

EXECUTIVE SUMMARY



FRENCH STRATEGY FOR ENERGY AND CLIMATE

MULTI ANNUAL ENERGY PLAN

2019-2023

2024-2028





EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

Courtesy translation

Warning : in the event of any legal inconsistency between the English courtesy translation and the French version, the French version shall prevail.

(http://www.ecologique-solidaire.gouv.fr/sites/default/files/synthese_finale_projet_de_ppe_vf.pdf)



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

To limit the impact of global warming on our societies, countries around the world have committed, through the Paris Accord, to reduce drastically their greenhouse gas emissions. Global warming 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.

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, these changes must draw and follow on measures that have already been initiated by building on the successes and providing visibility to the whole society.

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. The Multi-Annual Energy Plan (MAEP) will allow France to play its part in achieving these goals. 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 ambitiously by creating a clear, justified pathway to move irreversibly towards respecting the environment and the climate, while ensuring inclusivity. This Multi-Annual Energy Plan (MAEP) maps out the route that the government will take in the course of the next 10 years and further topics.



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

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 organized in order to develop a revised PPE;
- From March to June 2018: a public debate was organized by the *Commission Nationale du Débat Public* (National Public Debate Commission).
- January 2019: A draft of the PPE was made public. Several bodies were formally consulted: The Environmental Authority, regarding the Strategic Environmental Evaluation, the National Council for Ecological Transition, the Upper Energy Council, the Committee for the Management of Public Service Electricity Contributions, the Upper Council for Construction and Energy Efficiency, and the Committee for the Public Electricity Distribution Grid. Their formal opinions were made public on the Ministry website.
- From December 2018 to September 2019: a post-debate consultation was held with presentations in several regions of France, various meetings targeting specific issues, one meeting with representatives of 86 local debates on the MAEP, and a discussion meeting with member of the G400 Energy, a group of 400 people from all over France who were randomly selected to actively participate in the public debate on the MAEP.
- From 20 January to 19 February 2020: a public consultation was held on the website of the Ecological Transition and Solidarity Ministry.

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

The MAEP 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 energy independence, 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 MAEP 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 MAEP is the same as that for the SNBC (National Low Carbon Strategy, *Stratégie Nationale Bas Carbone*) for the period that it covers.

The MAEP in a few figures

Final energy consumption	7.6 decrease in 2023 and 16.5% in 2028 compared to 2012 <i>i.e. a 6.3% decrease in 2023 and a 15.4% decrease in 2028 compared to 2018</i>
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



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

	<p><i>i.e. a reduction of 14% in 2023 and of 30% in 2028 compared to 2016 (322MtCO₂)</i></p> <p><i>i.e., a reduction of 27% in 2023 and 40% on 2028 compared to 1990.</i></p>
Consumption of renewable heat	<p>196 TWh consumption in 2023</p> <p>Between 218 and 247 TWh in 2028</p> <p>I.e. an increase of 25% in 2023 and between 40 and 60% in 2028 of the 2017 renewable heat consumption (154TWh)</p>
Renewable gas production	<p>Biogas production of 24 to 32TWh in 2028 based on the assumption that costs will fall (4 to 6 times the 2017 production)</p>
Installed capacity for renewable electricity production	<p>73.5 GW in 2023, i.e. +50% compared to 2017</p> <p>101 to 113 GW in 2028, double the 2017 amount</p>
Capacity for nuclear electricity production	<p>4 to 6 nuclear reactors will be shut down by 2028 including the Fessenheim ones.</p> <p>Closure of 14 nuclear reactors by 2035, the date set for achieving a 50% share of nuclear electricity in the electricity mix.</p>
Economic growth	<p>1.3-point rise in GDP in 2023 compared to the business-as-usual scenario, and 2.1 points in 2028</p>
Employment	<p>Creation of about 238,000 jobs in 2023 compared to the business-as-usual scenario and about 440,000 jobs in 2028</p>
Household disposable income	<p>Rise in purchasing power of households by 1 point in 2023, compared to the business-as-usual scenario and 2.2 points in 2028</p>

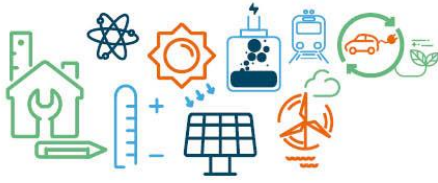
In order to take uncertainties into account and to guarantee France's energy supply, the Multi-Annual Energy Plan envisages two energy need scenarios, mainly based on two different hypotheses for the progression in demography, economic situation and energy efficiency. The results presented here are those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

The scenario used in this MAEP is structured so that changes in the various parameters of the MAEP, from energy production until its consumption, make it possible to reach all of the targets established by law.

The corresponding trajectory differs slightly from that presented in the draft MAEP published in January 2019. In particular, the energy efficiency goal in industry and the construction sector was raised, taking into account the measures taken or decided on in 2019.

The measures that are explicitly outlined in this document will have to be supplemented by additional measures to reach all of the objectives by 2030. Some measures are in fact necessary to obtain results similar to those that would have been achieved with the carbon tax, the increase of which was halted in November 2018.

The definition of these additional measures will rely in particular on the proposals developed by *Convention citoyenne pour le climat* (Citizens Climate Convention), and on the recommendations of the *Haut conseil pour le Climat* (Climate High Council).



For citizens, the PPE in 2023 will mean:

- 2.5 million additional dwellings renovated compared to end 2018;
- 3.4 million dwelling-equivalents connected to a district heating system;
- 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, heat pumps 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;
- The halting of electricity production from coal;
- 2 nuclear reactors shut down (Fessenheim);
- 200,000 self-consumption photovoltaics sites, including 50 collective self-consumption operations.

2. To achieve carbon neutrality: reducing energy consumption, of fossil fuel energy in priority

Keeping warm, getting about, manufacturing, etc., 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 2018, the final energy consumption level was in the order of 1,628 TWh. In the baseline scenario, it goes down by 7.6% in 2023 and by 16.5% in 2028 compared to 2012, to reach 1,378 TWh (a decrease of 6.3% in 2023 and 15.4% in 2028 compared with 2018).

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 MAEP 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.

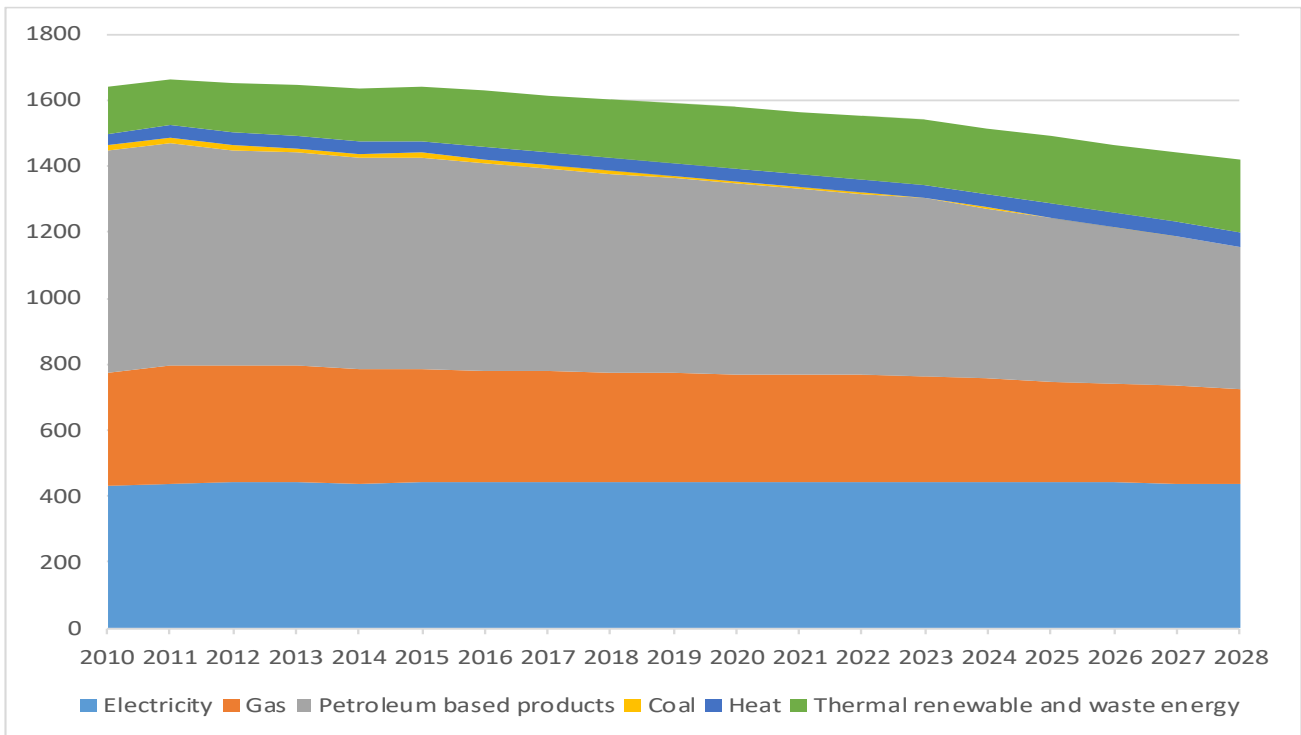
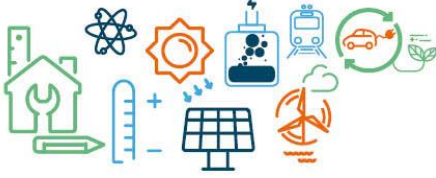


