GOUVERNEMENT
Liberté
Égalité
Fraternité

French strategy for energy and climate

Multiannual energy programming (2025-2030, 2031-2035)

Table of contents

0. Strategic overview

On a national scale, climate change is already having a tangible impact on the daily lives of French people, with an average temperature rise of +1.7°C compared with the pre-industrial era and an increase in extreme weather phenomena.

The Government is taking action to limit greenhouse gas emissions as far as possible, in line with our international commitments, and to adapt our society to the effects of climate change.

The three corresponding roadmaps - the National Plan for Adaptation to Climate Change (PNACC), the National Low-Carbon Strategy (SNBC) and the Multiannual Energy Programme (PPE) - form the basis of a coherent, integrated and ambitious action in this area, presented under the heading "French Strategy for Energy and Climate" (SFEC).

The EPP sets out the government's plans for transforming our energy system over the next decade. It is based on an inseparable triptych: combating climate change, controlling energy prices and preserving the security of our energy supply:

- combating climate change, by aiming to reduce our energy consumption and increase the production of low-carbon energies. The aim is to move from an energy mix made up of around 60% imported fossil fuels in 2023 to an energy mix made up of around 60% low-carbon energies in 2030;
- controlling energy prices, by defining a cost-optimal mix, adapting market rules to give long-term price signals, and putting in place targeted aid schemes. The aim is to guarantee the competitiveness of our businesses and protect the purchasing power of consumers;
- safeguarding security of supply, by anticipating changes in the energy mix and their impact on production, conversion, transmission and distribution infrastructures. The aim is to ensure that the transition away from fossil fuels does not pose a risk to security of supply.

As a result, the EPP sets out the main objectives set out below, putting in place the tools (incentive or prescriptive) to help achieve them.

		2023	2030	2035
EXI FOSSILS		Approximately 60%. OF ENERGY FINAL FOSSIL FUEL CONSUMED	42% OF ENERGY FINAL FOSSIL FUEL CONSUMED	30% OF ENERGYFINAL FOSSIL CONSUMED

GENERATIONC ARBON-FREE ELECTRICITY [1]		458 TWh	577 TWh	Between 666 and 708 TWh
NUCLEAR PRODUCTION		56 reactors 320.4 TWh	57 reactors in service 360 TWh *(400 TWh "managerial " of EDF)ambition*	
PHOTOVOLTAIC	How many?	19.3 GW[2] 22.7 TWh	54 GW *~66 TWh*	65 - 90 GW *~92 - 110 TWh*
	How do we do it?	* For ground-mounted photovoltaic: two calls for tenders per year for a total of around 1 GW per period (excluding renewals) from the first half of 2025; * For photovoltaic systems on buildings: three calls for tenders per year for around 300 MW per period (excluding renewals) from the first half of 2025; these volumes may be adjusted depending on changes to other support schemes. * These calls for tenders will be supplemented by one technology-neutral call for tenders per year, i.e. open to photovoltaic, hydroelectric and onshore wind projects, for a total of around 500 MW per period. * For agri-voltaics, depending on the economic maturity of the sector, these projects will be supported through the ground-mounted PV and building-mounted PV RFPs, or through a dedicated call for tenders, so the power will be deducted from that allocated to the previous calls for tenders. * For small installations, support through tariff decrees.		
ONSHORE WIND	How many?	21.9 GW[3] 48.7 TWh	33 GW *~72 TWh*	40-45 GW *~91 - 103 TWh*
	How do we do it?	Two invitations to tender per year for around 900 MW per period (excluding renewals), starting in the first half of 2025 * These calls for tenders will be supplemented by one technology-neutral call for tenders per year, i.e. open to photovoltaic, hydroelectric and onshore wind projects, for a total of around 500 MW per period.		

[1] Decarbonised electricity generation also includes electricity generation from bioenergy, of the order of 10 TWh. The load factors used: 14% for PV, 25% in 2030 and 26% in 2035 for onshore wind and 45% for offshore wind.

[2] Source SDES installed capacity and PV production 2023: https:

[3] Source SDES installed capacity and wind generation 2023: https://analysesetdonnees.rte-france.com/production/eolien

OFFSHORE WIND ENERGY	How many?	0.84 GW[4] 1.9 TWh	3.6 GW *~14 TWh*	18 GW *~71 TWh*
	How do we do it?	* Allocation of around 2.5 GW of onshore wind power (AO7 and AO8) in 2025; * Allocation of around 1.5 GW of floating wind and 1 GW of land-based or floating wind by the end of 2025 (AO9) ; * Launch of a call for tenders for a total of 8 to 10 GW of large-scale capacity, with the aim of awarding the contract by the end of 2026, based in particular on the mapping of priority areas over a 10-year horizon published in the interministerial decision of 17 October 2024 and which will be incorporated into the maritime strategies for the façades to be published in 2025; * Launch of one or more additional calls for tenders, based in particular on the areas remaining from the mapping of priority areas over the next 10 years, making it possible to reach a total of at least 26 GW allocated (including projects in service) by 2035.		
HYDRO-ELECTRICITY	How many?	25.9 GW (with STEP)[5] 54.2 TWh [6]	26.3 GW (with STEP) *~54*	28.7 GW (with STEP)[7] *~54TWh*
	How do we do it?	* Regular calls for tender in line with the pace of development of the sector * For small installations, support through tariff decrees.		
RENEWABLE AND RECOVERED COOLINGHEAT AND	How many?	172 TWh heat[8] 1 TWh cooling delivered by networks	276 TWh heat 2 TWh cooling delivered by networks	328-421 TWh 2.5 - 3 TWh cooling delivered by networks
	How do we do it?	* MaPrimeRénov' for private individuals;aid scheme * Energy saving certificate scheme, in particular via standardised operation sheets supporting the installation of efficient renewable heat production systems in all sectors of activity;		

[4] Value declared at 31/12/2023 to calculate the amount of offshore wind tax paid in 2024.

[5] Source DGEC + SDES: https://www.statistiques.developpement-durable.gouv.fr/chiffres-cles-des-energies-renouvelables-edition-2024?rubrique=21&dossier=174

[6] Production corresponds to renewable hydroelectric production net of production by STEPs from water previously pumped.

[7] The limited increase in hydroelectric capacity will not necessarily translate into an increase in producibility, particularly given the expected impact of climate change on water resources. However, the additional capacity will be decisive in making the facilities more controllable

[8] The data presented is for the year 2022.

		* Heat Fund scheme to develop renewable and recovered heat in all sectors of activity, including through the development of heating networks: €820m in 2024, and will help to achieve financed capacity of around 12 TWh/year by 2030; * Aides France 2030 à la décarbonation de l'industrie pour le développement de la chaleur bas carbone. * Circular Economy Fund for the development of heating systems fuelled by solid recovered fuels (SRF)		
BIOGA *(Targets in TWh PCS)*	How many?	19.5 TWh including 9 TWh injected into natural gas networks	50 TWh including 44 TWh injected into natural gas networks	50-85 TWh
	How do we do it?	Maintaining the feed-in tariff guaranteed by the State and introducing an extra-budgetary support mechanism for biomethane injection (Certificat de Production de Biométhane).		
BIOFUELS in transport	How many?	38 TWh in transmission	55 TWh in transmission	Between 70 and 90 TWh (transmission and non-transmission)
	How do we do it?	Incorporation obligation mechanism for suppliers. Evolution of the TIRUERT towards a mechanism based on the reduction of the carbon intensity of fuels.		
HYDROGEN (*installed electrolysis capacity*)	How many?	0 GW	Up to 4.5 GW *(9-19 TWh$_{(bcf)}$)*	Up to 8 GW *(16-40TWh$_{(bhp}$*
	How do we do it?	Investment in the sector's equipment, a mechanism to support the production of renewable, low-carbon hydrogen for industry, and incentives to encourage consumption in the transport sector by reducing the carbon intensity of fuels.		
FINAL ENERGY CONSUMPTION		1509 TWh	1243 TWh	APPROXIMATELY 1100 TWh

Warning: This document was translated by a machine translation tool and may therefore contain inaccuracies.

1. Introduction

WARNING

The historical data referred to as "today" are the most recent consolidated observed data (for the year 2023 or 2022 depending on availability).

A strategy to meet the Challenge of the Century: breaking our dependence on fossil fuels

France's choice, several decades ago, of electrical independence and nuclear power means that today we have a head start in terms of decarbonisation and the competitiveness of our electricity. Over 90% of our production is carbon-free, covering most of our national needs.

In addition to this historic choice, over the last fifteen years our country has made a major effort to develop renewable energies. Over the last ten years, our rate of deployment has been ten points higher than the European average. This development is set to extend to all energy carriers: biomethane, bioliquids, biomass, aerothermal energy, geothermal energy, renewable electricity, etc.

However, as in most major industrialised countries, our energy mix is still dominated by fossil fuels, with oil accounting for 37% and natural gas for 21% of our final energy consumption. For France, this creates a harmful dependency. Both for the climate, because of the consequences in terms of greenhouse gas emissions, but also in economic terms, by putting France and the French people at the mercy of geopolitical and market uncertainties.

France is currently facing a threefold challenge: sovereignty, competitiveness and accelerating the fight against climate change.

In terms of sovereignty, the invasion of Ukraine has shown just how vulnerable we are, given our dependence on imported fossil fuels that are subject to geopolitical uncertainties. The rise of protectionism is also leading to growing competition for control of technologies and supplies for the energy transition (United States, China), whether in terms of strategic raw materials or key components for low-carbon energy technologies. Regaining and building our independence therefore means limiting our dependence on these raw materials and components by multiplying sources of supply and deploying new industrial value chains in France and Europe.

In terms of competitiveness, it has to be said that our current energy mix is leading to a sharp deterioration in our trade deficit (between €25 and €80 billion a year in the 2010s and more than €100 billion in 2022 because of the crisis linked in particular to the war in Ukraine and the bill linked to fuel imports) and that it is subjecting our country to the very high volatility of international markets, due to exogenous events (geopolitical crises, meteorological events, etc.). On the contrary, thanks to the choice of nuclear power in the 1970s, France has benefited from abundant, competitively-priced electricity and has been able to maintain an industryelectro-intensive . The challenge is therefore to gradually abandon an energy mix that is unfavourable to our economy. This means preserving and amplifying the link between decarbonisation and the competitiveness of our economy over the long term, by integrating not only the nuclear component, but also renewable energies and flexibility, and by reinforcing energy savings through efficiency and sobriety.

Finally, in the fight against climate change, our country, like the rest of the world, is facing a race against time. In the ecological battle, every minute lost adds to the human, economic, social and financial cost of the transition.

This acceleration requires efforts from everyone and transformations throughout our economy (transport, agriculture, industry, buildings and energy). In particular, energy efficiency, the decarbonisation of the energy sector, renewable and recovered heat, and the electrification of uses are important levers for decarbonising the various sectors.

This threefold political, economic and climate imperative justifies the government's commitment to making France the first major industrial country to move away from fossil fuels. This objective is consistent with the French and European goal of carbon neutrality by 2050.

Moving away from fossil fuels will require an unprecedented effort in our energy history, both in terms of reducing consumption and in terms of energy production. This effort comes at a time when the French energy system will have to be almost entirely renewed over the next thirty years, whether in terms of nuclear facilities, renewable energy capacity, networks or energy consumption flexibility mechanisms (such as load shedding or storage).

The transformation facing France is therefore enormous. The investments required by the energy transition are unprecedented since the first Industrial Revolution, a century and a half ago. And beyond the investment, it is our entire model of society and collective progress that will be turned upside down by the decisions that need to be taken today.

To achieve this, this Multiannual Energy Programme has been drawn up using a method that draws on the lessons learned from past energy programming exercises.

Firstly, the development of the new French energy strategy is based on in-depth dialogue with all stakeholders, through consultation and co-construction phases. It is also based on even more robust scientific and technical foundations, in particular the energy-climate scenario modelling work carried out by the government, but also the "Energy Futures 2050" report by RTE experts, commissioned by the President of the Republic in 2019 and updated last September[9] . In line with the ecological planning approach, the aim of this strategy is to offer long-term visibility, to propose concrete solutions to the French people that take into account their purchasing power and to make the transition an opportunity for the development of sectors and the corresponding jobs, while ensuring technological neutrality in public policy decisions and constantly monitoring the competitiveness of businesses.

France's new energy strategy is also the result of a long process of public participation and consultation, which began in 2021.

In this same spirit of consultation, the implementation of genuine regional planning for renewable energies, which gives local elected representatives a say, marks a break with the centralised management of our energy system to date. Since March 2023 and the enactment of the Renewable Energy Acceleration Act (APER), local authorities have been invited to define acceleration zones within which projects will be encouraged to locate. These zones must be defined in order to offer the potential to accelerate the production of renewable energy, to contribute to solidarity between regions and to securing the energy supply, and also to meet the objective of preventing and controlling the dangers or inconveniences that could result from the siting of renewable energy projects. This system gives operators visibility over the most favourable areas, but also improves the acceptability of projects, thereby speeding them up. In order to ensure that this new mechanism is truly representative of the territories' share of the national target, the Regional Energy Committees, which are the forum for stakeholder consultation at regional level, will be responsible for verifying the consistency between the sum of these acceleration zones and the regional energy production

9 Generation Adequacy Report 2023 Edition - Energy Futures 2050, RTE, September 2023

targets. This concern for decentralisation and public policies that are as close as possible to the regions is also reflected in the fact that the PPE will, for the first time, be rolled out at regional level.

This decision to accelerate and localise the transition is accompanied by a strengthening of the State's management resources to effectively implement the French energy strategy: creation of an interministerial delegation for the new nuclear power plant, mobilisation of the Prefects for the development and acceleration of renewable energies, increase in the number of decentralised staff dedicated to energy issues and an increase in the capital of the EDF group.

If France is to become the first major industrial country in the world to move away from its dependence on fossil fuels, we need to take resolute action to move away from a predominantly fossil fuel-based economy to one that is more sober, more efficient and supplied almost entirely by low-carbon energies produced and controlled on our own soil.

That's how this graph works:

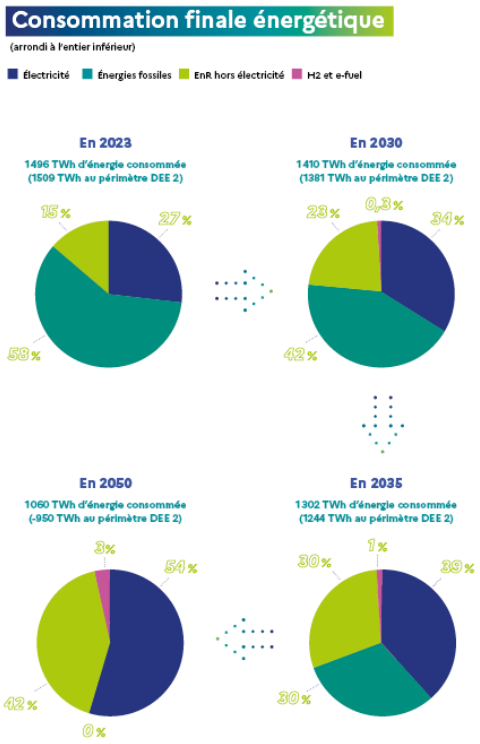


Figure1 Final energy consumption and projections to 2030, 2035 and 2050 (Kyoto scope, excluding international)bunkers[10]

This figure shows the final energy consumption projections to date. It should be noted, however, that the models are conservative. They indirectly incorporate all the public policy measures arising from Directive 2023/1791/EU on energy efficiency (DEE), the individual impact of which is difficult to estimate, and could in fact prove to be additional to other policies (particularly as regards the principle of giving priority to energy efficiency). The energy-saving dynamics resulting from the operational implementation of plans to accelerate geothermal and solar thermal energy, measures for the electrification of uses (transport, buildings, industry), work to transpose the directive on energy efficiency (introduction of the principle of primacy of energy efficiency, exemplary behaviour by public bodies, energy audits of businesses, local plans for heating and cooling, etc.), the bill for

[10] NB 1: The figures in this figure, particularly for 2050, are based on provisional modelling. NB 2: Part of the final energy is consumed in the form of heat sold (mainly via heating networks). It has been decided here to break this down into its renewable and fossil fuel components. Electricity is almost completely decarbonised by 2030, 2035 and 2050.

which is currently in the parliamentary stage, and the roll-out of the 6th period of the energy certificate scheme will be decisive in ensuring that we meet our 2030 energy consumption targets.

As for the long-term objective of reducing our final energy consumption by 50% in 2050 compared with 2012 levels, it will be necessary to make an additional effort on the basis of additional measures to be developed between now and the next planning exercise.

1.1. Multiannual energy planning

1.1.1. The nature of multiannual energy programming

The multi-annual energy programme (PPE) sets out the State's energy priorities for mainland France, excluding Corsica, over the next 10 years, divided into two 5-year periods. Every 5 years, the multi-annual energy programme is updated: the second 5-year period is revised and a subsequent 5-year period is added.

The PPE is governed by the provisions of articles L.141-1 to L.141-6 of the Energy Code, amended by the law of 17 August 2015 on the energy transition for green growth, and then by the law of 8 November 2019 on energy and climate. The PPE must contain sections on:

- security of supply ;
- improving energy efficiency and reducing primary energy consumption, particularly fossil fuels;
- developing the use of renewable energy and recovered ;sources
- balanced development of networks, energy storage and conversion, and energy demand management to encourage local energy production, the development of smart grids and self-generation;
- preserving the purchasing power of consumers and the competitiveness of energy prices;
- assessing the need for professional skills in the energy field and adapting training to these needs.

This multi-annual energy plan covers the two successive periods 2025-2030 and 2031-2035. The first period therefore covers 6 years, in order to ensure consistency with the objectives of the various regulations and the European objectives, most of which have 2030 as a central deadline.

This multiannual energy plan is made up of :

- a decree defining the main energy objectives and priorities for action;
- this report, which is annexed to the decree;
- a summary of the orientations and actions of the EPP.

In accordance with the French Environment Code, the PPE has been subjected to an environmental assessment.

1.1.2. Legal scope of multiannual energy planning

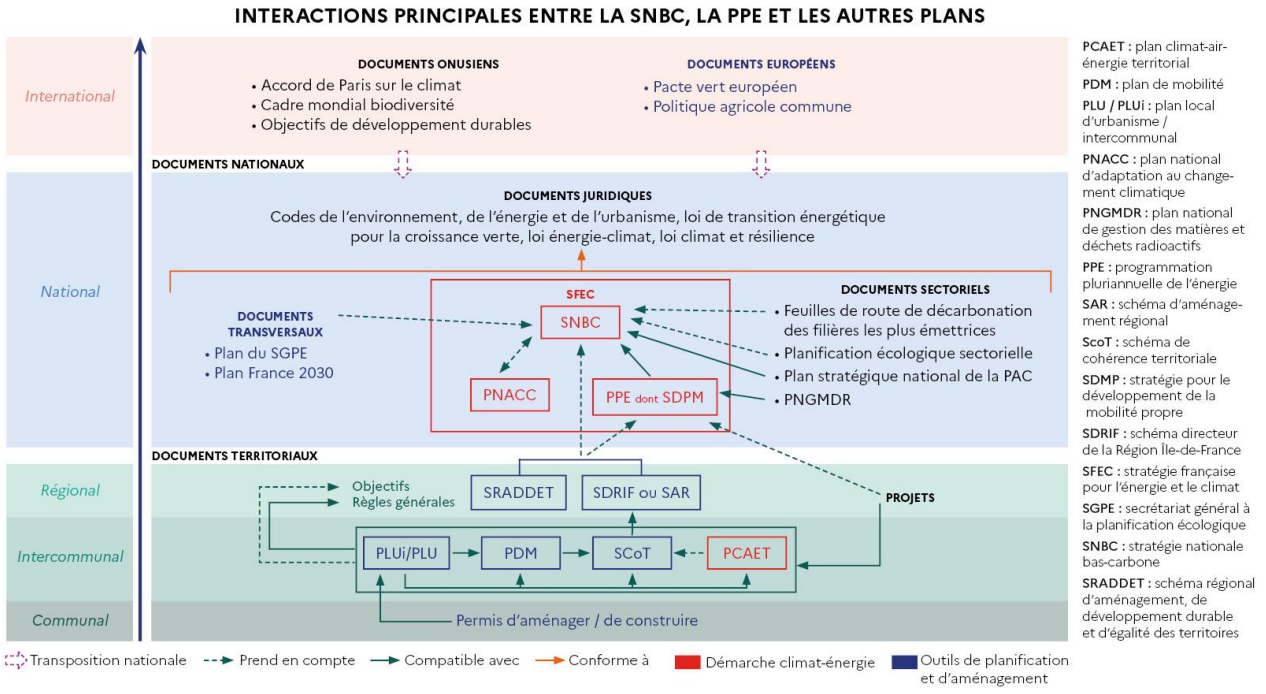
Strategies and planning documents that include energy guidelines must be compatible with the guidelines set out in the multi-annual energy plan.

The normative scope of :

- setting quantitative targets for the launch of calls for tenders for electricity production facilities (particularly), for capacity to reduce electricity consumption, or for investment to enable biomethane to be injected into gas networks;renewable energy
- the definition of the guidelines with which the authorisation to operate new electricity generation facilities, as well as EDF's strategic plan provided for in article L. 311-5-7 of the Energy Code, must be compatible;
- defining the level of security of supply for the French energy system, by setting the failure criterion used to assess the balance between electricity supply and demand, or the criterion for the security of supply of natural gas and the storage facilities that must be kept in operation.

1.1.3. Linking multiannual energy programming with other planning documents

The multi-annual energy programme is linked to various national plans, programmes and strategies that provide an operational framework for its priorities for action. The figure below illustrates this relationship.



Ce schéma simplifié rend compte des principales interactions entre la SNBC, la PPE et les principaux plans associés. De nombreux autres documents internationaux, nationaux, sectoriels et territoriaux existent.

Figure2 Relationship between the EPP and other national planning documents

1.1.4. Compatibility of the multiannual energy programme with the national low-carbon strategy

Article L. 141-1 of the Energy Code states that the EPP "*is compatible with the greenhouse gas emission reduction targets set in the carbon budget mentioned in article L. 222-1 A of the Environment Code, as well as with the low-carbon strategy mentioned in article L. 222-1 B of the same code*".

The PPE 3 and SNBC 3 projects have been worked on together to ensure that the PPE 3 is compatible with the carbon budgets and guidelines of the SNBC 3.

1.2. Process for drawing up the PPE

Scientific planning, based on a comprehensive model of our energy future

The development of France's energy and climate strategy is based on **extensive prospective modelling work.** As part of this, is building the DGEC an energy and climate scenario aimed at describing a target trajectory for reducing greenhouse gas emissions until the targets set for 2030 and are reached.carbon neutrality in 2050

This work is not a forecasting exercise, but a comprehensive and integrated planning exercise: the aim is for the State to propose, from among the various possible trajectories, a target scenario that meets the challenges expressed upstream, and that coordinates the various sectoral objectives by taking into account all the physical, social, economic and environmental constraints.

The modelling exercise is completed by a specific check to ensure that the results are consistent with each other ("looping"). For each time horizon, and for each of the energy vectors, it is necessary to check that the resources match the needs that emerge from the target scenario, to check its economic impact and acceptability, and to confirm the overall stability and robustness of the model, based on the work of the government and all the stakeholders (e.g. RTE's "Energy Futures 2050" study, etc.).

Some of the balancing points are particularly tricky, for example checking that electricity supply and demand are in balance, which involves fine-tuning the balance at every hour of the year on the basis of available resources and changes in electricity demand, or checking the biomass resource and its mobilisation, given the diversity of forms of biomass and their economic stakes, which are interwoven in an agricultural economy undergoing profound change (agricultural crisis and retirement of almost one farmer in two in 10 years).

The trajectories presented in this document are based on available projections to date and reflect the structural changes required between now and 2035 to achieve our objectives. However, these elements will continue to be re-evaluated and refined in the light of new knowledge about each of the levers to ensure that the long-term trajectory is in line with our objectives.

Work based on public debate and consultation with all stakeholders

The government has chosen to place public debate at the heart of the energy-climate planning exercise. Ecological planning sets general objectives, trajectories, levers for action and financial resources to support the players involved. The government's aim is to ensure that these objectives are implemented on the ground, through projects that are fair, realistic and desirable for all French people. In order to respond effectively to these challenges, identify the social impact of the proposed measures and provide solutions, the development of the French energy strategy is based on extensive consultation and dialogue with a wide range of stakeholders (business representatives, employee representatives, associations, local authorities, NGOs, citizens), which has been underway since October .2021

In this context, **the State has** :

- **Involve all the stakeholders** (scientists, economic players, the State, local authorities, associations, etc.) through a dedicated committee and sector experts via workshops and working groups (WG) to discuss the initial hypotheses and levers to be mobilised;
- **Involve the public** through consultation phases designed to gather their views on the country's climate and energy policy;
- **Supported economic players** in the sectors with the highest emissions in identifying the decarbonisation levers available to them and translating them into operational decarbonisation roadmaps (Article 301 of the French Climate and Resilience Act11 , roadmaps of the National Industry Council's strategic sector committees12 , roadmaps of the 50 industrial sites with the highest emissions, etc.).

In particular, the government has chosen to launch an unprecedented exercise in citizen dialogue on our energy future, with the organisation of a consultation entitled "Our energy future is being decided now", from October 2022 to February 2023 under the aegis of the Commission Nationale du Débat Public (CNDP). As part of this consultation process, the opinions of a "Youth Forum" were gathered, an exercise unprecedented in Europe, with 200 young people drawn at random from all over the country, including the French overseas territories.

In addition, as part of the ecological planning desired by the President of the Republic and on the initiative of the Minister for Energy Transition, 7 working groups were set up in May 2023 to update our country's energy and climate strategy. These groups, led by members of parliament and local elected representatives and involving all the stakeholders concerned (professional federations, social partners, experts, environmental and consumer associations, etc.), were tasked with sharing the constraints that our country is going to face in the context of the various challenges that lie ahead, making a diagnosis and identifying courses of action. They submitted their conclusions in September 2023[13] . These proposals have fed into the preparation of the current programme.multi-annual energy

Finally, **a national preliminary consultation was organised from 4 November to 16 December 2024, under the aegis of 3 guarantors from the National Commission for Public Debate**. This consultation enabled the government to publish the major objectives it planned to include in the multi-annual energy programme, to organise debates between experts on subjects at the heart of the transition such as energy production and consumption scenarios, financing and societal transformations, and to organise discussions in several regions on the construction of climate scenarios for 2050. The event attracted a huge response, with over 7,600 concrete proposals and almost 1.2 million votes cast.

Work based on all energy vectors, from production to the end consumer

The PPE for the next ten years aims to decarbonise the French energy system in its entirety, at every link in the chain, from the production or import of energy, right through to the end consumer, by integrating the entire transport, distribution and storage chain. At the same time, it includes all energy carriers, whether electricity, heat, gas or solid or liquid fuels. It is only by embracing all our energy uses and all energy carriers that we can prepare to replace fossil fuels wherever they are found.

11 https://www.ecologie.gouv.fr/feuilles-route-decarbonation-des-filieres-plus-emettrices

12 https://www.conseil-national-industrie.gouv.fr/decouvrez-19-csf

13 https://www.ecologie.gouv.fr/dossier-presse-travaux-preparation-strategie-francaise-energie-climat-restitution-des-groupes

The overall reduction and decarbonisation of energy consumption, in particular through the electrification of energy uses, should make it possible to initiate an accelerated process of phasing out fossil fuels (see Figure 4 below) thanks to an increase in the production of low-carbon energies (see Figure 3 below). At the same time, it has to deal with major constraints, particularly in terms of the physical capacity of natural resources for biomass production and the associated environmental issues, as well as the challenges facing the electricity sector, with strong growth in electricity consumption, skills and industrial capacity that need to be adapted, and grid stability that must be guaranteed at all times.

This transition imposed on the energy system will require, for the electricity system in particular, the development of a range of decarbonised flexibilities (storage, load shedding, interconnections, decarbonised thermal energy, etc.) to encourage consumption to be shifted outside periods of tension. It will also be necessary to adapt oil and gas infrastructures.

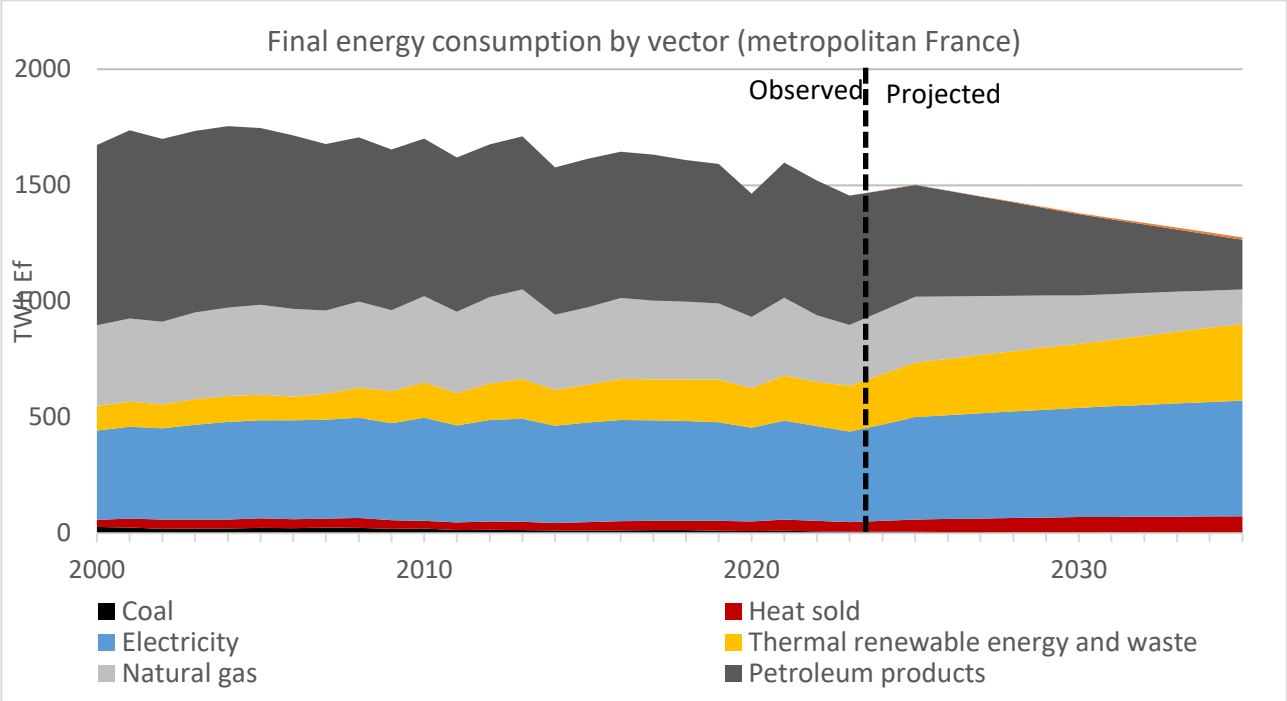


Figure3 Evolution of the actual energy mix (2000-2023) and projection of final energy consumption up to 2035 (SDES, May 2024; DGEC modelling, excluding international)bunkers

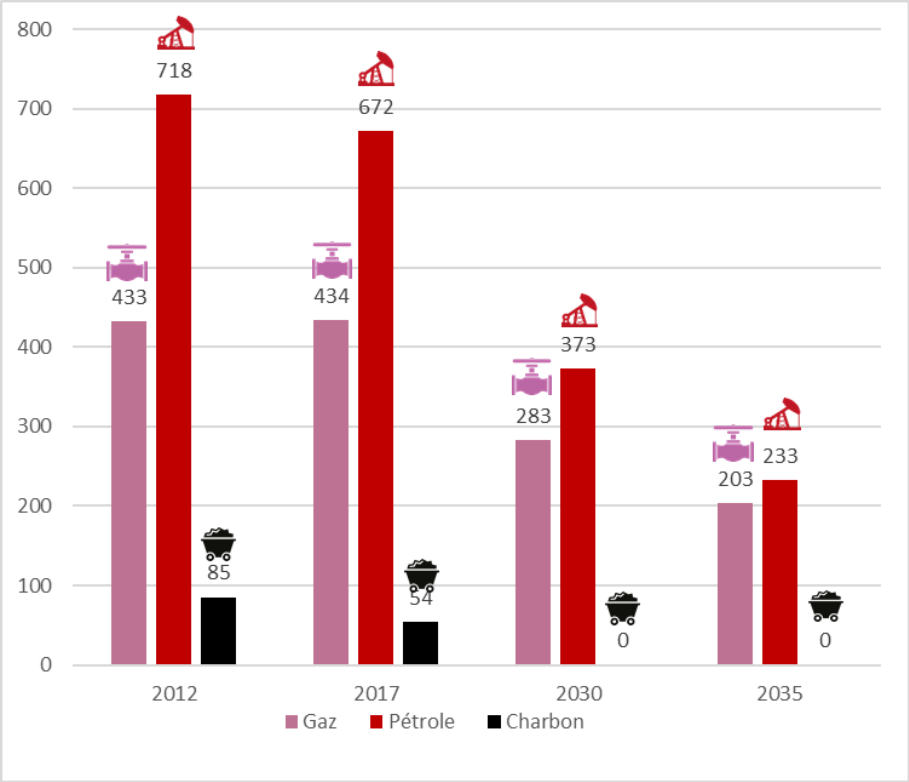


Figure4 Change in primary fossil fuel consumption for energy uses compared with 2012 (DGEC modelling, excluding non-energy uses)

1.3 Objectives to be achieved under the EPP

1.3.1. The international framework for combating climate change

Climate change requires countries around the world to work together. On this scale, the fight against climate change is guided by the United Nations Framework Convention on Climate Change (UNFCCC) adopted in 1992.

In 2015, world leaders agreed to ambitious targets in the fight against climate change: to **keep the rise in the global average temperature well below 2° C above levels pre-industrialand to continue action to limit the rise in temperatures to 1.5°** C. **This is the Paris Agreement**.

This agreement, drawn up under the French Presidency, **deals in a balanced way with the two facets of climate action**, namely mitigation - i.e. efforts to reduce greenhouse gas emissions - and the adaptation of societies to existing climate change.

Achieving these targets will require **immediate, rapid and far-reaching action to reduce GHG emissions** and **achieve GHG neutralityglobal by around 2050**[14] (zero net emissions) .

14 Carbon neutrality or climate neutrality is understood as a balance between GHG emissions and GHG absorptions by ecosystems managed by human beings (forests, agricultural soils) and by technological processes (carbon capture and storage or reuse).

1.3.2. The European framework

The **regulation "establishing the framework for achieving climate neutrality", known as the "European Climate Act",** is the cornerstone of the European Union's climate ambitions. It enshrines in European law the principle of climate neutrality by 2050 and sets out intermediate milestones for reducing greenhouse gas emissions.

By 2030, the European Union has set itself (article 4 of the above-mentioned regulation) the objective of **reducing its greenhouse gas emissions by -55% net by 2030 compared with 1990** (compared with -40% gross previously included in the European Union's first nationally determined contribution (2015 NDC)).

A number of European laws and objectives have been revised to reflect these objectives, including :

- The revised European Effort Sharing (ESRRegulation) , which [15]aligns Member States' targets for reducing GHG emissions from the transport, buildings, agriculture and waste sectors with the new European target for 2030;
- The European regulation on land use, land-use change and forestry (LULUCF) , which sets out the efforts that France will have to make in terms of forest management, strengthening long-lasting uses for wood from French forests, carbon storage in agricultural land (e.g. preservation of meadows, hedges, etc.) and reducing the artificialization of land.[16]
- Directive 2023/1791/EU on energy efficiency (DEE) , which determines the efforts that France will have to make to reduce its energy consumption. [17]
- Directive (EU) 2023/2413 on the promotion of energy from renewable sources, known as the "RED III Directive", which sets out the efforts that France will have to make in terms of renewable energy production.
- Directives (EU) 2023/95818 and (EU) 2023/95919 , which revise the EU Emissions Trading Scheme (EU ETS, the European carbon market) to make it more environmentally ambitious.

15 Regulation (EU) 2018/842 of the European Parliament and of the Council of 30 May 2018 on binding annual reductions of greenhouse gas emissions by Member States from 2021 to 2030 contributing to climate action to meet their commitments under the Paris Agreement and amending Regulation (EU) No 525/2013

16 Regulation (EU) 2023/839 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/841 as regards scope, simplification of reporting and compliance rules, and setting of Member States' targets for 2030, and Regulation (EU) 2018/1999 as regards improved monitoring, reporting, progress monitoring and review.

17 Article 4 of Directive 2023/1791/EU on energy efficiency sets a European target for 2030 of a maximum final energy consumption of 763 maximum Mtoe and a consumption of primary energy992.5 Mtoe. These targets aim to reduce energy consumption by at least 11. in 2030 compared with the projections in the EU's 2020 reference scenario.

18 Directive (EU) 2023/958 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC as regards the contribution of aviation to the emission reduction objective of all sectors of the economy of the Union and the appropriate implementation of a global market mechanism

19 Directive (EU) 2023/959 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 on the establishment and operation of a market stability reserve for the greenhouse gas emission allowance trading scheme of the Union

In addition, the European Union (EU) and France, individually, have committed to the Global Methane Pledge (GMP), an initiative launched at COP 26. The commitment made under the Global Methane Pledge is collective in nature, with GMP signatories pledging to work together to reduce global methane emissions by 30% between 2020 and 2030 . [20]

The guidelines set out in the EPP are part of this framework.

1.3.3. The national framework and purpose of the EPP

France has developed a number of tools to guide its policy on combating the greenhouse effect and the energy transition. These are the National Low Carbon Strategy and the Multiannual Energy Programme. These two documents are closely linked**: while the purpose of the SNBC is to define the long-term mitigation roadmap for all sectors** (including energy production and conversion), the **PPE makes it possible to describe precisely the orientations of the energy policy for the next ten years and, in particular, to translate our ambitions in terms of reducing our consumption and developing low-carbon energy production methods and green industrial sectors with** an operational aim for the State's action. The projection made by the SNBC up to 2050 is a possible trajectory for achieving France's objectives in terms of reducing greenhouse gas emissions.

The purpose of these documents is to define the collective transition path that will enable France to achieve its climate and energy objectives (see section 1.5).

1.3.4. Achieving carbon neutrality by 2050 and the challenges for the energy sector

In July 2017, France set itself the target of **becoming "carbon neutral" by 2050**[21] , in line with its commitment under the Paris Agreement. Achieving this target is a challenge that the reference scenario chosen by the French government for the SNBC 3 will have to meet.

Energy has a key role to play on the road to carbon neutrality, since by 2022 the share of greenhouse gas emissions due to energy use will represent 73% .[22]

The development of natural and technological sinks will be decisive in achieving carbon neutrality. However, the natural sink has fallen sharply in recent years as a result of a major forestry crisis, and there is a great deal of uncertainty as to how the sink will evolve as a function of the climate[23] . Against this backdrop, France's climate strategy could involve **a number of technologies for**

20 France reduced its methane emissions by 20% between 1990 and 2020.

21 This objective was then enshrined in the Energy Code (Article L. 100-4) by Law no. 2019-1147 of 8 November 2019 on energy and the climate.

22 Citepa, UNFCCC format, March 2024

23 In 2022, the LULUCF (Land Use, Land Use Change and Forestry) sector will absorb 18 Mt CO_2e (Citepa, Secten 2024). In the SNBC 2, sinks were estimated at 82 Mt CO_2e in 2050, including 67 Mt CO_2e stored by natural sinks (35 Mt $CO_{(2)}e$ by forests, 21 Mt $CO_{(2)}e$ by wood products and 11 Mt CO_2e by other land) and 15 Mt CO_2e by technological sinks.

absorbing greenhouse gas emissions[24] to achieve carbon neutrality, in support of sectors that have no other alternatives, but the development of these technologies will remain limited by 2050. Given these factors, it is crucial to aim to mobilise all emitting sectors **to reduce as much as possible residual by 2050**.

The EPP sets out guidelines for the period 2030-2035, with a view to initiating the structural changes needed to decarbonise the sector and achieve carbon neutrality by 2050.

In this timeframe, ecological planning must also ensure that it fully meets **the challenges of "closing the loop" in the scenario, including matching energy supply and demand over the long term.**

Generation of energy that does not emit greenhouse gases by 2050

By 2050, no energy should come from fossil fuels. This means that there will essentially be four sources of energy:

1. Decarbonised heat, particularly renewable heat other than biomass (geothermal, solar thermal, pumpsheat);
2. Biomass: solid (wood and solid recovered fuels, agricultural residues, etc.), liquid (biofuels, bio-oils), gaseous (biogas). Given the constraints on the resource, it will be necessary to take account of the efficiency with which biomass is used and converted into the various vectors, as well as the capacity of the sectors to use these different vectors;
3. Recovered energy: using waste heat from industry and recovering energy in situ;
4. Non-carbon electricity produced by renewable energies (hydro, wind, photovoltaic, marine, geothermal, etc.) or nuclear power, which can also be used to produce hydrogen or decarbonised synthetic fuels.

Loop constraints

Some uses can be met by using several energy carriers. In other cases, the energy sources are not perfectly interchangeable, even if the possibilities for substitution are evolving over time: for a long time, only oil cars, whereas poweredtoday electricity can also be used. Some uses are still captive: only electricity can power electrical and electronic .equipment

Thus, the French Climate and Energy Strategy aims to have, at each time step, a decarbonised energy consumption that is less than or equal to the anticipated production, in order to ensure that "the scenario . This closes the loop"involves estimating available production on the basis of a number of assumptions (particularly in the agricultural and forestry sectors for biomass), and comparing them with anticipated consumption in the various sectors. If the loop is not respected, we need to consider the reductions in consumption as well as the energy vector substitutions that can be made, and as a last resort, import capacities.

[24] technologies for the capture and storage of carbon of biogenic origin (bioenergy carbon capture and storage - BECCS), which come from energy production or the industrial sector and make it possible to capture biogenic emissions and then store them in deep geological layers or technologies for the direct capture of CO_2 from the air (Direct Air Capture - DAC), which make it possible to remove $CO_{(2)\ from}$ the atmosphere, which can then be stored in a geological layer.

1.4. Summary of the second PPE

The PPE 2 is monitored periodically. The latest version of the monitoring indicators is available at the following link: https://www.economie.gouv.fr/actualites/publication-des-indicateurs-de-suivi-2022-de-la-programmation-pluriannuelle-de-lenergie

Reducing energy consumption

The 2nd Multiannual Energy Programme (PPE 2) set a target for final energy consumption in mainland France (excluding international) of 1,528 TWh in 2023. In 2018, this energy consumption amounted to 1,621 TWh. In 2023, according to provisional values, it will be 1,509 TWh. Given the increase in the level of ambition in terms of reducing energy consumption in the 3rd multi-annual programmebunkersenergy (PPE 3), a major acceleration in the effort to achieve energy efficiency and sobriety will be necessary.

The objective set by the PPE 2 was to reduce primary consumption of petroleum products by 19% in 2023 compared with 2012, which would mean reaching a consumption level of 1,005 TWh in 2023. In 2023, according to provisional data, this consumption amounted to 1,006 TWh.

The fall in consumption has been driven by an active energy efficiency policy in the building, transport and industry sectors.

In the building sector, the creation of MaPrimeRénov' in January 2020 made energy renovation more accessible to those on the lowest incomes. Since then, around 2.44 million homes have been renovated, including around 330,000 comprehensive renovations, attracting around €11.8 billion in aid. this work has saved 6.2 million tonnes of COSince 2020, and 17.6 TWh/year of energy.[2]

France the public home renovation service, Rénov', was launched on 1st January 2022 to facilitate energy-efficient home renovation by providing more information and support for households at every stage of their projects. more than 589 France advice centres By 1 January 2025, there were ' and 2,700 advisers throughout France, thanks to the efforts of the government and local authorities, which are helping to fund the scheme.Rénov

In the field of transport, thanks to an active policy of support for the acquisition of clean vehicles through ecological bonuses and the conversion premium and tax penalties on the most emitting vehicles, as well as greening obligations for certain legal entities, the fleet of electric vehicles (including rechargeable hybrids) has grown considerably. At 1 January 2024, there were around 1,600,000 electrified (electric and plug-in hybrid) light vehicles (passenger cars and light commercial vehicles) in circulation. In 2024, 100% electric vehicles accounted for 16.8% of passenger car registrations and 6.9% of light commercial vehicle registrations. Between 2018 and 2024, almost 1.5 million electric vehicle purchase bonuses and more than 1.1 million conversion bonuses were paid out.

At the same time, the French government has organised the development of an electric battery industry for vehicles as part of the joint Major European Interest Project dedicated to batteries, which has led to the emergence of 4 projects electric in France. Greater attention has been paid to the resilience of the supply of critical raw materials for their production at European level (Critical Raw Materials gigafactory Act), and strict criteria on the life-cycle carbon impact of batteries have

been laid down as part of the battery regulation negotiated under the French Presidency of the EU and adopted by the European Union on 10 July 2023.

In line with this electrification of the vehicle fleet, the number of recharging points has been rising sharply since 2020. With the strong support of the French government, more than 154,000 recharging points are currently open to the public throughout the country. In addition, there are almost 2.2 million charging points currently deployed in homes and businesses. This makes France one of the three best-equipped countries in Europe, alongside the Netherlands and Germany, in terms of both the number and density of charging points.

