5th ten-year inspections for the reactors in question, except for the 2 reactors which will shut in the second period of the PPE in 2027 and in 2028, if security of supply allows it;
- If certain conditions relating to the price of electricity and the evolution of the electricity markets at a European level are fulfilled, the closure of an additional pair of reactors could occur by 2025-2026, based on a decision taken in 2023;
- The government will identify sites prioritised for closure, based on the programming submitted by EDF. With exceptions, the downsizing of the nuclear power park should not lead to any nuclear site stopping completely;
- The strategy for treating-recycling nuclear fuel will remain over the PPE period and beyond, until the 2040s. To this end, the moxing of a certain number of 1300-MW reactors will be undertaken and studies will be done on rolling out multi-recycling of the fuel in the reactors in the existing nuclear power system.

Structural decisions on our long-term electricity mix should be prepared during the first PPE period.

Achieving carbon neutrality by 2050 is a priority for France to meet climate challenges. It requires the long-term electricity mix to become completely carbon-free.

New nuclear capacity does not seem necessary for the electricity system before a timeline of approximately 2035. Beyond that, the question remains of how to build new means of carbon-free electricity production to ensure a balanced supply and demand in line with the decommissioning of the current nuclear system.

With technology in its current state, it is not possible to determine with certainty which electricity production technology will be the most competitive to replace the existing nuclear power plant system beyond 2035, between nuclear power and renewable energy coupled with storage and other flexibility solutions. After 2030 and for the 2050 horizon, these parameters should be combined to design the new French energy landscape and the respective shares for nuclear power and renewable energy. Several scenarios are possible, going from a 100 % renewable scenario to a scenario where nuclear power persists as a source of electricity production, integrated into the mix for reasons relating to production management and competitiveness. Because of this uncertainty, we must maintain a construction capacity for new nuclear reactors based on national technological and industrial capabilities.

In order to allow a decision to be made on any potential launch of a programme to construct new reactors, the government will conduct a complete work plan with the sectorfrom now to mid 2021 which will mainly cover to the following items:

- the demonstration by the French channel of its management capabilities for an industrial program for new reactors, by formalising the consolidated economic and safety feedback on the commissioning of the first EPRs, in particular Flamanville 3, and on the engineering phase and industrial mobilisation of

Hinkley Point C, and by a program to remove the risks of the new EPR2 reactor model proposed by EDF;

- the appraisal of the expected costs of the new EPR2 reactor model proposed by EDF and the technical economic comparison of nuclear power with other modes of low-carbon electricity production, taking into account all the direct and indirect costs (network development, total storage cost, management of nuclear waste, etc.)
- the analysis of the possible options for the implementation and funding of a program of new reactors for the French electricity system, including the question of the economic regulation model for these new reactors,
- the necessary actions to gain European commission validation of the selected funding and implementation provisions;
- the studies in order to decide which sites the new reactors will be installed on;
- the actions to be taken in terms of public consultation;
- the adaptations to the national legislative and regulatory framework which would be necessary for running such a program.

It also seems necessary to appraise, within the framework of the next PPE and on a regular basis, the alternative options to ensure a decarbonised electricity mix with the necessary guarantees in security of supply. In terms of the alternative options, the State will invest in research on batteries, hydrogen storage (as part of the Hydrogen Plan), power-to-gas and demand management in order to capitalise on the skills and expertise in this field in French industry and to bring down costs.

Measures

- Over the first period of the PPE, the government will continue to examine the different options available to ensure a long-term balance of supply and demand in the electricity system, in particular the option of building new nuclear reactors. This option will thus be kept open in order preserve the government's decision-making capacity;
- On this point in particular, by mid-2021, the government will conduct a work program with the sector to examine questions relating to the cost of new nuclear capacity and its advantages and disadvantages compared to other low-carbon means of production. It will also examine the potential funding models, the implementation conditions for the new reactor projects and public consultation, as well as questions relating to managing the waste generated by any new nuclear power park;
- Based on these elements and any changes in the energy context, the government will decide whether it is appropriate to launch a renewal programme for nuclear power facilities.