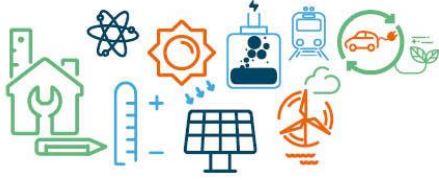
Figure 1: Progression of the real (2010-2016) and projected (2017-2028) energy mix by energy vector

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 1,394 TWh in 2017, drops by nearly one third in 2028 to reach 942 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 28 TWh, with the end of coal as a mean for energy production. Remaining coal consumption will essentially be for steel production, for which no operational method is yet available to massively substitute for coal;
- petroleum products should decrease by 34 % compared to 2012 to reach 569 TWh;
- natural gas should decrease by 22 % compared to 2012 to reach 345 TWh LHV.



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

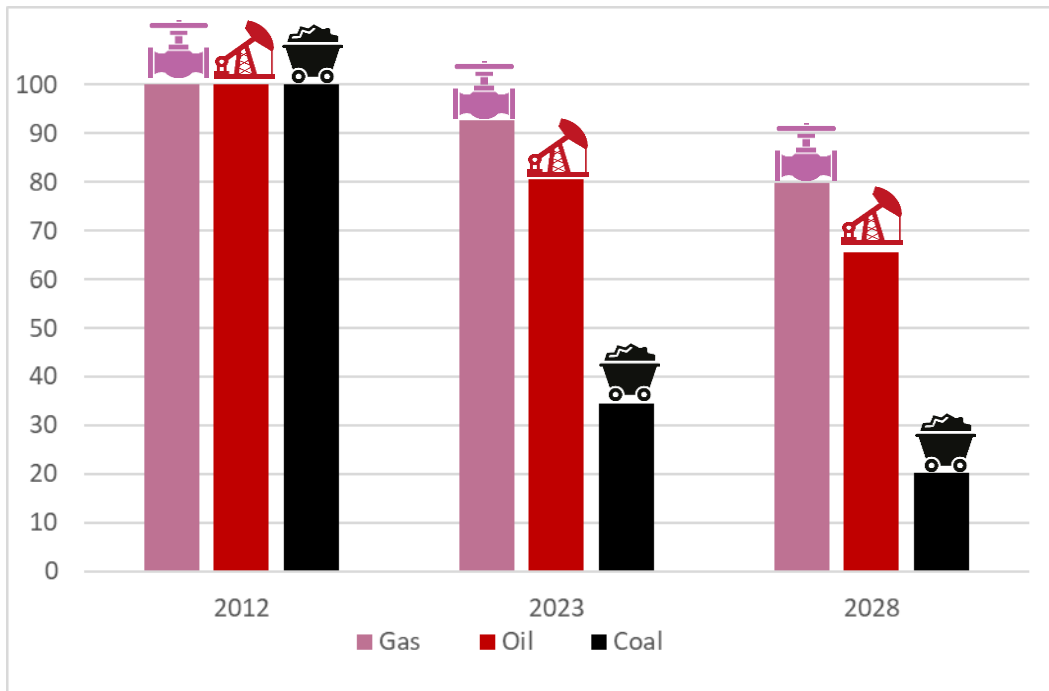


Figure 2: Reduction in the primary consumption of fossil fuel by energy vector

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 MAEP, all sectors are mobilised.

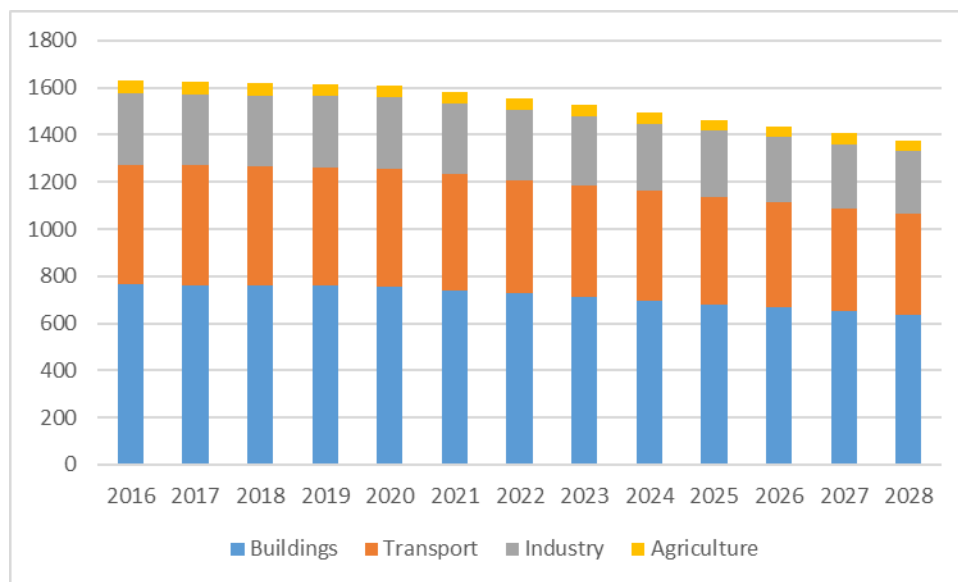
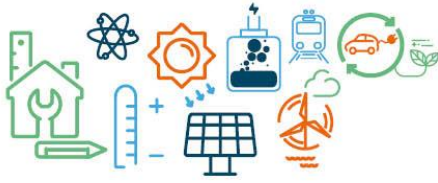


Figure 3: Progression of final energy consumption by sector since 2017 (TWh)



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

In order to transform investment choices and behaviours deeply 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 influences 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/tCO₂eq in 2022. Following the freeze on the rise for 2019, decisions remain to be made as to the measures needed to achieve similar results as this taxation.

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 an annual CEE market estimated to be €3.4 billion. The industry, local authorities and citizens benefit from it in addition of other targeted public policies incentives.

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

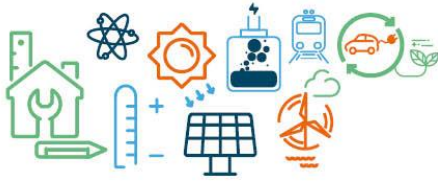
Transversal measures encouraging the reduction of energy consumption:

- Define in 2020 the goal of the Energy Saving Certificates (CEE) scheme for the next five years based on an analysis of energy saving potential and on feedback on the performance of the current system;
- Support an ambitious and effective European policy on the eco-design of energy-related products and energy labelling for these products;
- Push for a floor price mechanism for the carbon in electricity at European level, the setting of a carbon price for all sectors that fall outside of the European carbon trading scheme, as well as a carbon inclusion mechanism at the borders of the European Union to effectively reduce carbon leakage, in a manner consistent with WTO rules;
- Additional measures will have to be put in place, relying primarily on governmental bodies established in 2019, to obtain results similar to what the carbon component would have achieved.