As a central mechanism for public action on energy efficiency, the Energy Savings Certificates (EWCs) scheme has grown in importance throughout the period. The fourth period of the CEE scheme (2018-2021) was based on increased obligations (2,133 TWhc, including at least 533 TWhc for households in fuel poverty) compared with the third period, meaning that more energy-saving actions were financed by obligated players. The scope of the scheme has been extended to the industrial sector and to installations subject to the European Union Emissions Trading Scheme. The targets for the fifth period (2022-2025) have been strengthened compared with the fourth period (obligation increased to 3,100 TWhc over 4 years, including 1,130 TWhc for households in fuel poverty). This fifth period has also sought to improve the efficiency of the system.

With a view to reducing energy consumption and promoting less energy-intensive modes of consumption, France has also resolutely supported European policy on the eco-design and energy labelling of energy-related products throughout the period. It is scrupulously monitoring the implementation of successive work programmes, and is currently working on the 2022-2024 programme. The 2022-2024 work programme includes 38 reviews of existing measures, which will save an additional 170 TWh per year across Europe. Priorities include the revision of provisions concerning heating and cooling appliances and the development of energy labels.

In the industrial sector, the government's decarbonisation policy is based on decarbonisation roadmaps for the highest-emission sectors (metallurgy, heavy chemicals, cement) and has been supported by the France Relance plan, which has enabled over 200 industrial sites to reduce their COemissions by around 4 million tonnes $_2$ a year. In addition, support for deep decarbonisation is being rolled out as part of the France Relance plan and the national strategy for the development of low-carbon hydrogen, with almost €9 billion in public support.

More recently, on 6 October 2022, the French government presented its first energy efficiency plan, based on work carried out in ten sectors of activity and involving more than 300 federations. The aim of the plan was to reduce energy consumption by 10% compared with the end of 2019.

This mobilisation has produced unprecedented results. Over a twelve-month period (1st August 2022 to 31 July 2023), France reduced its combined electricity and gas consumption by 12% - after adjustment for weather effects and for all types of consumer, including those less exposed to the volatility of energy prices. This fall in consumption, which has had no impact on growth, has enabled France to reduce its greenhouse gas emissions by 8.5% in the last quarter of 2022 and by 5.8% over the course of 2023. This fall in energy consumption was maintained at -12% over the course of 2023-2024 (1st August 2023 to 31 July 2024, adjusted for weather effects), thanks in particular to the mobilisation of professional representatives around events dedicated to energy sobriety, as well as the general public through annual winter communication campaigns, reminding households of key gestures.

Developing renewable energies

The share of renewable energies in final energy consumption has risen to 22.2% in 2023, according to forecasts, putting us on a par with our European partners of a similar size, notably Germany. This testifies to the success of the government's efforts to accelerate the deployment of renewable energies.

The EPP targets for onshore wind power and photovoltaics have not been met. According to provisional data, solar photovoltaic capacity reached 19.3 GW in mainland France in 2023, against a target of 20.6 GW set out in the EPP. For onshore wind power, at the end of 2023, total installed onshore wind power capacity in mainland France was 21.9 GW according to provisional data, slightly below the target of 24.1 GW set out in the EPP. **The main reason for this is the long lead times involved in appraising applications** (often compounded by disputes over the authorisation granted). In the case of onshore wind power, aeronautical and military constraints restrict the development of projects, which also sometimes come up against difficulties in gaining local support. For photovoltaics, the current regulatory and legislative framework is increasingly restricting the development of ground-based projects, which may also explain the difficulties in achieving targets. Numerous measures have been put in place and are currently being rolled out to achieve the objectives of EPP3.

The first step in the above-mentioned efforts is to simplify the administrative procedures for setting up new renewable electricity generation facilities: Law no. 2023-175 of 10 March 2023 on accelerating the production of renewable energy (APER) provides for various measures to accelerate the development of renewable energy, and its implementing regulations have been in force since 10 March 2023. It defines agrivoltaics and provides a framework for its development. At the same time, it provides a framework for the development of ground-mounted photovoltaic systems in natural, agricultural and forestry areas, and strengthens the solarisation obligations for car parks and buildings previously introduced by the Climate & Resilience Act. Finally, in line with European legislation, it recognises that must meet renewable energy projectsan imperative requirement of overriding public interest, which will make it possible to secure exemptions for protected species granted to project developers. This effort is also being made at local level, through the mobilisation of all the parties involved, both the decentralised government departments responsible for supporting and examining projects and the local authorities involved in the local planning of acceleration zones and the regionalisation of renewable energy objectives, as provided for in article 15 of the APER law.

Several recent reforms have accelerated the development of offshore wind power, although the 2023 target has not yet been reached. The 2020 law on the acceleration and simplification of public action (ASAP) has made it possible to:

- To bring forward the administrative phases of pre-selecting candidates for offshore wind power tenders, in parallel with the public debates. This will speed up the competitive tendering process by several months without reducing the level of public participation;
- To pool public debates on offshore wind projects within the same maritime area. This will improve planning for offshore wind farms, while giving the public greater visibility;

- To give the Conseil d'Etat jurisdiction to rule in the first and last instance on appeals against offshore wind farm projects. This provision will shorten the time required for appeals by at least two years.

The APER Act of 2023 made it possible to :

- To pool the public debates on offshore wind energy and those on the revision of strategic coastal documents, with a view to more integrated planning;
- Anticipate offshore connections independently of the tendering process.

Finally, the APER law and decrees 2023-1419 of 29 December 2023 and 2023-1209 of 19 December 2023 have clarified and simplified the authorisation regime for offshore wind projects, particularly in the exclusive economic zone (EEZ).

So, while the target of 2.4 GW of installed capacity by 2023 set by the EPP has not been reached due to the long periods required to process authorisations, appeals and delays in work on the projects in the first two offshore wind tenders, the above-mentioned reforms should make it possible to speed up the development of future wind farms. It should also be pointed out that the French government has launched all the offshore wind tenders provided for in the current EPP (AO3 to 9), representing more than 7.5 GW, and that the planning work has made it possible to identify, in the interministerial decision of 17 October 2024 published following the "La mer en débat" public debate, areas where an additional 15 GW could be allocated over the next 10 years, with a view to reaching 45 GW in service by 2050.

At present, 3 projects totalling 1.5 GW have been commissioned: the 480 MW St Nazaire wind farm was commissioned in 2022, and the Fécamp and Saint Brieuc wind farms in May 2024. In 2025, the Courseulles-sur-Mer and Yeu-Noirmoutier projects will also be commissioned. Finally, the Dieppe-Le Tréport project will be commissioned in 2026.

In the case of **renewable heat**, the target for production by heat pumps by 2023 has been met and even exceeded (+27% compared with the production target), but not those for biomass (77% of the target achieved), solar thermal (89% of the target achieved) and deliveries of renewable and recovered heat and heat networks (67% of the target achieved).

Despite a budget for the Fonds Chaleur that has been increased since 2018, the context of tax incentives has not made it possible to differentiate sufficiently between low-carbon energies and fossil fuels for heat production, making it difficult to drive sufficient momentum to achieve the objectives of the PPE in this area. As a result, at the start of the period, the rate of development of heating was almost half that forecast in the EPP. The Fonds Chaleur budget for 2022 has been increased to €520m in order to tackle the energy crisis and, in particular, to speed up the deployment of heating networks, the main vector for renewable or low-carbon heat. It has been further increased to €595 million in 2023 to cope with the significant increase in new district heating network projects.

As part of the stimulus plan, the government has also introduced ambitious and proactive support for decarbonisation of industry, available from 2020 and continued in 2021 and 2022 for a total of €1.2 billion over the period 2020-2022. A very strong momentum on renewable heat projects was observed in 2022.

As far as **biomass** is concerned, the context of EPP3 has changed since EPP2. In fact, wood energy and biomass resources in general have become limiting factors, hence the downward revision of

targets in the new EPP. In addition, the development of wood energy will be subject to the prioritisation of uses on the one hand, and to the principle of cascade use of the RED III directive on the other.

As for **solar thermal energy**, the previous PPE foresaw a revival of the sector through the development of large-scale installations in industry and on heating networks, and outlined growth prospects for individual and collective housing. The years 2021 and 2022 were marked in mainland France by a recovery in the solar thermal market and the development of GISTs with glazed collectors, supported by a dedicated call for projects under ADEME's Heat Fund. This momentum is set to accelerate sharply over the next few years, with a view to achieving 6 TWh of solar thermal heat consumption by 2030 and 10 TWh by 2035. Meeting this challenge - by multiplying by 4 the number of collectors installed in the individual and collective sectors and reaching 1 million m^2 of collectors installed per year under GIST - will require a sustained effort in terms of industrial capacity, installation and operation, not forgetting the regulatory and financial aspects.

Deliveries of renewable and recovered heat, linked to the development of heating networks, have continued to increase steadily, but at a rate that is insufficient to meet the objectives of the EPP2. In fact, despite the advantage of a more stable and predictable price for the heat delivered over the long term, district heating networks were hit hard by competition from gas prices for several years, before the energy crisis created a great deal of enthusiasm for new projects. However, these projects must be allowed to get off the ground if they are to have a full impact, and this is subject to the condition that public support is not eroded, which could jeopardise this momentum.

With regard to hydroelectricity, the second EPP aimed to increase installed hydroelectric capacity in mainland France by around 200 MW by 2023 (i.e. 25.7 GW), and by 900 MW to 1,200 MW by 2028 (i.e. from 26.4 to 26.7 GW). **The EPP2 target of 25.7 GW of installed hydropower capacity was reached in 2023**. A number of measures have been taken since the adoption of EPP 2 to support the development of the sector and increase installed capacity, taking into account all the issues at stake, particularly the environmental ones.

This includes economic support for facilities authorised on the basis of **a tariff decree** (the State provides support for electricity production based on the characteristics of the facility and the investment required) or via **a call for tenders**. A tariff order supporting the development and renovation of hydroelectric facilities of less than 1 MW was issued in 2016. This aid scheme, known as H16, is open until 2026 and has supported 65 MW. In addition, 3 calls for tenders spread over 8 periods have been implemented since 2016, resulting in the competitive designation of 64 winners representing around 150 MW for facilities of less than 4.5 MW.

For hydroelectric concessions, in addition to the work carried out spontaneously by the concessionaires under their concession contract or which may have been the subject of specific riders, the Energy and Climate Law of 8 November 2019 opened up the possibility of carrying out power increases by declaration, under certain conditions. This possibility, specified in the law of 10 March 2023 on accelerating the production of renewable energies, made it possible by to approve almost January 2025**60 MW of power increases in** hydroelectric concessions .[1]

More specifically, **the Compagnie Nationale du Rhône concession was extended** by the law of 28 February 2022 on the development of the Rhône until 2041. This extension made it possible to include five-year investment plans and an additional works programme in the specifications appended to the law. The five-year investment plans include a section on developing the production

of hydroelectric power or other sources of energy, and have been mobilised for the construction of a new small-scale hydroelectric scheme of 8 MW and a study of the residual hydroelectric potential on the Rhône as a whole. The additional works programme currently includes increasing the capacity of the Montélimar power station and building 6 small hydroelectric power stations coupled with fish passes.

A number of complementary measures have also been studied, such as support for the renovation of facilities with a capacity of between 1 and 4.5 MW.

The objectives relating to the development of hydroelectricity also include targets for the **deployment of pumped-storage energy transfer stations (STEP**), facilities that enable electricity to be stored by pumping/turbining between two lakes at different altitudes. The EPP 2 set the objective of initiating steps to develop STEP **with a potential of 1.5 GW**, with a view to commissioning the facilities between 2030 and 2035. With this in mind, a public consultation was launched in the spring of 2023 to determine the economic framework conducive to the development of WWTPs and the possible need for public support. This work is continuing, and could be implemented during the award procedure for the new concession for the Lacs Blanc et Noir WWTP in the Haut-Rhin region, for which an award procedure is being prepared. In addition, in January 2024, an amendment to the Saut-Mortier concession approved the new project for a STEP with a pumping capacity of 18 MW, making it possible to develop the energy flexibility of the Ain hydroelectric chain (450 MW) and better reconcile the uses of water resources.

However, the legal uncertainty surrounding the renewal of hydroelectric concessions and the ongoing discussions with the European Commission mean that there is some uncertainty as to whether the objectives for the hydroelectric sector for 2028 will be metand 2035 , whether in terms of increasing hydroelectric capacity or developing WWTPs. Indeed, in the absence of concession renewals, the largest investments in modernisation, power increases or development of pumping capacity between two existing lakes cannot be made. In the short and medium term, the resolution of the pre-litigation issues surrounding the renewal of hydroelectric concessions is therefore essential if hydroelectric objectives are to be achieved.

Since 2022, the production of biomethane injected into gas networks has exceeded the target of 6 TWh set by the PPE 2 for 2023, with an injected volume of 7.0 TWh in 2022 and 9.1 TWh in 2023, compared with 0.7 TWh in 2018. At the same time, the national fleet of biomethane production facilities has expanded rapidly, rising from 76 units at the end of 2018 to 652 units at the end of 2023.

This strong development of the biomethane sector has been largely supported by the regulated feed-in tariff system, which has operated as an open window since it was introduced in 2011. However, despite the increasing maturity of the industry, the expected fall in production costs has not been observed, which led the government to organise a consultation with the industry at the end of 2010 on a review of the tariff framework and to obtain commitments from the main players to optimise the costs of methanisation. The announcement in 2019 of a new, less attractive tariff decree, incorporating in particular an automatic degression coefficient for the tariff, and henceforth reserved for small-scale facilities producing less than 25 GWh per year, led to a rush of feed-in tariff contracts being signed before the decree was published on 23 November 2020. The commissioning of the new facilities benefiting from these contracts, which generally took place 2 years after the contracts were signed, meant that the 2023 target for biomethane production set out in the PPE 2 was exceeded as early as 2022.

However, momentum for new projects slowed sharply after 2020, and given the need to revive the sector, which has also been facing significant inflation since the end of 2021, it was decided to increase the feed-in tariff in 2023. The latest tariff decree of 10 June 2023 made the tariff more attractive by introducing indexation to the cost of electricity supply - which rose sharply as a result of the energy crisis in 2022 - and by retroactively cancelling the effects of the automatic degressivity introduced at the end of 2020.

In addition, since facilities generating more than 25 GWh per year have no longer been eligible for the regulated tariff since 2020, a new budgetary system of purchase obligation following a call for tenders was introduced to support the development of large-capacity facilities, with the launch of an initial call for tenders at the end of 2022. However, this tender had to be suspended due to the risk that it would not be successful, and was relaunched at the end of 2023 following an increase in the ceiling tariff. The first bid submission period took place in February 2024.

Overall, the government's support for biomethane injection means that the industry is now on a trajectory that is compatible with achieving the PPE 2's top target for 2028, set at 22 TWh. In budgetary terms, however, the faster-than-expected development of the industry, at a higher-than-expected average production cost, means that the government's commitment under the feed-in tariff for the period 2019-2028 needs to be significantly increased, from €9.7 billion to €17 billion.

At the same time, the 2021 "climate and resilience" law introduced the biogas production certificate (CPB) scheme, the application details of which have been set out in two decrees and an order. This extra-budgetary scheme, which can be likened to a market mechanism, will be a major growth driver for biomethane production from 2026 onwards. It requires natural gas suppliers to return a quantity of certificates to the government each year, based on an overall trajectory for the incorporation of biomethane and the volume of gas delivered to their customers in the sectors subject to the scheme, i.e. the residential and tertiary sectors. Suppliers will be able to fulfil their obligation to return CPBs by producing biomethane themselves or by acquiring these certificates from third-party producers.

The creation of this system, which will automatically pass on part of the extra cost of producing biomethane injected into gas networks to end consumers, is designed to meet the ambitious targets set out in the EPP for 2030, while limiting the impact of support for the biomethane sector on public finances.

The targets for **advanced biofuels** set out in the PPE 2, i.e. 1.2% in petrol and 0.4% in diesel, have been achieved and are part of a trajectory for the use of renewable energy in line with European regulations to aim for 15% renewable energy in the road and rail sectors by 2030. The methodology is currently being revised to aim for a 14.5% reduction in the carbon intensity of energy used by transport as a whole by 2030, thereby giving preference to alternative fuels with a greater potential for reducing emissions.

In 2022 and 2023, after more than 15 years of public support for the emergence of renewable energies, most of these have become competitive in France. They will have generated €6.5 billion in additional net revenue, including €6.2 billion for onshore wind power in 2022 and 2023.

Nuclear power development

While acknowledging the key role of nuclear energy in the French energy mix and its decarbonisation, the EPP2 opened up several options as to the place of nuclear energy in our country.

The "Energy Futures 2050" work entrusted to RTE has confirmed the merits of electricity mix options based on the massive development of renewable energies, the continued operation of existing nuclear power plants as far as is technically and economically possible - without considering further closures - and the launch of a new nuclear power programme.

It was in this spirit that the President of the French Republic, in his Belfort speech, set out the political guidelines for making this choice for the country: following the public debate and the work carried out by the working groups, the present Strategy is intended to ratify this choice. The objectives of the PPE 2 are therefore no longer relevant.

In terms of phasing out fossil fuels

The aim of the EPP was to move away from fossil fuels, and its targets for reducing primary fossil fuel energy consumption by 2023 have been met. In fact, between 2015 and 2023, primary energy consumption of fossil fuels fell by 17%, from 1,208 TWh to 1,006 TWh in 2023, according to the forecasts, enabling the EPP target of 1,005 TWh to be achieved.

Firstly, as mentioned above, the overall reduction in energy consumption contributes to the objectives of reducing fossil fuel consumption.

In addition, in housing and transport, the efforts to convert the road vehicle fleet through conversion bonuses and incentives, and the efforts to renovate energy and transform heat production methods, confirmed in the revision of the energy regulations for new buildings (RE2020), have started to reduce consumption and paved the way for this strategy, making it possible to scale up the phase-out of fossil fuels in the main everyday uses of French people's lives. A detailed analysis of the measures that have reduced fossil fuel consumption in the transport sector is provided in Appendix 2 of the SDMP

In terms of production, this EPP confirms the closure of power plants that run exclusively on coal, with the aim of phasing out the use of coal for energy purposes by 2027. These plants will require support for employees and local communities: the government has ensured that vocational training measures for the employees concerned have already been put in place.

1.5. The trajectory structuring the EPP

The scenario taken into account in this EPP is structured so that the evolution of the various parameters making up the EPP, from energy production to energy consumption, makes it possible to achieve the objectives set at European level, to successfully move away from fossil fuels, and to have sufficient decarbonised energy to meet our needs.

The measures detailed explicitly in this document will need to be supplemented by additional measures to achieve all the objectives by 2030.

CENTRAL SCENARIO

	2023	2030	2035
OUTPU FOSSILS	Approximately 60%. OF ENERGY FINAL FOSSIL FUEL CONSUMED	42% OF ENERGY FINAL FOSSIL FUEL CONSUMED	30% OF ENERGY FINAL FOSSIL FUEL CONSUMED
CARBON-FREE ELECTRICITY GENERATION [25]	458 TWh	~ *577* TWh	Between 666 and 708 TWh
NUCLEAR PRODUCTION	56 reactors 320.4 TWh	57 reactors in service 360 TWh *(400 TWh "managerial " of EDF)ambition*	
PHOTOVOLTAIC	19.3 GW[26] 22.7 TWh	54GW *~66 TWh*	65 - 90 GW *~92 - 110 TWh*
ONSHORE WIND	21.9 GW[27] 48.7 TWh	33 GW *~72TWh*	40-45 GW *~91 - 103 TWh*
OFFSHORE WIND ENERGY	0.84 GW[28] 1.9 TWh	3.6 GW *~14 TWh*	18 GW *~71 TWh*

[25] Decarbonised electricity generation also includes electricity generation from bioenergy, of the order of 10 TWh. The load factors used: 14% for PV, 25% in 2030 and 26% in 2035 for onshore wind and 45% for offshore wind.

[26] Source SDES installed capacity and PV production 2023: https:

[27] Source SDES installed capacity and wind generation 2023: https://analysesetdonnees.rte-france.com/production/eolien

[28] Value declared at 31/12/2023 to calculate the amount of offshore wind tax paid in 2024.

HYDRO-ELECTRICITY	25.9 GW (with STEP)[29] 54.2 TWh [30]	26.3 GW (with STEP) *~54*	28.7 GW (with STEP)[31] *~54TWh*
RENEWABLE AND RECOVERED COOLINGHEAT AND	172 TWh heat[32] 1 TWh cooling delivered by networks	276 TWh heat 2 TWh cooling delivered by networks	328-421 TWh 2.5 - 3 TWh cooling delivered by networks
BIOGA *(Targets in TWh PCS)*	19.5 TWh including 9 TWh injected into natural gas networks	50 TWh including 44 TWh injected into natural gas networks	50-85 TWh
BIOFUELS in transport	38 TWh in transmission	55 TWh in transmission	Between 70 and 90 TWh (transmission and non-transmission)
HYDROGEN (*installed electrolysis capacity*)	0 GW	Up to 4.5 GW *(9-19 TWh(bcf))*	Up to 8 GW *(16-40 TWh(pci*
FINAL ENERGY CONSUMPTION	1509 TWh	1243 TWh	APPROXIMATELY 1100 TWh

[29] Source DGEC + SDES: https://www.statistiques.developpement-durable.gouv.fr/chiffres-cles-des-energies-renouvelables-edition-2024?rubrique=21&dossier=174

[30] Production corresponds to renewable hydroelectric production net of production by STEPs from water previously pumped.

[31] The limited increase in hydroelectric capacity will not necessarily translate into an increase in producibility, particularly given the expected impact of climate change on water resources. However, the additional capacity will be decisive in making the facilities more controllable

[32] The data presented is for the year 2022.

•2. Improving energy efficiency and reducing fossil fuel consumption

This section presents trends in energy consumption in France and analyses the determinants of consumption trends in order to identify the public policy levers available to the State to reduce consumption.

The projections for consumption in 2030 and 2035 are based on a scenario that incorporates the public policy measures described in this section, within the limits of the modelling capacity available.

Macro-economic assumptions

A scenario has been drawn up based on the macroeconomic parameters considered most likely to evolve.

Population

The population change framework used is the INSEE central demographic change scenario updated in 2021. This scenario is preferred to the Eurostat scenario proposed by the Commission because it reflects more accurately the recent demographic trends observed in France.

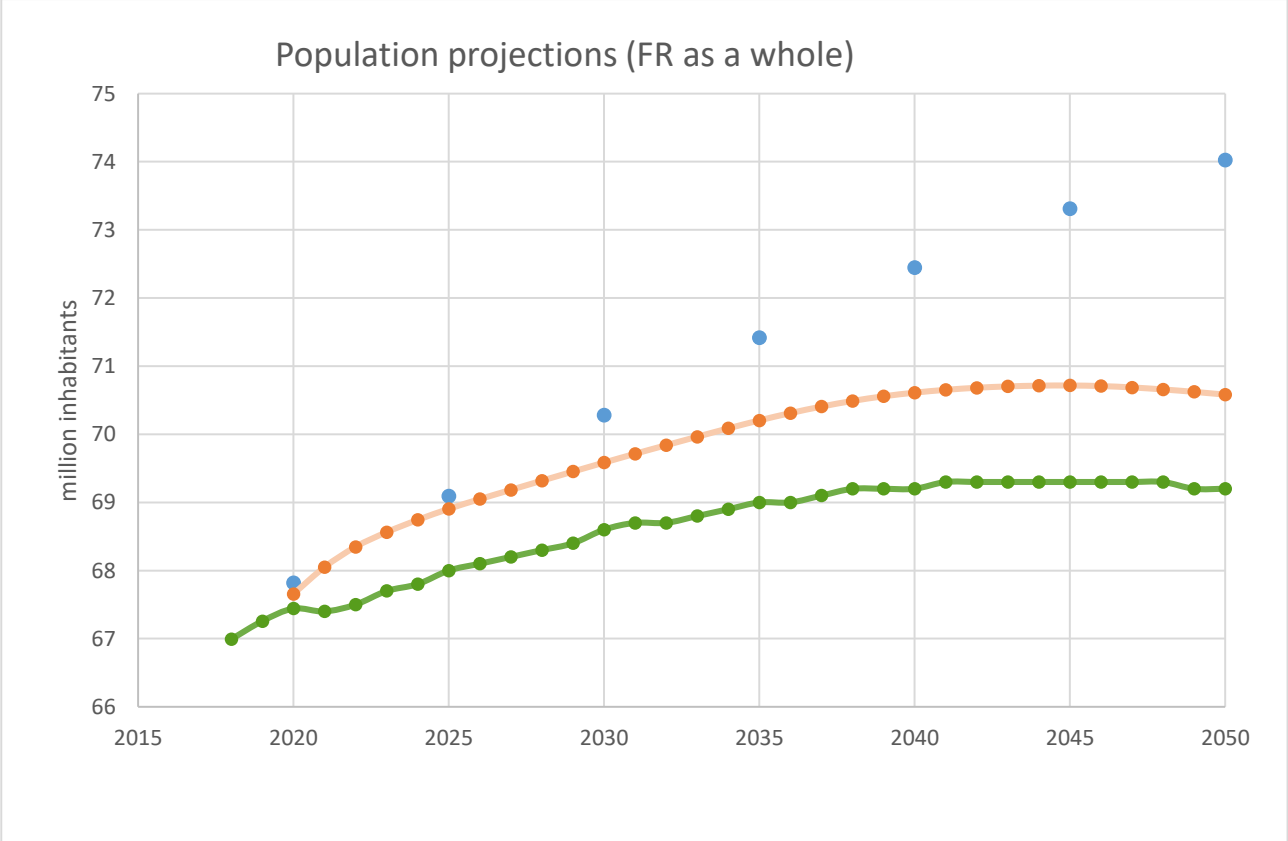


Figure5 . Population trends in the different scenarios (hexagon + DROM). Blue: EPP 2; Orange: European Commission; Green: INSEE central scenario, used for EPP 3.

Energy prices

The price framework for imported energy is that of the European Commission, which applies to all the Member States' reports.

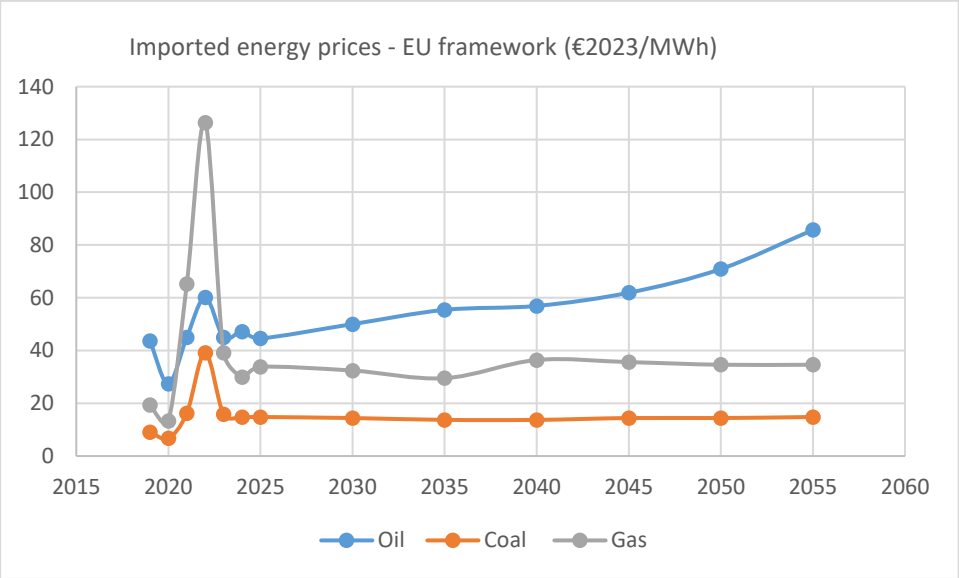


Figure6 . Evolution of imported energy prices - European Commission scenario for the March scenarios2024

Energy prices are projected taking into account these imported energy prices as well as network and distribution costs.

Taxation

For the projections presented in this document, the energy excise duties for oil and gas are those in force on 1st January 2024.

The tax rate taken into account is the standard statutory rate.

Economic growth

The GDP growth assumptions are based on the framework provided by the European Commission (framework assumptions provided by the European Commission to all Member States each year to ensure consistency and comparability of national scenarios). As the population assumption has not been included in the Commission's framework, the figures have been adjusted so as to maintain growthidentical , and to include the population growth of the INSEE 2021 scenario. GDP/capita

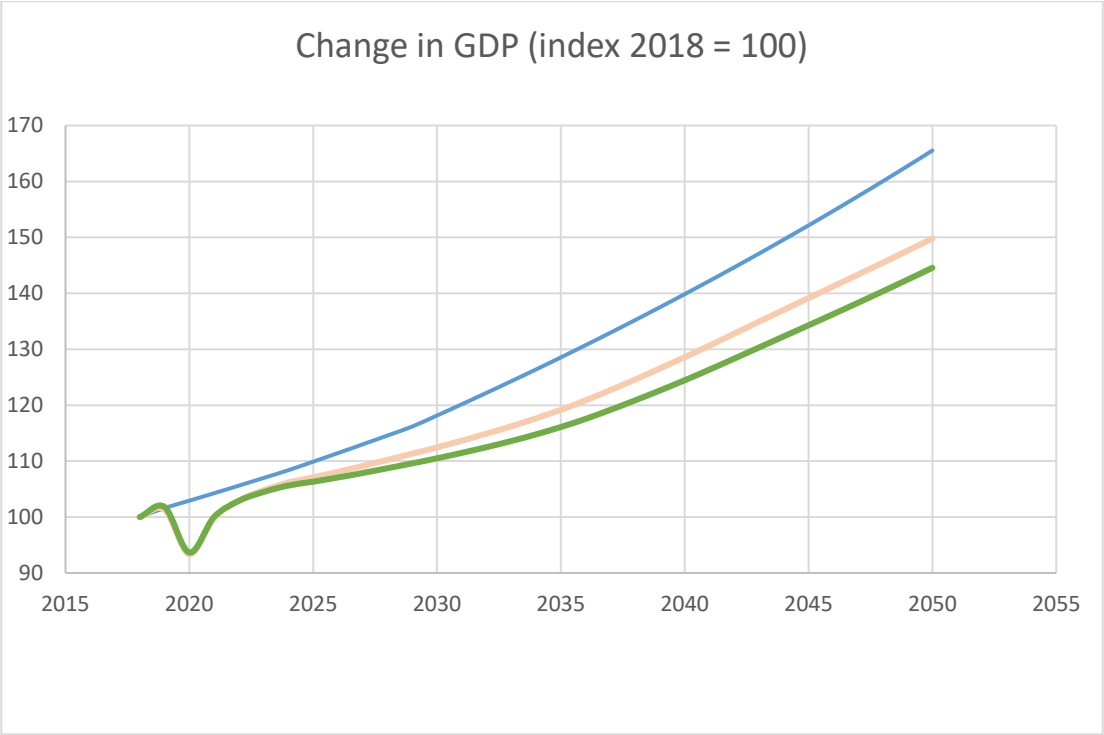


Figure7 . Change in GDP in the scenarios (hexagon + DROM perimeter). Blue: PPE 2; Orange: European Commission; Green: European Commission adjusted to INSEE population, used for PPE 3.

2.1. Reducing final energy consumption - Global approach

Reducing our energy consumption is essential if we are to achieve our climate objectives. It will not only reduce greenhouse gas emissions, but also secure our ability to meet our energy needs in the short, medium and long term with carbon-free energy. It also makes it possible to improve our energy independence.

The new Energy Efficiency Directive, revised on 20 September 2023 as part of the Fit for 55 legislative package, sets a new target for reducing energy consumption by 2030. France must therefore aim to achieve a final energy consumption of 1,243 TWh in 2030, according to the DEE perimeter, [33]which corresponds to a reduction in final energy consumption of around 29% over the period 2012-2030.

Between 2012 and 2023, France's final energy consumption will have fallen by around 14.1%, i.e. a dynamic of around -22 TWh/year. The overall rate of reduction in final energy consumption over the period 2024-2030 therefore needs to be almost doubled in order to achieve the target set out in the European Fit for 55 legislative package. In fact, final energy consumption amounted to 1,509 TWh in 2023. To reach the DEE's target of 1,243 TWh by 2030, energy consumption will have to be reduced by 38 TWh/year over the period 2024-2030.

[33] Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955.

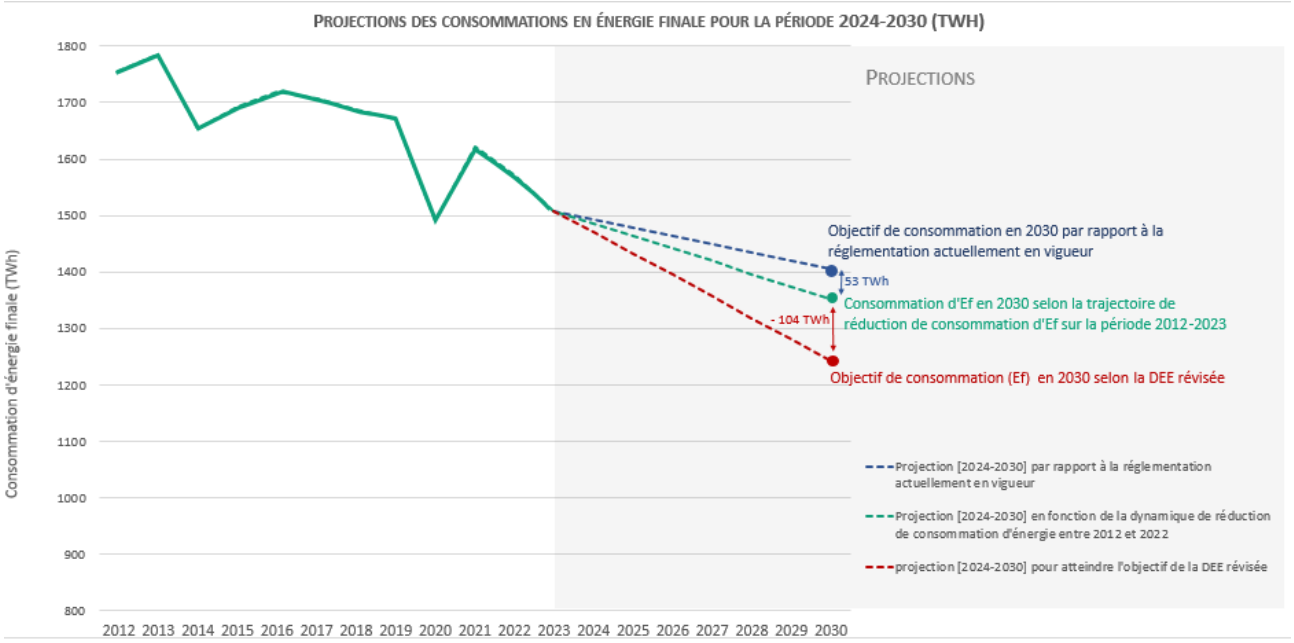


Figure8 . Projected final energy consumption to 2030 (DGEC modelling based on SDES data)[34]

The final energy consumption trajectories modelled for the National Low Carbon Strategy lead to final energy consumption in France in 2030 of 1,410 TWh, or 1,381 TWh according to the DEE perimeter[35] , representing a 21.3% reduction in final energy consumption compared with 2012 (1,756 TWh). These models include a reindustrialisation scenario, which would make it possible to reduce the French and European carbon footprint, but which would also automatically increase energy consumption in France by around 50 TWh. However, the reindustrialisation of France has a positive impact on the climate, since the electricity mix in France is largely decarbonised, while at the same time creating jobs and wealth for the regions.

Additional levers will need to be identified and activated to ensure that the targets for reducing energy consumption are met. The energy saving momentum generated by the operational implementation of plans to accelerate geothermal and solar thermal energy, measures to promote the electrification of transport, buildings and industry, work to transpose the Energy Efficiency Directive (introduction of the principle of primacy of energy efficiency, exemplary behaviour by public bodies, energy audits of businesses, local heating and cooling plans, etc.), the bill for which is currently before Parliament, and the forthcoming roll-out of the 6) (thperiod of the energy certificate scheme will be decisive in ensuring that we meet our 2030 energy consumption targets.

As for the long-term objective of reducing our final energy consumption by 50% in 2050 compared to 2012 levels, it will be necessary to make an additional effort on the basis of additional measures to be developed between now and the next planning exercise.

34 France's energy balance in 2023 - Summary (published on 14 January 2025): https://www.statistiques.developpement-durable.gouv.fr/bilan-energetique-de-la-france-en-2023-synthese

35 Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955.

ACTION CONSO.1

PRIORITISE ENERGY EFFICIENCY AND SOBRIETY

In application of the directive on energy efficiency, the French government requires that the principles of energy sobriety and efficiency be taken into account from the design stage of a plan or programme, a law, a project or a major investment decision. A bill will therefore propose containing various provisions for adapting to European Union law (DDADUE) a proportionate assessment of the extent to which energy efficiency and energy sobriety are taken into account in planning decisions or projects costing more than €100 million (€175 million for transport infrastructure).

In addition, a number of measures provided for in the Energy Efficiency Directive will be implemented to accelerate energy savings, including :

Public bodies will have to set an example and plan to reduce their cumulative final energy consumption by 1.9% per year (compared with their consumption in 2021) and renovate 3% of the surface area of their heated or cooled buildings over 250 mto a high level of energy performance each year[2];

The most energy-intensive companies will be required to carry out energy audits or implement energy management systems (currently only large companies are required to do so, regardless of their consumption);

Data centres larger than 1 MW will have to recover the waste heat they produce.

At the same time, since energy saving is based on behaviour and, in particular, certain key actions, it is essential to maintain the new habits that were put in place during the energy crisis of winter 2022-2023.

To achieve this, we need to continue to mobilise all stakeholders and households by reminding them of eco-gestures. It will continue to be essential to promote low-energy initiatives among economic players and their representatives, in order to maintain a constant focus on this subject and encourage the sharing of experience, both in terms of practical experience and the potential for economic gains (mobilisation at events, symposia, signing of commitment charters with the various sectors, etc.). The aim will be to consolidate and expand the initiatives launched during the crisis of 2022-2023 (maintaining internal dynamics, making investments to facilitate the implementation of sobriety, developing the combination of energy sobriety and electrical flexibility, etc.).

In addition, the Chaque Geste Compte (Every Gesture Counts) communication campaign, dedicated to energy savings, could be continued and broadcast systematically each year at the start of winter, using a multi-channel approach to reach as many people as possible. Although this campaign is aimed at households, it can also be used to support and encourage the implementation of energy-saving measures by professionals (particularly in the tertiary sector). Energy efficiency is also now a theme for action by the France public serviceRénov' . France advice centres Rénov' can now advise and encourage households to take energy-saving measures in their homes.

Finally, boosting energy efficiency also involves dedicated programmes, financed by energy saving certificates, to support, structure and organise initiatives and , which cover a wide range of activities (tertiary sector, agriculture, industry, tourism, households via housing, etc.).

For the record, these new low-energy habits helped to reduce gas and electricity consumption by 12% in 2022-2023 (from 1st August 2022 to 31 July 2023, compared with the reference year 2018-2019, climate-adjusted data), a reduction that was maintained at -12% in 2023-24 (from 1st August 2023 to 8 July 2024, compared with the reference year 2018-19, climate-adjusted data) .[36]

[36] Updated data available on the DGEC website: https://www.ecologie.gouv.fr/politiques-publiques/suivi-hebdomadaire-consommation-energetique-france

ACTION CONSO.2

REDUCING ENERGY CONSUMPTION IN ALL SECTORS

Various levers will be used to ensure that these objectives are met:

→ Continuing the drive to reduce energy consumption (see above)

→ Reducing energy consumption in the residential and tertiary sectors, in particular by renovating buildings to make them more energy-efficient.

For the residential sector, a significant acceleration in the rate of major renovation is planned. The government has set a target of around 600,000 individual and collective homes undergoing major renovation, in one or more stages, every year on average by 2030 for private and social housing, while maintaining a strong focus on decarbonising heating systems. This trajectory, which is highly ambitious given current trends (500,000 homes were no longer in "sieve" status by 2023, but the number of homes heated with gas/oil has remained stable) but is necessary if we are to get closer to our European targets, could be adapted in line with the dynamics observed in the markethousing energy renovation.

In the case of private housing, this momentum is being driven by increased financial incentives for major renovations under the MaPrimeRénov' (MPR) scheme, the CEE system, local grants, tools for financing the remainder of the cost (Eco-PTZ, prêt avance rénovation, etc.), tax incentives (in particular reduced-rate VAT of up to 5.5% for energy renovation work) and the France public serviceRénov' , which is being rolled out across the country. Some of these renovations will also be triggered by the energy decency requirements for letting and selling (mandatory energy audits), some of which came into force in 2023 and have been significantly stepped up in 2025. These regulatory measures have been accompanied by the introduction of incentives, such as the exit bonus for MaPrimeRenov. Lastly, the market has taken on board the notion of energy sieves, since the sale prices of passive houses are between 10% and 15% lower than the average national house sale price.

Decarbonising heating is also often accompanied by a reduction in energy consumption, since heat pumps, one of the main decarbonised alternatives to fossil fuels for heating, are highly energy-efficient. The plan is to phase out oil-fired boilers in the commercial sector by 2030, and to reduce the number of such boilers in homes by a factor of four (-75%), i.e. around 300,000 homes a year switching from oil-fired heating. Strong incentive mechanisms are also planned for the gradual replacement of gas boilers (with a target of 20% to 25% by 2030, i.e. around 350,000 homes per year switching from gas), in particular with the abolition of support for the installation of gas heating systems from [1]January 2025, as provided for in the directive on the performance revised energy of buildings (2024/1275/EU), and the maintenance of increased support for the decarbonisation of heating.

For the tertiary sector, the implementation of the 2019 tertiary eco-energy decree, which aims to reduce the final energy consumption of tertiary buildings by 40% by 2030 and by 60% by 2050 (or to achieve a maximum energy consumption threshold depending on the type of tertiary building in question), will speed up the reduction in consumption in the sector for buildings or groups of buildings over 1,000 m^2.

The tertiary sector eco-energy scheme will be supplemented by additional measures aimed at giving priority to renovating the most energy-intensive tertiary sector buildings, regardless of their surface area, in application of the revised directive on the energy performance of buildings (2024/1275/EU).

→ Lower energy consumption in the transport sector

In the transport sector, the reduction in energy consumption will be achieved first and foremost by controlling the demand for transport, whether for passengers or for goods, and by switching to less

energy-intensive modes of transport (cycling, walking, public transport, rail, waterways, etc.) wherever possible, in accordance with the attached strategy for the development of clean mobility.

Reducing fuel consumption will also require the development of lighter vehicles that consume less materials in their manufacture and are more fuel-efficient in use. This reduction in the weight of vehicles will be supported by the strengthening of vehicle taxation on the heaviest private vehicles (mass malus, introduced on 1 January 2022) and the strengthening of the conditions of eligibility for subsidies for the purchase of low-polluting vehicles (introduction of a maximum weight limit from 1 January 2023, introduction of a minimum environmental score from 15 December 2023).

- Electrification will improve the energy efficiency of vehicles. The momentum that is already underway needs to be stepped up, in line with the European Union's target of phasing out the sale of new light combustion vehicles by 2035. This development of the electric vehicle will be supported by (i) a strengthening of the automotive tax system applying to the vehicles that emit the most greenhouse gases (COmalus $_2$ and annual tax on COemissions $_2$ from vehicles used for economic purposes), (ii) the implementation and strengthening of the obligation to green vehicle fleets, (iii) a system of subsidies for the purchase of low-polluting vehicles, regularly revised to support this transition, with targeting of specific the most modest households (particularly marked in 2024 by the success of the social leasing scheme) and (iv) an ambitious roll-out of recharging stations throughout France. From 2025, the CEE scheme will support the purchase/leasing of new electric vehicles (passenger cars, light commercial vehicles, heavy goods vehicles, buses and coaches, motorised quadricycles) and the electric retrofitting of combustion engine vehicles.

Finally, as far as road freight transport is concerned, the levers that can be mobilised to encourage reductions in energy consumption are based in particular on controlling freight demand and optimising logistics flows, with the development of short circuits, the supervision of fast and/or free delivery (making shippers responsible, informing consumers, limiting free delivery and returns, etc.) or the development of just-in-time industrial processes. Logistical flows will also be pooled and consolidated to optimise loading rates and the distances covered by heavy goods vehicles. Modal shift will also have an important role to play in reducing the energy consumption of overland freight transport: modesmassified (rail, river) consume less energy. The National Rail Freight Development Strategy and the National River Freight Development Strategy (currently under construction) will help to develop these modes of transport.

→ Lower energy consumption in the industrial sector

In the industrial sector, the detailed identification of areas for improvement in energy consumption and greenhouse gas emissions by sector within the strategic sector committees, which began in 2020, followed by in-depth work on the 50 industrial sites to be decarbonised as a priority, will enable the State to focus its action on supporting French industry in an integrated approach, This combines reducing emissions at source through energy efficiency and waste heat recovery, decarbonising processes and, as a last resort, managing the emissions that are hardest to cut by carbon capture, in the absence of other technically and economically viable decarbonisation solutions. With regard to energy efficiency, the CEE scheme will continue to support energy-saving operations in the industrial sector. Carrying out energy audits or setting up energy management systems, generalised to all energy-intensive companies, will enable them to identify appropriate ways of reducing consumption.