4. Maintaining security of supply at a high level while complying with environmental requirements

Security of supply is defined as the capacity of the energy system to continuously meet foreseeable market demand at a reasonable cost. Security of supply is ensured in particular by controlling demand for energy, by the production of national and local energy, mainly renewable energy, and by the diversification of supplies. Maintaining security of supply at a high level for the benefit of all consumers (citizens, public or economic entities) constitutes an essential challenge for energy transition.

The main goals with regard to security of supply are:

- Confirm the supply criteria for gas and electricity;
- Accelerate the decrease in the electricity spike;
- Safeguard the mobilisation of the biomass resource while guarantee the balance between food usage

and ensuring the sustainability of soils, necessary for the sustainability of the sustainability of renewable biomass production.

Measures to ensure security of supply for liquid fuels

Security of supply for fuel is ensured for the whole of French territory. The drop in fuel consumption over time will entail a lower profitability for service stations which could be required to close. The closure of these stations could even destabilise upstream logistics over time (temporary storage depots). There is no real issue for the timeline of the PPE, but there could be one after that. **That is why it is important to put in place a system to monitor changes to the regional coverage.**

Measures to ensure security of supply for gas products

Security of supply for gas is ensured for the whole territory. This has been consolidated by recent changes to legislation and regulations. Gas consumption, like fuel consumption, will have to be reduced. The infrastructure system that ensures security of supply, in particular active underground gas storage sites, is correctly scaled for the 2019-2023 period. No need has been identified for new underground natural gas storage infrastructures or for the reactivation of any of the three currently mothballed underground storage facilities. Their removal from the scope of the regulation will make it possible to reduce costs likely to weigh on the use prices of the transport networks, to the benefit of natural gas consumers.

Developing natural gas consumption interruptibility at a level of at least 200 GWh/d across the large consumption sites will also give greater flexibility to the gas system.

Measures to ensure security of supply for electricity

Current analysis does not show any risk to the security of the electricity system by the end of the PPE timeline, in particular because of the flexibility of the existing means of production. The margins are limited at the beginning of the period with the shut down of thermal power plants. The development of flexibility tools for the electricity system (demand management, load management, interruptibility, storage, interconnections) must continue in the medium term even though they are not immediately indispensable, particularly in relation to the growth of intermittent renewable energies.

Measures:

- Set a load management goal of 6.5 GW by 2028 with an interim target of 4.5GW in 2023;
- Carry out studies to prepare a possible longer-term deployment of hydrogen as a flexibility solution to serve the electricity and gas systems.

Furthermore, the electricity system is very exposed to spikes in demand because of big developments in electrical heat in the past. The growth of these spikes has slowed down but could increase once more because of the cumulative effect of the electrification of buildings and vehicles, making it that much more important to manage demand. Containing then reducing these spikes is therefore an important challenge. Connected meters will be the first step in the development of smart use and precise management of the network. They open the door to developing the internet of things which will be able to automatically optimise device consumption.

5. Developing networks, storage and local production

The energy system depends on the networks functioning correctly, for which the challenges set by the energy transition are the acceptance of renewable and recovered energy (“R&REn“), the development of flexibility (principally in demand), and the use of new information and communication technologies.

5.1. Heating and cooling networks

Heat networks play an essential role in developing renewable energy and refuse-derived recovered energy, because they enable huge mobilisation of biomass, geothermal or solar, or the recovery of residual heat from

industry and waste-to-energy units. To reach the 2023 upper range i.e. 24.4 TWh, the pace of projects must be increased by 2.8.

	2016	2023	2028
Delivery of renewable and recovered heat (TWh)	13	24.4	31 to 36
Delivery of renewable and recovery cold by networks (TWh)	0.14	0.27	0.37-0.49

Table 8: Goals complementary to the renewable and recovery heat supply measures

Heat networks are very often profitable in economic terms. However, the size of the investments needed for their installation and a certain inertia within the systems create difficulties. This is why it is necessary to generate incentives.