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 three 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 energy performance, including taking into account comfort levels in summer. In particular, this regulation will introduce requirements in terms of greenhouse gas emissions, both to promote energy decarbonisation (leading to the implementation of a minimum rate of heat coming from renewable sources), as well as to take into account the full carbon footprint of the



building over its entire lifecycle, promoting virtuous construction techniques and the use of bio-sourced materials;

2. **Renovated existing buildings:** the energy renovation plan for buildings sets a goal of 500,000 home renovations per year, mainly thanks to the support provided by the Energy Transition Tax Credit and the MaPrimeRenov' allowance that gradually replaces it, the CEE and the "Dwelling better" (*Habiter mieux*) subsidies provided by the National Housing Agency (ANAH). It stipulates a 15% reduction in energy consumption in the State building stock, given that regulations for the tertiary sector now impose, a decrease in energy consumption of 40% for all buildings over 1,000 m² in 2030. A faster pace for public buildings renovation is expected. The *Grand plan d'investissement* (Large investment plan); devotes 4.8 billion euros for this end;
3. **Renewable energies in buildings:** as a result of the support of the tax credit for energy transition, and of MaPrimeRenov' which will gradually replace it, 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 buildings energy renovation is that much more essential because 7 to 8 million thermal sieves¹ within the building stock bring about fuel poverty situations for lower income households, whose restricted resources become increasingly dedicated to paying their heating bills. 11.6% of French inhabitants were spending more than 8% of their income for the payment of their dwellings energy bills in 2017. Particular attention will be paid to energy efficiency in the rented building stock, with an obligation to reach a minimal energy performance level by January 1st, 2023 for the dwelling to be deemed "decent" (and therefore offered for rent). When conceiving, building, and renovating buildings, a specific attention will also be paid on potential negative impacts on health and environment, such as on indoor air quality and noise.

During the first MAEP period, the incentives will be linked to improvements in information to property owners and lessors: energy audits will be funded by the energy-transition tax credit, and MaPrimeRenov' which follows, and if necessary an additional measure as part of the territorial support for energy renovation. The Energy and Climate Law mandates this energy audit by 2022 for all sale or rental of thermal "sieves". By the end of the second MAEP period, that is before 2028, owners of "thermal sieves" must have taken the necessary measures to improve the energy performance of their building so that it reaches a class E rating at the least. The Energy and Climate Law should therefore lead to the eradication of class F and G buildings by 1 January 2028 for individual houses and most multi-unit buildings, and, by 1 January 2023, for multi-unit buildings facing specific difficulties and enrolled in a support process provided by public authorities.

These measures and obligations will be made possible by relying on a new Energy Performance Diagnostics (DPE), which, after consultation with practitioners, will be improved to make it reliable and suitable as evidence by 2021.

The first MAEP period will enable a more detailed analysis of the composition of the housing stock and a better identification of the owners of the thermal sieves. In light of these studies and the results obtained during the incentives phase, sanctions for non-compliance to energy performance improvement requirements by 2028 could be defined in 2023 in the framework of the five-year energy programme law.

Furthermore, specific measures will be implemented to incentivise households to replace coal-based heating systems, heating oil boilers, and old gas heaters, with renewable energy heaters² or very high energy-performance gas heaters. The goal is to no longer use coal or heating oil for heating by the end of the MAEP, that is, 2028.

¹ Dwellings with energy performance certificate ratings of F or G.

² A renewable energy heater is a heater driven by heat pumps, a biomass heater, a combined solar system, or a connection to a renewable energy district heating system.



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).
- Eradicate inefficient homes (F and G performance certificates) in three phases (law No. 2019-1147 of 8 November 2019 on energy and climate):
 - A first incentive phase in anticipation of a mandatory energy audit, from 2022 onward, prior to the sale or lease of an inefficient home. This audit will contain renovation proposals and estimated costs, and will inform the prospective buyer or lessee of future energy costs;
 - A second phase, taking effect before 2028, imposing on owners of inefficient homes the obligation to undertake renovations that will improve their home's energy performance;
 - A third phase, from 2028 onward, with fines for property owners that would not comply with obligations to renovate inefficient homes.

For public buildings:

- Set up a task force aimed at accelerating the renovation of school buildings. Educational buildings (school, middle school, high school) represent around 50% of the building stock of local authorities. Public action on this segment of the stock also involves raising awareness of the energy savings implications for new generations;
- As part of the 2018-2022 *Grand plan d'investissement* (Large investment plan), the following financing tools, up to € 3 billion, are available to local authorities for the energy renovation of their buildings:
 - 2 billion euros in subsidized loans from *Caisse des Dépôts*;
 - 0.5 billion euros invested in equity by *Caisse des Dépôts* in large property projects or to support innovative economic models;
 - 0.5 billion euros from the local investment support budget (DSIL).
- Forbid, starting from January 1st, 2020, the purchase or heavy repair of heating oil boilers in State buildings, and plan the end of all heating oil use in State buildings (excluding operational issues);
- Release as open data the list and/or the map of buildings belonging to the State, including specifications of surface area and type of energy used for heating. All willing public entities (local authorities, hospitals, etc.) could also be invited to join in this measure;
- Implement a building renovation plan for 39 administrative units in France.

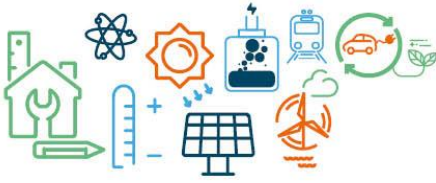
For professionals:

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:

- Working towards a minimum heat level generated by renewable sources;
- Including a criteria on greenhouse gas emissions for operating buildings and for the building's entire life cycle;
- Strengthening the requirement levels in terms of energy performance, including by including summer comfort levels;

The new regulations will lead to a suitable updating of the conversion factors of primary energy into electricity and the emissions coefficient for electricity-based heating currently used in regulations governing new buildings (RT 2012, Label E+C-, RE 2020).



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

- The conversion factor of final energy into primary energy for electricity will be fixed at 2.3, a value resulting from averaging values over 50 years, taking into account the electric mix diversification goals set in the Energy and climate law;
- The electricity emission factor will be determined using the monthly usage method, which leads to a value of 79gCO₂/kWh for electric heating;

For tertiary buildings, monitor the application of energy efficiency obligations for existing tertiary buildings, which aim to achieve a 40% reduction in their energy consumption by 2030 compared with 2010, focusing on buildings over 1,000 m² in all business sectors.

For private individuals:

- Make the Energy Transition Tax Credit (*Crédit d'impôt pour la transition énergétique, CITE*) and the MaPrimeRenov' premium which will replace it, more efficient via:
 - A new fixed rate scale in 2020 which will take into account the energy efficiency of actions;
 - Its disbursement by ANAH at the time renovation work is performed. The subsidy rate will be increased for low-income households, so that public support really triggers the actions needed to escape fuel poverty;
 - Its extension to owners-lessors in 2021, and the simplification of the request process for multi-unit collective renovation projects;
- Amplify the use of the recently simplified ecoPTZ, which can now apply, using a flat rate grant, to single-action work (i.e., installation of a central heating powered by renewable energy without requiring a collection of work projects);
- Maintain the VAT rate at 5.5% for energy renovation work eligible to the CITE and related work;
- Inform households better on the energy performance of their home and on renovation work to be made. To this end, co-finance, by means of the MaPrimeRenov' and the SARE programme, the provision of advice and home diagnosis in particular for low-income households owning "thermal sieves" dwellings (diagnosed as having F or G performance), and support comprehensive renovations of dwellings..

For individuals, discontinue the use of coal heating by 2028:

- Continue the initiatives for the installation of renewable heating. A renewable heating is a heating system powered by heat pumps, a biomass boiler, combined solar system, or a connection to a renewable energy heat network;
- Support local information, advice and support services for energy renovation;
- Use the ANGDM as a disseminator of information.