ACTION CONSO.3

PERPETUATING THE ENERGY SAVINGS CERTIFICATE SCHEME

The CEE scheme is based on an obligation for energy suppliers (known as obligated parties) to carry out or initiate energy-saving operations based on their volume of energy sold[37] . This obligation is set for a period of four years: currently, the fifth period, which began in 2022, runs until 2025. Energy-saving measures can be implemented in all sectors of the economy: residential buildings, tertiary buildings, industry, transport, agriculture and networks. The scheme involves individuals, businesses, local authorities, social landlords, the ANAH, etc. Eligible players (local authorities, ANAH, etc.) sell the CEE they generate directly on the market. The other beneficiaries receive financial incentives from the obligated parties for the energy-saving operations they carry out. Each incentivised energy-saving action gives entitlement to energy-saving certificates, which are measured in discounted cumulative kWh over the lifetime of the operation (known as "kWhcumulative") to take account of the lifespan of the equipment in particular. Energy suppliers ultimately finance these energy-saving operations by passing on the associated costs to consumers in their bills. The level of the obligation therefore has an impact on energy prices.

France introduced this system in 2006. Since 2014, it has been used to meet the annual energy savings obligations imposed on each Member State by the Energy Efficiency Directive, which recognises the Member States' option to implement this type of instrument. Article 8 of the revised Energy Efficiency Directive (EED - 2023/1791/EU) provides for a stepwise increase in the level of the energy saving obligation for the period 2021-2030 at the following rate (as a % of France's final energy consumption over the reference period 2016-2018):

→ 2021-2023: 0.8% or 13.5 TWh/year ;

→ 2024-2025: 1.3% or 22 TWh/year ;

→ 2026-2027: 1.5% or 25 TWh/year ;

→ 2028-2030: 1.9% or 32 TWh/year.

The EWC scheme also contributes to achieving the target of reducing energy consumption by 2030 set out in the EED, in conjunction with other regulations put in place to reduce energy consumption (such as the Eco-design regulations, which govern the energy performance of a large number of products placed on the European market). For France, this target, which has been raised as part of the European Fit for 55 legislative package, corresponds to a 28.6% reduction in final energy consumption in 2030 compared with 2012.

There are plans to make the CEE scheme permanent by extending it into a 6th period. The CEE scheme applies to all sectors, including the residential, tertiary, transport and industrial sectors, in order to achieve energy savings. The scheme will also be strengthened and made more effective through :

- strengthening of steering committees, in particular to monitor operations that will benefit from CEE ;
- strengthening the fight against fraud. The staff of the National Fraud Prevention Unit (PNCEE) will be increased. Legislative changes will be proposed, in particular to make it easier to "name and shame" players who have participated in fraudulent operations, and to enable the PNCEE to monitor and sanction operations before applications are submitted (in addition to simply rejecting them);
- better evaluation of the scheme: it is planned to increase the resources dedicated to evaluation. In addition, studies on the energy savings generated by operations under real conditions, and their potential, should be developed. The call for EWC programmes

37 Further information: CEE 2023 annual report available on the Ministry of Energy website

launched on 16 September 2024[38] also provides for the evaluation of the scheme in its Axis 1;

The levels of obligations under the CEE scheme will be set between the minimum and maximum levels shown below:

(IN TWhc OF OBLIGATIONANNUAL)	5TH EEC PERIOD				6TH EEC PERIOD					7TH PERIOD
Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031 à 2035
Minimum level	625	825	825	825	825	825	825	825	825	825
Maximum level	625	825	825	825	1750	1750	1750	1750	1750	2250

The minimum level corresponds to a relatively less central role for the CEE scheme in achieving the 2030 energy consumption reduction targets, and requires greater mobilisation of other levers to achieve the level of reduction inconsumptionexpected energy . This minimum level does, however, make it possible to meet the annual energy savings requirements imposed by the Energy Efficiency Directive, albeit with a virtually non-existent margin.

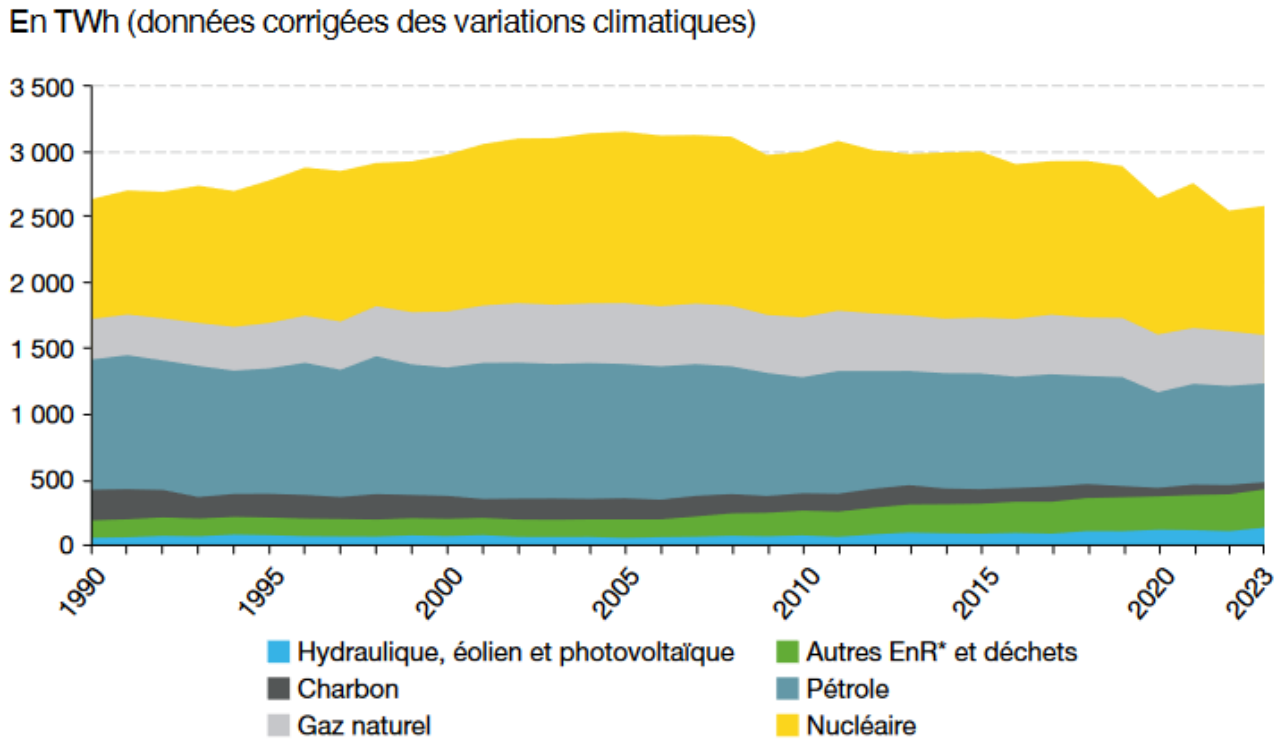
[38] Specifications for the 2024 call for EWC programmes:
https://www.ecologie.gouv.fr/sites/default/files/documents/CahierCharges_AAP-CEE-2024.pdf

2.2. Reducing fossil fuel consumption

2.2.1. Historical trend in primary energy consumption and reduction target

Current consumption :

Over the last decade, the energy mix has changed slightly, with renewable energies growing at the expense of fossil fuels, albeit at a slow pace compared with the overall energy mix. Natural gas consumption is relatively stable.



** EnR = énergies renouvelables.*
Champ : jusqu'à l'année 2010 incluse, le périmètre géographique est la France métropolitaine.
À partir de 2011, il inclut en outre les cinq DROM.
***Source :** SDES, Bilan énergétique de la France*

Figure9 . Primary consumption by form of energy - Source: SDES

Reduction targets :

The figure below shows primary fossil energy consumption in the past and projected in the provisional scenario of the French Energy-Climate Strategy ("AMS run 2").

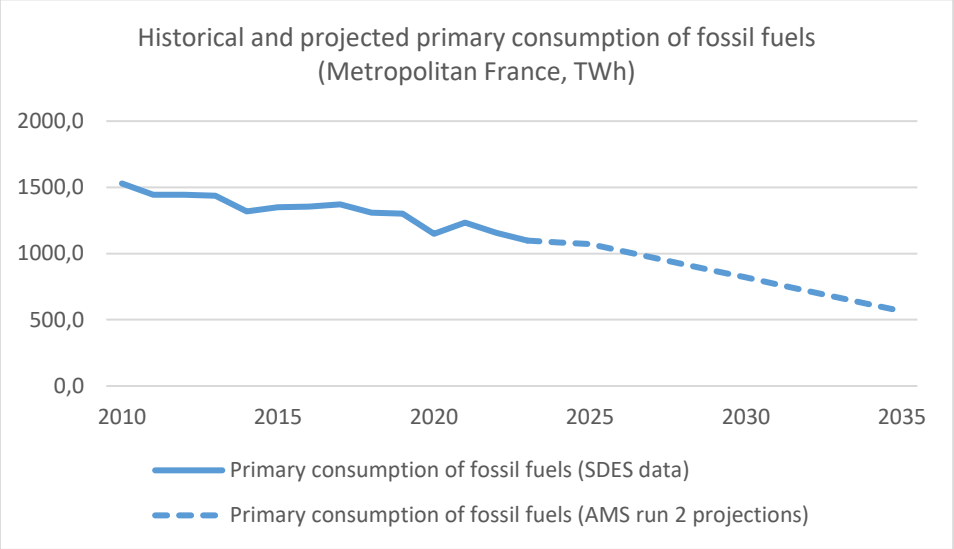


Figure10 . Primary consumption of fossil fuels for energy and non-energy uses - Past (2010-2022) and projected (2023-2035) trends

Primary consumption of fossil fuels for energy and non-energy uses (TWh), Metropolitan France perimeter	**2023**	**2030**	**2035**
Primary coal consumption (all products)	49.2	23.4	15.0
Primary consumption of natural gas	340.6	296.9	214.0
Primary oil consumption (Total crude and refined)	708.3	499.0	336.3
Primary consumption of fossil fuels (SDES data)	1098.1	819.4	565.4

As a result, primary consumption of fossil fuels will fall by around half between 2010 and 2035 in the provisional scenario of the French Energy-Climate Strategy.

The following figure shows this consumption, **excluding non-energy uses**:

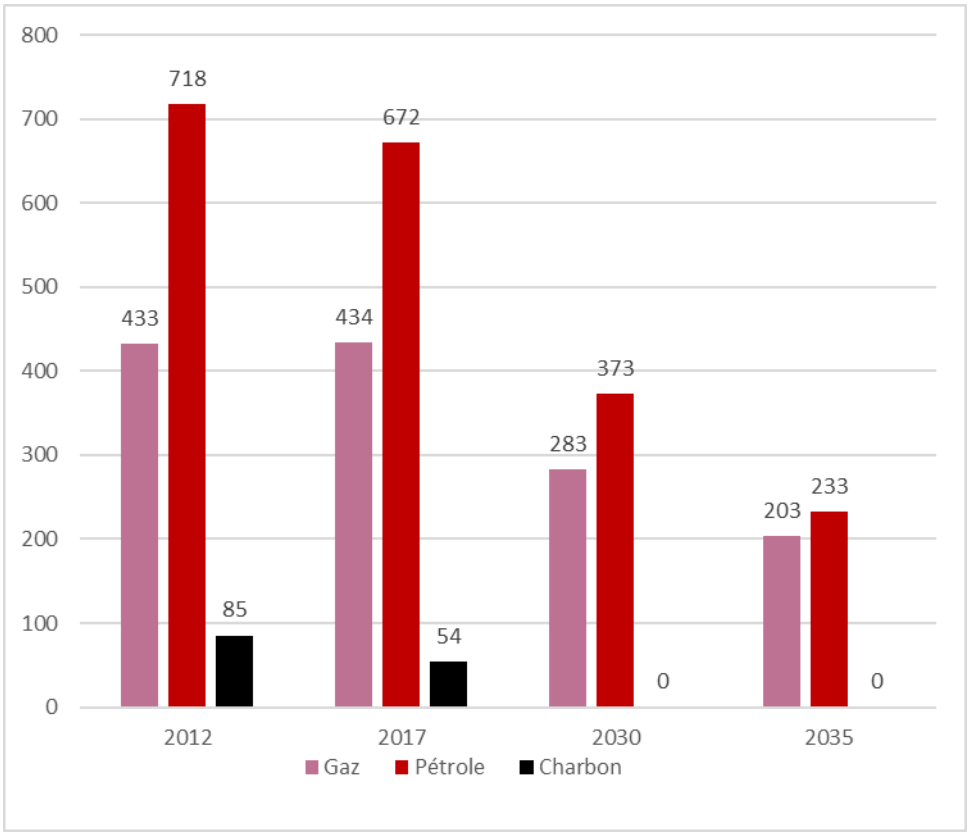


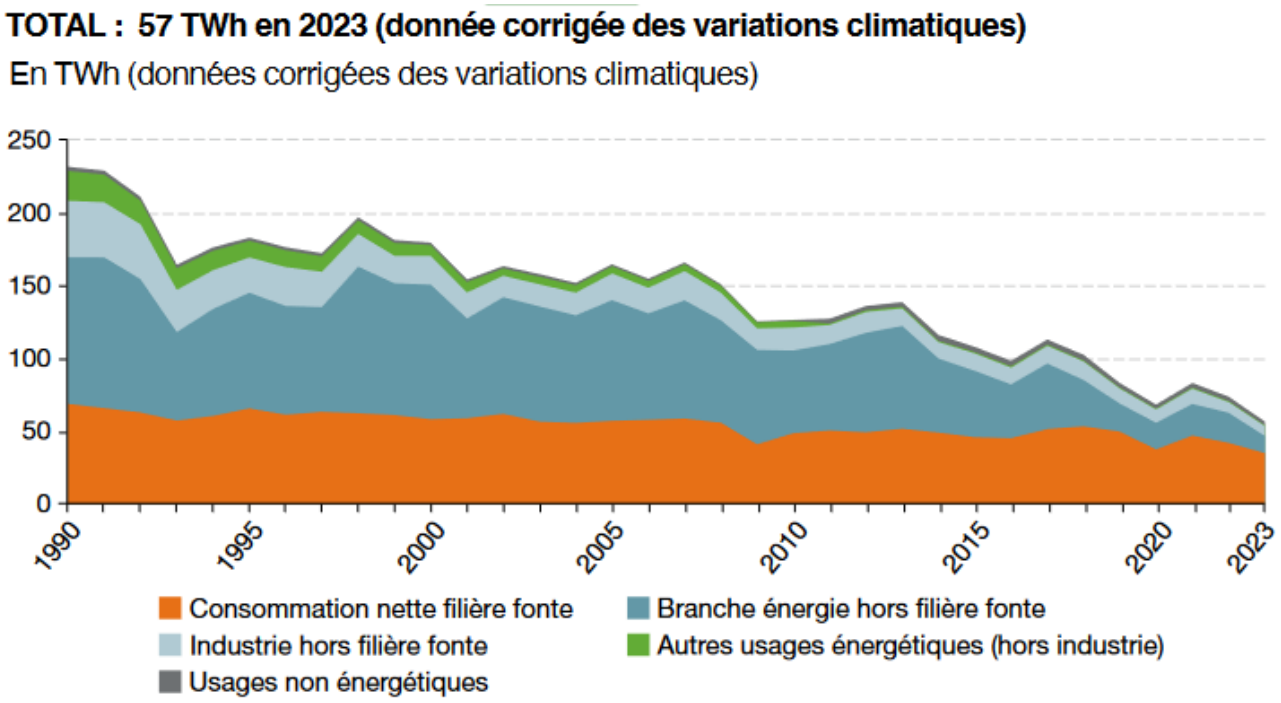
Figure11 . Change in primary fossil fuel consumption for energy uses compared with 2012 (DGEC modelling, excluding non-energy uses and the cast iron industry)

Achieving these targets will require a large number of measures and guidelines in all sectors of activity, which will be set out in detail in the **National Low Carbon Strategy**, France's roadmap for reducing its greenhouse gas emissions and achieving carbon neutrality by 2050.

2.2.2. Reducing primary coal consumption

Current consumption :

Primary coal consumption in France will fall sharply again in 2022 (-10%), and even further in 2023 (-23%) to 57 TWh, its lowest level ever. Supply and operating difficulties, as well as an unfavourable economic climate, with falling demand for steel and inflation in particular, have affected the cast iron industry, leading to the shutdown of some blast furnaces in particular. Consumption for the production of electricity and heat has fallen sharply as a result of improved output from the nuclear and renewable energy sectors. The main consuming sectors in 2023 will continue to be the cast iron industry (62%), electricity and heat production (21%) and manufacturing industry excluding blast furnaces (12%). Primary coal consumption is on a downward trend, with other forms of energy gradually replacing it in most sectors.



Avertissement : un opérateur a révisé fortement à la hausse ses productions de gaz dérivés, entraînant une rupture de série entre 2016 et 2017. Par ailleurs, à partir de 2017, les pertes, auparavant incluses dans l'écart statistique, sont intégrées à la consommation de la filière fonte.
Note : la somme des consommations des différentes branches représentées sur le graphique peut différer légèrement de la consommation primaire totale, cette dernière intégrant un écart statistique.
Champ : jusqu'à l'année 2010 incluse, le périmètre géographique est la France métropolitaine.
À partir de 2011, il inclut en outre les cinq DROM.
***Source :** SDES, Bilan énergétique de la France*

Figure12 . Primary coal consumption by sector - Source: SDES

Reduction targets :

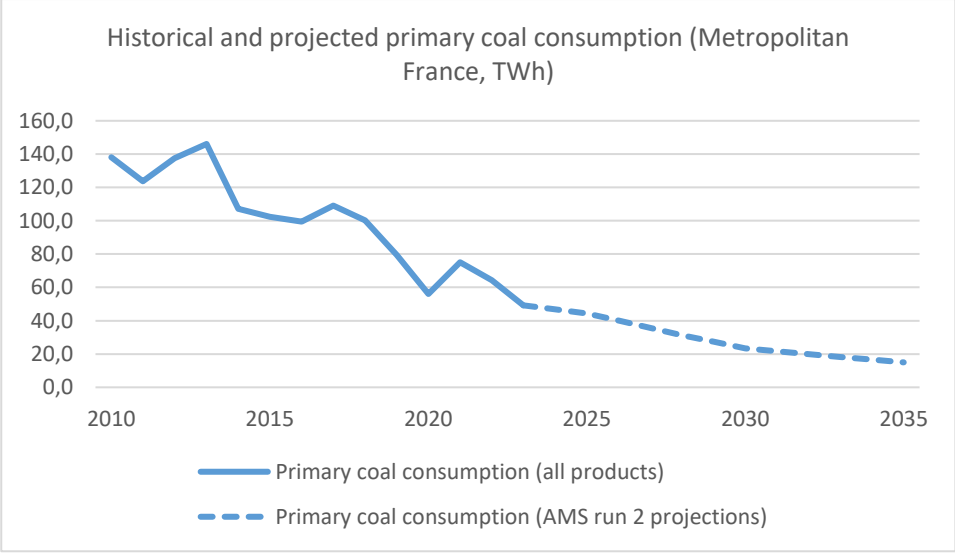


Figure13 . Historical and projected primary coal consumption

In the provisional scenario of the French Energy-Climate Strategy, primary coal consumption falls from 49 TWh in 2023 to 23 TWh in 2030 and 15 TWh in 2035, mainly as a result of decarbonisation

measures in industry and the heating of buildings. In 2030 and 2035, residual coal consumption will be solely for non-energy purposes and in the smelting industry (mainly in the steel industry).

ACTION CONSO.4

REDUCING COAL CONSUMPTION

In the energy sector :

- Stopping coal-fired electricity generation by 2027.

In the steel industry :

- Replace several blast furnaces with direct iron ore reduction plants using hydrogen or natural gas, coupled with electric arc furnaces, in order to reduce coal inputs into the smelting process.
- Supporting the use of hydrogen for direct reduction, through investment or operating aid, in particular as part of the Major Project of Common European Interest (PIIEC) for hydrogen and the call for tenders to support the production of carbon-free electrolytic hydrogen.

In industry excluding the steel industry :

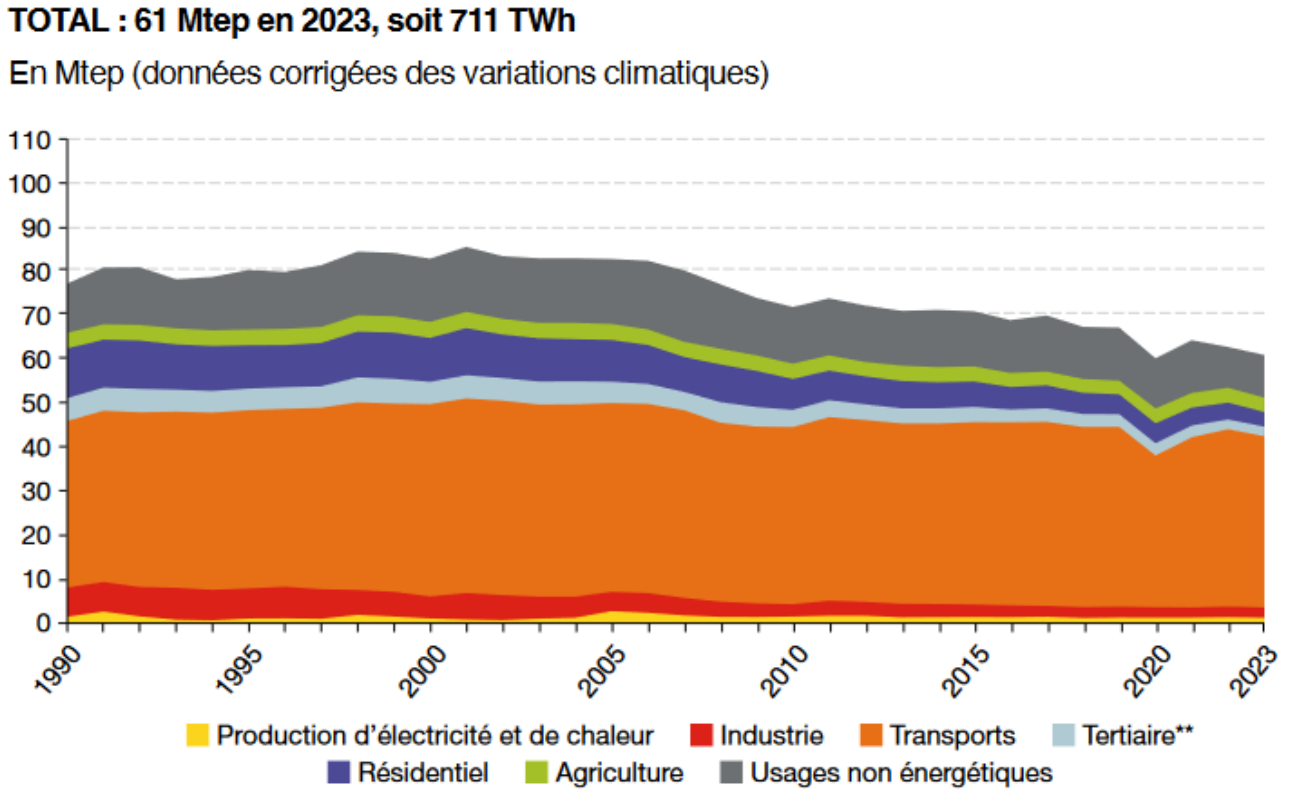
- Continue to provide certain national support schemes, the Heat Fund, energy saving certificates and European funds, in particular the Innovation Fund, in order to supplement France 2030 funding, to provide the necessary complement to trigger investment, while preventing windfall effects, and to reduce greenhouse gas emissions and coal consumption.

2.2.3. Reducing primary consumption of petroleum products

Current consumption :

In 2023, total consumption of refined petroleum products (excluding biofuels) will be 61 Mtoe on a climate-adjusted basis and 59 Mtoe in real terms. Compared with 2022, consumption across all sectors will fall by 2.9%. Only non-energy uses will increase in 2023. Total consumption has been declining steadily since the mid-2000s (by an average of 1.7% per year between 2005 and 2023), with industry, the residential sector and the tertiary sector the main contributors. The transport sector will account for almost two-thirds of refined product consumption in 2023, compared with half in 1990. Consumption of petroleum products by the transport sector will also fall in 2023 (-2.9%), following two years of increases due to the economic recovery and the end of traffic restrictions

linked to the health crisis, and will be below its 2019 level of (-4.8%)



** Hors biocarburants et soutes maritimes et aériennes internationales.*
*** Les consommations des armées sont comptabilisées ici au sein du secteur tertiaire.*
Champ : jusqu'à l'année 2010 incluse, le périmètre géographique est la France métropolitaine.
À partir de 2011, il inclut en outre les cinq DROM.
***Source :** SDES, Bilan énergétique de la France*

Figure14 . Total consumption of refined petroleum products by sector*

Reduction targets :

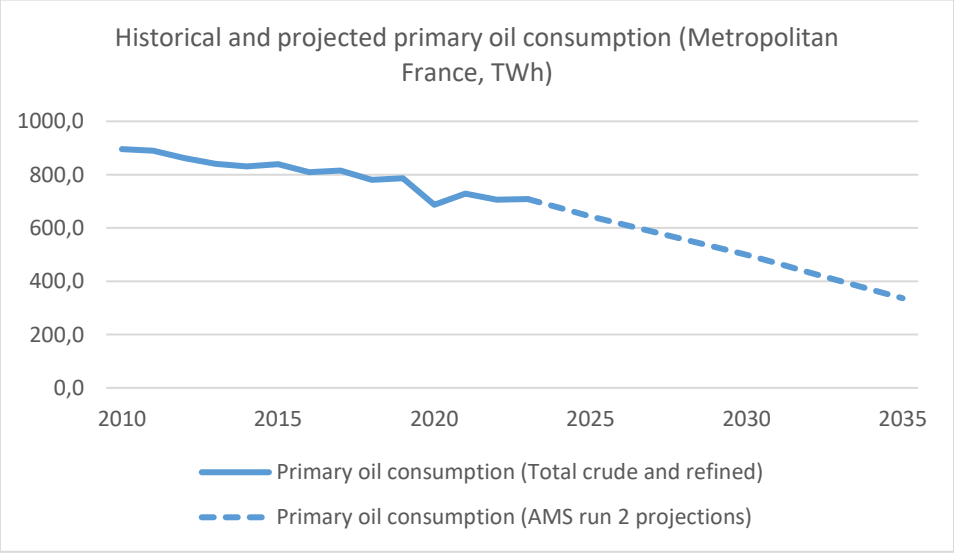


Figure15 . Historical and projected primary oil consumption

In the provisional scenario of the French Energy-Climate Strategy, primary oil consumption falls from 708 TWh in 2023 to 500 TWh in 2030 and 336 TWh in 2035, mainly as a result of measures to electrify vehicles and heating systems. The end of oil-fired electricity generation is scheduled for 2030. The long-term objective, announced by the French President, is to phase out oil-based energy consumption by 2045.

ACTION CONSO.5

REDUCING OIL CONSUMPTION

All the sectoral measures to support this objective are set out in the national low-carbon strategy.

In the energy sector :

- Stop producing electricity from fuel oil by 2030.

In residential and commercial buildings:

- Accelerate the replacement of oil-fired boilers, which have been banned since July 2022, using MaPrimeRénov', CEE and local grants to subsidise the purchase of low-carbon heating systems (including heat pumps). The government has set a target of replacing 75% of oil-fired boilers in the residential sector by 2030 with a low-carbon heating system, representing around 300,000 homes a year. The development of the "go-to" approach, via the France public service Rénov' for private housing, for example, could help to support the replacement drive.
- Massively develop low-carbon heating systems, in particular through public support for the development of the French heat pump industry, with the aim of producing and installing one million heat pumps a year by the end of 2027.
- Eliminate the use of fuel oil in the commercial sector by 2030, except in situations where the transition to a low-carbon system is technically or economically very complex.
- Continue to abolish the financial incentives for oil-fired boilers that are still in place in 2025, in accordance with the revised directive on the energy performance of buildings, some of which have already been abolished on 1 January 2025 (see action CHALEUR.1).

In transport :

- Deploy sobriety measures (e.g. for passengers, by acting on regional planning and on habits and perceptions, and for goods, by mobilising the players in the sector to reduce demand) and modal shift (towards more energy-efficient modes) to reduce oil consumption in the transport sector. The attached Clean Mobility Development Strategy sets out these measures in detail.
- Accelerate the electrification of combustion-powered vehicles, in line with the European target of ending the sale of new light combustion-powered vehicles by 2035. The development of electric vehicles will be supported by a bonus-malus system that will be regularly revised to support the transition for all French people, and by the ambitious deployment of charging points throughout France. From 2025 onwards,sheets will standardised CEE operation also encourage the acquisition of new electric passenger cars, vans and motorised quadricycles.
- Continue to support the deployment of electric heavy goods and passenger vehicles. In recent years, the public authorities have provided funding for the electrification of heavy goods vehicles (€60m in 2023 from budget appropriations, €130m in 2024 via the CEE E-TRANS

programme). In order to continue supporting the sector, from 1 January 2025, the purchase or lease of a new electric heavy vehicle (HGV, bus, coach) or electric retrofit operations will benefit from energy saving lump sums thanks to the creation or updating of dedicated CEE standardised operation sheets, which will replace the previous calls for projects. This decarbonisation objective will also have to be accompanied by the deployment of electric charging points at depots, destinations and on the road, which are essential for the introduction of heavy goods vehicles. The attached Clean Mobility Development Strategy details these measures.

In agriculture and forestry :

- **Gradually phasing out the use of fossil fuels for farm machinery and introducing less energy-intensive cultivation methods.** The replacement and renewal of tractors, supported by public aid and the desire to eventually reduce the use of agricultural RNG, will gradually be replaced by biofuels and electric or even hydrogen engines, depending on use. Structures that enable farm machinery to be pooled will enable investment in low-carbon equipment. In addition, farming systems will evolve towards agro-ecology with less energy-intensive cultivation techniques.

- Continuing to provide financial support, such as that provided by the Heat Fund and the energy saving certificate scheme, to facilitate **the thermal renovation and construction of energy-efficient buildings** that **use low-carbon energy sources, in particular geothermal energy and waste heat.**

In industry :

- Strengthen incentives to improve energy efficiency (CEE, other public support in line with existing support).
- Mobilising the circular economy as a lever for decarbonisation to reduce demand for primary production and improve its efficiency.
- Ensuring that the price of low-carbon electricity is competitive with fossil fuel alternatives
- Continue to provide certain national support schemes, such as the heat fund, energy saving certificates and European funds, in particular the innovation fund, in order to supplement France 2030 funding, to provide the necessary complement to trigger investment, while preventing windfall effects, and to reduce greenhouse gas emissions and oil consumption.

In refining :

- Decarbonising refinery sites by optimising their energy efficiency and electrifying them initially, alongside the use of low-carbon hydrogen for their needs and carbon capture and storage technologies, which will be deployed in the medium term.
- Anticipate refinery closures with a view to ensuring continuity of supply for the strategic value chains that depend on them - organic chemistry in particular - as well as a just transition to facilitate the retraining of employees and offer alternatives to the regions concerned (e.g. conversion to bio-refineries, new industrial sites, etc.).

2.2.4. Reducing primary consumption of natural gas

Current consumption :

Climate-adjusted gas consumption will reach an all-time low in 2023, at 417 TWh HCV (386 TWh in real terms), down 11.4% compared with 2022. The fall affects all sectors, but is particularly marked in the electricity and heat production sector (-28.1%). This is due to less intensive use of gas-fired power stations in 2023. For the other sectors, the fall between 2022 and 2023 is 6.4% in the residential and tertiary sectors and 7.2% in industry. The continuing rise in retail prices explains this fall, together with changes in user habits

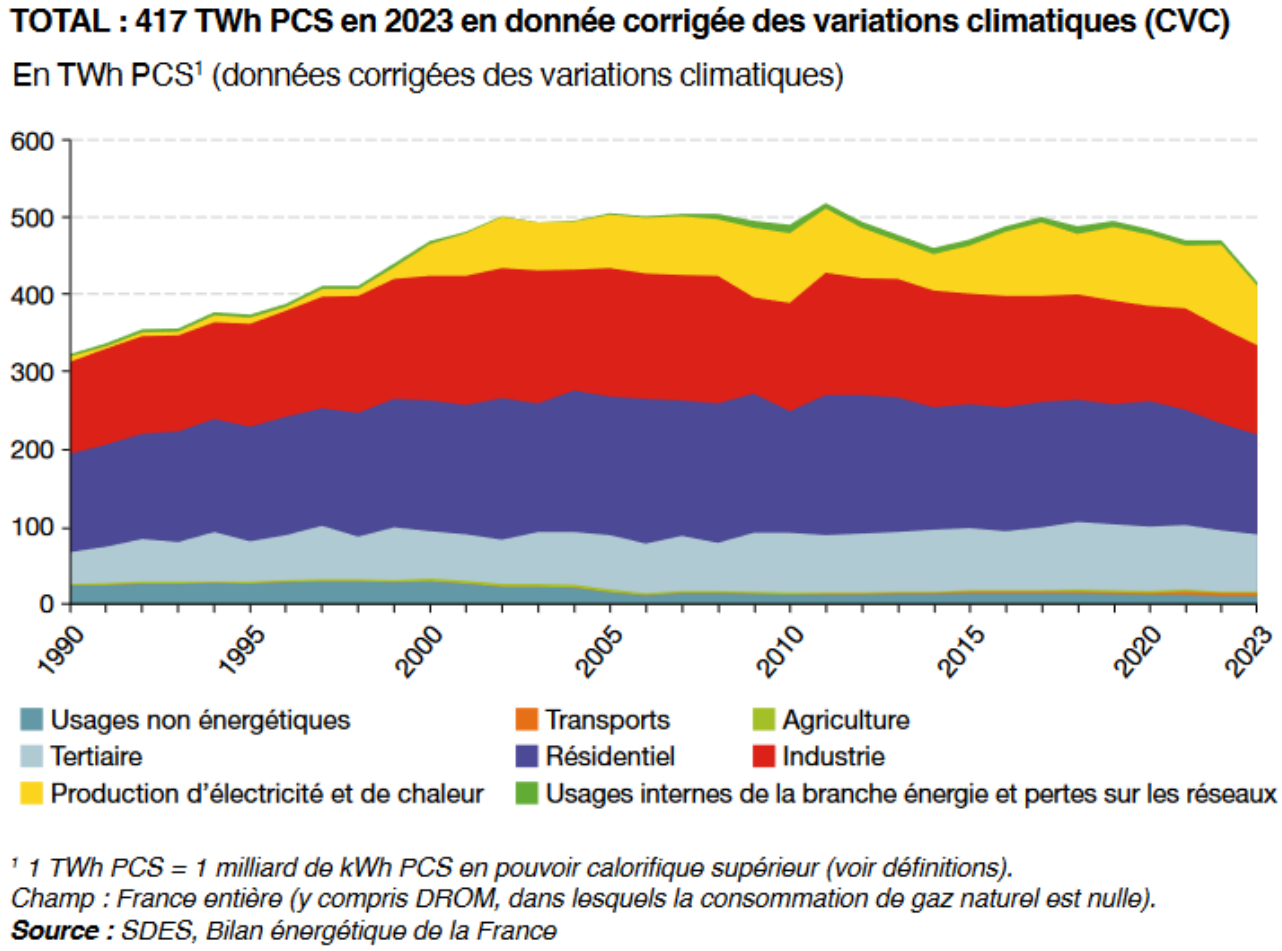


Figure16 . Total natural gas consumption (excluding losses) by sector

Reduction targets :

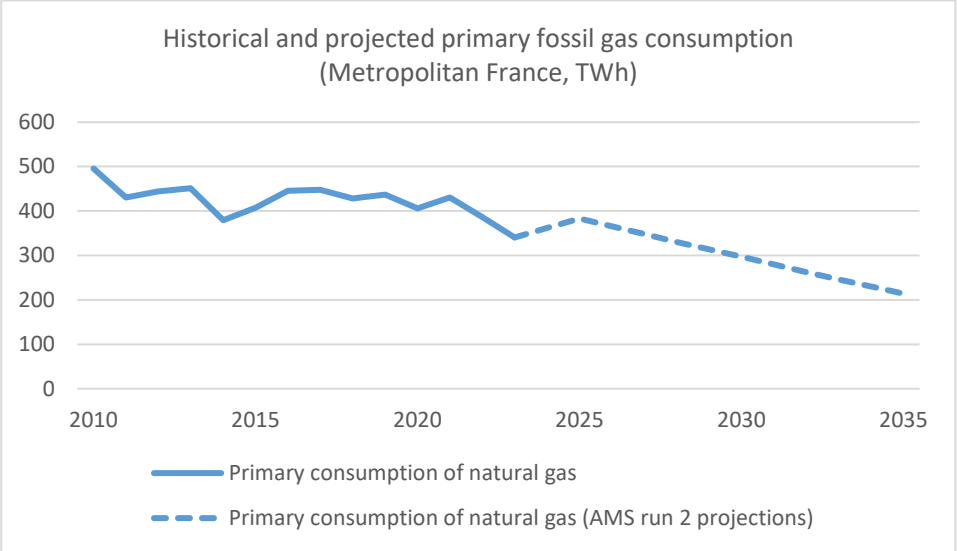


Figure17 . Historical and projected primary consumption of natural gas

In the provisional scenario of the French Energy-Climate Strategy, primary fossil gas consumption falls from 341 TWh in 2023 to 297 TWh in 2030 and 214 TWh in 2035, as a result of measures to decarbonise industry, renovate buildings and replace gas boilers with low-carbon equipment, as well as substitution by low-carbon gas.

ACTION CONSO.6

REDUCING GAS CONSUMPTION

All the sectoral measures to support this objective are set out in the national low-carbon strategy.

In residential and commercial buildings:

- Renovate the stock of single-family homes and multi-family dwellings to improve their energy efficiency. The government has set itself the target of renovating an average of 400,000 single-family homes and 200,000 multi-family homes per year by 2030 in the private and social housing sectors.
- Continue to abolish the financial incentives for gas boilers that are still in place in 2025, in accordance with the revised Energy Performance of Buildings Directive, some of which have already been abolished on 1st January 2025 (see action CHALEUR.1).
- Gradually replace gas-fired boilers (by around 20% to 25% in 2030 compared with 2021 in the residential sector, and by 15% to 20% in the commercial sector), both as part of major renovations and as part of step-by-step renovations. These renovations are supported by the schemesMaPrimeRénov' and CEE , which no longer subsidise the installation of gas-fired heating systems.
- Continuing to implement the 2019 tertiary sector eco-energy decree, which aims to reduce the final energy consumption of tertiary sector buildings by 40% by 2030 and 60% by 2050, will accelerate the reduction in gas consumption in the tertiary sector.

In industry :

- Strengthen incentives to improve energy efficiency (CEE, other public support in line with existing support).
- Mobilising the circular economy as a lever for decarbonisation to reduce demand for primary production and improve its efficiency.
- Ensuring that the price of low-carbon electricity is competitive with fossil fuels.
- Continue to provide certain national support schemes, the Heat Fund, energy saving certificates and European funds, in particular the Innovation Fund, in order to supplement France 2030 funding, to provide the necessary complement to trigger investment, while preventing windfall effects, and to reduce greenhouse gas emissions and gas consumption.

In heat production :

- Support the use of low-carbon thermal energies, in particular renewable and recovered energies for heat production (in particular through the Fonds Chaleur for the latter), so as to completely decarbonise centralised heat production by 2050.

In energy production :

- Supporting the deployment of renewable gases (see section 3.4.2)

2.2.5. Achieving our electrification targets

Over the last ten years or so, national electricity consumption has fallen overall, thanks to the results of the energy-saving plan introduced in 2022. However, this fall has been significantly amplified by the health crisis in 2020-2021 and then by the energy crisis linked to the war in Ukraine from 2022 onwards. This fall in consumption can be explained by the rise in energy prices (partly as a result of the crises) and by consumers' growing awareness of the need for energy efficiency, who are adapting their consumption patterns accordingly, leading to a change in usage. Compared valueswith historical average (2014-2019), consumption in 2023 will be down by 6.9%. The decarbonisation strategy proposed in this multi-annual energy programme will lead to a clear break with this historical trend, because while final energy consumption should indeed fall significantly as a result of energy efficiency and sobriety efforts, electricity will play an increasingly important role as a result of the transfer of uses from fossil fuels to electricity, and of France's ambition to re-industrialise. The magnitude of this increase in electricity consumption is described in chapter 3.5; it is the result of the trajectory constructed and planned in the National Low Carbon Strategy, which is the one that our energy system must follow in order to achieve our climate objectives, and which implies a reduction in energy consumption and, at the same time, a greater pace of electrification, resulting in an increase in electricity consumption as a share of the mix but also in absolute terms. [OB]

This trajectory is a target that the public authorities have set themselves to achieve the first stage in decarbonising our economy in the medium term.

Having this target trajectory at our disposal enables us to meet a first objective: **that of adequately sizing our generating fleet** to sufficiently develop the supply of decarbonised electricity in response to growing needs, in order to ensure our security of supply. Anticipating the construction of generation facilities is essential to ensure the decarbonisation of consumption.

Concerns about a possible lag in demand growth are emerging in the public debate, in a context where electricity consumption is stagnating and decarbonised production in France and Europe is showing strong growth.

Having this target consumption trajectory should also make it possible to monitor the actual decarbonisation dynamics of the various sectors and their aggregate contribution to achieving our climate objectives, and to adjust support policies where necessary. The multi-annual energy plan contains numerous actions and measures aimed at supporting the transfer of energy consumption from fossil fuels to electricity, in all sectors (residential, tertiary, industry, mobility, etc.). In order to ensure a consolidated and coherent vision, **the State will develop specific monitoring and steering of this aspect throughout the first period of the 2025-2030 EPP.**

In addition, the electrification of uses will have to be ensured by promoting flexible electrification solutions, with the aim of optimising security of supply and reducing greenhouse gas emissions at the best cost for the electricity system.

The reaction of electricity consumption and generation facilities to price signals will also help to limit the scale and number of negative price episodes[39] . While negative prices on the spot electricity market are due to the specific nature of electricity, which must be in constant balance, some occurrences may reflect sub-optimal use of the electricity system, in terms of both generation and consumption. It therefore seems necessary to re-examine the appropriateness of the rules that enable generation and consumption to react to market signals, in order to avoid economic de-optimisation of the electricity system.

ACTION CONSO. 7

ENSURING WE MEET OUR ELECTRIFICATION TARGETS

Draw up an "electrification scorecard".
This dashboard, which could be built using the databases available to the various players in the electricity system (ministries, network operators, electric mobility players, observatories, etc.), will be used to monitor past and foreseeable trends in electricity consumption, in relation to the trajectory defined by the programming documents. In particular, it will be used to prepare the adjustments to be made to the trajectories when the SNBC 3 and PPE 3 are revised between now and 2030.

Develop flexibilities as an economic opportunity for the benefit of consumers and the optimisation of the electricity system and its security of supply through APPRO.ELEC Actions 4 and 5 (see section 4.3).

[39] The frequency of negative price episodes increased sharply between 2018 and 2024. In 2018, prices were negative for 0.1% of the year's hours, compared with 5.4% of hours in the first half of 2024 (source: CRE, https://www.cre.fr/fileadmin/Documents/Rapports_et_etudes/2024/241126_Presentation_prix_negatifs.pdf , p.3).

Accelerating the electrification of the industrial sector

- Support a *Clean Industrial Deal* that includes an industrial and commercial policy to preserve stable European production in order to limit carbon leakage;
- At national level, continue to provide aid for the decarbonisation and electrification of industry (DECARB-IND) and introduce new support schemes to finance the additional operating costs associated with electrification (AO GPID);
- At national level, maintain a competitive electricity price for businesses over the long term, particularly businesses electro-intensive exposed to international competition (see section 6.4.4);
- At the European level, support a strengthening of support for the electrification of industry within the framework of the SEQE-EU Innovation Fund, in particular through the creation of a "decarbonisation bank";
- Monitor the impact of support for decarbonisation of industry on electricity consumption.

Accelerating the electrification of the residential and tertiary sectors

- Implement the heat pump plan to produce 1 million heat pumps a year by 2027 and strengthen the industry (see section 3.1.2.).

Accelerate the electrification of mobility (see carbon intensity sections of the SDMP in Appendix 1), in particular :

- Accelerate the adoption of electric vehicles by stepping up obligations to make company fleets greener, and by maintaining appropriate levels of support for the purchase or long-term leasing of electric vehicles, particularly for low-income households;
- Implement the master plan for the deployment of IRVEs along the national road network ;
- Deploying IRVEs on a roaming basis.

Promoting electrification at European level

- Encourage the European Commission to launch a European electrification strategy to identify best practice and create appropriate regulatory incentives at European level;
- Promote at European level the financing of the electrification of uses, in particular for industry, under conditions that encourage electrification solutions capable of flexibility.
- Promote at European level the introduction of an obligation to purchase electric vehicles when renewing the fleets of large companies.

Raising awareness among the general public of the benefits of the electrification of uses to decarbonise final energy consumption

•3. Energy supply / Developing the use of renewable and recovered energies

PEP 3 THEREFORE SETS MORE AMBITIOUS TARGETS THAN THE FOR DECARBONISED ENERGY PRODUCTION PREVIOUS PEP:

→ Accelerating the shift away from fossil fuels, in particular through the electrification of uses, leading to an upwardly revised level of decarbonised electricity production of at least 668 TWh in 2035, i.e. an increase of 22% compared with total production in 2021. This is a key element of the French strategy, as electrification is in many cases synonymous with intrinsic energy efficiency gains. A production level in excess of 668 TWh will enable France either to export more electricity or to accelerate the decarbonisation of certain uses.