Measures:

- Accelerate the mobilisation of renewable energies (especially biomass) and recovery energies in networks by maximising the R&R energy ratio of Heat Fund projects;
- Ask cities with more than 10,000 inhabitants to carry out feasibility studies into heating and cooling networks, in order to further densify and extend existing networks and speed up the creation of new networks;
- Keep VAT at 5.5% for heat deliveries from networks more than 50% supplied by R&R energy (and include solar thermal energy as an eligible R&R energy);
- Support the development of the most efficient renewable and recovery cooling networks through the Heat Fund;
- Establish at European level a recognised definition of renewable cold, when it is delivered by network;
- Encourage social landlords to develop R&R energy and anti-fuel poverty targets.
- Ensure the integration of R&R energy in regional policies and plans and planning documents;
- Promote a classification of networks to enable a local authority to make connection to its heat network compulsory for new buildings or buildings that have been substantially renovated, in certain areas and under certain conditions.

5.2. The electricity network and integration of renewables

System flexibility will be developed to facilitate its future proofing (management of electric vehicle charging, smart meters etc.). Enhanced work, in connection with the International Energy Agency, will be carried out on integrating intermittent renewable energies into the electricity system.

With regard to network changes relating to the closure of nuclear reactors, once the reactors have been identified, RTE will conduct the required network studies in order to identify the adaptations necessary for the new production and consumption geography.

An industrial plan to develop large scale electricity storage

Electricity storage is a key to the energy transition. R&D and innovations are promoted by the relevant future investment program, but we should go further by finding the means to develop large-scale storage to prepare French industry to be more proactive in this sector.

Measures:

- Launch, during the first period of the PPE, the process of developing electricity pump stations with a potential of 1.5GW, in order to commission the installations between 2030 and 2035;
- During the first PPE period, set up a framework for rolling out the development of "virtual lines" using battery storage facilities by 2028, to avoid having to reinforce the grid or cap renewable energies;
- Continue upstream R&D and demonstration efforts (e.g. a future investments programme for demonstrators, a single inter-ministerial fund for collaborative research projects, National Regulatory Authority (Autorité Nationale De Régulation, ANR) support for research and development projects, innovation competition for small businesses, but also demonstrators of grid services such as the Ringo project led by RTE), in order to develop competitive electricity storage solutions, which, in the medium term, could enable the share of renewable energy in the electricity mix to continue increasing;
- Together with sector committees, research possibilities for the development of a French battery production sector and set an ambitious plan for integrating all storage parameters between now and mid-2019.

5.3. Fostering refuelling infrastructures for alternative fuels

The development of alternative fuels, namely NGV, LPG-fuel, electricity, hydrogen, etc., represents an important lever for transitioning the transport sector, in particular for road and river transport.

Installing and maintaining a charging and refuelling network infrastructure is a major challenge in the development of alternative fuels. The structure of the distribution network must be adapted to each fuel type:

Channel	2017	2023	2028
Electricity	22,308 public charge points	100,000 public refuelling points	
LPG-f	1,750 stations	Vehicle fleet development only: The current infrastructure has the capacity for a 500% increase in fleet	
Hydrogen	Approximately 20 stations	100 stations	400 to 1,000 stations
NGV (LNG and CNG)	82 refuelling stations (February 2018)	770 stations	1,550 stations
Maritime LNG	Le Havre (electricity) Marseille (3 stations)	Development in all major ports	
Quayside electricity	Marseille (3 stations)	On a case-by-case basis, use of LNG at the quayside to supply electricity to all boats (more flexibility, higher power)	

Table 9: Development goals for alternative fuel refuelling infrastructures

Measures for development of alternative fuel refuelling infrastructures:

- Revise the legislative and regulatory framework concerning the development of technology and management of risks for NGV and hydrogen refuelling facilities so as to facilitate the rollout and management of electric charging stations between now and 2020;
- Encourage the development of electrical charge points through a decrease in the cost of connection, the CITE and mobilisation of the CEEs.