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 on-demand and 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:

Stop the sale of new private vehicles and light utility vehicles powered by fossil fuels by 2040 (mobility orientation law):

- Comply with the European objective for greenhouse gas emissions of 95gCO₂/km on average for new cars by 2021;
- Comply in the most efficient way with the European objective of 37.5% decrease of CO₂ emissions of new private vehicles sold in 2030 compared to 2021;

Keep in place the conversion subsidy, in order to work towards the replacement of as many old vehicles as possible by much lower emission new or used vehicles. The subsidy is doubled in 2019 for lowest income households and for non-taxable workers forced to travel long distances to go to work. It is upgraded to make conversion to an electric or plug-in hybrid vehicle more attractive. The goal is to reach a million beneficiaries by 2022;

Balance the total cost of ownership of electric vehicles: maintain subsidy and/or tax mechanisms. Put in place regulatory measures (low emission zones, usage benefits such as dedicated lanes or parking spaces);

- Strengthen the bonus/penalty system in order to incentivise the purchase of lower emission new vehicles and support the sale of electric vehicles;
- 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 heavy goods vehicles powered by alternative fuels until 2021; consolidate the system for heavy vehicles under 16t and establish technological neutrality for this measure (extension to hydrogen and electricity), expanding it to other modes, principally maritime;

Increase by 2c€/l the reduced diesel tax rate for the transport of goods by road;

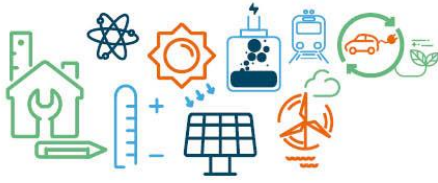
Remove over three years the tax advantage for non-road diesel (excluding agriculture and rail or river transport);

Increase the solidarity tax on airline tickets in order to contribute to the financing of sustainable transport infrastructure;

Support car sharing and all mobility solutions alternative to individual car use;

- Promote clean mobility for 2/3 wheel vehicles;
 - Initiate the development of low-emission 2/3 wheel vehicles and quadricycles as part of a charter for the greening of these vehicles:
 - Adapt all the tools for greening light vehicles to the specifics of two- and three-wheelers (energy label, minimum public purchase obligations for two and three-wheel motorized low-emission vehicles, etc.);
- 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 finalised in 2019);

Exempt from energy consumption tax (TICPE) all river navigation (except private pleasure navigation) in order to promote multimodal mobility. This exemption was previously reserved for the inland transport of goods;



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

Reduce the final electricity consumption tax (TICFE) rate for boats and ships that directly use electricity when docking. The objective is to make the use of electric recharging stations more competitive with regard to other modes of energy supply (engine and generator) when ships and boats are docked;

Creation of a sustainable mobility plan up to €400/year to encourage the use of bikes and carpooling for commuters;

Implement a bike and active mobility plan: create a €350 million bike fund to ensure bike path continuity and user safety; progressive implementation of markings for bikes and secure parking to combat theft; promote a bike culture in schools so younger generations will include this mode of transportation into their way of life;

Promote carpooling: reserved lanes and parking, public carpooling service and calculation of cost sharing between driver and passengers;

Develop a new framework for self-service solutions.

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 Mobility Law (LOM), adopted 19 November 2019, is the main implementation process for these actions.

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

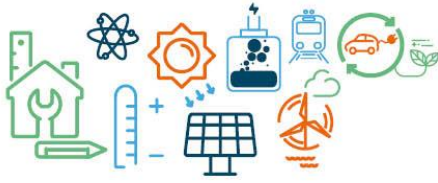
- Make clean mobility accessible to all by providing each area with a Mobility Organization Authority (AOM) and extending the role of the AOMs to active or shared mobility and mobility services of a social nature. The objective is to ensure that anyone can choose its mobility within a range of services 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

- Optimizing 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 behaviors that are more virtuous by implementing low-emission areas in conurbations and valleys affected by air pollution issues.

Promote low-emission vehicles (including river, maritime, and air vessels), and improve the energy efficiency of the vehicle fleet through reliance on the market for alternative fuels)

- Rely on purchase and tax incentives to reach ambitious goals in terms of the market share of low-emission vehicles (bonus/penalty, conversion subsidies), available to all;
- Set minimum levels for the inclusion of low-emission vehicles in public vehicle fleets (in accordance with the European Directive on Clean Vehicles in Public Service), and private vehicle fleets, and check that these objectives are met;
- Support this development through the deployment of alternative fuel distribution infrastructures: deployment of electric charging stations (including the right to use) and NGV and hydrogen filling stations;



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

- Promote the energy efficiency of domestic river and maritime transports, and reach the goal of carbon neutrality by enabling the supply of low-carbon fuels in all French ports and facilitating the conversion to other low-carbon technologies (batteries, biofuels, hydrogen, sail, etc.);
- Limit the impact of air transport on climate change by targeting substantial energy efficiency improvements and a very high substitution of fossil fuel energies by biofuels (50% in 2050).

Promote modal shift for passenger transport

- Develop multimodal mobility options by accelerating the release of data and the possibility for interested parties to offer route planning services as well the purchasing of transport tickets that include all of the legs of a given journey;
- Reinforce the share of active modes in daily mobility by creating an active mobility fund of €350M, making cycling and other active modes safer (safe parking, anti-theft bike tags, advanced stop lines at red lights, etc.), and adding incentives for such travel (sustainable mobility subsidy), and making them more accessible;
- Develop mass transit modes for freight by increasing investment in mass transport infrastructures (rail, river ways, and ports);
- 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).

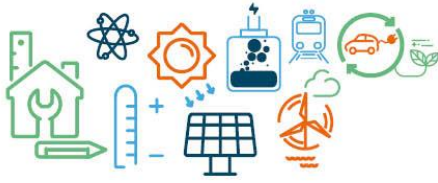
2.4. For an industry that is both high-performing and carbon-free

Increased control of the demand for electricity and the development of renewable energies will enable the decarbonisation of electricity production by halting the production of electricity from coal by 2022. The simulations conducted by RTE as part of its 2019 provisional forecast show that, providing action is taken to manage peak consumption, the system will indeed have enough of a margin to halt the production of electricity from coal gradually 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 the energy sector

Experiment with a controlled enlargement of energy saving certificates to energy saving operations performed in facilities subject to the European CO₂ emissions quota system;

Identify new modalities to support decarbonisation or energy efficiency in industry, in the framework of the *Pacte productif 2025* (productive agreement 2025);

Include a technical-economic assessment of geothermal or solar-generated heat in the energy audits of large and medium size enterprises;

Continue to increase the eco-energy loan (PEE) requests distributed by BPI France and dedicated to micro and small enterprises, which perform upgrades eligible for energy saving certificates. Extend the PEE programme until 2025;

Promote the deployment of energy management systems (such as ISO 50 001) and industry energy benchmarks;

Reduce by 75 % coal consumption in industrial sectors by 2028, except for the steel sector, for which no operational method is yet available to substitute massively for coal. 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;
- For district heating systems, prioritise in the Heat Fund the substitution of coal by renewable and recovery energies, and increasing the Heat Fund's resources. The challenge is to achieve a commitment by district heating systems management and representatives, which are part of the dozen of systems fully or partially powered by coal, to halt reliance on coal energy within 10 years. This measure is facilitated by the fact that the ADEME Board decided in early 2019 to align the rules of the Heat Fund to those defined within the EU framework on State aid.

In the iron and steel sector:

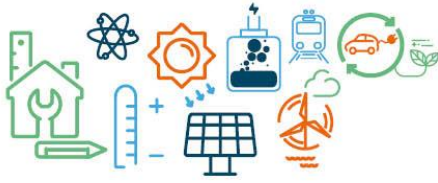
- Continue experiments to set up processes that emit less CO₂ in blast furnaces through the use of loans from the future investments programme;
- Over the period covered by the PPE, establish demonstrators of innovative processes enabling the complete replacement of coal;
- Continue the Heat Fund support 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 solid biomass;
- No new authorisations for power stations producing electricity exclusively from fossil fuel and end support programmes for new natural gas co-generation facilities.

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

The MAEP 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 MAEP will enable:



- a twofold rise in the installed capacity for renewable electricity in 2028 compared to 2017 with an installed capacity of 101 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 38 % 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, an increase of 50% to 100% of the current pace of development for renewable energy heating and cooling and energy recovery delivered by district systems.

3.1 Renewable heat is an essential decarbonisation vector

Heating represented 42.3% of final energy consumption in 2017, 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 639 TWh in 2023 and 579 TWh in 2028.