→ Upward revision of the development of photovoltaic electricity (54 GW in 2030, compared with a target of between 35 and 44 GW in 2028 in the previous EPP, which corresponds to an increase in deployment targets), while giving priority to competitive development on already developed areas:

- On the ground: giving priority to land that has already been artificially developed or where there are fewer issues, particularly in terms of biodiversity (car parks, wasteland, derelict roads, motorways, railways, etc.).
- On buildings: obligations have been introduced into the law to increase the number of new and existing buildings required to install photovoltaic panels.
- On natural, agricultural and forestry land: installations may not compete with agricultural production or sustainable forestry management, and in all cases may not lead to the clearing of areas larger than 25 hectares. projects On the other hand, will be able to provide a service to agricultural activity (adapting to climate change, protecting against meteorological hazards, improving agronomic potential or animal welfare).agrivoltaic

→ Accelerating the rate of allocation of offshore wind capacity to aim for 18 GW of installed capacity by 2035, by developing planning by maritime facade, allocating up to 10 GW of additional capacity by the end of 2026 (in addition to the procedures already launched) and continuing to develop the floating wind sector.

→ Maintain the current rate of around +1.5 GW/year for onshore wind power, ensuring a more balanced distribution across the country and investing in repowering.

→ Increased use of biofuels, up to around 55 TWh in 2030, an increase of 45% compared with 2023.

→ Development of biomethane, with around 50 TWh of biogas, including 44 TWh injected by 2030, corresponding to an injection capacity more than 4 times greater than today (compared with a target of between 24 and 32 TWh, including between 14 and 22 TWh injected, in 2028 in the previous EPP), taking into account the production and mobilisation limits of our biomass.

→ Development of renewable heat, with more than 280 TWh in 2030 (compared with a target of between 219 and 247 TWh in 2028 in the previous EPP), and recovery heat (between 14 and 20 TWh in 2030 compared with a target of between 7.6 and 9.9 TWh delivered to heating networks in 2028 in the previous EPP), corresponding to a more than twofold increase in the rate of deployment compared with today.

→ Deployment of network-delivered cooling, with 2 TWh in 2030 (compared with production of 0.99 TWh in 2022).

→ Support for innovation (see part 5) to move towards the indicative target set by EU Directive 2023/2413 (known as RED 3) for the deployment of innovative technologies.

→ Relaunching the nuclear industry :

- Removal of the objective of closing nuclear reactors before their end of life and continued operation of existing nuclear power reactors, taking into account international best practice, to enable them to operate after 50 or 60 years of operation, in compliance with all applicable nuclear safety requirements.
- Launch of a programme of work, led by EDF, to increase the available power (uprating) and annual output of existing reactors, for example by optimising or replacing certain parts, in compliance with all applicable nuclear safety requirements.
- Confirmation of EDF's programme to build 6 EPR2-type nuclear reactors, with a view to a final investment decision by EDF's Board of Directors so that the project can be launched by 2026 at the latest.
- Continued study of a possible second stage of at least 13 GWe, corresponding to the capacity of 8 EPR2s in their current design.
- Support for breakthrough innovation through the France 2030 plan, with the aim of launching at least one prototype of an innovative small nuclear reactor by 2030.
- Confirmation of France's strategy for the treatment and recovery of spent nuclear fuel and, with this in mind, continuation of work to renew the industrial facilities that enable it to be implemented, with a view to a decision being taken by the end of 2026, while ensuring that measures are taken to ensure that existing infrastructure meets requirements by 2035 and beyond.

3.1. Renewable and recovered heat and cooling

Heat currently accounts for just under half (43%) of final energy consumption[40] in France, of which only around a quarter is of renewable origin. France is counting on a sharp increase in the production of heat from renewable sources and the accelerated development of urban heating and cooling distribution networks to move rapidly away from fossil fuels.

Accordingly, the objectives of the EPP3 should enable consumption of renewable and recovered heat to rise from 172 TWh in 2022 to at least 328 TWh in 2035. The graph below shows the breakdown by sector. The targets set for the PPE3 mean that renewable and recovered heat consumption will more than double by 2035.

40 Final or available energy is the energy delivered to the consumer for final consumption (petrol at the pump, electricity in the home, etc.).

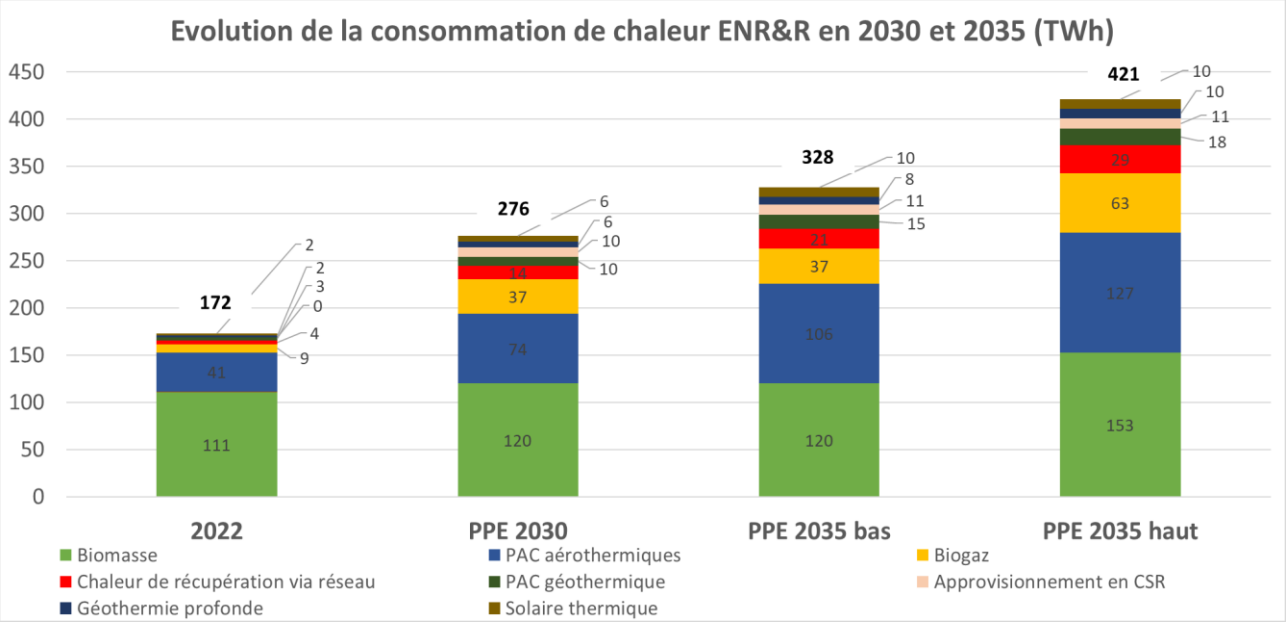


Figure18 . Evolution of ENR&R heat consumption up to 2030 and 2035

This increase in the consumption of renewable heat is based on the development of all renewable heat production methods, as well as increased use of waste heat recovery. The EPP3 therefore sets targets for each of the renewable heat production methods and for the recovery of waste heat used in heating networks. The largest contribution comes from the deployment of heat pumps. However, the development of solar thermal energy, geothermal energy and biogas represent the biggest challenges.

To develop renewable heat, the government has four tried and tested schemes:

→ The aid scheme MaPrimeRénov' for private individuals;

→ The energy saving certificate scheme, in particular via standardised operation sheets supporting the installation of efficient renewable heat production systems in all sectors of activity;

→ The Heat Fund scheme to develop renewable and recovered heat in all sectors of activity, including through the development of heating networks;

→ France 2030 support for the decarbonisation of industry to develop low-carbon heating.

Created in 2009, the Heat Fund managed by ADEME has enabled the massive deployment of renewable heat production facilities across France. Over the past 15 years, the Heat Fund has provided support for more than 8,500 renewable energy and recovery () installationsRE&R, including 3,800 km of distribution networks, thanks to €4.28 billion in aid, generating almost €14 billion in investment. This represents almost 45.4 TWh/year of additional productionrenewable energy , equivalent to the heat consumption of around 5 million homes. In addition, the France Relance and France 2030 programmes have supported the production of heat from biomass for the industrial target, to the tune of 6.4 TWh/year.

ACTION CHALEUR.1

SUPPORTING AND PROVIDING FINANCIAL BACKING FOR THE DEVELOPMENT OF THERMAL RENEWABLE ENERGIES

ADEME's Heat Fund was increased by 40% in March 2022, to €522 million for 2022 and €601 million for 2023. It was further increased to €820 million in 2024, enabling the creation of be financedaround 4 TWh/year of renewable capacity to.energy An equivalent level of support has been maintained for 2025. This will help to achieve a financed capacity of around by 203012 TWh/year . In 2025, discussions will be held with ADEME on the possibility of prioritising the appraisal of projects submitted to the Heat Fund.

MaPrimeRénov' will support the installation of heating equipment running on renewable energy sources for households that need it, in line with the decarbonisation trajectories of ecological planning. In addition, support for renewable heating projects will continue for private individuals as part of the public serviceFranceRénov' , and for manufacturers as part of the PACTE Industrie programme.

Support will be provided for the structuring of networks of renewable heat coordinators throughout the country, to help local authorities and businesses design their projects and stimulate the development of new renewable thermal energy production capacity. Lastly, the human resources and skills needed to deploy renewable heat will receive special attention as part of the Jobs and Skills strategy of the General Secretariat for Ecological Planning.

Finally, Directive 2024/1275 on the energy performance of buildings calls for the abolition of financial incentives for the installation of fossil fuel boilers from [1]January 2025. A number of schemes have been modified as a result, including the Green Fund, MPR, MPR copro, HM PB, MPLD, CEE, PAR, etc.the Green Fund, MaPrimeRénov' (MPR), HM PB (Loc'Avantages avec travaux), the energy saving certificate scheme (CEE), and the social housing eco-loan.

ACTION CHALEUR.2

SETTING UP A LONG-TERM FRAMEWORK FOR THE BUILDING HEATING MARKET

Following the consultation on the decarbonisation of buildings :

→ A long-term framework for the heating market will be put in place to steer the market towards low-carbon heating solutions and gradually reduce the proportion of gas boilers sold

→ Measures to support the end of the use of fuel oil to heat tertiary buildings by 2030 must be identified and put in place, in particular to support small and medium-sized businesses and local authorities in replacing their oil-fired boilers with low-carbon heating systems.

3.1.1. Solid biomass

Solid biomass is France's leading renewable energy source, accounting for 32.9% of primary consumption of renewable energy and 61% of primary consumption of renewable energy for heating in 2022. This sector includes both wood used by households (in independent heating appliances such

as inserts and stoves, as well as in boilers) and biomass heating plants in industry, collective and tertiary sectors, as well as the renewable heat produced by biomass cogeneration plants and, finally, the renewable part of the heat produced by urban waste-to-energy units.

Almost a quarter of French households use wood-burning equipment (logs or pellets)[41] . It may be used as the main source of heating in the home, or as a back-up to another form of heating using electricity, gas, fuel oil or a second renewable energy source (solar heating, heat pump, etc.).

In the collective, industrial and tertiary sectors, more than 7,000 heating plants, spread across the country, supply a district heating network or directly on the site of an industry, or collective or tertiary residential buildings.

The fundamental issue is the sustainability of the biomass resource, i.e. its rational use while preserving the natural environment in which it is harvested. Taking this issue into account has led to a reduction in energy consumption compared with the targets set in the previous EPP. In addition, a number of measures are being put in place to address this issue, in line with European legislation (the Renewable Energy Directive) and national measures (the hedgerow pact).

2022 CONSUMPTION AND GENERATION TARGETS IN TWh	2022	2030	2035 LOW THRESHOLD	2035 HIGH THRESHOLD
SOLID BIOMASS (CONSUMPTION)NET	110,7	120	120	153

ACTION CHALEUR.3

OPTIMISING THE USE OF BIOMASS TO DECARBONISE HEAT MORE EFFECTIVELY

Solid biomass is France's leading renewable energy source, making a major contribution to the decarbonisation of energy, particularly heat. It is a local, inexpensive energy source that complements the uses of wood-based products. It is also a resource that we need to preserve and exploit in a sustainable way (sustainable forestry, preservation of the carbon sink, biodiversity, etc.). The use of biomass must therefore be optimised through the use of high-efficiency appliances and the search for alternative solutions where appropriate. the replacement of old, inefficientSupport will continue to be provided for combustion appliances, in order to improve energy efficiency and reduce emissions of atmospheric pollutants. In addition, in the support schemes, priority will be given to uses for which there are few substitutes, such as high-temperature heat requirements for industry or district heating networks. Priority will be given to short-circuit uses, through the on-site recovery of sawmill by-products, to produce renewable heat and thus increase the energy autonomy of the wood-material sector. As part of the Heat Fund, project developers will be required to systematically study alternatives to biomass before considering the creation of a heating plant. They will therefore be encouraged to apply this approach when drawing up feasibility studies or, in the case of heating networks, master plans.

[41] SDES, https://www.statistiques.developpement-durable.gouv.fr/la-consommation-de-bois-energie-des-menages-en-2020

Other effective and relevant uses of biomass to decarbonise heat production may continue to be supported, taking into account the prioritisation of biomass uses (see table in section 4.5).

In order to improve knowledge of biomass supply and demand and thus optimise its use for decarbonising heat, the State will be supported on a technical level by a scientific interest group (GIS) bringing together the leading public establishments on biomass (ADEME, France Agrimer, IGNf, INRAe), whose agreement was signed on 1st March 2024. In particular, the GIS will conduct a critical analysis of the conversion factors used in the wood-energy sector, in support of the SNBC's modelling of biomass supply. The GIS will also be involved in developing methodologies to support the drafting of opinions by regional biomass units on biomass-consuming projects and their monitoring of local resources and uses. This work will feed into the doctrine that will be drawn up for the implementation by the biomass units of the prioritisation of biomass uses based on the principle of cascading biomass use.

3.1.2. Heat pumps

Heat pumps produce heat by drawing calories from the ground or groundwater (geothermal) or from the air (aerothermal).

The production of renewable heat from heat pumps will reach 50 TWh[42] in 2023 in the real climate, up 11% due to the increase in the number of heat pumps, against a backdrop of winter temperatures similar to those in 2022 and a slightly colder autumn.

The number of heat pumps installed in France continues to grow rapidly. However, there are contrasts between air-source and ground-source heat pumps: on the one hand, there has been strong growth in the air/air and air/water heat pump markets in recent years, while ground-source heat pumps have seen a sharp slowdown (fewer than 3,000 sales a year since 2015, whereas the total market has topped one million units sold by 2021).

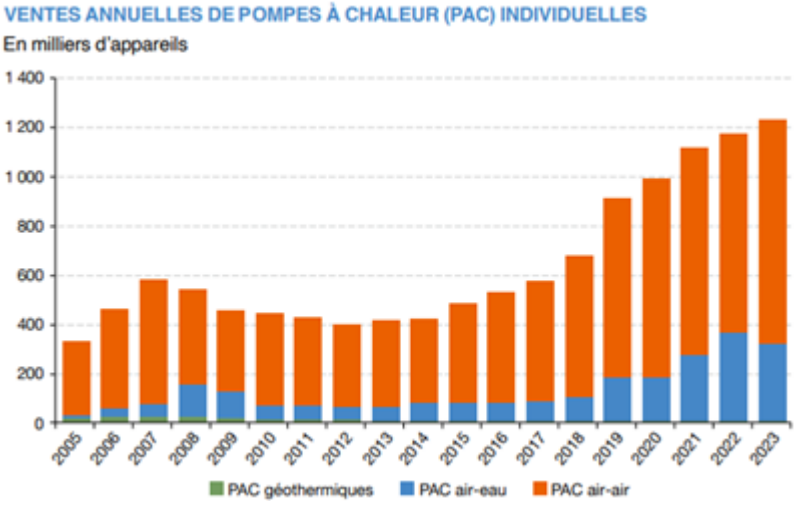


Figure19 . Annual sales of individual heat pumps - Source: Chiffres clés des énergies renouvelables - édition 2023, SDES

[42] Renewable heat production refers solely to heat extracted from the environment by the heat pump. Its electricity consumption is therefore not taken into account.

Sales of individual heat pumps continued to rise in 2023, reaching 1.2 million units, including 910,000 air-to-air heat pumps (up 13% year-on-year), 307,000 air-to-water heat pumps (down year-on-year) and 3,500 geothermal heat pumps (up year-on-year). The ambitious targets set in the previous EPP for 2028 (44 to 52 TWh produced from heat pumps) have already been achieved, with 50 TWh produced in 2023. In line with the PlanHeat Pump , public support for the development of the French heat pump industry will enable one million French heat pumps to be produced and installed each year by the end of 2027.

2022 CONSUMPTION AND PRODUCTION TARGETS IN TWh OF RENEWABLE ENERGY	2022	2030	2035 LOW THRESHOLD	2035 HIGH THRESHOLD
PAC (EXCLUDING GEOTHERMAL)HEAT PUMPS	41,1	74	106	127

ACTION CHALEUR.4

IMPLEMENT THE HEAT PUMP PLAN TO PRODUCE 1 MILLION HEAT PUMPS A YEAR BY 2027 AND STRENGTHEN THE INDUSTRY

In line with the objectives set by the French President, in April 2024 the government presented an action plan[43] to support the development of the French heat pump (PAC) industry and **produce at least one million PACs every year by 2027**. Air-to-water heat pumps will mainly be installed to replace gas or oil-fired boilers, and will help to achieve the objective of phasing out fossil-fired boilers by 2040, as set out in the directive on the energy performance of buildings.

In line with the increase in demand, **new heat pump production plants will be set up,** with part of the investment costs covered by the green industry investment tax credit (C3IV) and support in finding land or authorisations for project developers. Innovation grants will be dedicated to the development of new heat pump products, to meet a range of challenges such as integration, refrigerants and noise. The heat pump industry will receive support to develop training in installation, maintenance and equipment production. To encourage the development of heat pump production in France (and Europe), the heat pump plan includes a measure to make energy renovation aid (conditional MaPrimeRénov' and CEE) on compliance with resilience criteria in line with the NZIA.

A **specific plan will be put in place to develop heat pumps in collective housing**, which will include simplifying legislation to allow derogations from local town planning schemes. Work between government departments, the industry and local authorities will be launched and could lead to the adaptation of national regulations and/or the production of dedicated information for town planning departments, enabling local town planning plans to be adapted and practices to evolve. Subsidies will be reviewed to provide a better incentive for the installation of collective heat

[43] An action plan to produce one million heat pumps by 2027 https://www.economie.gouv.fr/actualites/plan-action-pompes-chaleur-2027

pumps, communication will be made with the building industry (project owners, project managers, construction and renovation professionals) and action will be taken with the heat pump industry and representatives of project owners and operators to develop a framework to ensure the quality of heat pumps installation and operation.

In the absence of a hot water loop, air-to-air heat pumps will make it possible to replace inefficient joule-effect electric heating, thereby improving the energy efficiency of homes and reducing peak electricity consumption.

A **heat pump centre of expertise (CEPAC) will be set up in the near future**, with the task of informing and equipping all building professionals. From the correct sizing of the system to the correct hydraulic installation, from setting the water law parameters to maximise the heat pump's performance to ensuring that noise and electrical connection constraints are properly taken into account, information must be accessible and professionals must be able to receive support through guides, technical tools and participation in building industry events and trade fairs.

Finally, **a national communication campaign will be launched in 2025** to encourage the installation of heat pumps, a crucial solution for achieving the targets for reducing COemissions $_2$ in buildings. Knowledge about the operation and performance of heat pumps will also be developed, along the lines of the Vrai/Faux report published in April 2024 .[44]

3.1.3. Surface and deep geothermal energy

Geothermal energy harnesses the thermal energy of the subsoil and groundwater (aquifers). It can be used in a variety of sectors (residential, tertiary, agricultural, industrial) to produce heat and cold (heating, cooling, air conditioning, heat storage, productionsteam) or electricity (mainly in French overseas departments and territories). By 2022, geothermal installations in mainland France would account for 1% of final heat consumption and 5% of thermal production by heating networks.

Surface geothermal energy" refers to energy systems using a geothermal resource with a temperature of less than 30°C and a depth of less than 200 metres, consisting of an underground collection system (e.g. vertical heat exchangers through which a heat transfer fluid flows), a surface production system (geothermal heat pump) and a control system. Surface geothermal energy covers all or part of the heating and cooling needs of buildings in the residential and commercial sector (heating, domestic hot water, air conditioning, cooling); it can also be used on farms or industrial sites.

Deep geothermal energy" uses groundwater at a temperature of between 30°C and 200°C at depths of between 400 metres and 3,000 metres, via a producer well and an injector well. These deep aquifers are located in porous or fractured sedimentary rock (sand, sandstone, limestone, chalk), mainly in the Paris and Aquitaine basins. Mainly used to produce heat for urban heating networks, deep geothermal energy can also be used for industrial (processes using steam, hot air or hot water), agricultural (heating greenhouses, fish farming, drying) or applicationsaquatic (swimming pools, water sports centres, thermal baths) . Deep aquifers (geological formations that are sufficiently porous or fissured and waterlogged) suitable for deep geothermal energy are located in sedimentary basins (sand, sandstone, limestone, chalk) such as the Paris and Aquitaine basins, the Rhine Graben, the Rhone Corridor, Limagne and Hainaut. The characteristics of deep aquifers allow direct heat exchange without the need for a heat pump.

If the EPP3 targets are to be met, the pace of project development will have to increase significantly over the period 2024-2030, by strengthening the sector's material and human capacities. The current

[44] For a clearer picture: True/false facts about heat pumps:
https://www.economie.gouv.fr/files/files/2024/Guide_pompes_a_chaleur_vrai_faux.pdf?v=1713344875

rate of development is below that forecast in the previous PPE exercise, even though BRGM estimates that surface geothermal energy alone could provide up to 100 TWh of geothermal heat in the next 15 to 20 years. In deep geothermal energy, one of the major challenges for the development of new projects is to improve knowledge of the subsoil, by analysing existing data at regional level and acquiring new data to characterise the target aquifers; several dozen deep geothermal energy projects are currently in the study phase.

2022 CONSUMPTION AND GENERATION TARGETS IN TWh	2022	2030	2035 LOW THRESHOLD	2035 HIGH THRESHOLD
SURFACE GEOTHERMAL ENERGY	3,2	10	15	18
DEEP GEOTHERMAL ENERGY	2,2	6	8	10

HEAT ACTION.5

IMPLEMENTING THE NATIONAL GEOTHERMAL ACTION PLAN

The national geothermal action plan, published in February 2023 and supplemented in December 2023 was drawn up in conjunction with industry players and [45] ,aims to accelerate the development of surface and deep geothermal energy in mainland France and the French overseas departments and territories through six key areas and around fifteen actions to :

- structuring the sector and strengthening its production and drilling capacity ;
- developing the range of initial and continuing training courses ;
- provide financial and other to project sponsors and users;support
- raise awareness among local players;
- simplify regulations ;
- improve our knowledge of the subsoil.

Each regional prefect is also responsible for drawing up and implementing three actions tailored to the regional context. At national level, the action plan is monitored by ADEME in coordination with a committee of public and private players that meets twice a year. For surface geothermal energy, the action plan aims to double the annual rate of installation of geothermal heat pumps, rapidly reaching 6,000 new installations per year in the individual sector and 1,000 new installations per year in the collective-tertiary sector. In deep geothermal energy, this national action plan should increase the number of operations by 40% to at least 110 operations in operation via projects launched before 2030.

[45] https://www.ecologie.gouv.fr/sites/default/files/documents/20231222_DP_Plan-action-geothermie.pdf

3.1.4. Solar thermal

Solar thermal energy covers all the technologies used to convert solar radiation into usable heat. The type of solar collectors used (unglazed collectors, flat-plate glazed collectors, evacuated tube collectors, concentrating solar collectors, etc.) varies according to the temperature level targeted. Solar thermal energy covers low and medium temperature applications - producing hot water for buildings, heating networks or industry - and high temperature applications above 100°C - in the form of steam for industry in particular.

By 2022, the solar thermal sector will account for 0.2% of final heat consumption in mainland France, with 2.4 million m² of solar thermal collectors in service, producing 1.3 TWh/year of renewable heat. There are two main categories of solar thermal installations:

- individual or collective installations for space heating and domestic hot water production (solar water heaters, combined solar systems, solar heat pumps, etc.);
- Large-scale solar thermal installations (LSIs), typically with a capacity of more than 1 MWth, supplied by flat plate collectors (up to 100°C) or concentrating solar power plants (up to 300°C). These installations mainly meet the low- or medium-temperature heating needs of district heating networks or industrial sites.

The previous PPE foresaw a revival of the sector through the development of large-scale solar thermal installations in industry and on heating networks, and outlined growth prospects for individual and collective housing. The years 2021 and 2022 were marked in mainland France by an upturn in the solar thermal market and the development of GISTs with glazed collectors, supported by a dedicated call for projects under ADEME's Heat Fund. This momentum is set to accelerate sharply over the next few years, with a view to achieving 6 TWh of solar thermal heat consumption by 2030 and 10 TWh by 2035. Meeting this challenge - by multiplying by 4 the number of collectors installed in the individual and collective sectors and reaching 1 million m² of collectors installed per year under GIST - will require a sustained effort in terms of industrial capacity, installation and operation, not forgetting the regulatory and financial aspects.

2022 CONSUMPTION AND GENERATION TARGETS IN TWh	2022	2030	2035 LOW THRESHOLD	2035 HIGH THRESHOLD
THERMAL SOLAR	1,5	6	10	10

ACTION CHALEUR.6

DRAW UP AND IMPLEMENT A NATIONAL SOLAR THERMAL ACTION PLAN

Based on the model of the geothermal action plan updated in December 2023, a national " action plan solar thermal"will be drawn up with all the players in the sector (professional organisations, associations, public bodies, etc.) to raise the profile of solar thermal technologies in the French energy landscape, develop the training on offer, facilitate the financial package for projects and strengthen the industrial production capacity for solar thermal equipment in particular.

3.1.5. District heating and cooling networks

The concomitant development of heating networks is essential to increase the use of low-carbon heat. Heating networks make it possible to pool needs and thus use sources of heat that are difficult to mobilise on an individual scale (industrial waste heat, deep geothermal energy), or to better control pollutant emissions linked to the use of biomass through the use of collective boiler rooms. Networks also make it possible to distribute carbon-free energy where it is difficult to produce it (dense urban areas).

At the same time, the deployment of cooling networks can be an important element in adapting to climate change, while controlling the impact in terms of energy consumption and heat islands.

The government has therefore also decided to set targets for the quantities of heat delivered by the networks. These will have to increase from 26 TWh, 64% of which will be from renewable energy sources, in 2022, to 68 TWh, 75% of which will be from renewable energy sources, in 2030, and then to 90 TWh, 80% of which will be from renewable energy sources, in 2035.

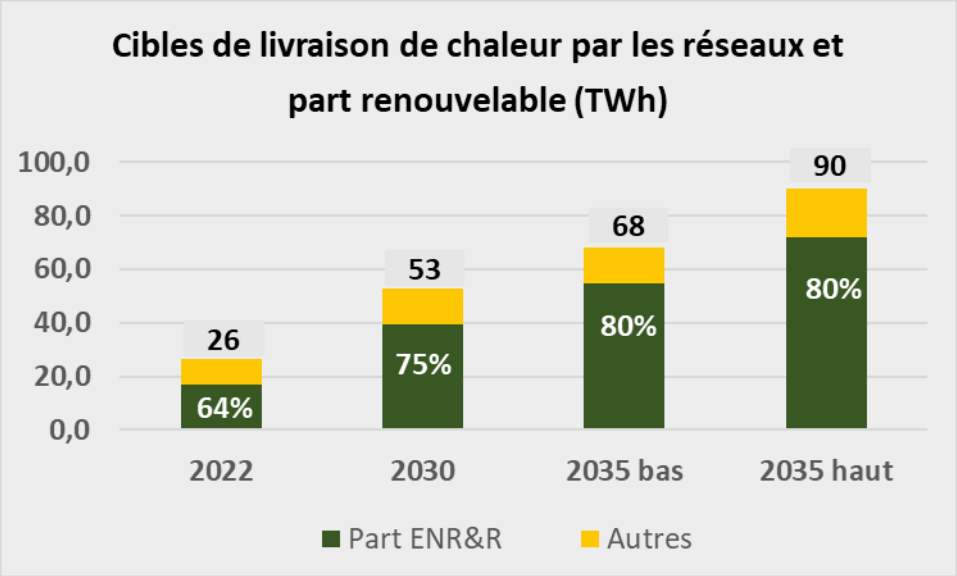


Figure20 . Delivery to ENR&R heating networks in 2030 and 2035

This level of delivery means that an average of 360,000 homes per year will need to be connected by 2035. This represents between 5.8 and 6.7 million homes connected in 2035, compared with less than 1.3 million in 2020. In the vast majority of cases, these connections will be for collective housing with collective heating, but a significant proportion may also replace individual fossil heating by creating a secondary water loop in the home.

An equivalent level of heat delivery will also be required for buildings outside the residential sector.

2022 DELIVERY AND HEAT DELIVERY TARGETS IN TWH	2022	2030	2035 LOW THRESHOLD	2035 HIGH THRESHOLD
QUANTITY OF ENR&R HEAT	17	39,5	54,5	72
TOTAL AMOUNT OF HEAT	26	52,7	68	90

Cooling networks were set up more recently. In 2022, the 40 cooling networks delivered 0.99 TWh (compared with 0.93 TWh in 2009). The French government has set the following targets for the supply of cooling to the networks:

2022 DELIVERY AND COOLING DELIVERY TARGETS IN TWH	2022	2030	2035 LOW THRESHOLD	2035 HIGH THRESHOLD
COLD DELIVERY TO NETWORKS	1	2	2,5	3

HEAT ACTION.7

SPEEDING UP THE DEPLOYMENT OF EFFICIENT HEATING AND COOLING NETWORKS

New digital tools, in particular the maps developed by the state-owned start-up France Chaleur Urbaine https://france-chaleur-urbaine.beta.gouv.fr/ and tool CEREMA's https://reseaux-chaleur.cerema.fr/espace-documentaire/enrezo, which identify areas with network deployment potential, will be used to step up efforts to create heating and cooling networks, in addition to the awareness-raising initiatives already underway. Municipalities and intercommunal bodies with more than EnRezo 5,000 inhabitants that do not have networks but have the potential to deploy them will be encouraged to carry out feasibility studies. In addition, EPCIs with more than 45,000 inhabitants will be required to draw up local heating and cooling supply plans, in accordance with the revised Energy Efficiency Directive. These action plans will make it possible to develop a local strategy for all forms of energy used for heating and the associated networks.

In addition, heating networks will continue to be supported by the Heat Fund, which will be scaled in line with the expected trajectory. Network operators will have to study the feasibility of using alternative solutions to biomass (geothermal, solar thermal, etc.) as part of the Heat Fund (ENR Choix method).

The classification of heating networks supplied with more than 50% renewable or recovered energy makes it compulsory for new or renovated buildings located within a priority development area to be connected to the network. This system can continue to be deployed by local authorities that own networks to speed up their development and ensure their long-term viability.

Other acceleration measures will be studied or tested, in particular supporting work to create secondary hot water loops in collective buildings, or setting strong targets for connection to heating networks and developing the consumption of low-carbon heat in major urban development projects (e.g. OINs), ORCOD-IN (rehabilitation of run-down condominiums, concerted development zones above a certain size), by making State/public funding conditional on these commitments and by reinforcing them).

3.1.6. Recovered heat

Waste heat is heat generated by a process which is not its primary purpose and which is not necessarily recovered. When this waste heat is recovered and used, it is referred to as recovered heat. The sources of recovered heat are very diverse: it can be the waste heat from industrial sites, tertiary buildings (data centres, waste water, etc.), existing household waste-to-energy units known

as UVEs (for the non-renewable part of the heat they produce), or heat from sites treating other waste (thermal treatment of sludge, etc.).

A target has been set for the recovery of waste heat delivered by the networks.

On-site recovery of waste heat should also be developed, to help reduce our energy consumption.

HEAT RECOVERY 2022 AND RECOVERY TARGETS IN TWh	2022	2030	2035 LOW THRESHOLD	2035 HIGH THRESHOLD
RECOVERY OF HEAT WASTE DELIVERED TO THE RCU	3,9	13,6	21	29

HEAT ACTION.8

SPEEDING UP THE RECOVERY OF WASTE HEAT

The creation of a guarantee mechanism to cover the risk of default by the industrial supplier of waste heat or the customer will be studied. ADEME's Heat Fund can already finance a replacement renewable facility in the event of the industrial supplier's default.

In addition, cost-benefit studies on the recovery of waste heat will be required for (new or significantly modified) industrial installations of more than 8 MW, service installations of more than 7 MW and data centres of more than 1 MW. As far as existing installations are concerned, studies of the potential for recovering waste heat will be generalised for installations of more than 10 MW. Data centres over 1 MW will be required to recover the waste heat they produce, unless technically and economically incompatible, in accordance with the requirements of the revised Energy Efficiency Directive.

Finally, the recovery of nuclear waste heat to supply heating networks will be studied. The possibilities for recovering heat from wastewater (networks, treatment plants) will be explored in greater depth: support for the development of technologies, projects under the Heat Fund, etc.

3.2. Solid recovered fuels

Solid recovered fuel (SRF) is waste that cannot be recycled and that has been specifically prepared for use as fuel in certain installations such as industrial boilers. The aim of SRF is to divert non-recyclable waste from storage (i.e. landfill), and the creation of SRF boilers to decarbonise the heat mix is a particularly suitable solution for industrial users. As a result, the 2020 economic recovery plan introduced a specific scheme to support low-carbon industrial heating, helping industrial companies to use heat sources that emit less CO_2, such as biomass or solid recovered fuel (SRF).

The use of RSCs is part of the drive to support the waste treatment industry and local authorities in meeting the targets set out in the Energy Transition for Green Growth Act, which aim to reduce the amount of non-hazardous waste sent to landfill by 50% by 2025, and those of the anti-waste law (AGEC), which require 70% of non-recyclable waste to be recovered as energy by 2025. The recovery

of RDF as industrial fuels provides an outlet for part of this 70% of waste that could not be recovered as materials.

2022 CONSUMPTION AND HEAT PRODUCTION TARGETS IN TWh	2022	2030	2035 LOW THRESHOLD	2035 HIGH THRESHOLD
CSR	0,2	10	11	11

HEAT ACTION.9

SUPPORTING THE DEVELOPMENT OF CSR HEATING SYSTEMS

→ Continue to support the development of RDF boiler plants, via ADEME calls for projects and depending on resources.

→ Continue to increase the TGAP on landfill.

3.3. Liquid fuels

3.3.1. Crude oil production in France

In 2023, domestic production of liquid hydrocarbons in France totalled 584,114 tonnes. Since 2019, production has fallen by 20%. It is at a very low level, representing less than 1% of French consumption of liquid hydrocarbons.

With a view to combating climate change, Act no. 2017-1839 of 30 December 2017 putting an end to the exploration and exploitation of hydrocarbons and containing various provisions relating to energy and the environment aims to phase out the extraction of hydrocarbons in France by 1st January 2040.

The 2017 law therefore decided to stop issuing new exploration licences in order to gradually phase out the country's residual hydrocarbon production.

If new permits for hydrocarbon exploration throughout France can no longer be issued, holders of currently valid exploration permits may continue to obtain a concession, and holders of currently valid concessions may have their permits extended, subject to the conditions laid down by law. In all cases, the exploitation of these deposits may not exceed the deadline of 1st January 2040.

3.3.2. Refining

Business at France's 6 refineries remains buoyant, particularly since the end of imports of refined products from Russia. The future of this key activity in terms of decarbonisation and the country's energy security is being closely monitored.

French refineries are committed to reducing their carbon footprint, sometimes by introducing co-processing. Some are transforming into biorefineries, such as La Mède in 2019 and Grandpuits by 2025. These energy transition transformations require technological adaptation and, consequently, major investment.

3.3.3. Biofuels and synthetic fuels

At present, most biofuel consumption comes from first-generation biofuels (known as "1G"), which are produced from agricultural resources that can also be used for food, and some of which are imported. In order to limit the impact of the production of these first-generation biofuels on food crops, their use is capped at 7% in compliance with European legislation. The production of first-generation biofuels is integrated into the French agricultural and food industries. It enables the production of food co-products that are used in livestock farming (oilcake).

The current challenge is therefore to develop the production of so-called "advanced" biofuels, mainly derived from co-products, residues and waste that do not compete with food or are part of sustainable forest management. Biofuels will support the decarbonisation of mobility in segments where alternatives are difficult to implement, particularly where the decarbonised solution is not very mature or non-existent.

In the short term, the production of these advanced biofuels should complement the supply of 1G biofuels to begin the decarbonisation of heavy mobility (maritime, river, air) in addition to land transport.

In the medium and long term, with the electrification of the vehicle fleet and the end of internal combustion engines in light vehicles, these fuels should enable greater decarbonisation of heavy mobility that is difficult to electrify (air and sea transport, site machinery, agricultural and forestry machinery, rail and river transport, certain specific heavy goods and collective passenger road transport, fishing, etc.). Particular attention will be paid to the maritime and aviation sectors, which are difficult to electrify. The EU regulation Refuel Aviation sets a target for the incorporation of sustainable aviation fuels (SAF) of 2% from 2025 and 20% by 2035 (including 5% synthetic fuels), creating a European SAF market, supported by a strategy to decarbonise the industry. A CAD incorporation trajectory will be determined, giving visibility to project developers and contributing to the development of production capacity.

To support European production, which is a guarantee of energy sovereignty, this trajectory will include synthetic fuels in particular, which will play a major role in decarbonising heavy mobility. In line with European objectives, it will give the industry time to reach technological maturity and overcome the environmental issues currently being raised, so that synthetic fuels can *ultimately* limit the pressures and challenges of biomass supply/demand balancing.

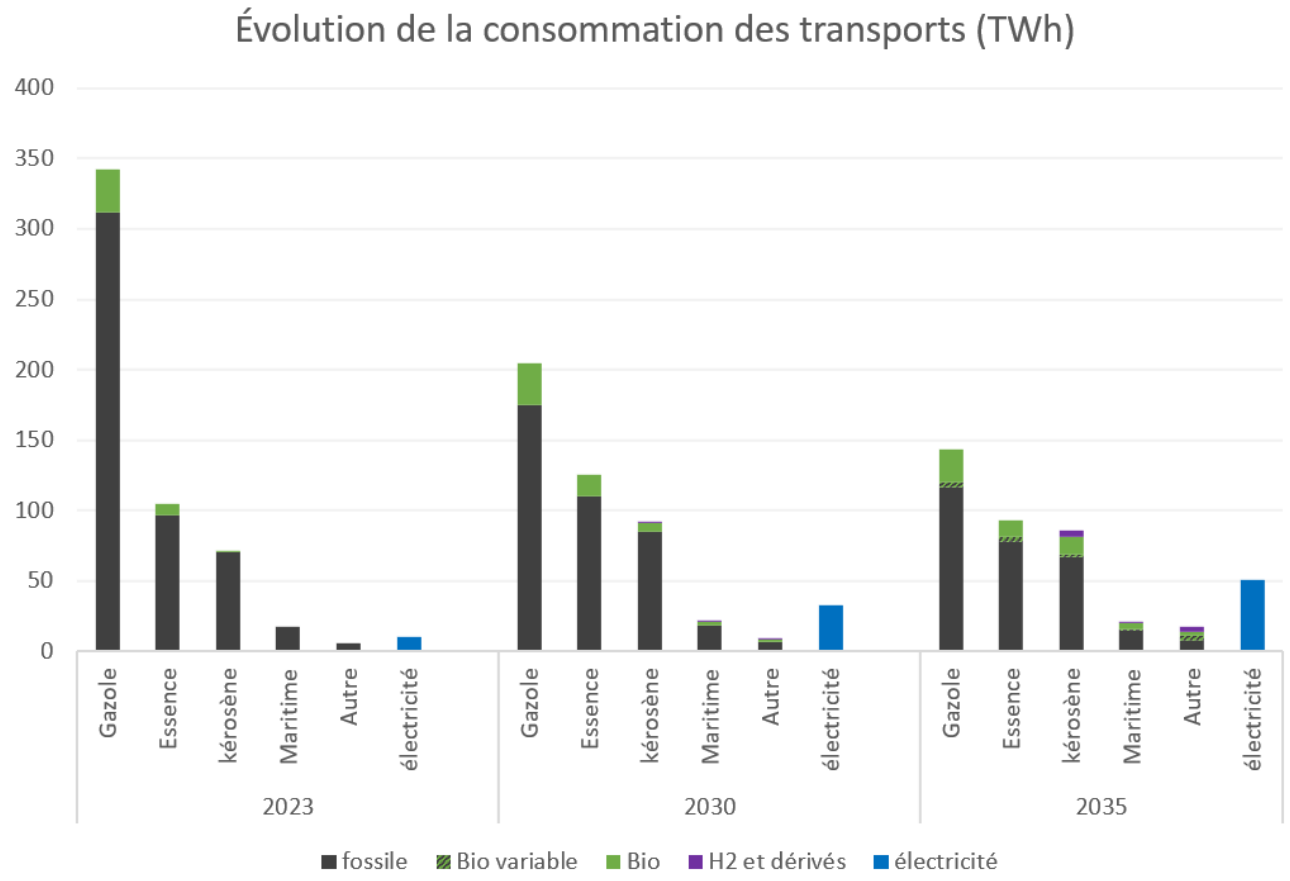


Figure21 . Trends in transport energy consumption (in TWh). As consumption data for 2020 and 2021 are affected by the COVID crisis, 2019 is used as the reference year.

In 2030, the need for biofuels for land, air and sea transport is estimated at 55 TWh in mainland France.

In 2035, the assumptions of the scenario underlying EPP3 could lead to consumption of around 70-90 TWh, for biofuels for transport, non-energy uses and overseas electricity production, and an increase for agriculture, maritime transport and the aviation sector.

National biofuel production in 2030 and 2035 is expected to be around 50 TWh. As is the case today, it will be based in part on imports of raw materials from processes whose sustainability can be traced and secured (for used oils in particular).

The incentive tax on the use of renewable energy in transport (TIRUERT) sets a target for the incorporation of renewable energy into fuels. The principle of this system is that the incorporation of renewable energy means that the taxpayer does not have to pay this tax once the target has been reached.

In order to promote biofuels with the highest greenhouse gas emission reduction rates, a new mechanism will replace the TIRUERT and will set greenhouse gas emission reduction targets in the form of a reduction in the carbon content per unit of energy used in the transport sector from well to wheel. An additional target for the use of renewable energy per fuel will also be imposed in order to ensure thatcontribute these sectors to the reduction of GHG emissions, in line with the structure of the RED3 targets.

On the basis of the above trajectories (diesel and petrol consumption, volumes of biofuels to be incorporated, number of electric vehicles, quantity of electricity consumed in mobility, volume of hydrogen consumed in mobility), the proposed national trajectory for the new mechanism to reduce greenhouse gas emissions would be as follows.

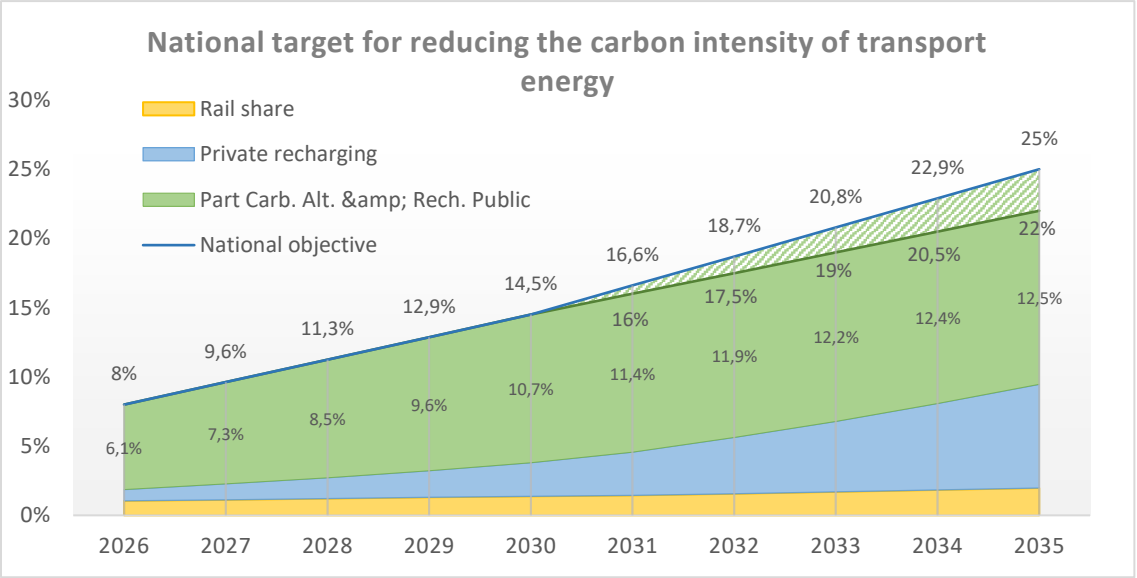


Figure22 . National trajectory and contribution of the mechanism to the objective of reducing GHG emissions from transport. By 2035, the target for reducing the carbon intensity of transport energy is between 22% and 25%.

The current TIRUERT Aviation will also be reviewed in order to take account of the provisions of the RegulationRefuel Aviation , which imposes specific incorporation targets for homogeneous aviation in the EU in volume terms for non-1G biofuels from 2025 and incorporation sub-targets for synthetic fuels from 2030, and to provide for their proper coordination with the RED III Directive.