6. Research and innovation

The transition towards a low-carbon economy (low in material and energy consumption, very circular and carbon-free) renders the expansion of research and innovation activities in the energy field absolutely necessary, in order to develop technologies and patterns of behaviour which will contribute to reducing emissions, and to position France competitively on future markets for low-carbon goods and services.

Many needs specific to research and innovation have been identified:

- in the energy sectors, on energy decarbonisation, energy efficiency, energy storage, intelligent management of transport and distribution networks, as well as solutions to capture, store and reuse carbon;
- in the non-energy sectors, to improve processes aimed at "carbon" and environmental efficiency, and resource optimisation, recycling and reuse;
- on social innovations (change in behaviour, conduct and assimilation of the changes etc.) and organisational innovations (public policies etc.).

These needs, in terms of meeting the low-carbon transition challenge, will mobilise all the players involved in low-carbon research and innovation actions nationally, but also across Europe and internationally.

The European Union is mobilising significant resources for energy R&D, in particular through the Horizon 2020 (H2020) program: a budget of € 5,931 million has been allocated to energy research (excluding nuclear) for the period 2014-2020. This significant effort towards supporting R&D into new energy technology will be continued as part of the upcoming Horizon Europe programme which plans to allocate € 15bn to cluster 4, energy-climate-transport.

France's contribution to H2020 is in line with its contribution to the Union's budget, i.e. about 16%. Increasing the return rate of loans for projects carried by French players (which has been around 10% for several years) is therefore an important issue. A 3-prong action plan has been adopted: encourage greater participation in the Framework Research and Innovation Program (Programme-Cadre De Recherche Et d'Innovation, PCRI) and coordinate the projects, supporting them in a more efficient way during all the stages of preparing for submission and implementing the projects, and establish an effective influence strategy with regard to programming.

Nationally, France has also allocated a large budget to the energy research field, contributing about 1 billion euros of public money each year.

Transversal measures:

- Continue and expand support for R&D and innovation for the energy transition, in particular by means of the Future Investments Program, in coherence with the main guidelines formulated by the Innovation Council, implemented in 2018;
- Confirm the commitments taken on as part of the Mission Innovation and in particular increase public funding of R&D in order to speed up the development of technologies serving the energy transition;

- Consolidate French participation in large international research programs and particularly in the upcoming Horizon Europe framework program;
- Develop new training for energy transition professions, with the support of higher education establishments or institutes such as the Institutes for Energy Transition.

Measures for smart grids:

- Refine the economic assessment of smart grid solutions in function to the beneficiaries (grid operators, producers, consumers), to target the most effective State support;
- Make better use of the potential for smart meter services, in particular by providing more information about their functions;
- Encourage the emergence of smart charging management solutions to facilitate the integration of electric vehicles.

Measures for nuclear:

- Providing that technical, economical and market studies on SMRs, expected in 2019, are conclusive, launching the completion of step-by-step conceptual design studies by the next MEP review, thus enabling a better assessment of the technology added value and the development of dedicated skills.
- Defining and supporting an R&D program carried out by the industrial actors and leading to the long-term closure of the nuclear fuel cycle. This program will rely in the medium-term on the fuel multi-recycling in pressurized water reactors, while preserving the ability for a potential industrial deployment of a fleet of fast-breeder reactors in the second half of the 21st century.

7. Preserving consumer purchasing power and competitive energy prices

7.1. Macroeconomic challenges of the PPE

The Three-me Model was used to assess the macroeconomic impact of the scenario proposed in the SNBC and the PPE. The modelling was based on the carbon trajectory initially programmed over the five-year presidency.