The MAEP 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:

Technical measures:

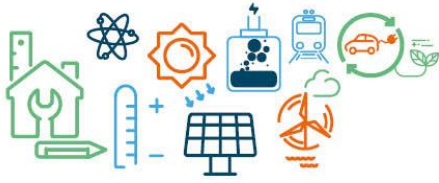
Make sure that the future environmental regulation for new buildings (RE 2020) leads to a minimum level of renewable heat in all new buildings (individual, collective and tertiary) as soon as it is put in place;

- 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 geothermal and solar thermal, in the upcoming RE 2020 environmental regulation;
- Facilitate the classification of high performance district cooling and heating systems;

Financial measures:

Continue to strengthen the Heat Fund starting in 2019 with an annual Heat Fund budget of € 307M in 2019 then € 350M from 2020 onwards. The level of commitment authorisation by ADEME regarding the Heat Fund will be stabilise at € 350M from 2022 onwards if no change in the carbon taxation happens before that;

- Simplify the Heat Fund rules: the requirement for refundable advances for heat fund projects was removed in 2019 and replaced with subsidies; in 2019 the internal aid guidelines set by ADEME were more closely aligned with the European guidelines by aligning with the maximum levels of aid for district heating networks that are more favourable for non-economic activities; encourage local and legacy contracts for renewal energy development, which will allow clusters of small projects to be subsidised;



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

Improve the efficiency of the CITE and MaPrimeRénov', which will replace it, by setting a fixed amount, different for each technology, taking into account, in particular, heat production from renewable sources 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);
- Better articulate the energy savings certificates (CEE) and subsidies for the Heat Funds in accordance with the European Community guidelines;
- Starting from mid-2019, the zero-rate eco-loan will be applicable to all work eligible for the CITE without any multi-project conditions.

	2017	2023	2028 low case	2028 high case
Biomass	120	145	157	169
Aerothermal Heat Pumps	23.5	35	39	45
Geothermal Heat Pumps	3.14	4.6	5	7
Deep geothermal energy	2	3	4	5.2
Solar thermal energy	1.18	1.75	1.85	2.5
Biogas (including injected biogas)	4	7	12	18
Total	154	196	219	247

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

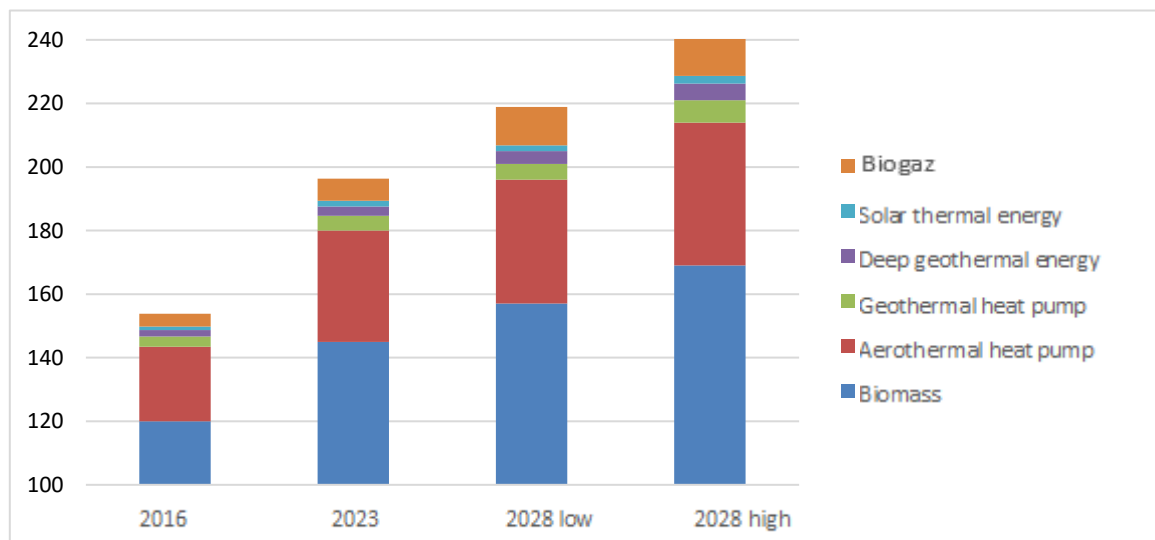


Figure 4: Progression of final energy consumption of heat by sector (TWh)



Measures specific to the promotion of solar thermal energy:

For individuals:

- Maintain CITE support for solar thermal devices (solar combined systems, individual solar water heaters, etc.) in the context of re-focusing the CITE on the most efficient activities;
- Create a communication kit for FAIRE advisors on the benefits of solar thermal energy at the individual level, to help them be better prepared to promote this solution.

In the collective, tertiary and industrial sectors:

Extend the Heat Fund's call for projects for large solar thermal surface areas, for which the project assessment criteria were reviewed in 2019, for a minimum of 3 years;

Allow Heat Fund grants for the reconditioning of faulty equipment, such as size audits, performance instrumentation, skills upgrading, conditional grants (for example if no support has already been granted for the installation, or if an AFC is planned);

Starting in 2019, solar thermal input into heat networks is taken into account in the allocation of reduced VAT rates for heat delivered by R&R energy networks;

Create a communications package targeting the agriculture sector on the benefits of solar energy;

- Diversify the role of wood energy coordinators towards other technologies, such as solar and geothermal energy.

Specific measures for solid biomass:

Prioritise heat recovery of biomass over high-yield cogeneration. Heat will be clearly prioritised to obtain added energy value from biomass;

Rapidly replace low-performance stand-alone wood fired heating devices (hearths, stoves, inserts) with better performing equipment in terms of yield and air quality (green flame, pellets etc.);

Organise an awareness campaign on best domestic use of wood;

Develop local analyses of biomass on a regional scale (as part of the development of regional biomass programmes), in order to mobilise available and unexploited biomass resources with inventory data updates (work in progress with the IGN);

Continue support for boilers in multi-unit dwelling and industrial heating via the Heat Fund.

Measures specific to heat pumps:

Ongoing support, via the CITE, for air/water heat pumps and geothermal heat pumps, by targeting the same deductible levels for either of these two solutions;

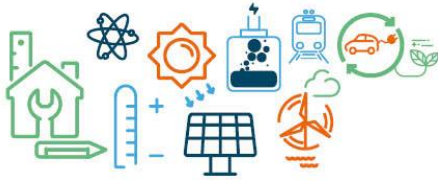
Supporting heat pump-assisted geothermal energy and renewable cooling projects through geothermal energy via the Heat Fund.

Measures specific to deep geothermal energy:

Set up a local support team, with at least one geothermal specialist per region, with the support of ADEME;

Support investment in geothermal energy, geothermal heating and 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 carried out by ADEME in 2019;



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

Allow the Heat Fund to participate in the financing of regional mapping for the Geothermal Resources of Minimum Significance (GMI), and if needed, to the financing of decision support tools on the financial profitability of surface geothermal resources;

Modify the mining code to mention explicitly the production of cooling using geothermal energy.

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 MAEP sets a goal of delivering renewable or recovered heat (waste heat, industrial heat, heat from 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.

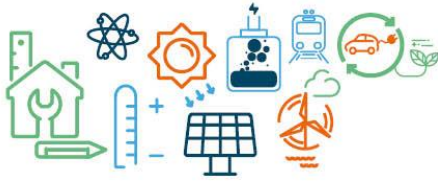
Industrial residual heat will represent a contribution of 0.84 TWh in 2023 (i.e. twice the 2016 baseline situation) and of between 2.3 TWh and 2.95 TWh in 2028 (i.e. a 5- to 6-fold increase compared to the 2016 situation).

Improved recovery of waste heat from household waste treatment units, and the development of heat recovery from the combustion of other waste such as recovered solids, contribute 3.6TWh in 2023 and between 5.3TWh and 6, 9TWh in 2028 (given that 50% is already included in the biomass target).