For land transport, the basis of the mechanism could evolve to take account of bio-NGV and LPG decarbonisation solutions. Special measures could be taken to support the decarbonisation of vehicles that are more difficult to electrify, such as non-road vehicles (agricultural machinery, construction equipment, etc.).

With regard to biomass-based energy products and sustainable fuels, France has adopted a strategy to promote research, contribute to the emergence of production sectors, support industrial demonstrators and investment, encourage deployment and anticipate medium- and long-term biomass requirements, as well as developing initial and continuing training.

ACTION CARBURANT.1

SUPPORTING THE DEPLOYMENT OF BIOFUELS

→ Supporting the establishment of the first industrial facilities for the production of advanced biofuels, particularly for the aviation and maritime sectors;

→ Define a multi-year trajectory of fuel incorporation targets, to achieve a 14.5% reduction in the carbon intensity of transport energy by 2030. Consultation on this trajectory was launched in July 2023;

→ Support the adaptation of oil logistics to the development of biofuels, in particular by including biofuels in discussions on storage;strategic

→ Gradually shift consumption towards sectors that will have few sustainable alternatives (heavy construction machinery, agricultural machinery, air transport, maritime transport, rail and river transport, fishing, etc.).

3.3.4. LPG

Liquefied petroleum gas (LPG) is used as a fuel. Although it accounts for only a small proportion of the primary energy consumed in France, when used as a fuel it is an important energy carrier in areas where there are no gas distribution networks. It is therefore key in certain rural areas. It will therefore be studied as part of work on the development of electrical, heating and water-heating systems, particularly in rural areas. The ways in which the industry can decarbonise LPG will be studied. For its use as a fuel, the avenues proposed by the industry will be studied, and may be encouraged through the mechanism providing incentives to reduce the carbon intensity of fuels. (see section 3.3.3 Biofuels and synthetic fuels).

3.4. Gases

3.4.1. Natural gas

Current situation and outlook for national natural gas production

France has few conventional natural gas resources. Commercial exploitation of the Lacq field, France's main natural gas field, is now limited and, since 2013, its production has no longer been injected into the grid but consumed directly on site. Law no. 2017-1839 of 30 December 2017 also provides for the phasing out of research and exploitation of new resources.

Natural gas supply

In the absence of significant domestic production, natural gas supply relies on imports. Two types of natural gas are distributed in France via separate networks: high-calorific gas or H-gas, which accounts for 94% of consumption, and low-calorific gas or L-gas. To ensure a high level of security of supply for H gas, France has built up an infrastructure comprising five interconnections for imports and five LNG terminals. This infrastructure provides access to diversified sources of natural gas.

The reduction in Russian gas exports to the European Union, starting in 2021, has significantly changed the origin of natural gas imported into France. Norway remains France's main supplier of natural gas, providing around a third of French H-gas imports (33% in 2023). Imports of liquefied natural gas (LNG) have risen sharply, with the United States now the second-largest source of H gas imported into France (25% of H gas imports in 2023), ahead of Russia (13%), Algeria (12%) and Qatar (6%). Generally speaking, the diversification of supply sources has tended to increase in recent years, with a reduction in imports from Russia and an increase in LNG imports.

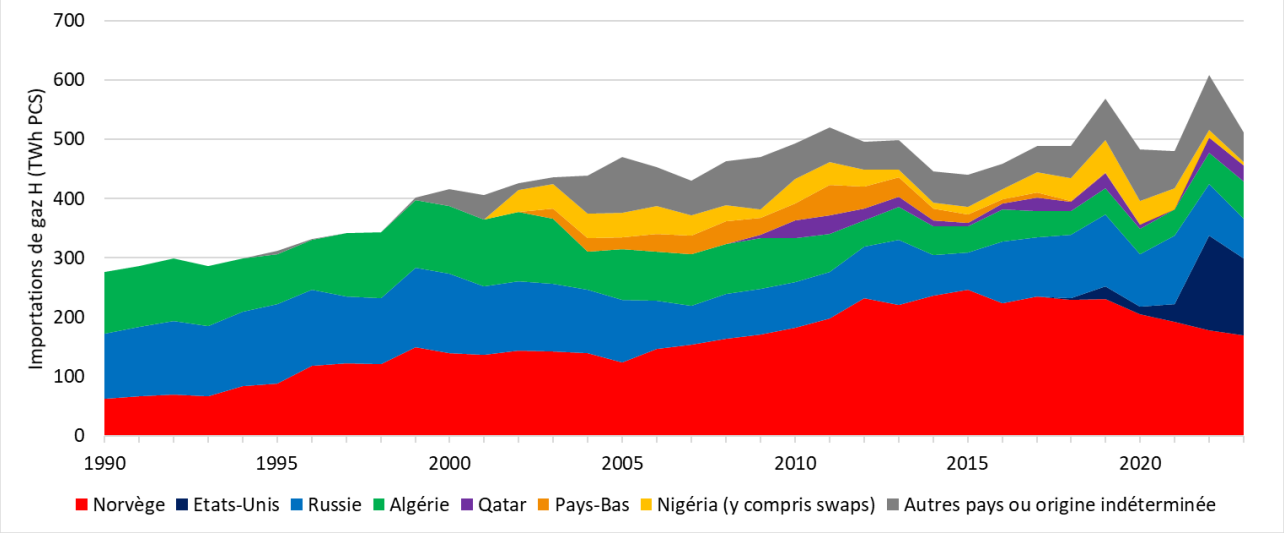


Figure23 . Origin of French imports of high-calorific natural gas since 1990 (source: SDES and GRTgaz)

The special case of low calorific value natural gas

Natural gas consumers in a large part of the Hauts-de-France region are supplied by a separate network with low calorific value natural gas, known as B gas. All B gas is imported from the Netherlands, and historically most of it was extracted from the Groningen field.

Following the observation of an increase in the frequency and intensity of seismic activity around the Groningen field, in an area hitherto classified as asismic, the Dutch government announced a reduction in the field's production ceiling, followed by a cessation of production in 2024. Exports continue from other sources, but are scheduled to cease in 2029.

In order to ensure continuity of supply for B gas consumers, a gradual conversion of the network to H gas has been launched. This is a large-scale operation, requiring changes to the natural gas transmission and distribution networks, as well as work at each consumer site to check that the various gas appliances (boilers, water heaters, gas cookers, furnaces and industrial equipment, etc.) can be supplied with H gas. Some appliances will have to be adjusted, adapted or even replaced in some cases, to guarantee the safety of people and property.

The operation to convert the network to low-calorific gas began in 2018 and will be completed by 2029 at the latest. It is being carried out in successive sections of the B gas network.

3.4.2. Renewable gas

At 30 June 2024, 694 facilities were injecting biomethane into natural gas networks. Their capacity amounted to 12.5 TWh/year, an increase of 5.9% compared with the end of 2023.

In 2030, the PPE 3 sets a target of 50 TWh PCS of biogas production, including 44 TWh PCS injected into the gas network distributed in France, which could represent around 15% of network gas consumption. Achieving this target will require a significant increase in the use of intermediate crops for energy purposes and greater use of livestock effluents and crop residues to produce injected biomethane. The value of developing intermediate crops between main crops for agro-ecological purposes should be emphasised, particularly in terms of carbon storage and reducing nitrogen losses. However, their development will have to take account of agronomic conditions and the place of energy crops in crop cycles. The use of intermediate crops and the mobilisation of livestock effluent for biogas production can reduce greenhouse gas emissions (methane), improve nitrogen management in agriculture and reduce the use of synthetic mineral fertilisers.

By 2035, biogas production from anaerobic digestion could be between 50 and 85 TWh HCV, in line with current assumptions for biomass production in this timeframe. Depending on their level of maturity and cost of deployment, other technologies (pyrogasification, hydrothermal gasification, etc.) that exploit non-competing resources, and in particular those that cannot be used for anaerobic digestion, could enable this production to be increased still further.

In accordance with the provisions of the French Climate and Resilience Act, the policy of support for injected biomethane, which until now has been essentially based on a budgetary system of compulsory purchase, is to be supplemented from 2026 by an extra-budgetary system consisting of a compulsory incorporation obligation imposed on natural gas suppliers, who will have to obtain and return biomethane production certificates (CPB) to the State. The final texts required for this system to come into force were published in July 2024.

Although the cost of producing biomethane is still three to four times higher than the cost of natural gas, as a renewable gas it meets the major climate challenge of decarbonising natural gas consumption, but also the challenge of energy sovereignty by replacing our fossil gas imports with domestic biogas production, as well as the economic challenges of providing stable, secure additional income for many farms and, more broadly, development opportunities for French companies that are well positioned in the sector.

ACTION GAS.1

SUPPORTING THE DEPLOYMENT OF RENEWABLE GASES

→ Define a trajectory for the obligation to surrender Biogas Production Certificates (CPBs) for the period 2028-2035, in line with the biomethane production objectives of the PPE 3, taking into account both the necessary decarbonisation of gas consumption and the impact on the cost to consumers in a context of a general increase in gas prices. A progress report on the CPB system will be drawn up by the end of 2027, focusing in particular on the operation of this new market and its impact on gas prices.

→ Adjust the level of public support from the open purchase obligation window (granted by tariff order) for small facilities whose forecast annual production is less than 25 GWh HCV per year, with the aim of ensuring an overall balance between budgetary and extra-budgetary support for the development of injected biomethane.

→ Reinforce controls on the proportion of main crops authorised for methanisation (currently set at 15%);

→ Examine, in consultation with the industry and taking account of competitiveness issues, ways of simplifying and facilitating the deployment of new renewable and low-carbon gas production sectors, while guaranteeing the sustainable use of the resources mobilised and the absence of conflicts of use

3.4.3. Hydrogen

Every year in France, around 900,000 tonnes of hydrogen are produced from fossil sources, around half of which is co-produced, mainly for refining, fertiliser production and the chemical industry.

To achieve carbon neutrality, we need to :

→ Decarbonising existing uses of hydrogen (excluding co-products), in particular by producing hydrogen through water electrolysis;

→ Meet new needs for carbon-free hydrogen by prioritising uses, both industrial and mobility, given the large volume of electricity required to produce hydrogen by electrolysis.

In 2020, France adopted an ambitious strategy to accelerate the deployment of hydrogen production by electrolysis and its use. This national strategy for the development of low-carbon hydrogen aims to master the entire value chain, its products and its key technologies. By supporting research and development projects through to industrialisation, as with the France 2030 programmes and the Major Project of Common European Interest (PIIEC) Hydrogen, the strategy aims to bring about the emergence of 5 gigafactories of electrolysers, as well as an industry of equipment manufacturers for hydrogen mobility.

Through the 2020-2021 recovery plan and the France 2030 investment plan, as well as the general budget, the French government has announced a commitment of almost €9 billion between now and 2030, with a dual objective of technological development and ecological transition.

The hydrogen strategy deployed since September 2020 has already supported around 300 MW of electrolysis capacity, both locally and on an industrial scale, in addition to the various investments already made across the value chain. However, this large-scale public effort at national level could prove insufficient to achieve the European objectives in this area, and efforts will be needed both from the private sector and via the European Union's financial instruments to support low-carbon hydrogen.

A number of consultations with all the stakeholders were held in 2023 and 2024, leading to the updating of the French hydrogen strategy.

The development of hydrogen produced by electrolysis will lead to an increase in the volumes of electricity passing through the electricity networks. To manage consumption peaks, the possibilities of reducing electrolysis consumption during these periods will be studied and encouraged. This reduction through occasional load shedding will contribute to the security of electricity supply. Flexible operating modes would also make it possible to concentrate hydrogen production during periods when cheap, low-carbon electricity is abundant, thereby optimising system operation. However, these possibilities presuppose the installation of hydrogen storage facilities to maintain a continuous supply of hydrogen to industrial customers.

The updated target is to install up to 4.5 GW of electrolysers by 2030. This capacity will be supplied by France's low-carbon electricity mix, or by dedicated renewable electricity production facilities, depending on the economic optimum to be found for each installation. This capacity will make it possible to support the production of electrolytic hydrogen in line with the long-term needs for low-carbon hydrogen identified in the SNBC.

ACTION GAZ.2

PROMOTE THE USE OF LOW-CARBON HYDROGEN IN INDUSTRY, IN LINE WITH EUROPEAN AMBITIONS.

The Renewable Energy Directive (RED III) sets ambitious targets for the share of carbon-free hydrogen consumption in industry and transport. France will promote the need for EU support for all low-carbon energies.

In addition to the various investments already made in hydrogen equipment, on 19 December 2024 the French government launched a support mechanism for the production of renewable, low-carbon hydrogen for industry.

ACTION GAZ.3

CONTINUE TO DEPLOY HYDROGEN PRODUCTION, AS A PRIORITY NEAR MAJOR CONSUMER CENTRES

Hydrogen production will be supported in three ways: (i) "centralised" consumption centres in the largest industrial hubs (Fos-sur-Mer, Dunkirk, the Chemical Valley and the Seine Valley), (ii) "semi-centralised" centres around smaller industrial hubs and, (iii) if the economic results are positive, a more diffuse activity, limited to specific use cases or to the need for a network for heavy or intensive mobility.

A special effort must be made to ensure that, by 2030, France's main industrial basins have the first production capacity for carbon-free hydrogen.

ACTION GAZ.4

ANTICIPATE THE DEVELOPMENT OF HYDROGEN :

Over the coming years, France will support the deployment of national hydrogen production. Priority development of the relevant infrastructures will be targeted at intra-hub networks to supply hydrogen consumers, and their connection to storage infrastructures, in order to optimise the production, storage and use of hydrogen within these industrial hubs. The hydrogen network will have to be developed alongside the existing methane networks, given the distinct characteristics of the two gases, and the need to continue to dedicate the majority of current transmission networks to transporting methane at least until 2035.

France will also continue the initial studies into the prospects and requirements for imports, which the French government currently considers to be limited, and their implications in terms of developing and financing a major transport network. These prospects could involve ammonia and other hydrogen derivatives in the future.

3.5. Electricity

Electricity currently accounts for just over a quarter of final energy consumption in France. The vast majority of this is decarbonised, thanks to nuclear generation (around by 2023) and renewable generation (around 29% by 2023) .[46]

Despite an overall fall in energy consumption, electricity consumption is set to rise sharply as a result of the electrification (direct or via hydrogen or e-fuel) of many uses (transport, heating, industry, etc.), accounting for more than 50% of our energy consumption by 2050. This means that **there will be a clear shift in the need to develop decarbonised electrical energies from 2025 onwards, and that nuclear power generation will need to be brought back up to its 2022 level.**

Figure 24 below shows the consumption scenarios studied by RTE in its latest forecast (2023-2035). Three scenario families were considered (see chapter 4 of the 2023-2035 Generation Adequacy Report for more details):

- prospective trajectories of successful acceleration ("scenario family A"), which jointly mobilise various essential levers to be associated with the electrification and reindustrialisation policy

[46] https://analysesetdonnees.rte-france.com/bilan-electrique-2023/production#Vuedensemble

(energy efficiency, sobriety, maximisation of nuclear production and acceleration of the development of renewable energies), making it possible to achieve the objectives set by the public authorities;

- a risk analysis of the consequences of a delay or lesser ambition on the various components of the reference scenario. Different trajectories (with less electrification, sobriety, renewable energies or energy efficiency) are analysed in a "family of B scenarios" which aims to quantify the consequences (in terms of greenhouse gas emissions, security of supply and the French economy) of a delay in achieving the objectives;
- Finally, the recent global crises in the geopolitical, energy and economic spheres, as well as the increased tensions in trade relations and supply chains, raise questions about the conditions for the success of an energy transition policy conducted in a more adverse global context. Accordingly, and in accordance with the work programme announced for 2021, RTE describes in this Generation Adequacy Report a "family of C scenarios" of "counteracted globalisation".

This panorama of possible scenarios illustrates the major uncertainties over the future trajectory of electricity consumption.

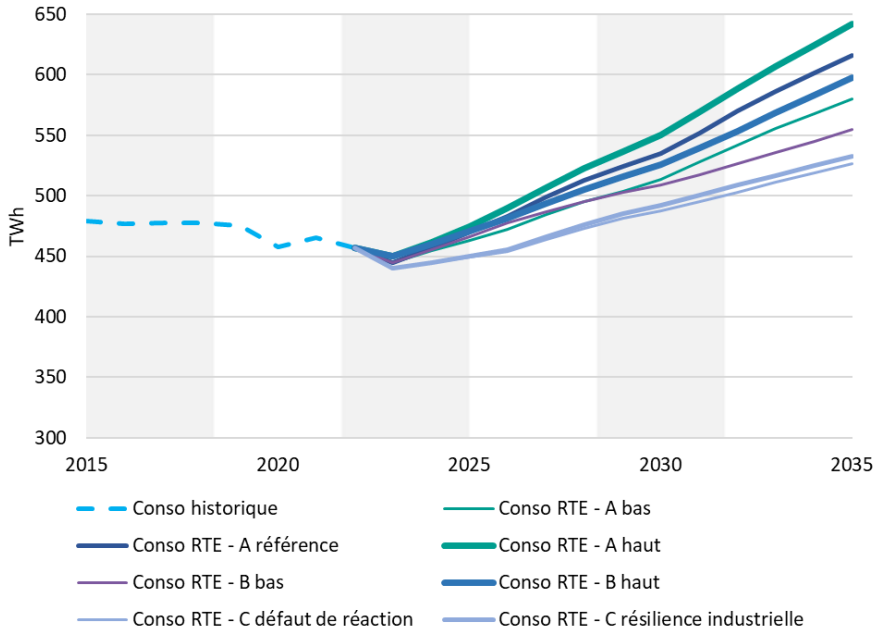


Figure24 . Projected electricity consumption in 2030 and 2035 (Source: RTE)

The level of electricity consumption used to size the French electricity generation system over the next 10 years is part of this range of possibilities. The SNBC 3 will therefore define a target trajectory for electricity consumption in order to achieve the first stage in the decarbonisation of our economy in the medium term. This target trajectory is based on a number of major assumptions: the reindustrialisation of our economy, improvements in energy efficiency, the electrification of energy uses, and so on. In addition, over and above the modelling exercises carried out to date, this exercise to define a target trajectory for consumption aims to better integrate the issues associated with the rapid development of digital technology, which will result in increases in electricity consumption. Overall, the final AMS scenario ("run 3") of the SNBC 3 should fall between A low and A scenarios RTE's (i.e. between 580 and 600 TWh of domestic consumption in 2035).ref

In order to cope with these increases in consumption, it is necessary to rely on an electricity mix based on the two pillars of low-carbon production available - nuclear, with increased production from the existing fleet and the construction of new reactors, and electric renewable energies, which will have to be developed significantly, powertaking into account the development times specific to each type of energy. Analyses, including those by RTE initially presented in its "report Energy Futures 2050" published at the end of 2021 and then confirmed by its 2023 forecast, have shown that logic of theadding productionlow-carbon , electricity through the development of renewable energies and the continued operation of existing nuclear reactors, increases the chances of achieving our climate targets and is economically efficient.

The EPP 3 defines objectives for each type of decarbonised electricity generation, in line with the work carried out by RTE, which has in particular endeavoured to define a development trajectory for electricity generation resources that will ensure the supply-demand balance at each point in time. Figure 25 below shows the electricity generation trajectory resulting from the objectives set by the EPP 3 for each type of generation.

It should be noted that, to ensure the supply-demand balance of the power system at all times, a generation margin must be taken in relation to the forecast level of consumption. In addition, the generation development trajectory has been defined so as to maintain a significant export balance by 2035. However, this surplus is likely to shrink in the years that follow as a result of the continued electrification of electricity consumption, and given the remaining uncertainties about consumption trajectories, we cannot rule out the possibility that consumption will grow faster than the target trajectory. Consequently, given the pace of development of the various means of production, which in practice sometimes proves to be longer than anticipated, as well as the risks of technical contingencies that could reduce the availability of certain means of production, **it is necessary to set ambitious targets for the development of means of production as of now, while ensuring that the development of electricity consumption is accurately controlled and monitored (see ACTION CONSO.7). The generation trajectory can be adjusted according to the observed trend in electricity consumption.**

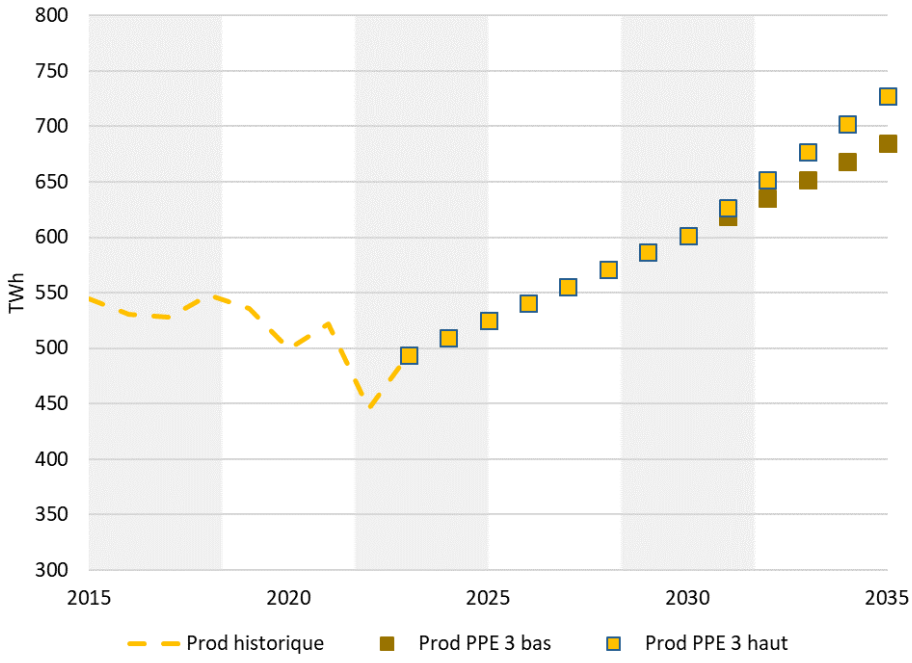


Figure25 Electricity generation projections for 2030 and 2035 (Source: DGEC modelling)

In addition to the projects already commissioned or well underway (Flamanville 3 reactor, onshore and offshore wind farms, photovoltaic projects) and the objective of restoring the availability of existing nuclear reactors :

- **Between now and 2030**, 4 additional new offshore wind farms resulting from tenders 1 to 3 will be commissioned (the Saint-Nazaire, Fécamp and Saint-Brieuc wind farms have already been commissioned), **bringing the total number of offshore wind farms in service to 7**. The development of additional onshore wind and photovoltaic projects, which are the only ones capable of making a significant contribution to the increase in low-carbon electricity production capacity by this date, will continue;
- **Between 2030 and 2035,** the commissioning of offshore wind farms that are currently being developed, awarded or planned, particularly following the planning exercise carried out in 2024, will make a significant additional contribution, with **around fifteen more offshore wind farms coming on stream**;
- **After 2035, the gradual deployment of the new EPR 2 and small modular or innovative nuclear reactors, as well as the continued operation of the existing fleet of nuclear reactors, will make** it possible to significantly bolster the electricity generation fleet, while continuing to develop renewable energies.

While the central scenario used in this document is a conservative one of nuclear generation of 360 TWh over the entire period, the objective given to EDF, and endorsed by the company's management as a managerial ambition, is to achieve annual nuclear generation in excess of 400 TWh. Like RTE in its Generation Adequacy Report, it has been decided to include in the modelling a conservative assumption of average annual generation of 360 TWh between now and 2035 in the event of unforeseen events. Compared with 2023, when nuclear generation was 320 TWh, this represents an increase in nuclear generation of 40 TWh in the median scenario and 80 TWh in the target scenario.

Priority will be given to investments that restore peak management capacity. Even if the total energy produced will not necessarily increase significantly because of the likely impact of climate change on water resources (reduced flow, multiple use of water), the development of total installed capacity will be a valuable lever for balancing the electricity system, both for peak consumption and for the total volume of production.

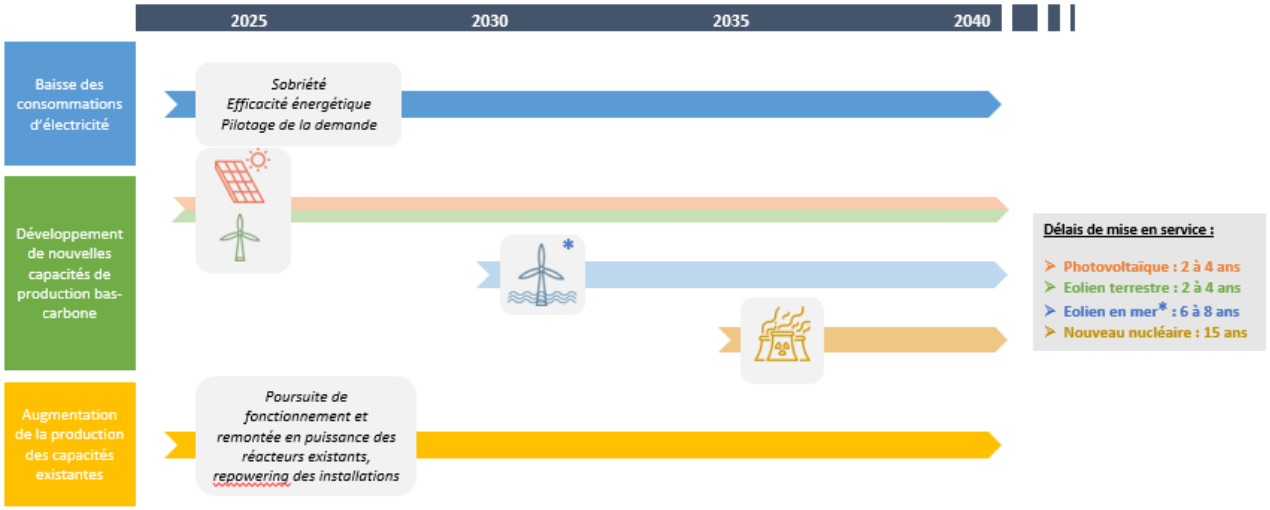


Figure26 . Temporality of the levers available to ensure the electricity energy loop[47]

The graphs below show the means of electricity production for the timeframes of the EPP when the measures set out in this EPP are adopted. In 2030, the EPP should lead to the production of around 217 TWh of electricity from renewable sources, 25 TWh from thermal sources and 360 TWh from nuclear sources, i.e. 36% of electricity production from renewable sources and 60% of electricity production from nuclear sources. In 2035, the EPP should lead to the production of at least 306 TWh of electricity from renewable sources, 19 TWh from thermal sources and 360 TWh from nuclear sources, i.e. 44% of electricity production from renewable sources and 53% of electricity production from nuclear sources.

Electricity mix, observed 2023 and low scenarios 2030 and 2035 of the PPE 3 :

[47] Offshore wind projects launched since 2010 will gradually join the production fleet, representing 3.6 GW in 2030, with 1.5 GW already in service by mid-2024. This graph therefore only shows the timeframe for the commissioning of new projects. This graph does not show the challenge of increasing nuclear output from the existing fleet, as it does not involve new capacity.

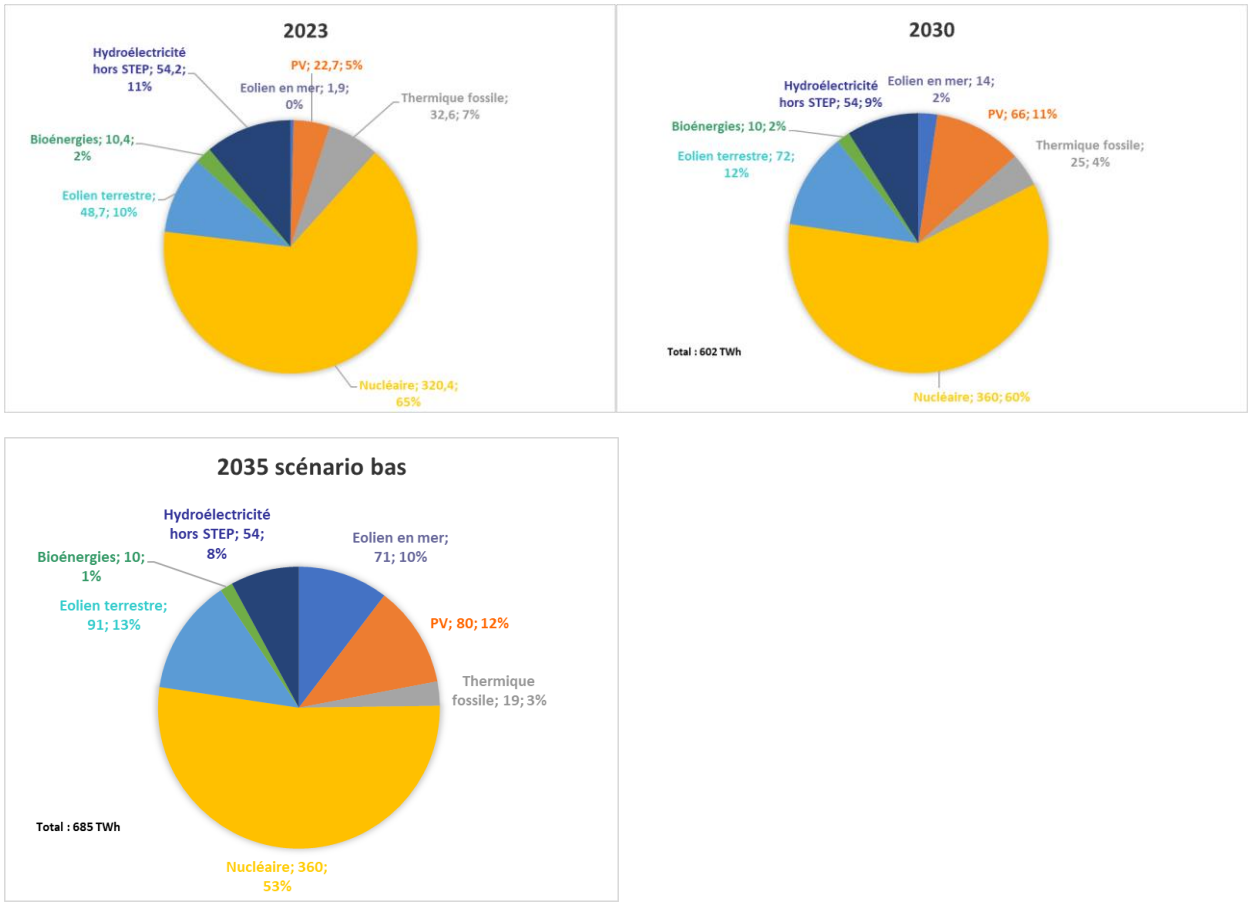


Figure27 . Electricity generation mix in 2023 and forecasts for 2030 and 2035 as set out in the PPE[48] (production volume of each type of electricity in TWh and share in the mix as a percentage)

Work currently underway on the third national plan for adapting to climate change **envisages incorporating the consequences of changes in consumption and production into planning exercises**energy: stress tests modelling situations extreme(heatwave or cold spell combinedwith periods without wind) will make it possible to estimate the resilience of the .electricity Modelling is carried out by RTE during the preparation of the Generation Adequacy Reports. system

[48] In accordance with article L. 141-4 of the Energy Code, the multi-annual energy plan will be updated at least every five years, to ensure that production and consumption targets are consistent up to 2035.

3.5.1. Renewable electrical energy

In 2030 and 2035 respectively, it will be necessary to **produce around 80 TWh and between 168 and 210 TWh more electricity from renewable energies** than in 2023 to meet the growth in demand and ensure our security of supply. This will be made possible by the determined deployment of all types

ACTION ELEC.1

UPDATE OF THE ASSESSMENT OF THE IMPACT OF CLIMATE CHANGE ON THE SYSTEM ELECTRICAL

When the Energy Futures 2050 report is updated in 2026, incorporating the objectives of EPP3, RTE will update its climate models in its assessments of the impact of climate change on the power system, ensuring consistency with TRACC. These changes will make it possible to comply with the most recent scientific standards in collaboration with various energy and climate players at European level (work on the Pan-European Climate Database carried out with Copernicus and ENTSO-E) and will aim in particular to move to a multi-model approach and to consider an evolving climate according to the time horizons studied. In particular, RTE will update :

- studies of exposure to climate change and the vulnerability of production across all sectors, and in particular the wind and photovoltaic sectors, based on climate scenarios that take account of the full spectrum of possible eventualities over different time horizons, including an assessment of the consequences of low-probability scenarios;
- studies on the prospects for changes in the availability of water resources and their consequences for electricity generation, taking particular account of the results of the Explore 2 study.

of renewable energy (photovoltaic, wind and hydroelectric)**, reaching around 117 GW in 2030 and between 152 and 182 GW in 2035.**

The EPP3 therefore reinforces the development of electric renewable energies and the following capacity targets (GW) have been set:

INSTALLED CAPACITY IN GW	2023[49]	2030	2035
PHOTOVOLTAIC	19,3	54	65 à 90
ONSHORE WIND	21,9	33	40 à 45
OFFSHORE WIND ENERGY	0,84[50]	3,6	18
HYDRO-ELECTRICITY (INCLUDING STEP)	25,9	26,3	28,7

[49] Data source SDES, see summary table 1.5.
[50] Value declared on 31/12/2023 to calculate the amount of offshore wind tax paid in 2024

If the above trajectories are adhered to, between 180 and 210 TWh more electricity will be generated from renewable sources in 2035 than in 2023.

ENERGY GENERATED IN TWh[51]	2023[52]	2030	2035
PHOTOVOLTAIC	22,7	~66	80 - 110
ONSHORE WIND	48,7	~72	91 - 103
OFFSHORE WIND ENERGY	1,9	~14	~71
HYDRO-ELECTRICITY (EXCLUDING STEP)	54,2[53]	~54	~54
BIOENERGIES FOR POWER GENERATION	10,4	10	10
TOTAL	138	217	306 - 348
			i.e. +168-210 TWh compared with 2023

[51] The load factors used: 14% for PV, 25% in 2030 and 26% in 2035 for onshore wind and 45% for offshore wind.

[52] Data source SDES, see summary table 1.5.

[53] The energy value is subject to hydrological hazards, which can cause production to vary by almost 20% from one year to the next.

cross-cutting measures The EPP includesfor all electric renewable energies:

ACTION ENR ELEC.1

CONTINUING TO SUPPORT RENEWABLE ENERGY INDUSTRIES AND SECURING SUPPLIES OF RAW MATERIALS

→ Support projects to relocate key industrial sectors for the energy transition (solar, onshore and offshore wind, geothermal, heat pump, network industry), following on from the working group for the reindustrialisation of renewable sectors launched in January 2023 in :

- formalising an industry pact for key sectors, along the lines of the solar and offshore wind pacts
- mobilising all the facilities available under the Net Zero Industry Act, particularly in terms of organising calls for tender, to strengthen their strategic autonomy and resilience, making greater use of non-price criteria without jeopardising the competitiveness of projects.
- supporting innovation and the structuring of industrial sectors contributing to the energy transition and the large-scale development of renewable energies, in particular with the tools of the France 2030 Plan, the measures of the Green Industry Act of 23 October 2023, and the Green Industries Tax Credit (C3IV).

→ Pursue our strategy to secure supplies of critical metals for the energy transition (lithium, nickel, cobalt, copper, aluminium, rare earths, etc.) in order to control their value chains, from extraction to recycling. France has adopted a strategy to secure supplies of raw materials, including ores and metals, for its industrial value chains, in line with the European regulation on critical raw materials. This concerns both primary raw materials, extracted from the mine and then processed, and secondary critical raw materials obtained through recycling. The strategy aims to increase knowledge of the French value chains and identify the needs of the industrial sectors that are essential for France, develop the broadest possible national production offer (from extraction to processing and recycling), and secure and diversify supplies through bilateral partnerships with producer countries and the creation of a dedicated investment fund with a budget of €2 billion, to which the State will contribute €500 million. These actions are in addition to support for projects via the France 2030 "critical metals" call for projects, the green industries tax credit (C3IV) and the investment fund set up by the State in 2023, and an update of the national mining inventory, through the launch of a campaign to identify our subsoil resources starting in 2024

→ Identify skills requirements and set up forward-looking skills management plans in partnership with the State, the Regions and the industry, to attract, train and recruit the people needed to meet the objectives.

→ Renewable energy support schemes should include measures to encourage the recycling of components.

ACTION ENR ELEC.2

OPTIMISING PUBLIC SUPPORT SCHEMES WITH A VIEW TO CONTROLLING PUBLIC SPENDING

→ Optimise support systems to enable the optimum development of renewable energy projects at a controlled cost, particularly in the case of self-consumption by private individuals.

→ Evaluate the benefits of using mixed tenders, in which the remuneration supplement contract covers only part of the energy produced by the installation, with regard to the objective of securing projects and optimising public spending.

ACTION ENR ELEC.3

ACCELERATE LOCAL RENEWABLE ENERGY PLANNING UNDER THE 2023 LAW TO ACCELERATE RENEWABLE ENERGY PRODUCTION (APER)

→ Support local authorities in the definition of the renewable energy acceleration zones provided for by law, and the Regions in the work of the regional energy committees and the updating of their regional planning, sustainable development and territorial equality schemes (SRADDET) (see § 7.2 on mobilising the territories).

→ Encourage the consideration of biodiversity and landscape issues at the planning stage of renewable energy projects, in line with the guidelines of the National Biodiversity Strategy.

In addition to the launch of RFPs, the EPP sets **indicative targets for the development of industrial production capacity for** components and equipment in France for electricity generation facilitiesrenewable

Industrial production capacity **At 31/12, in GW/year**	**2030**	**2035**
Photovoltaic		
Modules	5	5 à 10
Cells	5	5 à 10
Wafers	3	3 à 5
Ingots	3	3 à 5
Offshore wind power		
Blades	2	2 à 3
Aerial work platforms	2	2 à 3
Floating foundations	1	1 à 2
Permanent magnets	1	1
Substations	1	1 à 2

HVDC cables	2	2

No indicative target has been set for **small-scale hydropower**, whose value chain is already largely French or European.

With regard to **onshore wind power**, particular attention will be paid to maintaining a French or European value chain, as is currently the case. To this end, the authorisations granted (in terms of both models and machine sizes) will have to be compatible with this industrial objective.

3.5.1.1. Photovoltaics

The aim is to gradually increase the rate of development of solar power to at least 5.5 GW/year, compared with 3 GW/year in the previous EPP, with a target of 7 GW/year, in order to achieve the above-mentioned targets for installed capacity in 2030 and 2035. This rate is initially set at 4 GW of installed capacity per year, i.e. around 5 GW of capacity to be allocated or contracted per year. It will be adjusted from 2028-2029 onwards, to be increased if necessary to a maximum of 7 GW/year, taking account in particular of forecasts for changes in electricity consumption and the development of flexibilities, in order to ensure an optimum contribution to the supply-demand balance.

Photovoltaic projects on buildings and shading systems on car parks make it possible to minimise conflicts of use by creating synergies (provision of shade, self-consumption, etc.). It will be important to encourage the development of these projects through the obligations introduced by the Climate and Resilience Act and the Acceleration of Renewable Energy Production (APER) Act, as well as by introducing appropriate financial incentives.

As the potential for low-cost projects on buildings is limited, we also need to develop ground-mounted photovoltaic systems, while limiting the impact of installations on natural, agricultural and forestry (NAF) areas, which are severely restricted by the Climate & Resilience Act (limitations on the consumption of NAF space, even though exemptions from space consumption have been introduced for photovoltaic systems on natural and agricultural areas) and the APER Act (severe restrictions on land eligible for ground-mounted photovoltaic development). Agri-voltaics, an emerging but promising sector, will be an important lever for achieving our photovoltaic development objectives, while providing direct services to agriculture, and thus promoting the resilience of the farming world, provided that the costs are kept under control.

ACTION PV.1

PROMOTE A BALANCED DISTRIBUTION OF PHOTOVOLTAICS BETWEEN LARGE AND SMALL PHOTOVOLTAIC ROOFS, LARGE AND SMALL GROUND-MOUNTED POWER PLANTS, AND AGRIVOLTAICS

→ Work towards a **balanced distribution, taking into account the potentially higher costs of certain technologies and the need to minimise conflicts of use and impacts** (maximum use of derelict and degraded land, use of agrivoltaics).

As a rough guide, the breakdown would be as follows:

- 41% on small and medium-sized roofs
- 5% on small ground-mounted installations
- 54% from large-scale installations, corresponding to 38% ground-mounted and 16% roof-mounted. The exact share of agrivoltaics in this target remains to be refined, depending on the deployment possibilities of these installations, other photovoltaic installations and the needs of the farming community (see below).

The development of these different types of photovoltaics is likely to be concomitant.

→ Support the emergence of agrivoltaic projects following the recent introduction of the regulatory framework for agrivoltaics under Article 54 of the APER law and continue to encourage its development.

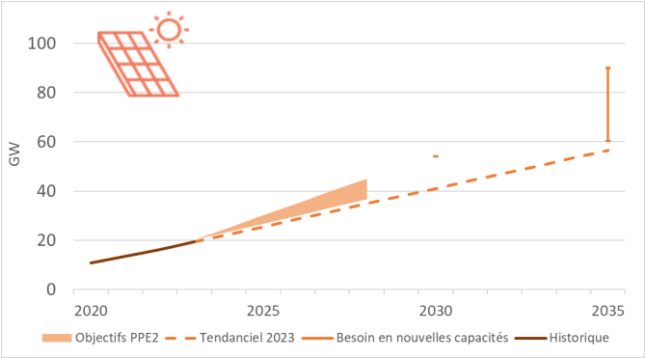
→ Adapt public support schemes in line with the target distribution, taking into account the size of projects and encouraging their industrial spin-offs (cf. ENER ELEC 1).

→ Introduce support by tariff decree for ground-based photovoltaic projects with a capacity of less than 1 MWp.

The annual rate of capacity to be allocated or contracted[54] (in GW per year) could be as follows in order to meet the 2030 target:

2025	2026	2027	2028	2029	2030
5	5	5	6,875*	7,5*	7,5*

** These targets could be adjusted to take account of forecasts for changes in electricity consumption, the development of other means of production and the development of flexibilities, without being less than 4 GW per year. A simplified revision of the EPP could be carried out at the end of 2027 for this purpose.*



In order to contribute to the above objectives, it is planned to launch the following tendering procedures for photovoltaics until 2035:

- for ground-mounted photovoltaic: two calls for tenders per year for a total of around 1 GW per period (excluding renewals) from the first half of 2025;
- for photovoltaic systems on buildings: three calls for tenders per year for a total of around 300 MW per period (excluding renewals) from the first half of 2025; these volumes may be adjusted depending on changes to other support schemes;

These calls for tenders will be supplemented by one technology-neutral call for tenders per year, i.e. for photovoltaic, hydroelectric and onshore wind power, for a total of around 500 MW per period.

For agri-voltaics, depending on the economic maturity of the sector, these projects will be supported through the ground-mounted PV and building-mounted PV RFPs, or through a dedicated call for tenders, the power of which will be deducted from that allocated to the previous calls for tenders. A technology-neutral call for tenders (photovoltaic, onshore wind, hydroelectric) will round out the system, with around 500 MW per year.

Focus on agrivoltaics :

[54] Assuming a 20% fall-off in projects

Article 54 of the law on the acceleration of renewable energy production published on 10 March 2023 distinguishes :

- agrivoltaic projects must provide a direct service to farming (one of the following 4: improving agronomic potential and impact, adapting to climate change, protecting against hazards, improving animal welfare) and guarantee the maintenance of a significant main agricultural activity and a sustainable income from it. Agrivoltaic installations must be reversible. (L. 314-36 of the French Energy Code).
- photovoltaic projects that are compatible with agricultural, pastoral or forestry activity (known as "compatible PV"), which may only be authorised on land identified in a departmental framework document drawn up on the recommendation of the departmental chamber of agriculture and identifying, in particular, uncultivated land or land that has not been farmed for at least ten years (R. 111-57 of the town planning code). These facilities must also be reversible (L. 111-29 and L. 111-32 of the Town Planning Code).
- the installation of greenhouses, sheds and shadehouses for agricultural use supporting photovoltaic panels. Their installation must be "necessary for the exercise of a significant agricultural, pastoral or forestry activity". Article L. 111-28 of the French Town Planning Code is designed to regulate the simultaneous installation of a greenhouse, hangar or shade house with a photovoltaic installation above it. The installation of photovoltaic panels on an existing greenhouse, hangar or shade house does not fall within its scope.

The various provisions of the law were supplemented by a Conseil d'Etat decree, signed on 8 April 2024, accompanied by a decree on the development of agrivoltaics and the conditions for installing photovoltaic installations on agricultural, natural or forest land, signed on 5 July 2024.

Because of the size of France's agricultural area (26.7 million hectares), agricultural land is a powerful lever for the development of photovoltaics (ground-mounted or agrivoltaics). As an order of magnitude, less than 1% of France's utilised agricultural area would be required to meet photovoltaic development targets if these targets were to be met solely from agrivoltaics (assuming a ratio of 0.5MW/ha). Given that other photovoltaic development vectors need to be activated as a priority (car parks and buildings, wasteland and derelict land), only a very small proportion of the usable agricultural area will need to be mobilised to achieve the photovoltaic development targets. As is first and foremost a tool for serving agricultural activity, development targets will also depend on the needs of the farming community. Ground-mounted photovoltaic systems, agrivoltaics excluding agrivoltaics, will be severely restricted by the provisions of article 54 of the APER law.