	2023	2028	2030
GDP	1.3	1.9	2.3
AV of the market sector	1.8	2.4	2.9
Consumption by households	0.4	1.3	2.2
Purchasing power of households	1.1	2.2	2.7
Jobs (number)	246,000	413,000	475,000
Trade balance	0.2	-0.1	-0.3
Energy bill	-0.6	-0.9	-1
Government balance (in % of GDP deviation from the WEM scenario (with existing measures)	0.5	0.8	0.8

Table 10: Main results of the macroeconomic assessment (in % deviation from the business as usual scenario excluding jobs and the government balance)

GDP should grow by 1.3 points more in 2023 with the measures adopted by the PPE and the SNBC than if they had not been adopted and by 1.9 points more in 2028. The rise in GDP should be in the order of +0.1 points per year on average, driven by the growth of internal demand. In fact, investments in energy efficiency

exert a positive knock-on effect on the economy: production grows which stimulates job creation and a rise in consumption which has a positive effect on the activities of all sectors. A virtuous circle of accumulation is activated.

The results are based on the following hypotheses:

- The revenues from the carbon taxation are distributed as decrease of other taxations applying to households and companies;
- Energy transition investment do not replace other investments, and are financed by bank credit. It is supposed that there is no rise of real interest rates;
- There are non employed workers;
- The other countries implement public policies to reach carbon neutrality in 2050.

The renewed economic activity is accompanied by a rise in inflation. That can be explained for three reasons:

- Producers pass on wage increases to their prices;
- The energy efficiency investments in industry and the tertiary sector and the transition from fossil fuel consumption towards other energies, stimulates a short-term rise in the cost per unit of production which also generates a rise in prices;
- Increased demand gives companies incentives to expand their margins which makes their products more expensive.

Over the 2019-2023 period, the surplus investment in the French economy compared to the business-as-usual scenario should be in the order of 93 billion euros and over the 2024-2028 period of 178 billion euros

Inflation reduces the competitiveness of companies compared to foreign competition. The price of exports increases by + 1.7% in 2023 and + 4.9% in 2028 compared to business as usual scenario. Thus, lower volumes of goods are exported, but they are sold at higher prices. In parallel to this, the increase in consumption leads to a rise in the level of imports.

It should be noted that the price increases driven by domestic demand causes companies to lose in terms of competitiveness compared to their foreign counterparts, however the rise in internal demand is sufficient to push up the added value of the market sector by about 1.8% in 2023 and about 2.4% in 2028. The PPE measures have either a neutral or an upward impact on the added value of most industrial sectors. The sectors that experience a drop in activity are those connected to transport, fossil fuels and nuclear.

Relaunching productive activity creates jobs: 246,000 additional jobs should be created in 2023 and 413,000 in 2028 more than business as usual scenario.

Falling unemployment favourises real wage increases. Ultimately, household purchasing power rises by 1,1% in 2023 and 2.2% in 2028 compared to business as usual scenario. A lower energy bill for operators also encourages a rise in expenditure on consumption to the benefit of other sectors of the economy, which increases domestic demand and has the effect of increasing companies' productions.

7.2. Preserving social cohesion by reducing fuel poverty

The end effect of the energy transition will be beneficial for households and reduce energy bills. However, the transition itself may prove to be a difficult period when energy prices rise and investments in terms of energy control have not yet been done. Poor households are more vulnerable than others in this respect and are likely to meet serious problems in financing investments which may well offer a return over the long term but will be difficult for them in the short term. For this reason, particular attention should be paid to their situation. Measures to support this transition have been put in place and must be monitored to assess the effectiveness of their implementation and their adaptability to needs. These could be completed following the Great Debate to be conducted in the 1st trimester of 2019.

A renovation plan for buildings which specifically targets heat sieves, with special measures for lower income households:

- Increase the value of energy cheques (*chèque énergie*) from 2019 onwards: the sums paid in 2018 will be increased by € 50. The eligibility criteria for energy cheques will be widened, so as to benefit the 20 % of households with the lowest incomes. This will extend the allocation of energy cheques to 2.2 million additional households, or 5.8 million households in total;
- Maintain the French National Housing Agency (Agence nationale pour l'habitat, ANAH) contributions to support energy renovation for lower income households so as to meet the targets set for this agency: 75,000 dwellings/year from 2018 to 2022.
- Reform CITE in particular by providing households assisted by ANAH with the option of transforming it into a bonus paid quickly by the latter, thus reducing what remains to be financed;
- Reform the Eco-PTZ in 2019 by greatly simplifying it and eliminating the requirement to undertake a package of renovation work;
- Roll out innovative solutions enabling the industrialisation of renovation solutions to benefit from an economy of scale;
- Boost grants for low and very low-income households for insulation and improvement of their heating scheme (adaptations of the CITE for example for disposal of oil tanks or installing renewable energy equipment, mobilisation of the Energy Saving Certificates with enhanced aid for low and very low-income households, etc.).