	2016	2023	2028 Scenario A	2028 Scenario B
Goal (TWh) for heat recovery in district heating systems	3	4.47	7.6	9.9

Principal measures

- Make mandatory the energy use of the biogas collected from waste landfills;
- Organise efforts to encourage household waste incineration plants and energy recovery units to recover more waste heat. These efforts would be planned together with the publishing of the BREF (Best Available Techniques Reference) documents for this sector. (BREF documents describe, for each activity sector, the best available techniques and performance levels associated with these techniques. The inspection of rated installations could include an examination of the energy efficiency ratio of each energy valuation unit in order to reach the best possible ratio in the admissible range);
- Collect feedback on the heat recovery cost-benefits analysis set up in 2015, and update it if needed;
- Set up a support network for industrial waste heat, for example through skills improvement of the existing local “industrial ecology” management networks, or by creating awareness among and assistance to, highly industrialised zones (i.e., port zones, chemical platforms, etc.);
- Evaluate the recovery potential of heat from waste water through the SRADDET, and the update of the ADEME study on waste heat;
- Maintain the aid disbursed under the Waste Fund for improving the energy efficiency of household waste incineration plants and under the Heat Fund for connections to heat recovery networks;
- Rerun the ADEME Waste Fund call for combustible solid waste recovery projects.



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

Liquid fuels, petroleum derivatives, represent a significant share of French CO₂ emissions in uses that are often difficult to substitute: transport in particular is heavily dependent on oil. The 10 years of the MAEP 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, listed in the IX-A Appendix of European Directive 2018/2011 (so-called RED2).

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	1.2	3.8
Diesel channel objective (%)	0	0.4	2.8

Table 2: The above table gives the percentage, in terms of energy, that advanced biofuels must reach in fuels. To help reach this goal, advanced biofuels can be counted as double their energy content. Advanced biofuels included in kerosene fuel can count towards the numerator for purposes of reaching the diesel fuel sector target and benefit from an additional multiplier of 1.2.

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

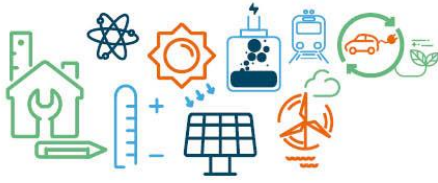
Natural gas is today crucial to the French energy system. Its storage capacity is vital to meet the demand during heat and electricity spikes in winter. Besides, natural gas is the least carbon-rich fossil fuel and therefore enables us to reduce CO₂ emissions and atmospheric pollutants when it substitutes petroleum, for example in transport. However, natural gas is no less a fossil fuel and therefore needs to be eventually replaced 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 2018, primary consumption of natural gas was 470 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 is a renewable that:

- can be stored easily;
- can be produced by farmers, offering them the opportunity to earn some extra income;



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

- 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 MAEP 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 MAEP 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 will be launched each year, for an annual production objective of 350 GWh HHV/year each;

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 purchase-price trajectory baseline, used to determine the size of the funding envelope with the aim of achieving an average of €75/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 €90/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 purchase-price trajectory baseline. 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 awarded 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);

Promote 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



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

storage medium for inter-seasonal intermittent renewable energy.

The hydrogen plan announced in June 2018 is divided in the MAEP 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)	5,000	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:

Set up a €50M/year support for decarbonised hydrogen and launch calls to call for projects on mobility and on hydrogen production using electrolyzers;

Set up a traceability system for decarbonised hydrogen in 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 projects which deploy ecosystems that pool various uses (mobility, industry, etc.) at the local level;

Conduct discussions with all players on simplifying and harmonising the licensing and certification procedures for boats and associated hydrogen fuelling solutions.

Continue support for innovation, in particular to support industrialisation and scaling up of French stakeholders.

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

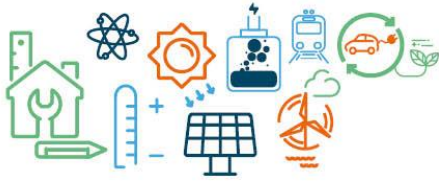
On the 2050 horizon, carbon neutrality will require the electrification of many applications. In the shorter term, efforts to control demand should be higher than or equal to these first transfers, which will lead to a stable or slightly lower electricity consumption.

The diversification of the mix and decentralisation of production will be continued during the whole MAEP 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 non-coal-based 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 that 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 highly 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, and conflicting uses

The Energy Transition for Green Growth Act set a target of 40% electricity from renewable sources in national production in 2030. In 2018, renewables accounted for 20 % of national production (2018 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 MAEP 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 MAEP, 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.

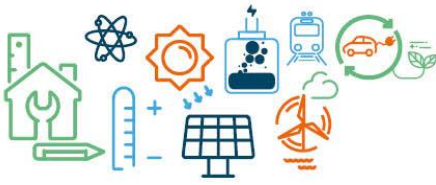
Wind power will be developed partly through renovation of existing systems that have reached the end of their life, which will enable us to increase the energy produced while keeping an identical or smaller number of masts. In total, the transition from 15 GW in 2018 to 33.2 GW in 2028 will lead to a 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 six offshore wind projects, which were subject to renegotiation, will all be operational at the start of the 2nd period of the MAEP. The seventh offshore wind project, allotted in June 2019, will be operation at the end of the second MAEP period. 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 3.75 GW, will be launched in the first period of the MAEP. 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. The Government considers the potential expansion of these initial floating wind farms from 2024 onwards during the second MAEP period, with a shared connection.

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 MAEP, 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.

As concerns tidal power technologies, studies and trial projects in service have shown that this industry sector has matured, even though production costs remain high compared with other technologies such as offshore wind. The Government considers that conditions for the launch of a call for tender are not met yet and therefore does not plan one during the period covered by the MAEP. The Government will closely monitor the trial projects that would continue, along with the evolution of the sector's performance over the coming years.



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

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 73.5 GW in 2023 and to between 101 and 113 GW in 2028:

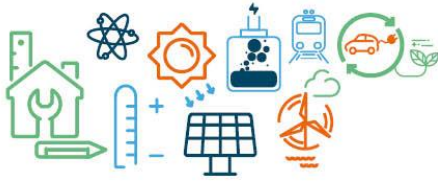
	2023	2028
Hydroelectricity	25.7	26.4-26.7
Onshore wind	24.6	33.2-34.7
Offshore wind	2.4	5.2-6.2
Photovoltaics	20.1	35.1-44.0
Solid biomass	0.8	0.8
Biogas-Methanisation	0.27	0.34-0.41
Geothermal energy	0.024	0.024
Total	73.5	101 to 113

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

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 (excluding repowering)		0.5 GW	0.5 GW	0.6 GW		0.75 GW		0.925 GW		0.925 GW		0.925 GW		0.925 GW		0.925 GW		0.925 GW		0.925 GW		0.925 GW		0.925 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



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

Grant date for the call for tenders	2019	2020	2021	2022	2023	>2024
Floating wind turbine			250 MW <i>South Bretagne</i> (€120/MWh)	2 x 250 MW <i>Mediterranean Sea</i> (€110/MWh)		1000 MW per year, fixed or floating, depending on prices and resources, with target prices converging towards the market price for fixed wind
Fixed wind	600 MW <i>Dunkirk</i> (€45/MWh)	1000 MW <i>Eastern English Channel</i> <i>North Sea</i> (€60/MWh)	500 – 1000 MW <i>Sud-Atlantique*</i> (€60/MWh)		1000MW (€50/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). The projects assigned starting in 2024 will primarily focus on the expansion of existing floating offshore wind farms using a shared connection.

** In this context, an offshore wind installation off Oléron may be assigned*

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, and improve, where possible, the conditions for the dismantling of facilities.

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;

Generalise the principle of a complete excavation of the foundations of wind turbines when dismantling, and increase the amount of financial guarantees in order to account for new technologies;

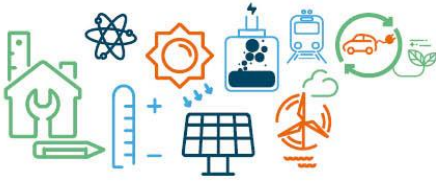
Implement measures to make the development of wind power more balanced at the national level and avoid the risk of saturation. Proposals will be made during spring 2020;

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 urbanised or degraded land, and parking lots, and taking care that these projects are respectful of biodiversity and agriculture lands;

Maintain a target of 300 MW per year for installations on small- or medium-sized rooftops (smaller than 100 kWc) through an online portal, steering projects towards self-consumption. Boost the development of projects on medium-sized rooftops (> 100 kWc) b;



Support innovation in the photovoltaics sector via calls for tender, to encourage new ground level solar solutions (agro-voltaics allowing a real synergy between agricultural production and photovoltaic energy, floating power stations, etc.) and on buildings.