ACTION PV.2

SETTING UP FACTORIES IN FRANCE

France has a number of plants on its territory, which should make it possible to produce up to 10 GW of components in various strategic links in the value chain by 2035 (3 to 5 GW in the silicon value chain, 3 to 5 GW of ingots & wafers, 5 to 10 GW of cells and modules).

This will have to be done with a view to controlling public spending.

3.5.1.2. Onshore wind power

To achieve the objective of maintaining the rate of development of onshore wind power at around +1.5 GW/year, with a more balanced distribution between regions, the measures set out in this EPP are as follows:

ACTION EOL TERR.1

MAINTAINING THE PACE OF DEVELOPMENT OF ONSHORE WIND POWER WHILE MAINTAINING HIGH ENVIRONMENTAL QUALITY

→ Continue with calls for tenders in order to ensure sufficient profitability for projects and thus support the development of onshore wind power, taking projects into accountrepowering , in order to achieve the objective of maintaining the rate of development at around +1.5 GW/year.

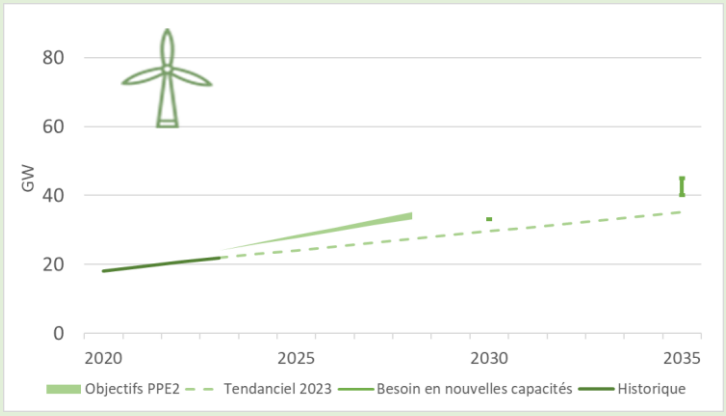
→ Enable the continued use of a European onshore wind energy industry, by taking account of this objective in calls for tender and when authorising wind farms (NZIA regulation, size of machines, etc.).

→ Invest in research and innovation programmes to reduce the impact of wind turbines on avifauna, in particular by studying and improving the effectiveness of detection-reaction systems.

→ Put in place a system to reduce light pollution, for example by means of detailed beaconing depending on the presence of aircraft in the vicinity of the wind turbines.

→ In addition to the mechanism introduced in the APER law, set up a planning system for the development of compensation radars to free up areas for onshore wind power in zones subject to servitudes by military and weather radars, in particular by allowing costs to be shared.

→ Develop the work of the Renewable Energy and Biodiversity Observatory set up by the OFB and ADEME, to capitalise on knowledge of the impacts of renewable energy projects and best practices for minimising them.



In order to contribute to the above objectives, it is planned to launch the following competitive tendering procedures for onshore wind power until 2035: two invitations to tender per year for around 900 MW per period (excluding renewals) from the first half of 2025.

These calls for tenders will be supplemented by one technology-neutral call for tenders per year, i.e. for photovoltaic, hydroelectric and onshore wind power, for a total of around 500 MW per period.

3.5.1.3. Offshore wind and other marine renewable energies

ONE OBJECTIVE: TO AIM FOR 18 GW OF INSTALLED CAPACITY BY 2035, BY DRAWING UP A PLAN FOR EACH COASTLINE, LAUNCHING PROCEDURES LEADING TO THE ALLOCATION OF UP TO 10 GW OF ADDITIONAL CAPACITY BY THE END OF 2026, AND CONTINUING TO DEVELOP THE FLOATING WIND ENERGY SECTOR.

Installed offshore wind capacity in 2030 is expected to be 3.6 GW, and the procedures for tenders 4 to 9, currently underway or awarded, will make it possible to reach a total capacity of around 10.5 GW in the following years. **The challenge will then be to achieve the target set out in the Offshore Wind Pact of 18 GW commissioned by 2035, via one or more multi-GW tenders, while creating the conditions for further ambitious development in the years that follow.**

While the development of offshore wind power has accelerated significantly since 2019, with extensions already identified for some wind farms, long-term planning is needed to achieve a target of more than 45 GW by 2050. **To this end, a public debate was held on the four coastlines of mainland France, from 20 November 2023 to 26 April 2024, under the aegis of the National Commission for Public Debate (CNDP)**, to discuss issues relating to the future of the sea, the coastline, marine biodiversity and offshore wind power. In particular, it aimed to **plan the priority project areas to be allocated under the current EPP, as well as to pre-identify areas** potentially larger **for longer-term projects (between 2040 and 2050). These different zones were included in the interministerial decision of 17 October 2024.**

In order to secure the trajectory to 2035, the EPP 3 provides for the allocation of an additional 8 to 10 GW[55] by the end of 2026 (AO10), in locations identified at the end of the public debate. In line with the objectives of the Offshore Wind Pact, one or more new calls for tenders of equivalent size could be launched between now and 2030, so as to reach at least 26 GW in service by 2040.

[55] Subject to grid connection capacity.

Call for tenders	Provisional award date	Power	Location	Cumulative offshore wind power capacity
AO7	Early 2025	1.2 GW	South Atlantic	6.6 GW
AO8	Early 2025	1.5 GW	Centre-Manche	8.1 GW
AO9	End of 2025	2.7 GW	Southern Brittany (0.5 GW) Mediterranean (2x0.5 GW) South Atlantic (1.2 GW)	10.8 GW
AO10	End of 2026	At least 8 GW	Multi-façade	18 GW in service by 2035
AO11 and above	2030-2031	According to AO10*.	Multi-façade	26 GW in service by 2040 45 GW in service by 2050

* to reach at least 26 GW

The geographical breakdown and the split between land-based and floating technologies for the wind farms in tenders 10 and subsequent tenders is detailed in the map attached to the interministerial decision of 17 October 2024.

In addition to the **objective of a cumulative capacity of 26 GW allocated by 2030-2031, it will be necessary to continue the rate of allocation, in line with the objective of at least 45 GW in service by 2050**. The location of the wind farms needed to meet the 2050 target will be the subject of new phases of public participation, in particular during the revision of the strategic documents for the French coastline.

With regard to other marine renewable energies**, a 250 MW tidal turbine tender will be launched in the Raz Blanchard area, with the aim of awarding the contract by 2030.** Depending on the results of the first tender and changes in the cost of the technology, **one or more additional tenders** may be launched, particularly in the same area. The timing will depend on the network studies launched by RTE for the connection of these projects.

These projects will be carried out with a high level of consideration for environmental issues, particularly with regard to birdlife, and fishing.

ACTION ENER MAR.1

MOVING FROM A PROJECT-BY-PROJECT DEVELOPMENT APPROACH TO OVERALL PLANNING FOR EACH SEAFRONT

→ Fully include offshore wind power in the revision of the maritime façade strategies to be adopted in 2025, by defining maps relating to the development of offshore wind power (following the public debate "la mer en débat" of 2024) taking into account the various issues (technical constraints, environment, landscape, fisheries...) in accordance with the decision of 17 October 2024.

→ Anticipate technical studies to characterise sites and initial environmental conditions in project areas and the work required for connection upstream of competitive tendering procedures for offshore wind farms.

→ Launch and award by the end of 2026 a tender for around 8 to 10 GW of offshore wind[56] (including floating and land-based projects), in the areas resulting from the offshore wind planning exercise conducted in 2024, so as to ensure that 18 GW commissioned by 2035 is achieved.

→ Launch and award one or more invitations to tender by the end of 2030, in the areas resulting from the offshore wind planning exercise carried out in 2024, so as to reach 26 GW commissioned in 2040.

→ Support the adaptation of the metropolitan port system to the development of offshore wind energy, particularly floating wind energy.

→ Disseminate the results of the studies launched by the Offshore Wind Observatory since 2022 so as to avoid, reduce and compensate for the impacts of future projects.

→ A **250 MW tidal turbine tender will be launched in the Raz Blanchard area, with the aim of awarding the contract by 2030.** Depending on the results of the first call for tenders and changes in the cost of the technology, **one or more additional calls for tenders may be launched, particularly in the same area**. The timing will depend on the network studies launched by RTE for the connection of these projects.

→ Continue to monitor the potential, cost and feasibility of other marine renewable energies (including osmotic and wave energy).

ACTION ENER MAR.2

CREATING MANUFACTURING AND ASSEMBLY CENTRES IN FRANCE

France is supporting the modernisation of existing industrial sites (manufacture of blades and nacelles) and the development of industrial facilities for the manufacture of foundations and turbines, and their key sub-components (permanent magnets, etc.), as well as the equipment needed for connection to the grid (offshore substations, high-voltage connection cables), and the adaptation of the metropolitan port system to the service of wind farm development and

56 Subject to grid connection capacity.

maintenance. In particular, the strategy aims to create centres for the manufacture and assembly of floats and their sub-components, and for turbine-float integration, in order to achieve a production capacity of at least 500 MW/year on each coastline by 2030, with a view to commissioning 18 GW in 2035 and 45 GW in 2050.

3.5.1.4. Hydropower

Hydroelectricity is currently the leading source of renewable electricity in France (more than 40% of renewable electricity production and a total capacity of 25.9 GW in 2023). **The aim is to increase installed capacity by 2.8 GW by 2035, largely on existing installations. This 2.8 GW will include around 1,700 MW of pumped storage power stations - essential for increasing our electricity storage capacity - and, as an indication, around 610 MW on installations of more than 4.5 MW and 440 MW on installations of less than 4.5 MW.**

The third national plan for adapting to climate change provides for a number of actions to ensure the resilience of hydroelectric production facilities while maintaining a high level of production. These actions are envisaged within the framework of managing the stock of facilities of varying ages:

i. Continue with the integration by operators of studies to estimate the consequences of climate change on hydrology (Explore2 and its derivatives).
ii. Continue to take account of the effects of climate change, in terms of the safety of structures, in particular through regular updates of hazard studies and bringing hydraulic structures into compliance.
iii. Integrate other water resource issues within hydroelectric reservoirs, with studies on the subject of multi-purpose WWTPs.

ACTION HYDRO.1

INCREASING THE HYDROELECTRIC CAPACITY AND FLEXIBILITY OF THE ELECTRICITY FLEET (INCLUDING STEPS)

→ Increase large-scale hydropower capacity (above 4.5 MW - and including the development of STEPs) by **almost 2,300 MW by 2035**, in particular by optimising and over-equipping existing facilities through, for example, adapting the existing regulatory and economic framework and resolving the pre-litigation issues surrounding the renewal of hydropower concessions.

→ **Continue with calls for tenders or tariff decrees to support the development of small-scale hydroelectricity and introduce a support scheme for the renovation of authorised hydroelectric facilities** in operation**, to increase capacity by almost 440 MW by 2035**, while maintaining a high level of protection for biodiversity and the natural functions of watercourses, and giving priority to projects with the least impact on aquatic environments and water quality, in line with France's European commitments.

3.5.1.5. Electricity generation from bioenergy

Biogas was first developed in the form of combined heat and power (CHP), but is now mainly used for direct injection into networks, where it is more efficient.

Support for new biogas cogeneration plants to produce electricity will no longer be possible, given this move towards injection and the costs of this process. For these facilities, work will be carried out on their conversion to injection.

However, in order to encourage the methanisation of livestock effluent as close as possible to farms and with the aim of reducing greenhouse gas emissions from the agricultural sector, the production of bioNGV on the farm and the transport of biogas or biomethane could be encouraged, particularly when the biomass available is too far from the sites for connection to the network.

3.5.2. Self-consumption and local energy production

Self-consumption means that an electricity producer consumes all or part of the electricity produced by its installation itself. There are two main categories of self-consumption:

- **Individual self-consumption** is defined in article L. 315-1 of the Energy Code as "*the fact that a producer, known as a self-producer, consumes all or part of the electricity produced by his installation himself on the same site*".
- **Collective self-consumption**, as set out in article L.315-2 of the Energy Code, occurs when *"the supply of electricity is made between one or more producers and one or more final consumers linked together within a legal entity"*. Collective self-consumption can be described as extended when the participants are not on the same site but meet the criteria, in particular geographical proximity, defined by order. The order of 21 November 2019 sets a maximum power of 3MW (0.5MW in ZNIs) and a maximum distance of 2km between the most distant participants for a single operation. This maximum distance may be extended to 10 and 20 km in rural and peri-urban areas.

Self-consumption of electricity is a fast-growing model, based mainly on photovoltaic operations. Most of these are small-scale projects run by private individuals, SMEs or local authorities. At 30 June 2024, there were almost 500,000 individual self-consumption installations, an increase of 79% in one year**, with a total installed capacity of 2.6 GW**. In terms of collective self-consumption, there were more than 400 active operations with a total installed capacity of almost 30 MW. The rate of deployment of these operations is also high, and their number is doubling every year .[57]

Self-consumption contributes to the development of new low-carbon renewable energy production capacity. By bringing production and consumption closer together, it putsback consumers at the heart of energy issues and gives them a stake in the development of renewable energies. It also brings other benefits:

- **Controlling electricity bills and strengthening energy independence:** For consumers, the impact on costs is direct, with electricity bills stabilised and reduced on the basis of the production costs of their facilities. As a result, they have better visibility of electricity costs and are less dependent on fluctuating market prices, at least for part of their consumption. Finally, they are encouraged to organise their consumption in line with production times.

[57] According to figures from the French ecological transition observatory run by Enedis (which covers around 95% of the distribution network)

- **Creating social links and local roots:** Self-consumption, whether collective or individual, makes it possible to offer local energy, by bringing production and consumption locations closer together. It can be a tool for local authorities to strengthen local synergies between different players in a given area. In this way, local authorities, private individuals and SMEs can work together on an energy project that provides them with shared benefits, particularly in economic terms.

While it does not seem appropriate to set a target for the development of self-consumption as such, it is important to make self-consumption part of the energy transition for the development of all types of renewable energy (photovoltaic in particular, but also onshore wind power, etc.).

ACTION AUTOCONSO.1

MAKING SELF-CONSUMPTION PART OF THE ENERGY TRANSITION LANDSCAPE FOR THE DEVELOPMENT OF ALL TYPES OF RENEWABLE ENERGIES

→ Maintain government support for self-consumption by homes, local authorities and businesses

→ Plan to re-examine the economic model for self-consumption in order to adjust support schemes.

The government **is committed to developing this sector, in particular by making it easier for local authorities to use collective self-consumption** (exemption from the obligation to set up an annexed budget, the possibility of increasing the geographical scope of collective self-consumption operations, etc.)**, but also by supporting self-consumption in calls for tenders,** with specific provisions, as well as in tariff decrees.

The development of energy projects based on local and shared governance must also be encouraged, to give local and regional authorities the tools they need for a successful energy transition. Rating criteria linked to "shared governance" and "collective financing" have therefore been incorporated into calls for tenders for onshore renewable energies, valuing projects led by local communities or citizens.

In addition, since the publication of the decree of 26 December 2023, the structuring of energy communities, whose main objective is to generate social, environmental and economic benefits for the regions, has been regulated and facilitated. These initiatives illustrate France's commitment to promoting local, innovative solutions in line with its climate and energy ambitions.

3.5.3. Nuclear power

France's nuclear fleet comprises 57 electricity-generating reactors at 18 different sites, with an installed capacity of 62.9 GWe. These reactors, operated by EDF, are all based on the same technology known as "pressurised water" and are divided into different standardised levels depending on the power of the reactors:

- 32 900 reactors MWe;
- 20 1300 reactorsMWe ;
- 4 reactors of 1450 MWe ;

- 1 1650 reactorMWe , the Flamanville 3 EPR technology reactor, commissioned in May 2024.

By 2023, the nuclear fleet was generating 320 TWh, or around 65% of France's total electricity output.

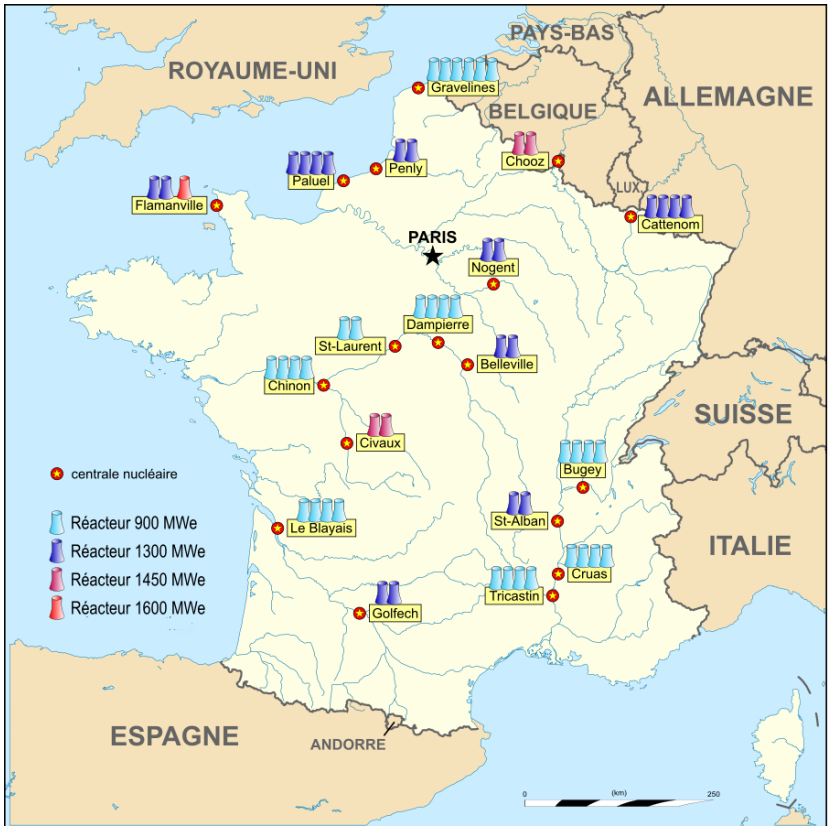


Figure28 . French nuclear power reactors in operation in 2024

The operating licence issued for each nuclear reactor is not limited in time. In addition to regular shutdowns for maintenance and refuelling, every ten years EDF must carry out a full safety review of each reactor, during which compliance with the initial authorisation is verified. Here too, safety improvements are implemented to achieve a higher level of requirement. This level is continually reviewed by the French Nuclear Safety and Radiation Protection Authority (ASNR) on the basis of experience feedback, best available techniques and the work of the International Atomic Energy Agency (IAEA). At the end of each review, the ASNR decides whether the reactor in question should continue to operate.

Of the reactors in operation in 2024, 52 were commissioned during a period of around 15 years between 1979 and 1994. At the end of 2023, the operating life of reactors in service in France was between 21 years (Civaux 2) and 44 years (Bugey 2), with an average of 37 years.

The choice of a strategy for managing the timetable for the final shutdown of the oldest reactors is an important issue. In its report "Futurs Energétiques 2050", RTE indicates that a marked reduction in nuclear production capacity by 2050 would make security of supply dependent on risky technological and industrial bets (risk of a "cliff effect"). Maintaining the option of retaining a significant proportion of nuclear-generated electricity in the French mix by 2050 requires a shutdown schedule for existing reactors that is compatible with the commissioning of new production capacity, in order to ensure that needs are covered.

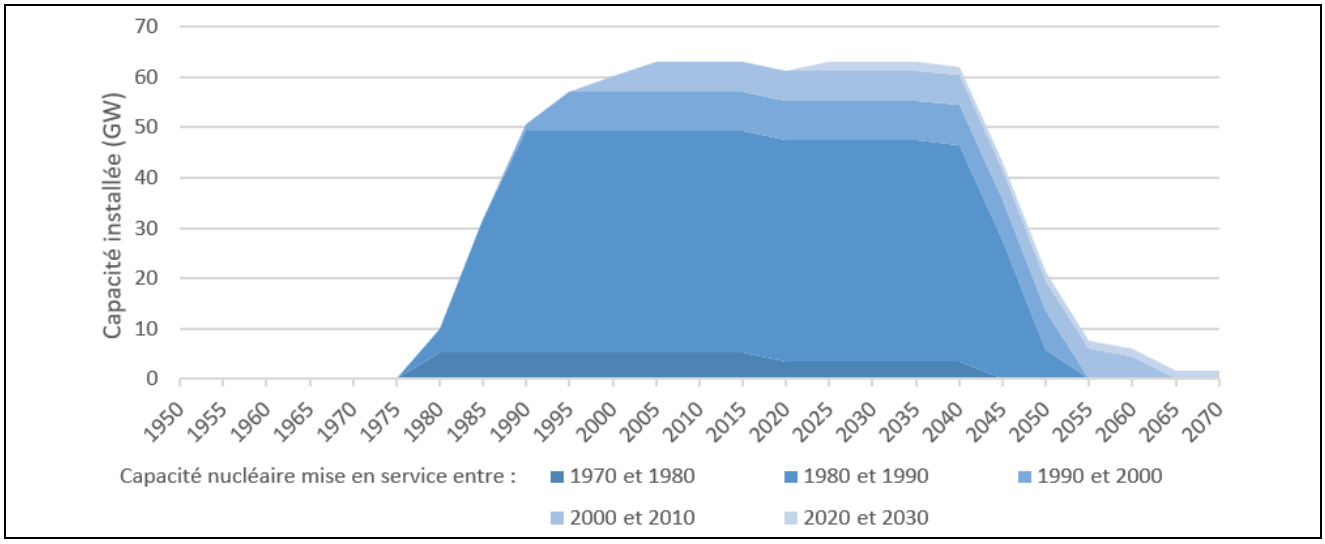


Figure29 . Illustration of the risk of a "cliff effect" in the event of a large number of reactors being shut down over a relatively short period.

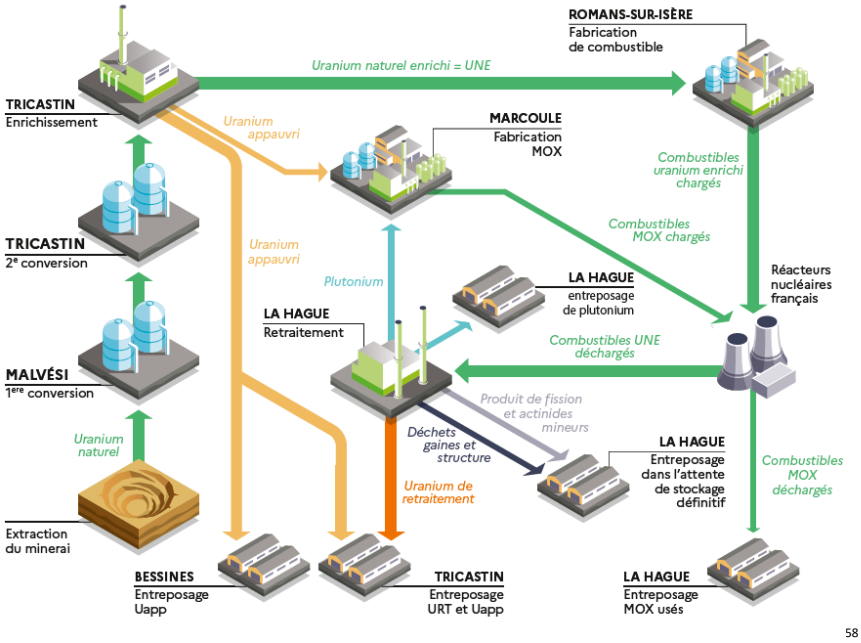
In addition, with a view to shutting down most of the reactors currently in operation over a relatively short period, the 2019-2028 multiannual energy plan (PPE2) has asked the nuclear industry to study ways of building new capacity:

- The EPR2 reactor, developed by EDF, is the technology available in the short term in the high-power segment (around 1,650 MWe). It is adapted to the characteristics of the French electricity grid.

- The development of Small (SMRsModularReactors), with outputs ranging from a few tens of MWe to around 300 MWe, has also been launched at less advanced stages of maturity, in particular with the support of the France Relance and France 2030 plans. This low-power offer could complement the high-power reactors and would also be intended for export.

Lastly, Act no. 2023-491 of 22 June 2023 on the acceleration of procedures relating to the construction of new nuclear facilities near existing nuclear sites and the operation of existing facilities repealed the target of a 50% nuclear share of the electricity mix by 2035.

France also has an industry that covers the manufacture and supply of fuel to reactors and the management of spent fuel, from ore extraction to waste management, including the reprocessing and recovery of spent nuclear fuel.



58

Figure30 . French nuclear fuel cycle facilities in 2024

The fuels used in nuclear reactors are most often composed of enriched natural uranium oxide (UNE). Spent UNE fuel can be reprocessed on an industrial scale at the La Hague plant (Manche). Plutonium from reprocessing is used at the plant Mélox in Marcoule (Gard) to manufacture fuelMOx [59] , while uranium from reprocessing (URT) is used to manufacture enriched reprocessing uranium (URE) fuel. Residual radioactive waste (high-level waste (HLW) in the form of standard compacted (CSD-C) or vitrified (CSD-V) packages) is destined for deep geological disposal in the facility planned (Meuse). fuels Cigéo Spent and ERU are stored pending their subsequent reprocessing.MOx

This strategy, known as mono-recycling of spent fuel, was put in place in France as the first step towards closing the fuel cycle, which is based on the use in fast neutron reactors (RNR) of substances resulting from nuclear reactions that are not currently recovered industrially. The current strategy is already likely to meet the objectives of energy independence and sovereignty, since it offers the potential to reduce France's need for natural uranium by 10% through the option MOx and by a further 15% through the ERU option, giving a total reduction of 25%. These savings reduce France's exposure to geopolitical uncertainties and could prove invaluable in the event of global growth in fuel demand. This strategy also contributes to reducing the environmental impact of the nuclear sector, to the economic development of the regions where the plants are located and to France's trade balance.

In addition, Orano, EDF, CEA and Framatome are taking part in a programme of R&D and associated industrial feasibility studies supported by France 2030 to study the benefits of multi-recycling uranium and plutonium in PWRs (MRREP) in terms of economic competitiveness and materials and waste management, in line with the requirements of the previous PPE. In the medium term, the multi-recycling of plutonium and TRU could represent an additional step in the recovery of used fuel and the saving of uranium resources, up to 40% compared with an open cycle.

The French nuclear industry's mastery of the full range of nuclear expertise is a competitive advantage for many companies in the export market and makes a major contribution to France's

[58] Uapp: depleted uranium; TRU: reprocessed uranium; MOX: see below.

[59] A mixture of plutonium oxide and depleted uranium oxide produced by enriching natural uranium.

energy independence. The work and projects underway to continue operating the existing fleet, to build new reactors and to develop innovative nuclear power are mobilising the industry's industrial players. The industry is well prepared, notably through initiatives that complement the performance plans of major contractors, such as the "MATCH" programme of the French nuclear energy industry group GIFEN and the work of the University of Nuclear Professions (UMN), which should enable the French nuclear industry to meet the challenge of revitalising itself and ensuring a competitive supply of low-carbon electricity in the coming years.

ACTION NUC.1

CONTINUE TO OPERATE NUCLEAR POWER REACTORS AFTER 50 YEARS AND THEN 60 YEARS, AS LONG AS ALL APPLICABLE SAFETY REQUIREMENTS ARE MET.

Existing nuclear power reactors will continue to operate, taking into account international best practice, including allowing them to operate after 50 years and then 60 years of operation, as long as all applicable safety requirements are met. In accordance with the law, the ten-yearly safety reviews will periodically validate the ability of each reactor to continue operating. EDF will conduct studies, in conjunction with the French Nuclear Safety Authority (ASN), to clarify the operating prospects for the existing nuclear fleet after 50 and 60 years, including the necessary considerations on adapting reactors to climate change.

ACTION NUC.2

INCREASING THE AVAILABLE POWER OF EXISTING REACTORS AND RESTORING THE HIGHEST LEVELS OF OPERATIONAL PERFORMANCE.

EDF is carrying out a programme of work to increase the available power of existing reactors during scheduled maintenance, in compliance with the applicable nuclear safety provisions. Nuclear production forecasts for the coming years will take into account the increase in nuclear capacity that would result from the implementation of this programme. The French government has asked EDF to set itself the objective of restoring the highest levels of operational performance, with the target of restoring nuclear generation to 400 TWh by 2030. The central scenario of the EPP assumes generation of 360 TWh.

ACTION NUC.3

CONFIRM THE LAUNCH OF EDF'S INDUSTRIAL PROGRAMME TO BUILD THREE PAIRS OF EPR2 REACTORS.

EDF is carrying out a programme to build 6 new EPR2 nuclear reactors, with two reactors on the Penly site, two on the Gravelines site and two reactors on the Bugey site. The French government confirms its support for this programme and is looking forward to a final investment decision by EDF's Board of Directors, with a view to launching the project by 2026 at the latest.

ACTION NUC.4

FURTHER STUDY OF A POSSIBLE REINFORCEMENT OF THE ELECTRONUCLEAR PROGRAMME.

The French government will study in greater depth the possibility of strengthening the nuclear power programme with EDF and the operators concerned, in order to examine questions relating to the sizing, the right needs and the adaptation of the EPR2 design, so as to be in a position, by 2026, to take a decision on the construction of a possible second stage of at least 13 GW, corresponding to the capacity of 8 EPR2s in their current design.

ACTION NUC.5

ENCOURAGING THE DEVELOPMENT OF SMR AND SMALL INNOVATIVE REACTORS.

The French government will continue to support breakthrough innovation through the France 2030 plan, with the aim of achieving a first concrete design for a small modular pressurised water reactor and launching at least one prototype of an innovative small nuclear reactor using a different technology by the beginning of the 2030s. This target may be updated between now and then. The French government will continue its work to assess the appropriateness of deploying such reactors in France, particularly in terms of their contribution to heat production, hydrogen production and fuel cycle closure. The government will also prepare, where appropriate, the identification of relevant sites and will complete the review of the applicable legislative and regulatory framework, with a view to preparing any adjustments that may be considered necessary to ensure that the framework is appropriate to the issues at stake.

ACTION NUC.6

PURSUE THE STRATEGY OF REPROCESSING AND RECYCLING NUCLEAR FUEL AND COMPLETE WORK ON RENEWING DOWNSTREAM CYCLE FACILITIES.

The nuclear fuel reprocessing and recovery strategy will be pursued over the period of the EPP and beyond. With a view to renewing downstream nuclear cycle facilities, the nuclear industry will, by the end of 2026, under the supervision of the French government, carry out work aimed at defining the most appropriate industrial scenarios for the future of the post-2040 fuel cycle, as well as the associated financing arrangements and decision-making timetable, while taking care to promote the sustainable management of radioactive substances, security of supply and cost control.

ACTION NUC.7

DEFINE A NEW ROADMAP AND BEGIN WORK ON CLOSING THE CYCLE AND SETTING UP A FLEET OF RNR IN FRANCE.

The development of fast neutron reactors (RNR) would make it possible to become permanently independent of natural uranium supplies by reprocessing all the associated spent fuel. The production of radioactive waste would also be reduced.

However, the existing facilities can neither industrially manufacture fuel for use in fast breeder reactors nor industrially reprocess spent fuel from fast breeder reactors. What's more, they are scheduled to cease operating in 2040. However, the time between the introduction of a fuel into a reactor and the recovery of the materials resulting from its reprocessing is around 20 years.

The industry will continue its work on multi-recycling in PWRs and will include it in a roadmap that it will define by 2026 at the latest, in conjunction with the CEA, with a view to identifying the technological and decision-making milestones that will make it possible to set up a fleet of PWRs and associated fuel cycle facilities in France by the end of the century at the latest.

In addition, the industry will work with the CEA to qualify the fuel requirements associated with new innovative nuclear reactor concepts and the fuel cycle adaptations to be considered, with a view to identifying the relevant time horizons. The CEA and the nuclear industry will also ensure that their work on closing the fuel cycle is consistent with the work being carried out by the nuclear industry on the future of industrial facilities downstream of the nuclear fuel cycle.

ACTION NUC.8

IMPLEMENT A EUROPEAN INDUSTRIAL PROCESS FOR THE CONVERSION AND ENRICHMENT OF REPROCESSED URANIUM.

The French industry will continue its work on the installation of a TRU conversion plant in Europe, with a capacity enabling EDF to cover its needs from 2030.

ACTION NUC.9

MAINTAIN A CUTTING-EDGE NUCLEAR RESEARCH CAPABILITY ACROSS THE FULL RANGE OF GOVERNMENT NUCLEAR POLICY PRIORITIES.

In conjunction with the French nuclear industry, the CEA will carry out a programme of investment in nuclear research infrastructure to maintain a cutting-edge nuclear research capacity across all the priorities of the French government's nuclear policy.

During the future EPP, the national radioactive materials and waste management plan (PNGMDR) will continue to be the planning document in this area, whose guidelines (in particular the implementation of Cigéo) will be followed. The current plan covers the period 2022-2026 and is due to be updated at the end of this period.

3.5.4. Thermal power plants

The 2019 energy-climate law provided for regulatory tools to enable the last coal-fired power plants to be closed. The Gardanne coal-fired power station will close in 2021, as will the one at Le Havre. In addition, in accordance with the provisions of article 8 of the decree of 21 April 2020 relating to the multi-annual energy programme (PPE 2), no new fossil-fired power station of more than 20 MW (10 MW for power stations using fossil fuels other than natural gas and coal as their main fuel) may be authorised.

Following the energy crisis linked to the war in Ukraine and the drop in availability of the French nuclear fleet in 2022, Law 2022-1158 of 16 August 2022 on emergency measures to protect

purchasing power authorised the Cordemais and Saint-Avold power stations to operate a **under derogation from the 2019 energy-climate law, with an obligation to fully offset the carbon emissions linked to these activities.**

Even with these derogations, total coal-fired electricity generation in 2022 remained lower than in 2021 (2.9 TWh or 0.6% of total generation) and at a significantly lower level than that observed up to 2017 (9.7 TWh).

While the exceptional measures taken in 2022 **do not call into question the objective of closing coal-fired power stations, it is important that this transition is made while preserving France's security of energy supply** (see section 5.3.2).

RTE's analyses show that the use of fossil-fired generation at peak times (oil-fired combustion turbines, coal-fired power stations) will remain very limited, during winter consumption peaks, and compatible with the emission ceilings in force. In its latest projections, RTE confirms that the closure of coal-fired generation by 2027 is compatible with compliance with the security of supply criterion, given the development of generation capacity envisaged by that date and in the context of a controlled increase in electricity consumption. The decarbonisation of the fossil-fired fleet will therefore require the cessation of coal-fired electricity generation by 2027.

On the other hand, existing gas-fired power stations and combustion turbines remain necessary for security of supply. While some of the oldest combustion turbines may have to be closed, the objective for the rest is to use low-carbon fuels to replace fuel oil by 2030.

The guidelines set out in the EPP2 for fossil-fired power stations will therefore be continued in the EPP3.

ACTION THERM.1

DECARBONISING THE FOSSIL FUEL FLEET

→ **Support the launch of studies or pilot sites** by operators for the conversion of existing thermal power plants to use fuels that emit less CO2, with a view to achieving 100% decarbonisation, paying particular attention to the availability of biomass.
→ **Organising and supporting the** end of coal-fired electricity generation.

•4. Security of supply, optimisation of the electricity system and development of networks

Security of supply can be defined as the ability of the energy system to continuously meet foreseeable market demand at a reasonable cost by balancing supply and demand.

In addition to this objective of balancing supply and demand, the French strategy fully integrates the objective of energy sovereignty, to free ourselves from our dependence current on imported fossil fuels. Strengthening domestic production on the one hand, and diversity of supply sources on the other, are key.

As far as natural gas is concerned, the rapid decline in Russian gas exports from mid-2021 has created tensions across Europe. A large part of Europe's supply, historically provided by Russian gas imports by pipeline, has had to switch to imports of liquefied natural gas (LNG) by ship. France mobilised all

its resources to ensure that as much natural gas as possible could be exported to neighbouring countries (Belgium, Germany) that had been hard hit by the reduction in Russian gas exports.

In March 2022, at the Declaration of Versailles, the Member States of the European Union agreed to phase out their dependence on Russian gas, oil and coal imports as soon as possible. France has supported the ban on Russian coal imports, as well as the progressive ban on imports of crude oil and petroleum products originating in Russia, and supports work towards a ban on Russian gas imports.

This new PPE reassesses the relevance of gas storage infrastructures in the light of changes in our consumption and the new context of natural gas supply.

At the same time, the challenges of maintaining the existing nuclear generation fleet mean that we need to be even more vigilant about the security of our electricity supply, especially given the future growth in electricity consumption. Compared with the previous EPP, EPP 3 will focus on studying and promoting the resilience and optimisation of our electricity system, in particular by means of stress tests. It will also pursue the objective of controlling peak consumption. In addition to the objective of developing load shedding, it will be based on the development of a range of flexibility options: demand management (consumption modulation), battery storage, controllable generation resources such as nuclear power plants, pumped storage power stations (STEP), decarbonised thermal power plants and interconnections.

4.1. Security of supply for liquid fuels

Security of fuel supply consists of ensuring continuity in the distribution of liquid fuels produced locally from crude oil processed in refineries and imported, taking into account the various risks facing the oil system, in particular climatic hazards and loss of supply sources, as well as the continuity of oil logistics.

In oil logistics, the aim of security of supply is to ensure the continuity of flows and the building up of stocks by oil operators.

The level of strategic stocks in mainland France, reassessed annually, is slightly higher than European regulations (Directive 2006/67/EC) and France's commitment to the International Energy Agency.

Throughout the energy-climate trajectory, the government is ensuring that oil logistics evolve to support the energy transition, with the aim of ensuring the country's sovereignty:

- developments in refining to ensure the production of alternative fuels in France and to reduce the use of fossil fuels in processes,
- adapting transport, storage and distribution infrastructures and changing the business model for service stations to reflect changing usage patterns, while maintaining a sufficient network of service stations to avoid creating "white zones".

Increasing local production of biofuels will help to reduce France's current heavy dependence on imports of crude oil and refined products. Particular attention will also be paid to avoiding dependence on imported raw materials, by diversifying supplies. With this in mind, the issue of biomass looping is central to the EPP. The actions planned to adapt the networks are presented in § 4.6.2 below.

4.1.1. National issues: refining and strategic stocks

- **Refining**

Refining in France (see section 3.3.2 Refining) is a factor of energy resilience, particularly in the face of geopolitical uncertainties.

Refining in mainland France is on a downward trend, with the closure of 6 refineries since 2011, for example, but it should not be allowed to decline too quickly, as it makes a major contribution to national energy security and to the supply of downstream petrochemicals, producing the main molecules that feed into industrial value chains. Operators are also being encouraged to anticipate the consequences of climate change by adapting their infrastructures in advance. In conjunction with the industry, a study will be carried out into the consequences of reduced fossil fuel consumption in terms of maintaining security of supply.

- **Strategic stocks**

Strategic petroleum stocks are built up to enable a collective response to major disruptions in the supply of petroleum products. They are made up of the following products: crude oil, diesel, petrol, domestic heating oil and jet fuel

With the reduction in the use of fossil fuels and the development of the production of so-called "advanced" biofuels and synthetic fuels (see section 3.3.3 "Biofuels and synthetic fuels"), measures to guarantee the security of fuel supply will have to evolve and take account of the energy transition, in consultation with the dedicated governance of the European Union and the International Energy Agency.

It does not appear necessary to build up specific stocks of low-carbon liquid fuels (LCLC) in the short term, particularly for diesel, excluding non-substitutable fuels, given the limited share of LCLC in road fuels. However, it should be noted that some fuels benefit from special tax and regulatory provisions, and that the fuel mix will change as part of the energy transition. Changes in consumption will influence the need for strategic storage, which contributes directly to security of supply.

The reduction in diesel consumption in favour of petrol has already been taken into account.

ACTION LOG PET 1

MONITORING TRENDS IN THE CONSUMPTION OF LOW-CARBON FUELS WITH A VIEW TO BUILDING UP STRATEGIC STOCKS

→ To monitor the situation of liquid fuels, particularly non-substitutable fuels, in view of the increase in releases for consumption of certain qualities, with a view to providing input for consultation with the European Union and the International Energy Agency on changes to strategic oil stocks obligations.

Lastly, a location plan national strategic stock is updated annually to ensure the distribution of strategic storage, which helps to maintain intermediate fuel depots at regional level.

ACTION LOG PET 2

MONITORING THE NETWORK OF STRATEGIC STOCKS TO ENSURE THAT THEY ARE PROPERLY DISTRIBUTED

→ Maintain annual monitoring of the location of strategic oil stocks, to ensure security of supply within the territories.

4.1.2. Local issues: intermediate logistics and service stations

- **Intermediate logistics**

During the energy transition, care must be taken not to suddenly disrupt oil logistics in France, and in particular the intermediate depots, which provide a national network, to enable a gradual transition. In fact, fuel consumption needs will gradually decline, making it necessary, at least until 2040, to maintain a petroleum product storage and distribution infrastructure that is appropriate and capable of meeting environmental and security of supply challenges. With fossil fuels set to decline, all infrastructure is subject to regulatory constraints (in particular to limit industrial risks and environmental impact), requiring financial investment that could become less profitable.

- **Service stations**

Service stations also require special attention to ensure that they are properly distributed across the country, both in terms of maintaining a fuel distribution service and in terms of their role in deploying alternative energies and maintaining services in rural areas.
Those that distribute more than 500 m3 of fuel per year are required to declare the prices charged at their stations (decree of 8 July 1988) on the "prix-carburants.gouv.fr" website, which gives the authorities detailed knowledge of most of the French network.

Recent projects aimed at helping service stations in difficulty to modernise and diversify their infrastructures involve identifying service stations likely to benefit from financial aid.

ACTION LOG PET 3

SUPPORTING SERVICE STATIONS IN THEIR TRANSFORMATION

Measures are planned to support the independent service stations that are essential to the regional network:
→ Provide long-term support for independent service stations as they diversify their activities (installation of IRVEs[60] , new non-energy activities).
→ Initiate discussions on the "socio-economic" models of "service stations of the future", integrating the diversity of mobility and the associated services adapted to independent service stations.

In addition, in order to provide the authorities with a complete picture of the network, particularly in areas where the network is less dense, work is underway to create an obligation to declare the existence of refuelling outlets open to the public on the prix-carburant.gouv.fr website, which could also be used to collect information that would give the government a better picture of all the stations (energies distributed and volumes distributed, type of stations[61] , non-fuel services offered).

Finally, regular studies are carried out by the government to ensure that a dense network is maintained and to anticipate the creation of "white zones", based on a number of indicators, and in

60 Electric vehicle recharging infrastructure.

61 Oil groups, supermarkets and hypermarkets, independent retailers...

particular the accessibility (measured in minutes) of the stations for people with combustion-powered vehicles. The distribution of service stations across the country is currently satisfactory, and although a few départements remain to be monitored, they all meet the accessibility criterion maintained in this PPE, i.e. that 90% of private individuals in the département are less than 25 minutes from a service station.

ACTION LOG PET 4

MONITOR THE NETWORK OF SERVICE STATIONS TO ANTICIPATE THE RISK OF WHITE ZONES APPEARING

→ Improve knowledge of service stations and their characteristics by making it compulsory for all stations to be listed.

→ Carry out regular studies on the current network and the future development of the network, taking into account changes in usage and strategies for closing, maintaining or transforming retail outlets, and interacting with local public bodies to identify essential stations.

4.2. Security of supply for gas products

4.2.1. Level and criteria of security of gas supply

Security of natural gas supply means ensuring the continuity of gas supply in the face of the various risks to which the gas system is exposed, in particular the vagaries of the weather and losses of supply sources, as well as the continuity of natural gas transmission on the network, in particular in the face of the risks of congestion.

The objective of security of supply of natural gas corresponds to the possibility of ensuring the supply of natural gas consumers, with the exception of consumers who have contractually agreed to a supply that is likely to be interrupted, when :

- A cold winter of the kind that statistically occurs once every fifty years;
- Extremely low temperatures over a period of three days, such as statistically occur once every fifty years.

This level of security of supply is stricter than the minimum level provided for in Regulation (EU) 2017/1938. In view of the uncertainties associated with the reorganisation of the gas system, following the reduction in Russian gas exports to the European Union, the current criterion mentioned above is retained.

The tools used to ensure security of natural gas supply can be divided into three main categories:

- Tools for sizing the gas system with a view to the future;
- Obligations assigned to gas players, in particular suppliers;
- Safeguard measures in the event of a gas crisis.

4.2.2. Sizing the gas system

Over the last decade, the gas system has undergone major improvements to facilitate the flow of

natural gas.

The gas system currently has seven main interconnection points and five LNG terminals located on three seaboards, providing access to diversified sources of gas.

Since 2021, the Russian government's unilateral decision to limit natural gas exports has had a major impact on the operation of thegas system. European The supply of natural gas to Germany and Belgium has been severely affected, and the possibility of importing natural gas from these two countries to France has disappeared. The temporary installation of a floating LNG terminal in the port of Le Havre, for a maximum period of five years, has made it possible to recover redundancy margins, so as to be able to preserve natural gas supplies and transit capacities in the event of the unavailability of a major gas infrastructure. The continued decline in natural gas imports should enable us to regain the flexibility margins needed to achieve this objective by 2028, without having to resort to the additional capacity of the floating LNG terminal.

Within mainland France, gas flows are ensured by a network of transmission and distribution networks, operating in synergy with natural gas storage infrastructures. The possibilities for natural gas flows within the French gas system are considered sufficient to allow the implementation of a single balancing zone, effective since 1 November 2018.