Provide solutions for mobility

- Enhance the premium for lower-income households for converting old vehicles immediately by moving the goal for replacing old vehicles from 500,000 to 1,000,000 over the five-year presidency, with a doubled premium for very low-income households (as well as non-taxable [i.e. low income] motorists with big mileages), while working on attractive loans to finance what remains to be paid;
- Develop public transport, car sharing and more generally alternatives to individual car use over the whole territory as soon as possible, by targeting the most fragile groups;
- Mobilise the energy savings certificates to help lower income households for mobility (support for car sharing and developing bike use, addressing the mobility needs of households in precarious circumstances).

These measures will be put into effect in particular through actions to raise awareness and support the schemes, and better follow-up to check that they function properly (limiting what remains to be paid or easily funding this sum through loans, time period for payments, etc.), and adapting them as need be. The consultations, soon to be conducted in the regions, will pay particular attention to questions of accessibility to support measures and their ease of implementation. The mobilisation of local authorities and associations will also be an issue and a powerful lever for this effectiveness and social cohesion angle.

7.3. Ensuring competitivity in energy prices

Energy is a vital competitivity factor for some French companies that are facing strong competition not only from across Europe, but also often worldwide. Thus, for certain industrial activities (production of aluminium, chlorine, silicone etc.), electricity supply can reach 30 % of production costs.

The competitiveness and the very existence of these industries that support jobs and combat unemployment, which are government priorities, depend therefore on an energy supply that is competitive and predictable in the long term.

The price energy competitiveness is also an important issue for households power purchase.

Measures:

- The government will propose the modalities of a new regulation on established nuclear power which will guarantee consumer protection against price rises in the market beyond 2025 by letting them benefit from the competitive advantage linked with agreed investment in the established nuclear power system, at the same time giving EDF the financial capabilities to ensure the economic sustainability of the production tool in order to meet the needs of the PPE in the low price scenarios;
- Any future rise in tax measures relating to energy products will be compensated by easing taxation on other products, work or income that will allow the totality of taxation revenue to decrease of 1% of GDP in 2022;
- Sustain the different aid schemes for electro-intensive and gas intensive companies;
- Finalise the implementation of the framework for the interruptibility of natural gas consumption.

7.4. Ensure the follow-up and support necessary in terms of jobs and skills

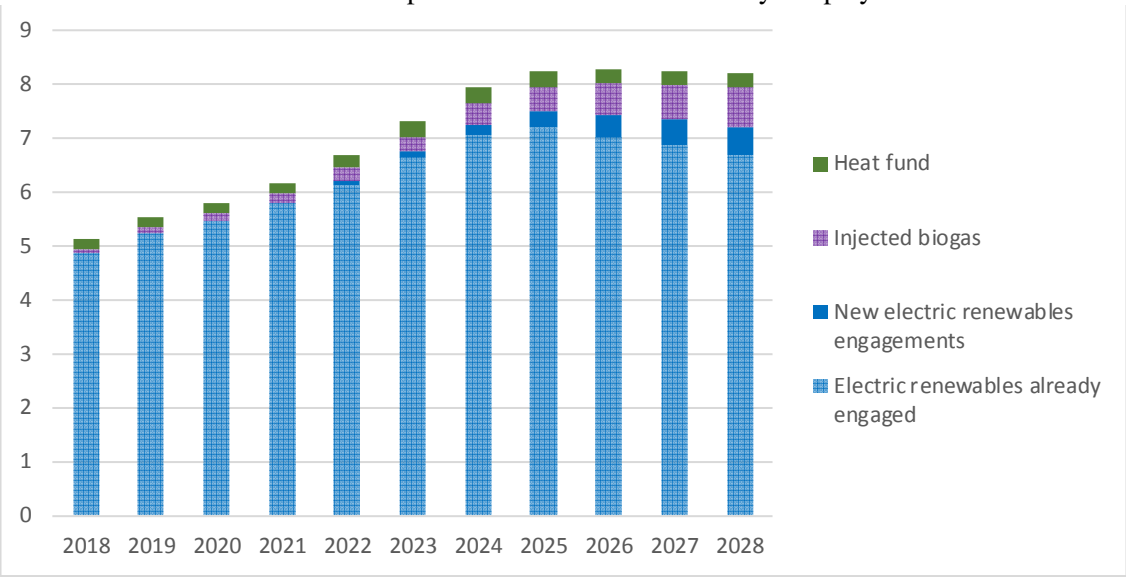
The effect of the climate and energy strategy will be positive overall for the French economy. However, some sectors will grow as others shrink. It will therefore be necessary to support individuals, sectors, and regions to put the transition into effect.