Measures specific to offshore wind production:

When launching a new project, always consider a later expansion and the setting up of a shared connection in order to reduce its impact.

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 spatial 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;

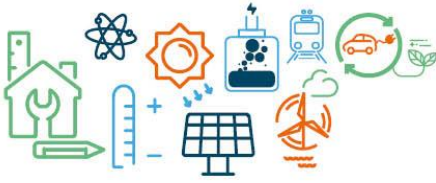
Widen the scope of self-consumption to allow for collective self-consumption projects of greater scope (large development projects / eco-neighbourhoods).

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.

On 30 September 2019, EDF sent the Minister of Ecological Transition and Solidarity and the Nuclear Safety Authority, a request to revoke exploitation, as well as a declaration of the **permanent shutdown of the two reactors at the Fessenheim nuclear power station**, with reactor 1 expected to be shut down on 22 February 2020, and reactor 2 on 30 June 2020.

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;



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

- 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 MAEP (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;**
- EDF has recommended the Government study the shutdown of pairs of reactors at the Blayais, Bugey, Chinon, Cruas, Dampierre, Gravelines and Tricastin sites. Reactors shutdown that will not entail the shutdown of a production site will be prioritised;
- **The general principle will be the shutdown of the 12 reactors (excluding Fessenheim) with a deadline falling at the latest at their fifth 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 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 MAEP 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,



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

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 MAEP 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 MAEP 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 sector from now to mid-2021, which will mainly cover the following items:

- the demonstration by the French channel of its management capabilities for an industrial program for new reactors, based on a work hypothesis of 3 pairs of EPRs, 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 MAEP 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. Several contrasting scenarios will be appraised: from a 100% renewable scenario to a scenario where nuclear remains a source of electricity production on the long-term. The Government will keep the option of building new nuclear reactors open in order to preserve the Government's decision-making capacity;

On this point in particular, by mid-2021, the government, in conjunction with industry, will conduct a work program 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;

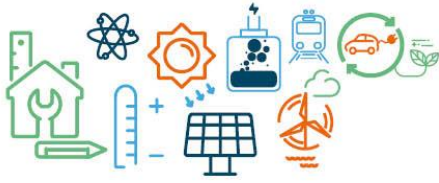
Based on these elements and any changes in the energy context, the government will decide whether it is appropriate to launch a renewal programme for nuclear power facilities.

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 meet foreseeable market demand continuously 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 guaranteeing 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 MAEP, 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 of electricity

Current analysis shows that the electrical grid's security margin will remain small during the first MAEP period, during which thermal power stations will be decommissioned, with a period of heightened vigilance in 2022-2023. The tools that provide the grid with flexibility (demand management, load management, interruptibility, storage, interconnections) will continue to be developed on the mid-term, particularly as they relate 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.

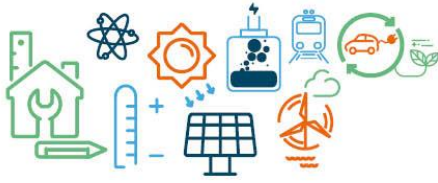
Furthermore, the electricity system is very exposed to spikes in demand because of big developments in electrical heat in the past. The growth of these spikes has slowed down but could increase once more because of the cumulative effect of the electrification of buildings and vehicles, making it that 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 optimise device consumption automatically.

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.



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

	2017	2023	2028 Scenario A	2028 Scenario B
Delivery of renewable and recovered heat (TWh)	14	24.4	31	36
Delivery of renewable and recovery cold by networks (TWh)*	0.76	1.4	2	2.7

** Analysis of the sector based on the following types of production: Free cooling, compression cooling system with the evacuation of heat to a water source, refrigerator heat pump, and absorption cooling system.*

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:

Technical measures:

- Ensure that R&R energies are included in local plans and policies and urban documents;
- Facilitate the classification of heating systems, which allow a community to make the connection to its district heating system obligatory for new buildings or highly renovated buildings;
- Establish, at the European level, a recognised definition of cooling by renewable energy when delivered by a district system;
- Impose the creation of master plans for all heating and cooling systems in towns equipped with such systems, updated every 10 years, by systematically evaluating the opportunity to create a public service for the distribution of cooling;

Financial measures:

- Accelerate the mobilisation of renewable energies (especially biomass) and recovery energies in district system by maximising the R&R energy ratio of Heat Fund projects;
- Keep VAT at 5.5% for heat deliveries from district system more than 50% supplied by R&R energy (and include solar thermal energy as an eligible R&R energy), with an increase to 60% by 2030;
- Support the development of the most efficient renewable and recovery cooling district system through the Heat Fund;
- Create a review clause for the Heat Fund support within 4 years based on technical and financial criteria;
- Articulate better the Energy Economy Certificates (CEE) and the Heat Fund grants based on terms that are in accordance with the European Community framework.

Encouragement measures:

- Encourage public housing lessors to set objectives in terms of R&R energies.
- Carry out a collective evidential campaign in cities with over 10,000 inhabitants to create a feasibility study of a district heating and cooling system in order to pursue the densification and extension of existing systems and accelerate the creation of new ones;



Create information campaigns targeting all audiences (project owners, project managers, the general public), to make known the district systems as well as the district systems watchdog and the Via Seva website;

Structure a supervisory network for industrial waste heat.

5.2. The electricity network and integration of renewables

Moving forward, energy transition will give rise to new challenges for the stakeholders in the electric system, and drive major changes in the transport and distribution networks.

The transport network must adapt to the changes in flows between the energy production and energy consumption locations, in concert with the development of renewable and decentralised means of production. The development of interconnections with neighbouring countries, which make it possible to benefit from the proliferation of the production of renewable energies Europe-wide and optimize production capacities needed to provide electricity supply security, also plays an important role.

RTE will also commission studies that make it possible to identify the adaptations needed to the new production and consumption spatial distribution, particularly in relation to the closing of nuclear reactors, once they have been identified, and the setting up of offshore wind farms. They will take into account the development of more decentralised means of production, self-consumption, storage, and the electrification of certain uses (heavy deployment of electric vehicles in particular).

In this context, the regional plans for connecting to renewable energy networks (S3REnR) will be based on a forward-looking vision in order to identify future investment needs.

System flexibility will be developed in order to ensure the system is resilient to future upgrades (managing electric vehicle charging, smart meters, etc.). A major effort, in conjunction with the International Energy Agency and the RTE, will be carried out on the integration of intermittent renewable energies into the electrical grid.

The development of smart grids will also make it possible to improve the adaptation of the network and facilitate its operational management.

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;

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.



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

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	End 2019	2023	2028
Electricity	28,000 public charge points	100,000 public charge points	
LPG-f	1,650 stations	Vehicle fleet development only: The current infrastructure has the capacity for a 500% increase in fleet	
Hydrogen	Approximately 30 stations	100 stations	400 to 1,000 stations
NGV (LNG and CNG)	110 CNG and 35 LNG refuelling stations	770 stations	1,550 stations
Maritime LNG	Le Havre, Marseille-Fos, Dunkerque, Nantes Saint-Nazaire	Development in all major ports	
Quayside electricity	Marseille (3 stations)	On a case-by-case basis, use of LNG at the docks 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;

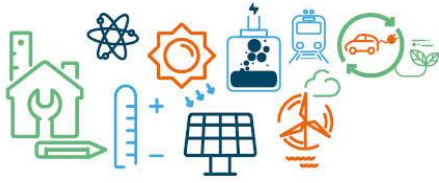
Encourage the development of electrical charge points through a decrease in the cost of connection, the CITE and mobilisation of the CEEs.

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 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 accordance with the main guidelines formulated by the Innovation Council, implemented in 2018;

Confirm the commitments taken on as part of the Innovation Mission and in particular increase public funding of R&D in order to accelerate 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;

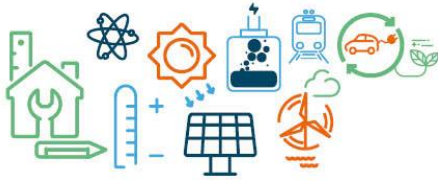
Make better use of the potential for smart meter services, in particular by providing more information about their functions;

Encourage the emergence of smart charging management solutions to facilitate the integration of electric vehicles.