The current size of the gas system is sufficient to supply French consumers. Given that natural gas consumption is expected to fall, efforts will be made to optimise the use of existing infrastructure, or even to reduce it. This optimisation of the use of existing infrastructures particularly concerns underground natural gas storage infrastructures. Article L. 421-3-1 of the Energy Code provides for the definition, as part of the multi-annual energy planning, of storage infrastructures that guarantee security of supply in the medium and long term.

In view of the uncertainties associated with the reorganisation of the gas system, following the reduction in Russian gas exports to the European Union, it is proposed to ensure that the current storage infrastructures remain in operation, while adjusting their capacity.

The underground natural gas storage facilities that must remain in operation to guarantee security of supply in the medium and long term are those listed below, representing a working volume of 133.4 TWh HCV and an offtake capacity of 2,196 GWh HCV/d, with filling corresponding to 45% of the working volume:

Infrastructure	Operator	Year of commissioning	Type of storage
Beynes	Storengy	1956	Aquifer
Céré-la-Ronde	Storengy	1993	Aquifer
Cerville-Velaine	Storengy	1970	Aquifer
Chemery	Storengy	1968	Aquifer
Etrez	Storengy	1980	Salt
Germigny-sous-Coulomb	Storengy	1982	Aquifer
Gournay	Storengy	1976	Aquifer
Lussagnet / Izaute	Teréga	1957	Aquifer
Manosque	Geomethane	1993	Salt
Saint-Illiers-la-Ville	Storengy	1965	Aquifer
Tersanne / Hauterives	Storengy	1970	Salt

4.2.3. Obligations assigned to gas operators

Continuity of supply obligations

Natural gas suppliers are obliged to ensure continuity of supply for all their customers, with the exception of customers with interruptible contracts, at the level corresponding to the security of supply objective mentioned in 5.2.1.

In addition, natural gas suppliers must be able to ensure continuity of supply to these same consumers, including in the event of the main source of supply disappearing for up to six months under average weather conditions. The supply of gas on the French market is subject to ministerial authorisation. Proof of compliance with continuity of supply obligations may be requested when supply authorisations are updated each year.

Diversification bonds

Above a certain market share, a natural gas supplier is obliged to diversify its supply entry points on the national territory. The details of this obligation are set out in article R. 121-1 of the Energy Code. In order not to penalise new entrants, this measure does not apply below 5% market share.

Continuity of transmission obligations

The natural gas transmission and distribution system operators must size their infrastructures in such a way as to be able to ensure the transmission of natural gas at a level corresponding to the objective of security of supply.

Infrastructure operators are also required, as part of their public service obligations, to give advance notice of the dates on which their facilities will be unavailable, so that suppliers can ensure continuity of supply.

Obligation to fill subscribed storage capacity in essential infrastructures

In order to avoid strategies for monopolising the capacity of essential underground natural gas storage infrastructures, article L. 421-7 of the Energy Code stipulates that gas suppliers who have subscribed storage capacity in these infrastructures are obliged to ensure a minimum filling level on 1 November.

Obligation to market natural gas stocks

Articles L. 421-3 and L. 431-9 of the French Energy Code stipulate that natural gas suppliers are obliged to offer unused and technically available stocks of natural gas held in essential underground natural gas storage facilities and unused and technically available stocks of liquefied natural gas held in LNG terminals, during market calls organised by natural gas transmission system operators for network balancing purposes.

4.2.4. Safeguard measures in the event of a gas crisis

In the event of a crisis, and when preventive measures are not sufficient to guarantee the supply of natural gas to French consumers, specific measures may be activated:

- the recommendation by public authorities to moderate energy demand;
- activation of interruptibility contracts for natural gas consumption ;
- as a last resort, load shedding of consumers by the network operator to which they are connected;
- a call for European solidarity if these measures are not sufficient to maintain supplies to residential consumers and essential social services.

A general review of these measures will be carried out in 2022 and 2023.

Interruptibility of natural gas consumption

The law on the energy transition for green growth provides for the possibility of implementing mechanisms interruptibility whereby certain consumers make a commitment to network operators

to reduce their consumption when necessary. If an additional need for flexibility is identified, interruptible capacity can be contracted.

Natural gas load shedding

If there is a shortage of natural gas at a given point on the network, the network operator may decide to load shed certain consumers. These measures, which may be local or national in nature, are designed to force consumers to reduce or suspend their consumption. As it is not possible to carry out automatic load shedding remotely, the network operator contacts the natural gas consumer directly to ask him to reduce or stop his natural gas consumption.

A call for European solidarity

Regulation (EU) 2017/1938 provides for the establishment of a European solidarity mechanism in the event of a gas crisis. In extreme situations, if demand from residential consumers and essential social services cannot be met, even after all other consumers have been disconnected, France could call on this mechanism to obtain the necessary natural gas from neighbouring Member States. Conversely, Germany, Belgium or Spain could call on this mechanism, which would lead to industrial consumers being unloaded and compensation being paid in return.

4.3. Security of electricity supply and optimisation of the electricity system via a range of flexibilities

Security of electricity supply is defined as maintaining a balance **between electricity production and demand at all times, particularly during peak consumption full stops.** This balance is subject to various hazards: excess demand, for example due to weather conditions, unavailability of generation capacity, etc. A balancing fault can instantly affect the entire European grid connected. The balance is maintained by RTE, which is responsible for balancing the French electricity system.

The main challenge is therefore to design the power system so that it can cover not only annual energy needs, but also the power required to meet peak demand, while at the same time decarbonising the system. The passage of consumption peaks depends first and foremost on the "flexibility" of the power system, i.e. the ability of the power system to adapt to the variability of production and consumption patterns and to the availability of the network, according to the relevant market deadlines[62] . This means adjusting consumption and generation upwards or downwards, to ensure a balance between these two quantities at all times. This flexibility can be mobilised both on the supply side (production resources such as hydroelectric power stations, for example) and on the demand side (interrupting consumption at peak times, shifting consumption to off-peak times), and also includes storage (including, in particular, electric batteries and pumped energy transfer stations (PETS)) and interconnections between neighbouring countries.

As highlighted in chapter 6 on the supply-demand balance and flexibilities in RTE's 2023 Generation Adequacy Report published on 16 July 2024[63] **, the development of renewable energies, which is necessary to achieve the objective of carbon neutrality, will have to be accompanied by increased use of flexibilities** from 2030 onwards, which may be provided by different combinations of consumption and generation control, referred to in the remainder of this chapter as "flexibilities packages".

[62] According to European Parliament and Council Regulation 2023/0077/A(COD) on improving the organisation of the EU electricity market, which will be transposed into national law.

63 https://assets.rte-france.com/prod/public/2024-07/BP2023-chapitre6-Equilibre-offre-demande-flexibilite.pdf

4.3.1. The security of supply criterion

The French security of supply criterion is the **main regulatory tool used to size the electricity system** to ensure medium-term security of electricity supply.

Since the publication of the PPE 2 decree in 2020, it is now defined as a **dual criterion stipulating that the risk of supply-demand imbalance may not exceed three hours per year on average and that the average annual duration of load shedding must remain less than two hours.** The "failure" of the electricity system is thus defined as the need to resort to back-up resources (excluding market mechanisms) and, as a last resort, to load shedding.

This definition appears in the Energy Code (article D. 141-12-6) and its level is set by the minister responsible for energy by regulation on the basis of RTE studies. It is the result of a **trade-off in the general interest between the benefits that consumers derive from a reduced risk of power cuts and the cost to the community of developing additional means of generation supply and consumption curtailment to reduce this risk**.

The determination of the security of supply criterion has been harmonised at European level since 2019. The study published by RTE in 2022[64] **confirmed that the method used in France complies with European requirements, and led to the Order of August 2022 confirming [65]the level of the current criterion, at the suggestion of CRE[66]** . It is therefore **against this standard that RTE conducts its security of supply analysis.** It should be noted that this security of supply criterion is currently one of the most demanding in Europe.

ACTION APPRO ELEC.1

PURSUE DISCUSSIONS AND WORK ON POSSIBLE CHANGES TO OR ADDITIONS TO THE SECURITY OF SUPPLY CRITERION, IN CONJUNCTION WITH RTE, CRE AND AT EUROPEAN LEVEL

→ When considering changes to the security of supply criterion, take into account the development of storage in significant proportions and the depth of failures and energy not distributed (i.e. the number of customers cut off and not just the duration of the outage) to better meet the challenges of the energy transition and society's expectations.

→ Continue the analysis of various stress tests for the study of compliance with the criterion to better assess the resilience of the power system in connection with RTE's work (part 6.2.1.4 of RTE's 2023 BP).

64 RTE, *Proposal for updating the security of supply criterion for the French electricity system*, 2022
65 Order of 5 August 2022 on the security of electricity supply criterion
66 CRE Deliberation n°2022-152 of 25 May 2022 proposing a value for the security of electricity supply criterion for mainland France

4.3.2. Developments in security of supply over the horizon of the EPP

Over the last fifteen years, the risk to security of supply has increased, particularly as a result of the reduced availability of nuclear power plants and the closure of thermal power plants, with the risk increasing between 2020 and 2023. However, the actual conditions have been favourable (fall in consumption from the end of 2022, good weather conditions, contribution from interconnections) and have made it possible to avoid resorting to load shedding measures.

In its 2023 Generation Adequacy Report, RTE states that **the French power system has now passed the most delicate period identified in past studies**. **Over the coming years, the risk of imbalance between electricity supply and demand will diminish and should meet the regulatory criterion.** This gradual improvement will be made possible mainly by the increased availability of nuclear power, even if it is not expected to return to its level of the early 2010s. It is also the result of the development of renewable energies, in particular the commissioning of the first offshore wind farms, which is essential for security of supply. Interconnections with neighbouring countries will continue to play a favourable role, just as they were decisive in helping us through the winter of 2022-2023.

By 2030, the acceleration of decarbonisation will create a need for additional capacity, which can be met by various solutions, from consumption management to the conversion or construction of decarbonised thermal power plants. RTE analyses that the need for capacity is not limited to capacity contributing to covering short, one-off episodes during peak full stops (load shedding, battery storage), but extends to production capacity that can be mobilised over longer periods (decarbonised thermal power plants, STEP, etc.), given the characteristics of the various failures.

By 2035, the level of security of supply will depend on France's ability to implement a number of measures by 2030 (electrification, flexible use of energy, energy saving and efficiency measures) and on the success of industrial challenges (extending nuclear power, developing offshore wind power, making electrolysis more flexible). Requirements for security of supply over this timeframe are more uncertain, but should in principle decrease. According to RTE**, the capacities deployed as part of the flexibility mix for 2030 are a no-regrets choice for ensuring security of supply in 2030 as well as in 2035 and over the longer term. To ensure the supply-demand balance of the electricity system at all times, a production margin must be taken in relation to the forecast level of consumption. The surplus will make it possible to export a few TWh.**

Focus: Experimentation with a device to limit electricity meter power in the event of a crisis

Following the high levels of tension observed by RTE during the winter of 2022-2023, affecting electricity supply and the balance between production and consumption, the public authorities have asked Enedis to work on a new safeguard measure that could reduce the risk of load shedding, i.e. the risk of temporarily interrupting the entire household electricity supply. Load shedding is the ultimate measure for securing the electricity network.

Enedis has identified a new collective measure to reduce electricity consumption in France during tense situations (EcoWatt orange or red): temporary power limitation. Faced with the risk of a power cut in France, this measure would aim to preserve a minimum power supply for all private customers by limiting it to essential uses with a power of 3kVA. This operation would be carried out via the Linky meter during peak consumption periods on a working day (6.30am-1.30pm and 5.30pm-8.30pm), for a limited period of time for each customer (2 hours maximum), in shifts.

Limiting consumption by individual customers can be restrictive. But it is a new option for trying to avoid the risk of temporary power cuts on a day of high tension between production and consumption, or failing that, if that were not enough, to significantly reduce the number of households affected by scheduled load shedding.

For the time being, this system has only been tested on an experimental basis, in February 2024, in a single département: Puy-de-Dôme. The trial went satisfactorily, with orders to limit and then restore nominal power being correctly transmitted to the households concerned. An assessment of the trial was carried out by Enedis in July 2024, in particular to identify the technical feasibility and benefits of this measure if it were rolled out on a large scale.

ACTION APPRO ELEC.2

STUDY THE INTEGRATION OF THE ELECTRICAL POWER LIMITATION DEVICE INTO THE RANGE OF MEASURES OF THE ELECTRICITY NETWORK PROTECTION PLAN

Carry out this study in the light of the conclusions of the trial conducted in 2024 (see focus above), and the technical feasibility of applying such a measure throughout the metropolitan area.

4.3.3. Strategies to meet the need for additional capacity by 2030

As indicated in chapter 6 "Supply-demand balance and flexibilities" of RTE's 2023 Generation Adequacy Report published on 16 July 2024[67] , a need for additional capacity has been identified for 2030 under certain conditions: if consumption increases in order to achieve the decarbonisation and reindustrialisation objectives, without further development of sobriety, and if the availability of nuclear power does not return to the levels of the 2010s. Various "flexibility packages" will be able to cover this need in addition to the development of demand flexibility.

Figure 6.22 Solutions pour assurer l'équilibrage en puissance au sens du critère réglementaire à l'horizon 2030 : les différents « bouquets de flexibilité » possibles

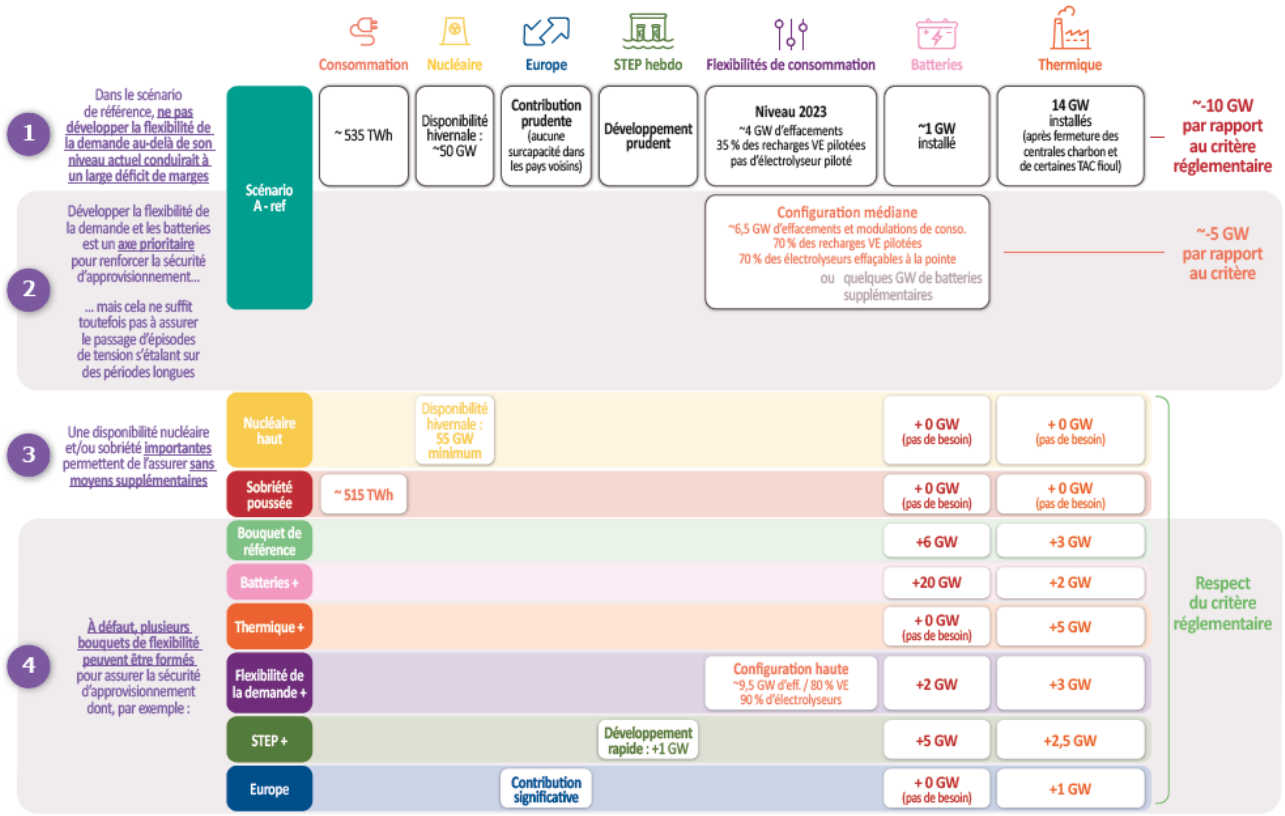


Figure31 . Solutions to ensure power balancing within the meaning of the regulatory criterion by 2030: the various possible "flexibility packages" (RTE)

Specific support measures have already been put in place in recent years, such as the call for tenders for load shedding, under which RTE contracts for load shedding capacity every year between 2018 and 2023. On 21 December 2023, for the period from 2024 to the first quarter of 2026, the Commission approved a new support scheme under the State Aid rules, via a call for tenders open to decarbonised flexibilities (including load shedding and storage). In the same way as electricity generation facilities, load shedding also participates in market mechanisms (balancing mechanism, reserves, NEBEF mechanism and capacity mechanism). The capacity mechanism, which has been operational since 2016 and is authorised until 2026, is currently being overhauled for the winter of 2026-2027, and will be able to support the new flexibilities needed for security of supply. This reform has been included in the Finance Law for 2025.

67 https://assets.rte-france.com/prod/public/2024-07/BP2023-chapitre6-Equilibre-offre-demande-flexibilite.pdf

According to RTE's BP2023, the need for additional thermal resources reaches 3 GW in the reference mix and between 2 and 5 GW in the other mixes, in configurations marked by a rapid increase in consumption and a cautious development of nuclear sobriety and availability. Technically, this can be covered by maintaining power plants that are due to close (the last coal-fired plants) or are likely to close (the oldest combustion turbines and cogeneration plants), by converting some of these units to low-carbon fuels, or by building new thermal units that run on low-carbon fuels from the outset. In other configurations (with a high level of sobriety or with nuclear power availability in excess of 55 GW in winter), there may be no need for additional thermal resources.

ACTION APPRO ELEC.3

CONTINUE TO ANALYSE AND WORK WITH ALL THE PLAYERS INVOLVED TO IDENTIFY OBJECTIVES AND MEASURES RELATING TO FLEXIBILITIES AND THE FUTURE OF THE THERMAL FLEET, PARTICULARLY IN LINE WITH THE IMPLEMENTATION OF THE REFORM OF THE ELECTRICITY MARKET.

- **Consider flexibility as a whole**, i.e. the ability to modulate[68] the national load curve, in order to meet the needs of the electricity system in 2030 and 2035 for reasons of security of supply, optimisation of the electricity system or network management.
- **Define the relevant indicators** in order to characterise the modulation needs (consumption and generation combined) to which the power system must respond, and develop the appropriate decarbonised flexibilities packages. A study of the French power system's flexibility requirements will be carried out in 2025 by RTE and submitted to CRE for approval, as part of the implementation of the provisions of the European reform of the electricity market.
- **Make the capacity mechanism permanent after 2026** to guarantee compliance with the security of supply criterion by remunerating the necessary capacity, in accordance with the Finance Act for 2025.

Focus: flexible demand

Demand flexibility, which consists of reducing or increasing the electricity consumption of a given site or group of sites, on a one-off or structural basis, to meet the needs of the electricity system, is becoming **a priority**.

Managing peak consumption means being able to call on both **one-off reductions in consumption in response to short-term market signals (load shedding), and more structural postponements of consumption**, enabling larger volumes to be shifted to the best time via, for example, supply offers time-seasonal such as mobile peak or peak/off-peak offers. **The time-seasonality of the tariff for the use of public electricity networks (TURPE)**, defined by the Commission de Régulation de l'Energie, is an incentive for suppliers to send more differentiated signals to end customers.

[68] Modulation consumption (respof electricity . production) refers to any action by the end consumer (resp. producer), whether regular or one-off, aimed at voluntarily increasing or decreasing the level of effective extraction (resp.) of injectionelectricity on the public transmission or distribution networks of one or more consumption sites.

As pointed out Ademe in its opinion of January 2025[69] , demand flexibility is currently mainly implemented through peak/off-peak control of hot water tanks and load shedding by major industrial companies, but is set to evolve to adapt to the greater variability of renewable production and to address all consumers. The aim is to "consume less" and "consume better".

ACTION APPRO ELEC.4

DRAW UP A "PLAN FOR SCALING UP FLEXIBLE DEMAND" BY STRENGTHENING ECONOMIC INCENTIVES TO MANAGE AND POSITION CONSUMPTION

- **To support CRE's work on the optimal placement of off-peak periods in the next TURPEs (TURPE 7 and 8),** against a backdrop of continued development of renewable energies, particularly photovoltaics, which are creating new constraints and opportunities for the electricity system. As a result, off-peak hours will gradually be moved to the middle of the day from autumn 2025.
- **Encourage the development of tariff offers that promote flexibility of use**, such as mobile peak offers (load shedding that cannot be dissociated from the supply (EIF)), tariffstime-of-use , the continued development of tariff signals sent by regulated energy sales tariffs (TRVE) or the development of new products on the forward markets that are better suited to changes in the electricity mix.
- **Develop economic incentives or regulatory requirements for controlling new equipment,** in particular water heaters, electric vehicle charging points and heating and air conditioning systems.
- Encourage the development of digital tools to modulate consumption.
- Study the technical and economic conditions necessary for the development of peak shaving of electrolysers.
- **Entrust RTE with the coordination of a "demand flexibilities barometer" to be published annually,** which will make it possible year after year to define and monitor indicators for the development of flexibilities, and to monitor, in particular, the deployment of connected equipment to control usage.

- **<u>Battery storage and STEP</u>**

By 2030 and 2035, batteries and STEPs combined with demand-side flexibilities will be able to meet three quarters of intraday modulation needs.

[69] Flexibility and storage: what role for the consumer in the development of the electricity system? opinionAdeme , January 2025.

As Ademe indicated in its opinion of January 2025[70] , hydroelectricity and thermal storage (hot water tanks) can already be used to cover daily needs with longer-term variations. With the increase in renewable energies, battery storage is tending to develop, particularly for daily needs. The aim will be to shift consumption towards the time when electricity is produced, so as to recharge the storage systems already in place at consumers' homes (electric vehicles, hot water tanks) to balance supply and demand.

Batteries will be developed within the framework of the electricity and capacity markets. This framework may evolve to allow the development of all flexibilities, including battery storage.

ACTION APPRO ELEC.5

ADAPTING THE REGULATORY AND ECONOMIC FRAMEWORK FOR STEP DEVELOPMENT

Adapt the regulatory and economic framework to achieve at least an additional 1.7 GW of STEP by 2035, for example by launching calls for tenders (see section Hydroelectricity 3.5.1.4).

- **Interconnections**

Interconnections will continue to play a major role in ensuring security of supply and optimising the operation of the national and European electricity system: they enable the least costly generation resources to be called upon at any given time across Europe, and make a major contribution to reducing greenhouse gas emissions from electricity generation in Europe. The use of imports avoids additional costs and the construction of additional flexibility resources in France (in particular new thermal power stations) to cover very high consumption periods.
However, their contribution is envisaged in a deliberately cautious way, on the assumption that the mixes of neighbouring countries will be sized as closely as possible to their own security of supply criteria (no overcapacity). In RTE's studies, this leads to a relatively stable contribution from interconnections to France's security of supply, despite the increase in exchange capacity.

ACTION APPRO ELEC.7

CONTINUING TO DEVELOP INTERCONNECTIONS AND SETTING NEW TARGETS

Continue this work in line with projected needs, taking into account the cost/benefit ratio, prudent assumptions and cooperation with our neighbours (see electricity networks section).

Study the costs and benefits of an interconnection to Corsica or a connection between mainland France and Corsica in terms of savings for the community and security of supply.

[70] Flexibility and storage: what role for the consumer in the development of the electricity system? opinionAdeme , January 2025.

4.4. Security of uranium supply

The French nuclear fleet meet its nuclear generation needs, uses different types of nuclear fuel to based on natural uranium or uranium from reprocessing, in the form of UOx or MOx. Security of uranium supply is the responsibility of EDF, which manages all French nuclear power plants.

An electric utility's uranium requirements depend mainly on :

- changes in the nuclear fleet and its operating methods;
- the spent fuel recycling strategy, which is likely to meet the objectives of energy independence and sovereignty, since it offers the potential to reduce France's need for natural uranium by 10% using MOx and by a further 15% using ERU, giving a total reduction of 25%. The multi-recycling of plutonium and TRU could, in the medium term, represent an additional step in the recovery of spent fuel and the saving of uranium resources, up to 40% compared with an open cycle.

EDF uses several levers to strengthen its security of supply:

- geographical and commercial diversification of supply sources for each stage of the fuel cycle (mining, conversion[71] , enrichment and assembly manufacture). This diversification is particularly important for the mine, since EDF obtains its supplies from several countries (including Niger, Kazakhstan, Canada and Australia)[72] ;
- long-term contractual security. As a general rule, EDF's requirements for each stage of the cycle are covered for around ten years by its main suppliers;
- inventory management. EDF maintains large stocks of uranium throughout the nuclear fuel cycle (mining, conversion, enrichment, new fuel, reactor fuel, reserve fuel). These stocks ensure that the reactors in France's nuclear power fleet can operate for several years, thereby meeting the risks of supply disruptions.

ACTION APPRO U.1

ENSURING A SECURE SUPPLY OF URANIUM

The French industry will guarantee the availability of uranium needed to operate France's existing nuclear power plants and the new capacity planned, in particular by continuing efforts to diversify supply sources geographically and to secure supply chains.

4.5. Security of biomass supply

A non-intermittent renewable energy source, biomass was identified in the National Low Carbon Strategy (SNBC2) published in 2020 as **a key element in the energy mix by 2050, revealing a specific challenge in terms of the balance between supply and demand.** In fact, in the SNBC2, the consumption of biomass resources, which was on the rise in most sectors, exceeded domestic resources by around 7%.

71 The conversion of TRU on an industrial scale is currently only possible in Russia. EDF is examining the possibility of setting up a European industry.

72 EDF no longer imports uranium from Russia.

The latest modelling work carried out as part of the preparation of the SNBC3 supports the idea that the transition will mobilise more biomass (products, waste and residues of biological origin). In particular, these scenarios predict an increase in the consumption of biomass for energy purposes. In particular, the deployment of biofuels in the road transport sector and for international will mobilise a significant amount of biomass, and industry will also increase its consumption of biomass, for both energy and non-energy purposes. This trend requires monitoring and dedicated governance (see below).bunkers

The first issue the is**availability of resources in France**. With a view to **sovereignty of supply**, the challenge is to define the assumptions and **appropriate production trajectories for the different types of biomass** that will make up the available supply: wood, intermediate crops, livestock effluents, etc. A proactive vision that would lead to an increase of around 40% in the biomass energy resource mobilised by 2035 compared with 2019 is favoured. With this in mind, the ranking of biomass uses (see table below) gives priority to non-energy uses of biomass. Returning biomass to the soil and preserving the carbon sink (both by converting biomass into wood products and by keeping forest ecosystems healthy) are two essential levers for preserving and restoring the biomass resource, without which the availability of biomass for various energy uses would be uncertain in the future, against a backdrop of pressure on the resource. They are also two essential levers for reducing the environmental impact of biomass mobilisation (see below).

The second, more complex, issue is the **optimal 'allocation' of biomass between user sectors,** with the aim of ensuring the best possible match between the nature of the biomass available and the type of energy carrier (solid, gaseous or liquid) required by each sector. Strategic choices therefore need to be made as to the importance attached to the use of biomass in the various sectors, in particular by calibrating more precisely the systems of public support for sectors that base their model on the mobilisation of biomass resources. These decisions need to be taken on the basis of a number of criteria (environmental and socio-economic impacts, the possibility of using co-products in short circuits, etc.), including the individual capacity of each sector to replace fossil fuels with other vectors, in particular by examining the possibility of electrification as a viable alternative to the use of biomass. In particular, in the individual mobility and heavy road mobility sectors, the long-term priority is to develop electric vehicles rather than maintain a fleet of thermal vehicles using biofuels. An initial guideline for prioritising the resource has been established: it prioritises, among energy uses, those uses for which there is no better alternative.

Table1 Hierarchy of uses of biomass resources[73]

USES OF BIOMASS	EXPLANATION
NON-ENERGY USES, WHICH TAKE PRIORITY OVER ENERGY USES	
HUMAN FOOD	Food sovereignty.
ANIMAL FEED	The challenge of protein autonomy - up to the needs of a lower consumption of animal proteins consistent with the overall scenario of transition in diets.
SOIL FERTILITY (RETURN OF RESIDUES AND COVER CROPS TO THE SOIL)	As needed to maintain the yield and health of ecosystems.
CARBON SINKS AND MATERIAL USES	In order to promote carbon storage (forests, soils, hedges, etc.) in line with the needs required to meet the climate objectives set by the SNBC, and with a view to developing the material uses of biomass (wood products, bio-based materials and fibres, chemicals), priority should first be given to increasing the lifespan of bio-based products, reuse and recycling.

[73] NB: the lines within the 4 blocks of the table ("non-energy uses" / "priority" / "to be developed reasonably" / "to be moderated") are not ranked in order of importance.

ENERGY USES TO BE GIVEN PRIORITY	
INDUSTRY - HIGH TEMPERATURE AND NON-ENERGY HEAT	No low-carbon alternatives.
HEATING NETWORKS	Provided that priority is given to the recovery of waste heat and alternative technologies to biomass (geothermal, solar thermal, etc.).
ENERGY CONSUMPTION BY AGRICULTURE AND THE FORESTRY AND WOOD INDUSTRY	Particularly for agricultural machinery. Possibility of short circuits and making the most of agricultural energy production (also the possibility of considering more electrification). Forestry and wood industry: self-consumption of own resources and energy production that can be used on site, in balance with other non-energy uses of these resources.
HEAVY CONSTRUCTION EQUIPMENT	Few low-carbon alternatives.
ENERGY USES TO BE DEVELOPED REASONABLY AND SUBJECT TO CONDITIONS	
AIR TRAFFIC (DOMESTIC AND INTERNATIONAL)	Possibility of reducing traffic through price signals, modal shifts and sobriety. Limitation of biomass allocated to this sector, which will have to finance more e-fuel.
MARINE BUNKERS	Possibility of using e-fuels (e-methane, e-methanol, e-ammonia, hydrogen and e-diesel produced from e-kerosene). Depends on the level of maritime traffic, with on the one hand a desire for re-sealing in France, and on the other a drop in imports of goods in connection with re-industrialisation.
TRANSPORT - PL, BUS AND COACH, AND RIVER AND RAIL TRANSPORT	Development of biofuels through controlled incorporation rates, with priority given to the electrification of a proportion of uses. Possibility of using other sources (in particular H2 and LNG) for specific uses.
TRANSPORT - LIGHT VEHICLES	Through controlled incorporation rates and in a transitional perspective, while maintaining the priority given to the gradual electrification of the fleet.
INDUSTRY - OTHER USES	Uses with viable decarbonisation alternatives (heat pumps, electrification, RCU[74], geothermal energy, etc.).
RESIDENTIAL AND COMMERCIAL - SOLID BIOMASS FOR EFFICIENT HEATING AND DHW	Possibility of prioritising the use of solid biomass in efficient (post-2005) and very efficient (post-2015) appliances by encouraging the replacement of non-efficient appliances, subject to the possibility of increasing the electrification of residential and tertiary heating via heat pumps. Prioritise appliances that replace fossil-fuel (oil/LPG) equipment in rural areas, by identifying possible alternatives beforehand.
OVERSEAS (MAYOTTE, GUYANA, CORSICA)	Co-generation from local or imported biomass, provided that production is sustainable. Potential for further development of renewable energy in electricity. Reminder: Non-interconnected areas have dedicated EPPs.
ENERGY USES WHOSE DEVELOPMENT SHOULD BE MODERATED	
ELECTRICITY GENERATION	Favour other technical solutions, particularly for basic production.
RESIDENTIAL AND COMMERCIAL - NON-EFFICIENT HEATING AND HOT WATER	Reduce the use of inefficient appliances (installed before 2005) that consume solid biomass.
RESIDENTIAL AND TERTIARY - COOKING	A more efficient and less dangerous electrical alternative (induction in particular).

In addition to the issue of matching supply and demand, all the need to be taken into account**environmental and socio-economic implications** of using biomass . The first objective is to ensure **the sustainability of biomass production conditions in** both agriculture and forestry, in order

[74] District heating network

to limit undesirable effects. The opposite could have a number of consequences: degradation of forest sinks, soils and water quality, loss of carbon stocks in the soil, deforestation and erosion of biodiversity. It is vital to analyse and fully integrate these environmental implications into the biomass use strategy, particularly with regard to impacts on air quality. This may lead to a preference for using biomass in one sector rather than another, depending on its ability to manage these impacts (for example, in industry, which is subject to stricter standards for filtering biomass emissions). The second objective, given that agricultural land cannot be extended indefinitely without undesirable effects (particularly in that such an extension could lead to the transformation of natural ecosystems, either within the country or in third countries), is to avoid **competition with food uses.**

Global food security has been the focus of specific attention for a number of years, and this in 2009 led to the introduction of a framework for the "sustainability of bioenergy" in the European directive on renewable energies (known as the "RED"). It is also in response to this challenge that food uses of biomass are given priority in the hierarchy of uses (see table above). The production of conventional biofuels from resources in competition with food has been capped in this directive, as has the use of food crops for methanisation in the Environment Code. This directive, which was supplemented in 2018 and 2023, covers issuesmuch broader than just competition between food and energy uses.

Finally, the **technical and economic constraints weighing on the production and use of biomass** (transaction costs, inertia of agricultural systems, stability of outlets and prices, etc.) must also be taken into account in order to make the most reliable projections possible.

ACTION BIOMAS.1

BALANCING BIOMASS SUPPLY AND DEMAND FOR THE ENERGY SECTOR

- → To strengthen supply, update the national biomass mobilisation strategy adopted in 2018, ensuring dialogue and consistency with the Regional Biomass Schemes;

- → In order to prioritise demand and ensure the best possible allocation of biomass supply, implement principles of prioritisation (compliance with the principle of cascade use of biomass within the meaning of the RED directive for wood, for example, prioritisation of uses, etc.), by applying it in particular to the system of public aid to biomass-consuming sectors and by strengthening the conditionality of this aid, in line with the European framework;

- → Clarify, establish, systematise and legitimise the role of the Regional Biomass Units in validating supply plans for projects using biomass and prioritising biomass uses.

- → Strengthen the governance of these various issues, transparency and dialogue with the stakeholders concerned through the Thematic Commission, "bioeconomy" as reformed in July 2024 ;Interfilières

- → Improving understanding, monitoring, projections and scenarios on supply and demand, as well as anticipating and preventing environmental impacts, by building on the "biomass" scientific interest group announced in March 2024, and on the work of the regional biomass cells.

- → Ensuring the sustainability of biomass production systems (agricultural, forestry, etc.) through the rapid application of the framework adopted at European level, in a way that is easy for operators to understand.

4.6. Energy infrastructure and networks

The energy transmission and distribution networks have undergone major changes in recent years, and these are set to accelerate.

Electricity networks will undergo structural changes in the coming years, both nationally and internationally. The European Union's electricity network action plan, presented at the end of November 2023, highlights the need for €580 billion in additional investment in networks between now and 2030. At a global level, the International Energy Agency (IEA) highlights the need to double the pace of these investments by 2030, from the current level of around 300 billion dollars per year to 600 billion dollars per year. The number of installations to be connected to the grid is increasing significantly with the energy transition, both on the producer side (for example, in France in 2023, around 207,000 renewable energy installations were connected to the public distribution grid, compared with 61,000 in 2021) and the consumer side (connection of charging points for electric vehicles, decarbonisation of industry, etc.). In this respect, the EPP introduces a change of approach for structural network developments in order to improve the anticipation of these developments and thus accelerate connections, while ensuring the sustainability for network operators and consumers of the planned massification of investments.

The gas networks will have to evolve in terms of both their structure and their pricing approach in order to take account of the profound consequences of the decarbonisation of our energy system: allowing the connection of new renewable or low-carbon gas production projects, while at the same time seeing their use fall as a result of the overall reduction in gas consumption. This will mean giving operators the means to support the transition of gas-using territories as a priority, as they represent the largest fixed costs.

At the same time, a review of the development of new gas networks (hydrogen and CO_2 in particular) needs to be carried out by developing their regulatory framework, which will have to take account of the new European framework (Gas Package) but also of the issues specific to these infrastructures (high volume risk, which means that the basic approaches to regulated assets need to be supplemented).

4.6.1. Heating and cooling networks

See section 3.1.5.

4.6.2. The liquid fuels network

Throughout our energy-climate trajectory, the government is making sure that oil logistics will evolve to support the energy transition with the aim of ensuring the country's sovereignty: changes in refining to ensure the production of alternative fuels in France and to reduce the use of fossil fuels in processes, adaptation of transport, storage and distribution infrastructures with a change in the business model for service stations due to changes in usage.

ACTION CARB.1

PREPARING FOR THE TRANSFORMATION OF THE LIQUID FUELS NETWORK

→ The transformations envisaged will have to maintain the capacities needed to ensure France's security of supply and sovereignty. These changes will take account of technical developments (co-processing of crude oil and bio-based oils, replacement of fossil hydrogen by electrolytic hydrogen, COcapture$_2$, electrification).

→ The adaptation of existing cross-border pipeline networks to the transport of synthetic fuels and biofuels, and to the reduction in the transport of crude oil where necessary will have to be carried out in conjunction with the beneficiary countries (mainly Germany and Switzerland) and the North Atlantic Treaty Organisation.

4.6.3. The gas network

The gas network transports natural gas from import points, LNG terminals and renewable and low-carbon gas production facilities to consumers and export points. It comprises transmission pipelines, compressors and distribution networks, operating in synergy with underground natural gas storage facilities.

The gas network consists of :

- the transmission network used to transport large volumes of natural gas over long distances. It represents almost 40,000 km of pipelines in France. LNG terminals, interconnection points with networks in neighbouring countries and natural gas storage facilities, as well as several hundred very large consumers of natural gas, are connected to the transmission network;

- distribution networks, which carry natural gas to end consumers at lower pressure and over short distances. They represent more than 200,000 km of pipelines. The natural gas distribution networks are owned by local authorities and operated under concession by network operators. A third of France's municipalities, home to almost 80% of the population, have a natural gas distribution network.

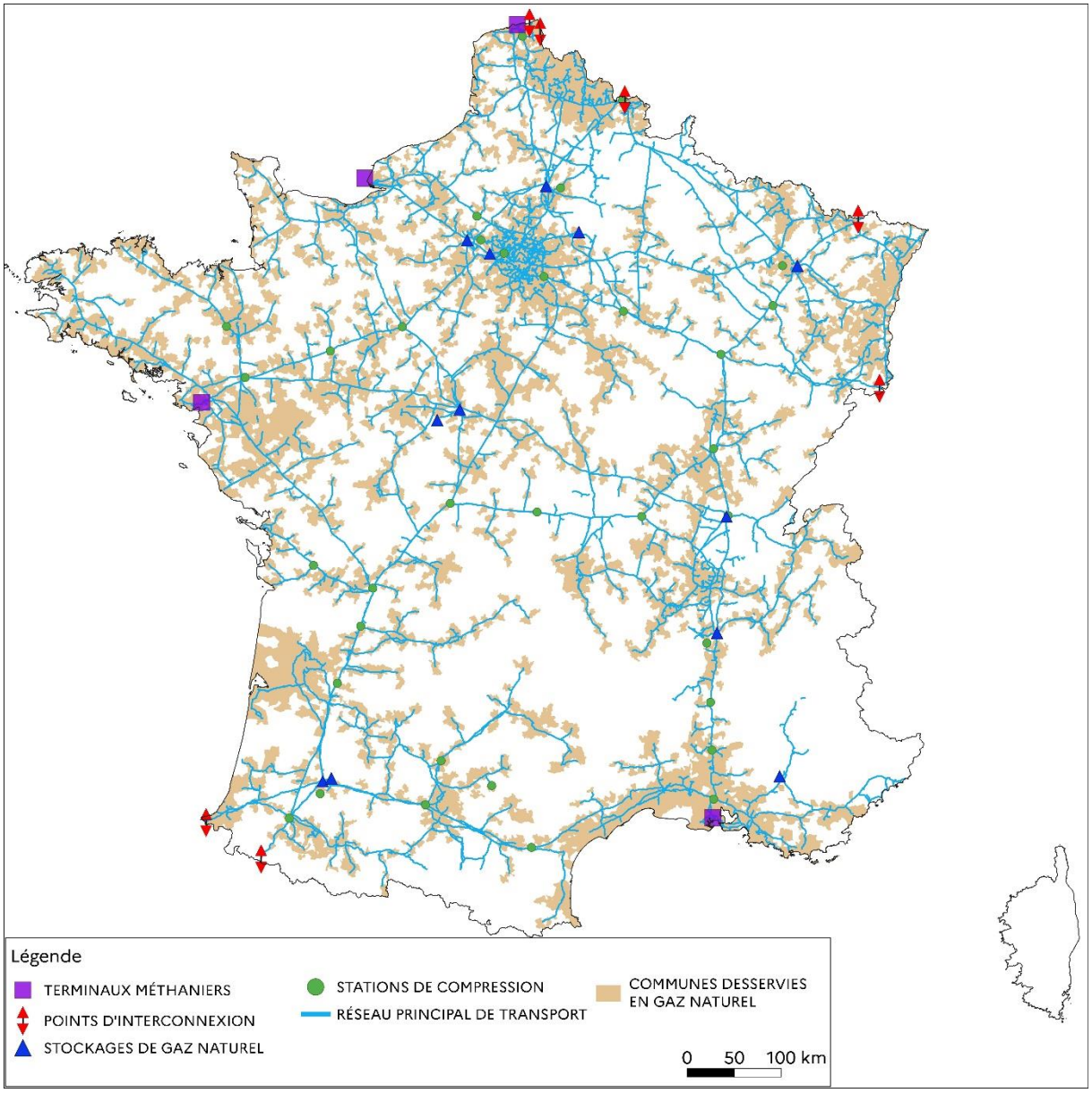


Figure 32. The French gas network in 2024

Adapting the gas network to the drop in Russian gas exports to the European Union

The supply of natural gas to the European Union and France has been disrupted by the reduction in Russian gas exports, which began in 2021 before accelerating in 2022, following Russia's invasion of Ukraine.

The French gas system has historically been designed to enable natural gas suppliers to ensure diversified and flexible supplies, with the pipeline Franpipe enabling direct imports of Norwegian gas, LNG terminals providing access to the global liquefied natural gas (LNG) market and interconnections with the German, Belgian, Spanish and Swiss networks.

This flexibility in the French gas system has enabled natural gas suppliers to set up alternative supplies to compensate for the fall in Russian gas exports, thereby preserving supplies for their customers and contributing to Europe's gas supply. The fall in Russian gas exports was offset by an increase in LNG imports.

Since 2021, a number of adjustments have been made to the French gas system to take account of the new supply context:

- Export capacity to Germany and Switzerland has been increased in the interests of solidarity, in order to facilitate supplies to countries to the east of France, which were previously more dependent on Russian gas supplies;

- LNG terminal capacity has been increased, by optimising the use of existing facilities, in order to adapt to the increase in LNG imports;

- a floating LNG terminal has been temporarily installed in the port of Le Havre, for a maximum period of five years, to restore redundancy margins, in order to be able to preserve natural gas supplies and transit capacities in the event of the unavailability of a major gas infrastructure. The continuing fall in natural gas imports should make it possible to regain margins of flexibility by 2028, enabling this objective to be achieved without having to resort to the additional capacity of the floating LNG terminal (see section 4.2.2 The sizing of the gas system).

The upheaval in natural gas supplies has also led to a change in the gas flows observed within the French network. Whereas gas flows used to come mainly from the north-east, the reduction in Russian gas exports and the increase in LNG imports at LNG terminals are now leading to flows from the west and south. This inversion of dominant flows can lead to congestion on the French natural gas transmission system. Until now, such congestion has been dealt with by activating a combination of mechanisms, without any new investment. The prospects for a fall in methane gas consumption mean that we need to optimise the use of existing infrastructure. The frequency and extent of congestion on the French natural gas transmission system will continue to be monitored in the coming years.

Adapting the gas network to the development of renewable and low-carbon gas production

The natural gas network has historically been designed to transport natural gas from a limited number of import and production points to consumers. Historically, most natural gas distribution networks have been located in urban areas, particularly metropolitan areas. In particular, this location enabled the costs of these networks to be amortised more effectively over a wider consumption base.

The development of renewable and low-carbon gas production is leading to an increase in the number of injection points in the natural gas networks, spread throughout the country, and particularly in the more rural areas where the methanisation facilities are located. Connecting renewable and low-carbon gas production facilities requires investment in network extension and reinforcement, as well as the construction of reverse flow facilities enabling methane gas to flow, in contrast to the usual flows, from the low-pressure networks to which certain production facilities are connected to the high-pressure networks.

The investment needed to integrate renewable and low-carbon gases is estimated at between €6 billion and €10 billion between now and 2050.

Adapting the gas network to lower methane gas consumption

The fight against climate change and the move away from fossil fuels will result in a drop in methane gas consumption. This raises the question of the relevance, and even the economic sustainability, of maintaining and significantly developing a methane gas network. The reduction in methane gas consumption reduces the basis on which fixed network costs are passed on, thereby increasing unit costs, i.e. the proportion of network costs per volume of gas consumed.

A study has been carried out by CRE and DGEC in 2022 to identify the challenges associated with gas infrastructures in a context of falling methane gas consumption.