The government has tasked Laurence Parisot with preparing the plan for jobs and skills programming, stipulated by the law. Her task report will soon be made public. The government will actively learn from this report in order to organise job and skills programming and launch the resulting actions.

7.5 Managing the public funds needed while ensuring the goals are met

For electricity, the new Multi-Annual Energy Plan will lead to a commitment of 30 billion Euros of additional public support between 2018 and 2028 to be invested over 20 years. This will be added to the 95 billion Euros expenditure already projected. These sums are significant and will enable us to increase renewable energy production by 100 TWh/year. This means that the development of renewable energies will be 10 times less costly than for projects already carried out by previous governments, reflecting the much lower cost of these channels.

For gas, 7 to 9 billion Euros of additional public support could be committed between 2018 and 2028 in order to encourage the development of renewable gas production. In order to control the cost of this public support, it will be conditional on efforts to lower production costs to be taken by the players in these channels.



Projected public expenditure on planned RE over the PPE period, with a price trajectory for electricity reaching € 56/MWh in 2028 (€bn)

Given the investments to be made, public expenditure for the energy transition will increase before stabilising by 2028, it will then probably decrease when older, more expensive purchase contracts come to an end, while remaining very sensitive to prices on the electricity market. Most of the expenditure over the period is connected with prior commitments anyway.

8. Mobilising the regions for energy transition

Local action is at the heart of the energy transition, whether in terms of energy efficiency, renewable energies, storage or networks. All these projects have a strong local component. In this context, the drive provided by regional authorities is essential.

Local governance schemes exist. Their coordination with the national framework, in particular the PPE, with regard to the free administration of local authorities, is still being explored.

The State will adapt its actions to disseminate best practices for the energy transition in the regions, in association with local authorities.

Main measures implicating the regions:

- Endow each region with an organising authority for mobility (AOM) and extend the role of the AOMs to active or shared mobility and mobility services of a social nature;
- Put tools in place enabling Authorities Responsible for Electricity Distribution (Autorités organisatrices de la distribution d'électricité, AODE) and distribution administrators to improve the prioritisation and coordination of their investments;
- Revise the Regional Plans for Connection to the Renewable Energies Network (Schémas régionaux de raccordement au réseau des énergies renouvelables, S3ENR) in order to prevent saturation;
- Improve planning by ensuring improved coordination between the various geographical spheres of electrical network planning (Europe with the TYNDP, France with the SDDR, regionally with the SRADDET and S3RENR, departmentally with the New Organisation of the Electricity Market (Nouvelle organisation du marché de l'électricité, NOME) legal convention, inter-municipalities with the PCAET), as well as between electricity and other energy networks;
- Encourage open access to data pertaining to local network limitations, notably in order to optimise the establishment of production projects or infrastructure installations for the charging of electric vehicles, and to facilitate local energy planning exercises.