Measures for nuclear:

As concerns the French plans for SMRs (small modular reactors), launch the completion of step-by-step preliminary conceptual design studies by the next PPE 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 3rd generation 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 MAEP

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

	2023	2028
GDP	1.3	2.1
AV of the market sector	1.8	2.6
Consumption by households	0.6	1.3
Purchasing power of households	1	2.2
Jobs (number)	238,000	440,000
Trade balance	0.1	-0.4
Energy bill	-0.5	-0.9
Government balance (in % of GDP deviation from the WEM scenario (with existing measures))	0.6	1.1

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

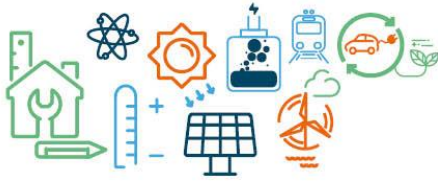
GDP should grow by 1.3 points more in 2023 with the measures that make it possible to reach the targets specified in the MAEP and included in the benchmark scenario of the SNBC, than if they had not been adopted, and by 2.1% more in 2028. The rise in GDP should be in the order of +0.2% per year on average, 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:

- Fictitious price signals are introduced to incentivise social players to make energy efficiency investments and to change their behaviour. They are calibrated in such a way so that the CO₂ emission reduction targets are reached. They represent, without being explicitly so, regulatory and/or energy taxation measures, the proceeds of which would be fully disbursed to taxpayers without generating distortions;
- These fictitious price signals represent budgetary or regulatory measures, some of which remain to be defined, that must be taken to incentivise energy savings and to reach established climate targets, in particular to offset the freeze on the originally planned carbon tax trend. It is, however an estimate, which has significant limitations when it comes to simulating as-of-yet, undefined public policy measures;
- 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 267 billion euros

Inflation reduces the competitiveness of companies compared to foreign competition. The price of exports increases by + 1.5% in 2023 and + 5% 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.

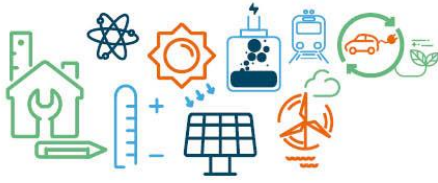
It should be noted that the price increases driven by domestic demand causes companies to lose in terms of competitiveness compared to their foreign counterparts, however the rise in internal demand is sufficient to push up the added value of the market sector by about 1.8% in 2023 and about 2.6% in 2028. The MAEP 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: 238,000 additional jobs should be created in 2023 and 440,000 in 2028 more than business as usual scenario.

Falling unemployment fosters real wage increases. Ultimately, household purchasing power rises by 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. Low-income households are more vulnerable than others in this respect, and are likely to meet serious problems in financing investments that 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.



Increase the energy allowance (*chèque énergie*) starting in 2019:

The amounts were increased by €50 in 2018 for eligible households. The base for the energy allowance has been broadened to benefit 20% of households and reach those with the lowest incomes. This will make it possible to expand the distribution of the energy allowance to 2.2 million additional households for a total of 5.8 million households.

Set up a building renovation plan that specifically targets the reduction of “thermal sieves”, and which places particular emphasis on lower income households:

Make the energy-transition tax credit (CITE), and the premium that will replace it, more effective by means of:

- A new fixed rate scale in 2020 which will take into account the energy efficiency of actions;
- Its disbursement by ANAH at the time renovation is performed. Grant rates will be boosted for low-income households, so that public aid serves as a veritable driver of the work needed to escape fuel poverty;
- Its extension to owners-lessors in 2021, and the simplification of the request process for multi-unit collective work projects;

Disseminate the use of the recently simplified ecoPTZ, which can now apply, using a flat rate grant, to single-action work (i.e., installation of a central heating powered by renewable energy without requiring a collection of work projects);

Inform households better on the energy performance of their home and on renovation work to be made. To this end, co-finance, by means of the MaPrimeRenov’ and the SARE programme, the provision of advice and home diagnosis in particular for low-income households owning “thermal sieves” dwellings (diagnosed as having F or G performance), and support comprehensive renovations of dwellings..

Deploy innovative solutions, which make it possible to industrialize renovation solutions by enjoying an economy of scale effect.

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 current, 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;

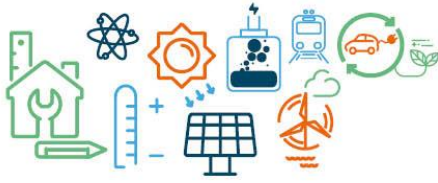
Develop public transport, car sharing, and on-demand transport, and more generally alternatives to individual car use over the whole territory as soon as possible, by targeting the most fragile groups;

Use the energy savings certificates to help lower income households develop energy savings in mobility (support for car sharing, developing bike use instead of thermal vehicles, etc.).

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 competitiveness in energy prices

Energy is a vital competitiveness factor for some French companies that are facing strong competition not only



from across Europe, but also often worldwide. Thus, 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 MAEP 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.

Laurence Parisot submitted her report on the Jobs and Skills Work Plan (PPEC) to François de Rugy, Minister of State, Minister of Ecological Transition and Solidarity, Muriel Pénicaud, Minister of Labour, and Emmanuelle Wargon, State Secretary for the Minister of State, on 19 February 2019.

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 19.2 to 33.4 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 amounts 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, 10 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.

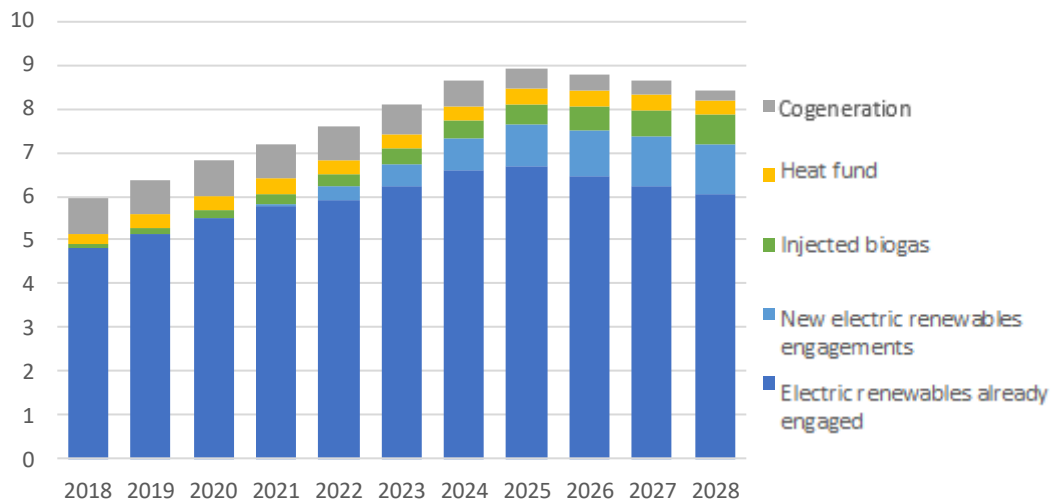
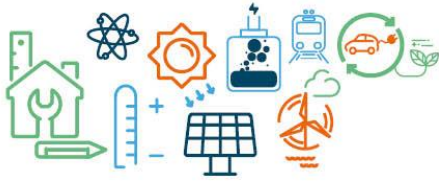


Figure 5: Projected public expenditure on planned RE over the MAEP period, considering a price trajectory for electricity reaching € 56/MWh in 2028 (€bn)

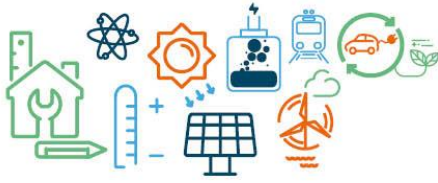
Given the investments to be made, public expenditure for the energy transition will increase before stabilising by 2028, it will then probably decrease when older, more expensive purchase contracts come to an end, while remaining very sensitive to prices on the electricity market. Most of the expenditure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



EXECUTIVE SUMMARY MULTI ANNUAL ENERGY PLAN

2019-2023 2024-2028

DRAFT JAN. 2020

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;

Anticipate needed development of networks by ensuring improved coordination between the electrical network future studies done at various geographical levels (Europe with the TYNDP, France with the SDDR, regionally with the SRADDET and S3REN, 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.