This study concludes that almost the entire natural gas transmission network will continue to be needed in the medium term to manage seasonal and regional differences between production and consumption and transit between Member States, as few pipelines can be converted to transport other gases (H_2, CO_2, etc.).

The natural gas distribution network has been extensively upgraded in recent years, and will have a role to play in integrating biogas. There is little scope for significantly reducing the cost of using natural gas distribution networks between now and 2030.

In the absence of specific measures, the allocation of fixed costs to a declining methane gas consumption base could lead to an increase in the unit costs associated with gas infrastructures.

ACTION RES GAZ 1

PREPARING THE GAS NETWORK FOR THE DROP IN METHANE GAS CONSUMPTION

→ Drawing on feedback from initiatives that have been carried out, in France and abroad, to support the reduction in methane gas consumption, and conducting an experiment, at local level, on planning the development of the natural gas distribution network.

→ Take account of the expected fall in methane gas consumption when setting tariffs for the use of gas infrastructures.

4.6.4. The electricity network

4.6.4.1. Structural changes in the years ahead

Because they transport electricity from production centres to consumers, electricity grids are at the heart of the power system and a key link in the energy transition. The network is made up of :

- the public electricity transmission network, designed to transport large quantities of energy over long distances, operating at voltage levels of between 50 and 400 kV and comprising around 100,000 km of lines;

- and the public distribution network, designed to deliver electricity to end consumers in smaller quantities and over shorter distances. The public distribution network operates at lower voltage levels (below 50 kV), and represents almost 1.4 million kilometres of lines.

Issues

The number of electricity generation facilities is set to increase significantly over the next few years, both for projects connected to the transmission grid (nuclear power stations, offshore wind farms,

large onshore renewable energy farms) and to the distribution grids (small and medium-sized renewable energy farms). These commissionings will change the type of flows historically observed on the grids, with an increase in centralised generation (from coastal areas and nuclear production basins) and more diffuse locations (although with marked regional dynamics, for example for solar power in the southern half).

At the same time, the needs generated by the electrification of processes, particularly in industry and mobility, will lead to a sharp increase in connection and reinforcement requirements. The decarbonisation drive alone in France's main industrial areas (particularly in the industrial port areas of Dunkirk, Fos-sur-Mer and Le Havre) implies a demand for connections of around 13 to 15 GW between now and 2030.

These developments will therefore require rapid structural changes in network development strategies and associated investments. By way of illustration, for industrial decarbonisation zones, RTE has started a "race against the clock" from 2022 to plan pooled and priority infrastructures and launch studies and administrative procedures with a significant acceleration in the upstream consultation phases, in parallel with legislative changes (acceleration laws and green industry).

For the transmission network, they are presented in the first guidelines of the ten-year development plan for the transmission network, drawn up on the basis of consumption and production projections appearing in the Generation Adequacy Report, published by RTE in February 2025. As far as the distribution network is concerned, they were detailed by Enedis in 2023 in its preliminary network development plan.

The associated challenges are manifold. For the electricity transmission network, RTE presented four technical priorities: (i) launching a programme for the industrial connection of low-carbon resources, (ii) strengthening the network structure, (iii) renewing the network and adapting it to climate change and (iv) putting in place systems to ensure network security.

On the one hand, achieving the targets set for the decarbonisation of the energy sector will necessarily require an increase and acceleration in connections, particularly of electric renewable energies to enable their large-scale integration, charging infrastructures for electric vehicles, and projects to decarbonise industry.

RTE should aim to connect 18 GW of offshore wind farms by 2035, in addition to developing structural projects to adapt the transmission system to meet demand in major industrial areas. It should continue to develop interconnections between France and its neighbours, and maximise economic spin-offs in France and Europe by encouraging the development of a manufacturing industrial base linked to the connection of offshore wind farms.

With regard to the offshore wind capacity to be connected, RTE will also have to examine the economic, contractual and technical conditions in greater detail during the initial phases of the competitive procedures with equipment suppliers, and propose an optimised connection timetable, so that the overall delay in the initial timetable - enabling the commissioning of offshore wind capacity of 18 GW in 2035 - does not exceed two years. In the event of a delay, RTE will have to propose to the French government, for approval, the best possible trade-offs in terms of the origin of supplies and the dates on which connections will be made available, to enable it to limit the impact on the offshore wind industry as a whole.

Enedis has connected 3.8 GW of renewable energy installations in 2022 and 4.4 GW in 2023, and expects the total capacity of these installations to double between now and 2032, rising from 35.5 GW at the end of 2023[75] to 70 GW in 2032 .[76]

In addition, the emergence of new production and consumption areas means that the main transmission network (400 kV lines) needs to be adapted to meet the increase and general change in flows within France and between European countries. These adaptations will involve both minor changes (e.g. changing drivers) and more extensive restructuring of the network, with the creation of new routes in the coming years. In the absence of development and reinforcement of the 400 kV network, congestion will appear from 2030 on certain routes and will gradually spread to the rest of the network. The resulting restrictions on production could amount to several TWh per year, resulting in compensation and balancing costs of the order of several billion euros per year. In addition, the use of more carbon-intensive means of production to compensate for these limitations would significantly increase greenhouse gas emissions.

In this context, better planning and anticipation of network developments is essential to the success of the energy transition. That's why the law to accelerate the production of renewable energies has introduced the first legislative changes in this direction, particularly as regards the regional grid connection plans for renewable energies, drawn up by RTE in conjunction with the distribution system operators.

These needs also arise in a context where a large part of the existing network needs to be renewed to take account of the challenges of adapting to climate change (increased heat waves, flooding, etc.) and ageing (the transmission network, for example, was mainly built in the post-war period and during the development of first-generation nuclear power plants).

The stakes are also high financially, with increased investment over the coming years, well as in terms of manufacturing and human resources (recruitment).

RTE believes that, due to the acceleration of the energy transition, some of the investments planned between 2035 and 2050 and described in "Energy 2050Futures " will be actuallybrought forward to the period 2030-2040. **As a result, the new SDDR, whose initial guidelines were presented in February 2025, provides for significant increases in investment, with a total of around 100 billion€ between now and 2040**. By way of comparison, the SDDR drawn up in 2019 provided for 33 billion€ euros, but only up to 2035 and on the basis of less ambitious climate objectives. As far as the distribution network is concerned, Enedis is planning to increase by 25% fromits annual investment to 2032[77] , from €4.4 billion/year in 2022 to more than €5 billion/year by 2032, giving a total programme of around €100 billion by 2040.

While the stakes in terms of investment are very high, it should be emphasised that they are financed by network users, on the one hand via the connection contribution and on the other via the tariff for use of the public electricity network (TURPE). They are therefore not a burden on the state budget, but they do have a cost for electricity consumers. On average, TURPE accounts for 20 to 30% of household electricity bills. By way of example, the financial mass covered by TURPE revenues in 2023 represented €16 billion for Enedis and €4.2 billion for RTE. This "authorised revenue" has increased by more than 3% per year between 2017 and 2023 (a total of €2.9 billion) in order to meet

75 Wind and photovoltaic projects only.

76 Enedis projection in the *Network Development Plan, preliminary document 2023:* https:

77 Network development plan, preliminary document 2023

the needs of the electricity system as it evolves to meet the challenges of decarbonisation, both for the connection of new consumption (industry, housing, electric vehicles) and for the new means of production to be anticipated (offshore wind, nuclear, photovoltaic, etc.). Part of RTE's investment is also financed by interconnection auction revenues, which may have a downward impact on the level of the TURPE HTB.

The revision of the network tariff (TURPE 7) currently underway will enable the network to better meet its financing needs, by providing visibility for the coverage of costs and new investments, particularly those that need to be anticipated to speed up the connection of consumers and producers, and by striving to control the financial impact of this massive network transformation effort on the energy system as a whole. The French Energy Regulatory Commission (CRE) plays an essential role in assessing and approving RTE's investment programmes. Each year, RTE submits its investment programme to the CRE, which examines it in detail to ensure that it meets the needs of the French electricity network while optimising costs for consumers.

Studies and work by the transmission system operator will also be needed to take into account future changes in generation and consumption profiles, which will lead to specific physical operation and economic management of the electricity system.

Finally, from an industrial point of view, several factors are putting pressure on the overall supply of the electrical networks sector. Demand for equipment is rising sharply overall, and there is strong competition between electricity network operators on a global scale. The limited number of suppliers of certain critical equipment (cables, transformers, converter stations) can also drive up prices.

These tensions are already affecting supply times and costs for network operators, and thus the pace of the energy transition, which means that network operators need to adapt their supply policy or standardise their catalogue.

Interconnections, essential for a well-integrated European electricity market

Metropolitan France is interconnected with all neighbouring countries, which means that, thanks to its geographical position and low-carbon electricity production, it is able to export electricity on a structural basis, to the benefit of its trade balance. In 2024, France recorded 89 TWh in net electricity exports, beating the record of 77 TWh set in 2002. Thebalance export was positive on all its borders: Germany-Belgium (27.2 TWh), Italy (22.3 TWh), United Kingdom (20.1 TWh), Switzerland (16.7 TWh) and Spain (2.8 TWh).

Its interconnection capacity is set to increase significantly between now and 2030, with at least five interconnection projects already underway (with Ireland, Spain, Germany and Belgium) totalling around 5 GW of additional exchange capacity. Beyond 2030, several gigawatt interconnection projects are planned with Spain and the United Kingdom, and are currently at the study stage. The costs associated with an interconnection project are shared between the different countries on the basis of the estimated benefits of the project for each of them, in accordance with procedures decided jointly by the national regulators (in France, the Commission de régulation de l'énergie). Adaptation of the internal network is an essential prerequisite for these additional projects.

RTE's 2024 network development plan, the first guidelines of which were presented in February 2025, has refined the need for additional interconnection capacity according to the investment priorities set out therein. It specifies that it is not appropriate to develop new interconnections until the internal structure of the French network has evolved accordingly.

.

ACTION RESELEC 1

MAKE THE NECESSARY ADJUSTMENTS TO THE TRANSMISSION SYSTEM BY 2035, WHATEVER THE SCENARIOS ENVISAGED, AND CONTINUE TO IMPLEMENT LONG-TERM PLANNING FOR THE ELECTRICITY SYSTEM, THROUGH THE TEN-YEAR TRANSMISSION SYSTEM DEVELOPMENT PLAN (SDDR) AND SYSTEM DEVELOPMENT PLANS FOR PUBLIC DISTRIBUTION SYSTEM OPERATORS

→ Deploy a framework adapted to the anticipation of network developments, based on the changes introduced by the APER law:

- Launching reviews of the regional grid connection plans for renewable energies in order to extend their timeframe, make planning more robust by encouraging producers to register with grid operators at an early stage, and by providing that certain priority investments can be committed as soon as they are deemed to have "no regrets" in order to speed up the provision of facilities
- Deepen the provisions made possible by the APER law (e.g. management of queues) and move away from the historical approach of responding to connection requests on an ad hoc basis to a supply approach in certain priority areas (such as industrial zones), with facilities and investments shared between consumers, as envisaged by RTE in its new SDDR.

→ Strengthen the structure of the grid to enable new production facilities to be evacuated, new consumption areas to be supplied, and to ensure the economic and environmental performance of the electricity system, in particular by developing and reinforcing the 400 kV network without regrets between now and 2035 to avoid congestion on the electricity grid that is both costly and a source of greenhouse gas emissions.

→ Gradually adapt the grid to climate change and renew any infrastructure that needs to be renewed to ensure the performance and resilience of the electricity system.

→ Ensuring that investments are sustainable for network operators through the public network usage tariff (TURPE), while taking care to control the impact on consumers.

→ Securing and strengthening the industrial value chain associated with electrical materials and equipment by developing the French and European offer.

→ Encourage the installation of flexibilities that can help to overcome network constraints

→ Initiate new interconnection projects, as identified in the SDDR 2025-2040, on condition that the economic, environmental and industrial benefits of these are demonstrated, and that the internal network reinforcements needed to maintain the associated exchange capacities are planned.

4.6.4.2. Developing the electricity network to integrate a growing proportion of non-controllable generation

The evolution of the electricity mix will be based on a reduction in controllable thermal energy sources at French and European level, and the development of renewable energies with low

controllability, particularly wind and photovoltaic. In the long term, these renewable energies with low controllability will account for a significant proportion of the electricity mix, supplemented by hydroelectric power and nuclear generation.

The electricity system is faced with increasing episodes of excess production of electricity that is either unavoidable or has low variable costs (nuclear, renewable) compared with demand, at certain times of the day, particularly in spring and summer. This situation is reflected in more frequent episodes of low or negative prices, and in very sustained exports to neighbouring countries to ensure that the grid is balanced.

For example, balancing the power system today relies essentially on the corrective actions implemented by RTE as part of the balancing mechanism. In the event of overproduction, these consist of ordering actions to reduce production by activating the "downward" balancing offers submitted to this mechanism. However, RTE is regularly faced with a shortage of downward offers on the balancing mechanism, forcing it to use exceptional corrective actions.

ACTION RESELEC 2

STRENGTHENING THE TOOLS FOR ADJUSTING GRID OPERATION TO A GROWING PROPORTION OF NON-CONTROLLABLE GENERATION

→ **amend the legislative provisions relating to the mechanismbalancing** : historically, the balancing mechanism has only been compulsory for producers connected to the transmission system whose installed capacity is greater than or equal to a certain threshold. It is therefore planned to make it compulsory for all facilities connected to the public network to offer all available capacity on the balancing mechanism, through both downward and upward adjustments.

→ **initiate a review of the changes that need to be made to the various production support mechanisms** (remuneration supplement contracts, feed-in tariffs) in order to develop incentives for the facilities concerned to shut down or offer production at its variable cost during periods of excess production.

→ **develop flexibilities on the consumption side**, in order to shift consumption to the most opportune periods of the day and absorb surplus production: this action makes it possible to optimise the operation of the electricity system at a lower cost, while providing tangible economic and environmental benefits, by taking advantage of the abundance of low-carbon and inexpensive energy during the midday periods (cf. § 4.3).

4.6.5. Recharging infrastructure for alternative fuels

Note: for more details on this subject, please refer to the clean mobility development strategy in Appendix 1.

Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of infrastructure for alternative fuels and repealing Directive 2014/94/EU, known as AFIR, came into force in April 2024.

Electric vehicle recharging infrastructure (IRVE) for road vehicles

Since 2020, there has been very strong growth in the deployment of IRVEs open to the public, particularly for high-power recharging, which allows vehicles to be recharged in less than 30 minutes, facilitating long-distance roaming. By 2023, all service areas on the concessionary road network will be equipped with fast-charging stations for light vehicles, and rest areas are also starting to be equipped. In addition, large commercial areas, often close to major roads, have launched programmes to install high-power IRVEs.

In particular, the AFIR regulation sets deployment targets along the TEN-T road network (central and global), as well as output power targets for charging stations. This latter objective, which breaks with the objective of the repealed 2014 directive, which set an objective in terms of the number of charging points, illustrates the importance of charging power, in particular the connection power of charging stations and the adaptation of the electricity distribution network. In addition, the DGITM is finalising (for the first half of 2025) a Master Plan for Electric Vehicle Charging Infrastructure for Roaming on the National Road Network (SDIRVE-RRN), which will set out the needs over the coming years along the entire national road network.

Generally speaking, the massive increase in the number of electric vehicles should not weaken the French electricity system. The total energy consumption of electric vehicles over the next 10 or 15 years can be absorbed without difficulty, given the changes in generation capacity and other consumption anticipated at that time. The issue is more one of power demand, particularly because of the growth in the number of electric vehicles, but also because of the arrival of electric heavy goods vehicles, which will adopt the MCS (megacharging system), which can exceed one MW per charging point. Work underway with the grid operator and electricity distributors will make it possible to plan for any power increases needed for recharging while roaming, at road haulage depots or at destination. The development of charging control solutions will be necessary to avoid an excessive impact on peak consumption; moreover, in certain cases, the restitution of energy by the vehicle's battery, known as "vehicle to X", could provide network balancing services.

ACTION CARB ALT .

ANTICIPATING THE DEPLOYMENT OF CHARGING POINTS ON MAJOR NATIONAL ROADS

Set targets for the deployment of charging points for light and heavy vehicles by 2035 (in terms of connection capacity to meet the number of charging points required) for the main routes on the national road network, through a master plan for charging infrastructure for electric vehicles (SDIRVE-RRN) involving :

- For road network managers, and in partnership with electricity network managers, set and refine targets for power and charge points at area level, based on local characteristics and electricity network constraints;
- For electricity network operators, better planning and anticipation of the necessary network adaptations thanks to greater visibility of medium-term requirements.

Shore-side electricity supply for ships in port

From 1 , the AFIR regulation will January 2030require ships to be connected to the shore power supply in ports of call, and will therefore require the deployment of shore power stations in the French ports concerned.

4.6.6. Interactions between networks

The electricity and gas sectors are already closely linked, since the peak resources needed to ensure security of electricity supply are generally gas-fired generation facilities. Similarly, the electricity and natural gas markets are closely linked, with the price of electricity quite heavily dependent on the price of gas. In order to take account of the new dynamics of consumption and their daily, weekly or annual profile, the transitions and transformations between vectors and in particular between electricity and gas, or between electricity and heat, should increase. The different vectors therefore need to be considered in a more global way: this is called sectoral coupling.

These discussions are currently taking place at several levels, from the European level, with the strategy for coupling sectoral systems, to the local level, with the development of smartgrids, collective self-consumption or the coupling of several systems on the same site (cogeneration, recovery of waste heat, development of electrolysers associated with industrial processes, etc.).

In addition to optimising consumption, taking sectoral coupling into account will have direct implications for infrastructure sizing and planning (plansten-year network development), in particular to ensure security of supply.

The development of flexibilities is also a challenge for the resilience of energy systems. Indeed, disruptions to one energy system can lead to disruptions to other systems, whether in terms of prices or the operation of these other systems themselves, and lead to shifts in consumption from one energy source to another. The interplay between natural gas and electricity supplies is no longer in doubt: the aftermath of the invasion of Ukraine and the energy price crisis have underlined the interdependence of the two energy systems.

•5. Research and innovation for the development of new energy technologies

Research and innovation policy, an essential lever for accelerating and achieving the low-carbon energy transition.
Research and innovation are a major focus of the energy transition policy, helping to consolidate the positioning of competitive industries that will create the jobs of tomorrow, creating the conditions for society to take ownership of this transition, and addressing environmental issues throughout the innovation cycle for emerging technologies and those currently being deployed while ,working together to decarbonise the energy mix and reduce consumption.

The profound transformation required for the transition to a low-carbon society can only be achieved through a complex combination of technological breakthroughs, innovation and changes in behaviour, from individual consumers to industrial designers. By providing solutions, research meets these social, economic and technological challenges. To nurture research on these different issues over the long term, it is essential to maintain a balance between skills in key disciplines such as chemistry, mathematics, biology and the human and social sciences.

Public investment in R&D for energy is around €1,725m, following two years of strong growth: +12% in 2021 and +11% in 2020. The top two areas are nuclear power (€962m, 56%) and new technologies (€614m, 36%), followed by fundamental research (€133m).

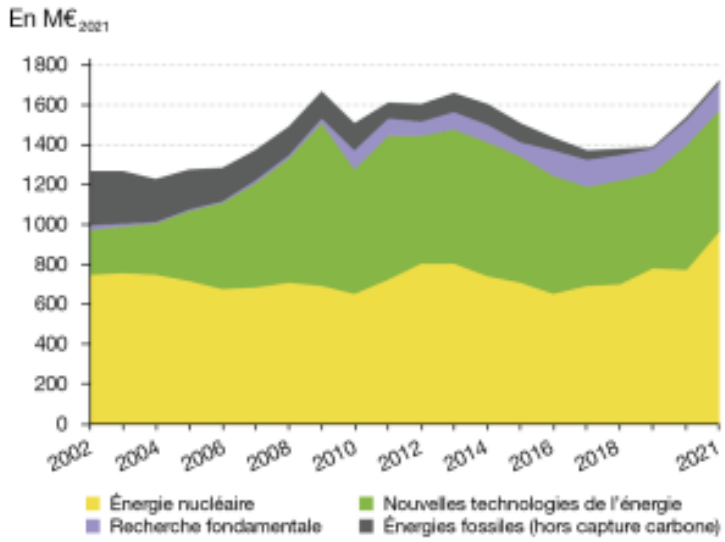


Figure 33. National public R&D expenditure on energy by field from 2002 to 2021 - Source SDES (publication October 2023)

In addition to funding public research establishments, the French government supports collaborative research projects between public and private R&D players and innovative business projects, and encourages the transfer of research to industry. Given the specific nature of the energy sector, all the scientific, technological, economic and societal barriers can only be overcome through actions supported by both public and private research and through a collaborative approach between the various players.

Technological challenges

In the technological fields, whatever the specific features of each scenario for achieving carbon neutrality, which will contribute to meeting France's climate commitments by 2050, both on the demand side and the supply side, solutions resulting from research are expected in the decarbonisation of industrial processes, energy efficiency, large-scale deployment of low-carbon energies, particularly renewable and nuclear, the development and control of storage resources for the various energy carriers (electricity, heat, gas, etc.), intelligent management of the transport and distribution networks for the energy carriers, large-scale development of carbon capture and storage solutions, the development of recycling, the preservation and supply of natural resources, the development of renewable energies, the development of renewable energies, the development of renewable energies, the development of renewable energies and the development of renewable energies.), intelligent management of energy transmission and distribution networks, large-scale development of carbon capture and storage solutions, development of recycling, preservation and supply of natural resources, development of bio-based products, in particular biochemicals and biomaterials, and support for organisational innovations.

To detect the emergence of new technologies and guide public policy accordingly, France is adopting a proactive, multi-dimensional approach. A number of local players are involved in this, for example through the networks of SATTs (Sociétés d'Accélération du Transfert de Technologies), competitive clusters, university innovation clusters and the regional presence of ADEME and BPI France. This watch enables us to monitor trends and prospect for new technologies, so that we can feed into the work of drawing up public innovation policies for the future development of energy technologies.

Social and organisational issues

Research in the humanities and social sciences has its part to play in the technological issues surrounding the ecological transition, because changes in usage and questions of social acceptability and appropriation arise as a result. Changes in lifestyles towards a low-carbon economy require work on forms of social organisation, institutions and economic models. The aim is to decompartmentalise the sciences and create beneficial exchange relationships between the humanities and social sciences and the formal and natural sciences. The benefits are manifold:

- A cross-disciplinary approach between research and social sciences and humanities players, to ensure that research areas and innovation paths correspond to the real needs of society.
- Facilitating the industrial deployment of new energy technologies, in particular by addressing issues of acceptability.
- Bringing research establishments closer to civil society with the aim of winning over a wider audience
- Anticipating possible rebound effects (Jevons effect) linked to the deployment of new energy technologies

Investments in France 2030

The France 2030 plan has supplemented the existing resources of the Programme d'Investissement d'Avenir with additional funding, representing an unprecedented effort in research and innovation to support highly innovative and ground-breaking projects, with a major focus on supporting the ecological transition.

For research activities, the Priority Research Programmes and Facilities (PEPR) provide support for research, with the aim of building and consolidating French excellence in priority scientific fields at national level. These PEPRs support the energy transition through technological, economic, societal and environmental transformations. For this upstream research (technologies that are not yet mature, associated with low TRLs), the French National Research Agency (ANR) is the State's operator.

Since 2021, a number of PEPRs have been launched in emerging energy-related scientific and technological sectors, focusing on energy systems to accelerate the decarbonised production of electricity and heat, promote decarbonised hydrogen, new-generation batteries, decarbonisation of industry, advanced materials, understanding biogeochemical cycles, more responsible management of water, the subsoil as a common good, recycling, biosourced products and biotechnologies, among others.

In the field of energy transition, it is then a question of demonstrating technologies and their uses in real-life conditions, and then ending up with products that can be deployed. The government's support for the various acceleration strategies accompanies the various key stages, from identifying the barriers to be overcome in research and development, to the transition to industrial scale, right through to the opportunities for mass deployment with the first commercial capacities.

Game changers
An ANRT working group has undertaken a SWOT-type approach, based on the identification of market strengths, weaknesses, opportunities and threats, to qualify various potential disruptions to energy supply and demand by 2030-2040 (wind, solar, nuclear, biomass, networks, digital, hydrogen, low-carbon fuels, vehicles, aviation, industry, buildings) and thus define research and development priorities.

AI, or emerging technologies in Artificial Intelligence
While artificial intelligence offers significant opportunities for combating climate change, and will contribute to our economy and society as an embedded solution in mobile devices (autonomous cars, logistics robots, robotsagricultural, personal assistance robots, etc.), each of these solutions will have to be high-performance, robust and resilient if they are to be accepted and therefore easily and widely deployed.

The results of this research, ranging from hardware to software, from energy consumption to the development of new architectures, will have an impact on all energy sectors and links.

Ambition at European level
To ensure greater visibility in the medium and long term, French research players are mobilising both at national level and as part of collaborative European programmes.

In the field of energy, France has an academic fabric, research and innovation bodies and training structures that are often at the top of international rankings (CEA, IFPEN, CNRS). There are strong links with major international industrial players in the energy sector, as well as with SMEs and ETIs.

In the light of international competition and to enhance the attractiveness of the European Union, the possibilities for structuring European energy industries are being examined. This cooperation and consultation is taking place at several levels through the SET PLAN (committee. **Strategic Energy Technology Plan**)The SET Plan aims to put in place a Community cooperation policy to accelerate the development and deployment of low-carbon technologies. To this end, it helps to coordinate nationalactivities research and innovation in the field of low-carbon energy development between Member States and associated countries, and to align national research and innovation programmes with each other.

This space for dialogue between researchers and their research ecosystems is of geopolitical and strategic importance for the European Union. With the aim of maximising the effectiveness and

impact of these actions, in the long term they will create more socio-economic opportunities in established and emerging markets.

Indicators for monitoring research and innovation policy

Several players are working to develop indicators in this area. In collaboration with the ministries and the four operators (ADEME, BPI France, ANR and the Caisse des dépôts et de consignation) of the France 2030 investment programme, the SGPI is developing indicators to assess the impact of support for innovation. The CGDD also collects data on public investment in energy research and development (R&D) for the IEA (International Energy Agency), providing a comparable framework for IEA member states.

•6. Socio-economic and industrial issues, consumer purchasing power and competitive energy prices

6.1. Macro-economic issues and socio-economic impacts of the EPP

6.1.1. Macro-economic issues of the EPP

The report "Les incidences économiques de l'action pour le climat" by Jean Pisani-Ferry and Selma Mahfouz published in May 2023[78] presents the economic impact of the transition and therefore of the EPP:

- The **climate transition is on the scale of an industrial revolution**, but will have to be twice as fast.
- The **transition is based on three economic mechanisms**: the **reorientation of progress** technical from brown to green, the beneficial effects of which will materialise in the medium to long term; **sobriety**, which presupposes a change in practices and collective norms and can be conducive to well-being; the **substitution of capital** (public and private investment) for fossil fuels (the main mechanism over the next 5 to 10 years).
- While the transition may result in a fall in business productivity growth in the short term, an orderly transition that is sufficiently predictable for households and businesses to be able to anticipate the measures and adapt accordingly could **generate gains in activity in the long term.** These gains will only materialise under the good conditionsfollowing : absence of friction on the reallocation of capital and labour, international coordination of transition policies, transitionorderly, etc. The transition also presents an inflationary risk, which public policies will have to seek to control. In any case, the cost of action is much lower than the cost of inaction.
- **The competitiveness of European industry is at stake**. We need to of green industries. So too is support for the energy competitiveness of businesses in relation to other major economic powers, given the differences in energy prices.support the development
- **Transition raises issues of equality and just transition**. Transition presupposes the ability to finance public and private alternatives. Even if they can sometimes be profitable in the long term, some green investments may not be financeable without public support for low-income households or even the middle deciles. Consequently, the French strategy will continue to provide the necessary public support to households, particularly the most vulnerable, to ensure that the transition is feasible for all. The problem of financing green investments will also arise for businesses, particularly the smallest ones, which will not necessarily be able to finance all the costs of decarbonisation. They will also need support. Finally, sobriety efforts will have to be shared by all players.

  The far-reaching changes linked to the transition can therefore **continue to be supported within a limited budget**: aid for energy-efficient home renovation, aid for paying energy bills, aid for

78 https://www.strategie.gouv.fr/publications/incidences-economiques-de-laction-climat

purchasing electric vehicles, etc., **with more targeted support in line with the guidelines that will be adopted in terms of prioritisation.**

According to this report, the ecological transition would ultimately generate economic and environmental compared to a scenario of climate inaction, i.e. without sufficient mitigation policies to prevent the deleterious effects of climate change from materialising. However, the ecological transition could lead to a slowdown in economic growth, particularly over the next decade. The report also includes an assessment of co-benefits *ex-ante* the macroeconomic impact of a number of additional decarbonisation measures (fiscal measures and sectoral measures in construction, road transport, industry and energy production). In the presence of a negative shock to productivity justified by the crowding-out effects that additional investment in decarbonisation could have on productive investment, these additional measures could lead to a fall in activity and inflationary effects compared with a reference scenario incorporating the existing measures. Overall, this report highlights the uncertainty surrounding the macroeconomic impact of transition policies and calls for further evaluation work.

The modelare used to assess the macro-economic impact of the EPP and the SNBCThree-ME [79] and the IMACLIM [80]. This macro-economic assessment is carried out by comparing the "scenario AME" or "with existing measures" with the "scenarioAMS" or "with additional measures. This additional assessment is currently underway. It will contribute to the discussions on the operationalisation of planning, and will complement the issues identified in the report "Les incidences économiques de l'action pour le climat" by Jean Pisani-Ferry and Selma Mahfouz, published in May 2023.

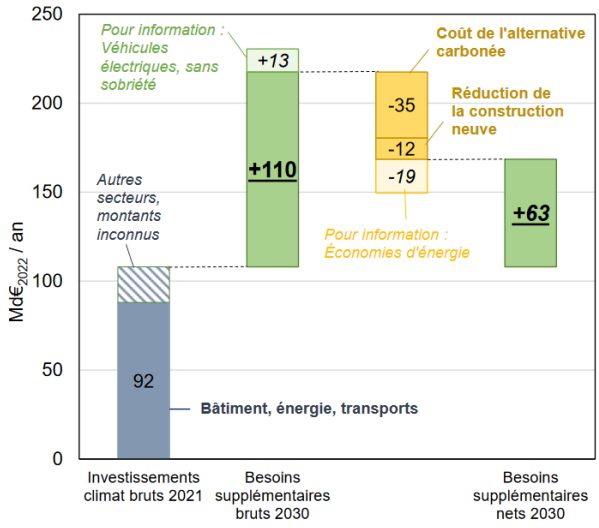
79 Three-ME is a Keynesian computable general equilibrium model developed since 2008 by OFCE and ADEME. It is a hybrid multi-sector model.

80 IMACLIM is a multi-sector hybrid general equilibrium model of the French open economy developed by CIRED.

6.1.2. Issues surrounding investments to combat climate change

Achieving the objectives of the ecological transition will require substantial financing, primarily from the private sector, but also from the public sector. In 2022, according to the latest edition of I4CE's climate finance overview[81] , private and public climate investments will reach €100 billion, up 9% on 2021 (driven by energy-efficient home renovation and low-carbon vehicles).

In a working paper published in April 2024 (based, among other things, on the report "Les incidences économiques de l'action pour le climat"), the French Treasury estimates [82] by Jean Pisani-Ferry and Selma Mahfouz and the 2023 edition of I4CE's climate financing overview[83]that decarbonisation will require additional private and public investment that could amount to around €110bn/year in 2030 compared with 2021. This could be limited to around +€63bn/year in net additional annual investment (after subtracting the lower investment in carbon-based alternatives and the fall in new construction). By way of example, the increased use of electric vehicles would reduce gross investment in internal combustion vehicles by around €29 billion a year in 2030. Energy efficiency measures also play a key role in moderating these investment requirements: without them, investment requirements for electric vehicles would be €13 billion higher per year. However, investment requirements for 2050 are not yet known. These investments will lead to energy savings that could partly cover these additional costs.



Secteur		Présent document de travail[1]
Total	**Bruts**	**+110 Md€/an**
	Nets	***+63 Md€/an***
Bâtiment	Bruts	+39 Md€/an avec redirection vers des investissements coût-efficients
	Coût de l'alternative carbonée	*−6 Md€/an*
	Baisse construction neuve	*−12 Md€/an*
	Pour information : Économies énergétiques (résidentiel)	*−10 Md€/an*
Transport	Bruts	+43 Md€/an
	Coût de l'alternative carbonée	*−29 Md€/an*
	Pour information : Économies énergétiques (véhicules routiers)	*−9 Md€/an*
	Pour information : véhicules électriques évités par des mesures de sobriété	*−13 Md€/an*
Énergie		+17 Md€/an
Industrie		+5 Md€/an avec Opex
Agriculture et forêt		+5 Md€/an
Déchets		+1 Md€/an

Sources : Résidentiel, transport hors infrastructures et renouvellement forestier : chiffrage des auteurs ; Tertiaire et construction neuve : I4CE (2023a) SNBC3 ; Infrastructures de transport : JPF-SM (2023) ; Énergie : borne haute RTE (2023) ; Industrie : DGE (2023) dont investissements à l'achat pris en non supplémentaires ; Agriculture : borne inférieure des chiffrages mobilisés ; Forêt hors renouvellement forestier : moyenne des chiffrages disponibles ; Déchets : Rexecode (2022).

[81] Institute for the Economy and Climate

[82] The additional investment needed between now and 2030 to help the climate is estimated by the report at €101bn/year in low-carbon investment and €66bn/year net of reductions in carbon investment (€35bn/year in brown investment). The report will be published in May 2023 and can be accessed at the following link: https://www.strategie.gouv.fr/publications/incidences-economiques-de-laction-climat

[83] The Institut de l'économie pour le climat (I4CE) estimates that each year on average between 2024 and 2030, an additional €58bn/year will need to be invested in climate protection compared with 2022. By 2030, on the same sectoral basis, these needs are close to those identified by Jean Pisani-Ferry and Selma Mahfouz.

*Figure 34. Additional low-carbon investment requirements in 2030 compared with 2021, estimated by the French Treasury's working paper (Source: "Quels investissements pour les objectifs français de décarbonation en 2030", **April 2024, Logan Gourmand).***

In addition to increasing low-carbon investment, meeting climate targets requires a reduction in fossil fuel investment. In total, these will have to be halved between now and 2030[84] , with a particular focus on fossil-fuelled road vehicles and a reduction in the construction of new buildings that use fossil fuels. This reduction represents an opportunity to finance the low-carbon expenditure needed to replace them.

These investment requirements are estimated on the basis of a approach bottom-up, sectoral describing a chronicle of investment in gross fixed capital formation and consumption of low-carbon durable goods, making it possible to meet the objectives of the SNBC 3 and therefore of the PNIEC. Most of the time, the requirements are calculated in current euros and do not allow for the internalisation of price variations resulting from macroeconomic mechanisms.

Sectoral analysis of investment requirements for 2030

The French Treasury estimates that the need for additional investment in 2030 is particularly high in the building sector, in line with the Pisani-Ferry - Mahfouz report and I4CE estimates. This would amount to +€39bn/year, including +€22bn/year for the renovation of residential buildings, based on the assumption that renovations will be targeted at cost-efficient measures. The total amount of investment to be made in this sector is likely to be affected by investment in new construction, which could lead to a reallocation of investment between construction and renovation.

In the transport sector, climate investments will have to be increased by €43 billion per year in 2030, mainly for the acquisition of zero-emission vehicles (an additional €27 to €33 billion per year for passenger cars, and €7 to €12 billion per year for LCVs and HGVs) and for transport and recharging infrastructure (€6 to €15 billion per year). The sobriety assumptions have an impact on total investment, since in a scenario with a smaller fall in total vehicle registrations, investment in electric vehicles would be around €13 billion a year higher and investment in combustion vehicles would be €6 billion a year higher.

In the energy sector, the need for additional investment by 2030 is estimated at €17 billion per year, mainly in electricity generation (to meet rising demand and low-carbon production) and low-carbon fuels, as well as in networks (transmission, distribution and flexibility). As part of the EPR2 programme, the French government has evaluated the investment costs involved in building 6 new nuclear reactors, with the first reactors due to be connected to the grid by 2035. These were estimated in 2021 at €51.7 billion$_{2020}$, spread over a total construction period of 25 years, corresponding to average annual investments of around €2 billion/year.

The need for additional investment in decarbonising industry is estimated at between +€2 and +€3 billion/year on average in 2024-2030 to achieve the objectives of the SNBC2, compared with the observed emissions reduction trend. They could reach up to +€4bn/year in 2030 if the SNBC-3 targets

[84] October 2025, "Stratégie pluriannuelle des financements de la transition écologique et de la politique énergétique nationale (SPAFTE)".

are met, and +€5bn/year if operating costs (maintenance and energy costs) are included, which are highly uncertain but could reach +€1bn/year.

There have been few recent studies of the additional gross investment needs in agriculture and the forest and land sector. Existing figures identify minimum additional gross investment needs of around €1bn/year for agriculture[85] , considering only the acquisition of new low-carbon machinery. For forestry, the investment needs cover the reinforcement of sustainable management, the renewal of forests to adapt to climate change, and the increase in forest area. The total remains uncertain, but would represent an additional investment requirement of around €3 to 4 billion per year between now and 2030 . [86]

Financing instruments and breakdown by player

A collective effort is needed involving businesses, local authorities, the State and the French people as a whole. To this end, the Comité du financement de la transition écologique (CFTE) has been tasked with coordinating the efforts of manufacturers, financiers and public authorities to mobilise the financial resources needed for France's ecological transition. **Against a backdrop of budgetary constraints, the government's priority will be to mobilise private funding and to target public funding according to criteria of efficiency, incentives and social justice, with a multi-year perspective**, as well as to reduce certain "brown" expenditure.

To provide this visibility and a multi-year perspective, article L. 100-1 A of the Energy Code stipulates that the Government must now submit a "strategyto Parliament every yearmulti-year defining the financing of the ecological transition and national energy policy" (SPAFTE) . The first edition of this strategy, published on 21 October 2024[87] , provides information on the breakdown of investment between the public sector, businesses and households. Financing for decarbonisation now appears to be on the increase for all players, and this dynamic must be strengthened and continued. The public sector is currently investing more than the private sector in decarbonisation, in proportion to its total investments. In 2022, it will have invested 20% of its total investments in low-carbon assets[88] , compared with 13% for the private sector (households and businesses). If the private sector were to align its share of low-carbon investments by 2027[89] with that of the public sector in 2022, and if the public sector were to continue the upward trend in its own share, then low-carbon investments could increase by €63 billion between 2022 and 2027 and move closer to the investment targets needed to achieve the decarbonisation objectives.

To make such a scenario a reality, a wide range of public policies are needed to ensure that private and public funding is efficiently mobilised to support investment in the ecological transition. Public intervention needs to be as effective as possible, for example by enabling the financing of essential public goods and support for vulnerable households and businesses. A combination of tools can be

85 These figures need to be looked at in more detail, as they are mostly partial, focusing on the sector's energy transition. Moreover, they do not include all the costs of the environmental transition for the sector: costs linked to certain changes in agricultural practices and training, research and development, investments needed to meet specific non-COtargets $_2$ (in particular non-energy emissions, such as those linked to methane). The needs of the agricultural sector could increase by around €5 billion per year by 2050, including staff costs and current consumption.

86 https://www.tresor.economie.gouv.fr/Articles/9e631895-bbef-4e9e-8cb6-9c1090986cd9/files/50ee53e8-9451-4077-9476-f81dd8dc1f0d?, p. 47 et suivantes

87 https://www.economie.gouv.fr/files/files/directions_services/economie-verte/SPAFTE-2024.pdf?v=1729513896

88 Based on a perimeter defined in the SPAFTE and covering the building, transport and energy sectors.

89 The first edition of SPAFTE focuses on the 2027 horizon

used to redirect the flow of private finance towards projects for the ecological transformation of the economy. Regulatory levers help to trigger investment by certain households and businesses, for example in greening vehicle fleets, reducing energy consumption in buildings, reducing pollutant emissions from industry or protecting biodiversity. Carbon pricing tools can be used to encourage economic players to steer their production and consumption decisions towards less carbon-intensive alternatives. In addition, the redirection of private finance flows is encouraged by the introduction of 'green' bonds, labels and targeted government guarantees, as well as by the development of 'green' savings products. Public subsidies and targeted taxes are useful tools to complement these different levers in certain cases.

In line with this multi-year strategy, the Finance Act for 2025 consolidates the ecological course set in 2024, achieving an unprecedented level of spending in favour of the transition. The content of this spending will evolve in line with the needs and maturity of the sectors concerned, and will give greater priority to the most efficient measures. In particular, government funding will focus on energy-efficient renovation of buildings, greening the vehicle fleet, developing public transport, decarbonising industry, accelerating renewable energies and the agricultural transition. Caisse des Dépôts Group is also mobilising to help finance the transition for local authorities and businesses, and has announced an unprecedented contribution of €100 billion to the ecological transition over the period 2024-2028. As part of the green reindustrialisation programme, it has also been decided to step up Bpifrance's support for the ecological transition. The government's action includes its own investments, but above all support for other players to encourage them to make the transition: support for private individuals through grants for home renovation and the purchase of clean vehicles; support for businesses, notably through calls for projects to decarbonise industry, the heat fund, and so on.

In the process of making investments greener, the **redirection of household savings will be encouraged**, in particular through new schemes such as the Plan d'Epargne Avenir Climat (PEAC) provided for in the Green Industry Act. Asset management companies could also be supported in this redirection with the creation of Transition Bonds (OT), also provided for in the 2024 Finance Act (article 185). In addition, a new financial support mechanism for investments in decarbonisation is being prepared in line with the status report and outlook for the deployment of the CCUS in France[90] , including calls for tender in favour of major industrial decarbonisation, electrification or carbon capture projects by covering, for example, part of the costs associated with capture units, the gradual implementation of new transport infrastructures or access to storage.

Alongside these investments, **innovative financing solutions are being developed**:

- For example, **the low-carbon label**[91] **provides an incentive to reduce national greenhouse gas emissions** by providing a framework for and officially recognising emission reduction and carbon sequestration projects in France, the final balance of which is recorded as "Emission Reductions" (ER), where 1 ER corresponds to one tonne of CO_2eq[92] . The low-carbon label is a scheme that provides tangible funding for the emergence of climate-friendly projects. It has also established itself as one of the benchmark schemes for climate offsetting in Europe, and could inspire the European framework currently being developed by the *Carbon Removals Certification Framework* (CRCF). Last but not least, the scheme is highly localized to

[90] https://www.entreprises.gouv.fr/files/files/industrie/etat-des-lieux-et-perspectives-de-deploiement-du-ccus-en-france.pdf

91 https://www.ecologie.gouv.fr/label-bas-carbone.

92 To date, more than 2 $MtCO_2$eq could be avoided and/or sequestered over the next 30 years by certified projects, and we can expect to reach a of 15 MtCOpotential eq in 2030 (which will therefore be avoided and/or sequestered between 2030 and 2060).2

meet the expectations of financiers to get involved in local, exclusively French, offset projects.

- For building renovation, innovative financing schemes such as third-party financing, financial leasing and Energy Performance Contracts have been developed. Third-party financing was opened up to the State, public institutions and local authorities on an experimental basis by the law of March 2023[93] on third-party financing.
- With regard more specifically to **the obligation to finance low-carbon projects**, a number of measures have been introduced recent years that have increased demand for the financing of low-carbon projects with high environmental integrity in France and around the world. These include
  - The progressive obligation to finance low-carbon projects in line with greenhouse gas (GHG) emissions from domestic flights for aircraft operators subject to the EU Emissions Trading Scheme and generating more than 1,000 tonnes of CO_2 per year on national territory (Climate and Resilience Act);
  - The obligation to finance low-carbon projects up to the level of emissions from coal-fired power stations extended to deal with the energy crisis linked to the war in Ukraine (MUPPA law[94]);
  - The commitment to finance low-carbon projects to the extent of the GHG emissions of all flights made by employees of State services and public establishments, whether national or international (Eco-responsible Public Services circular).

In addition**, the reform of the European Union Emissions Trading Scheme** (EU ETS) provides for an accelerated reduction in the emissions cap (-62% in 2030 vs. 2005, compared with -43% before the review), the inclusion of the maritime sector and a trajectory for the abolition of free allowances for the aviation sector as well as for certain sectors at risk of carbon leakage as the border carbon adjustment mechanism is gradually ramped up. This should **result in an increase in the revenue that Member States derive from the European carbon market**, and a strengthening of the Innovation Fund, which **finances innovative low-carbon technology projects in European industrial sectors**. One of the challenges in the coming years will be **to make effective use of these increased resources for France's ecological transition**, while respecting the principle of budgetary universality and meeting the objective set for all Member States of devoting 100% of the revenue from the EU ETS, or its equivalent in financial value, to climate-related expenditure (compared with 50% before the reform). Since 2013, France has been earmarking part of its EU ETS revenue (€2.1bn/year in 2023) to fund the Agence nationale de l'habitat (ANAH), in particular to finance the home energy renovation programme MaPrimeRénov' (€700m/year in 2023 and 2024).

6.2. Preserving household purchasing power

6.2.1. Combating fuel poverty

The fight against fuel poverty is based on preventive measures (such as support for energy-efficient home renovation or the introduction of the tariff shield during the recent crisis) and assistance for households in fuel poverty (help with paying bills with the energy cheque).

[93] Law no. 2023-222 of 30 March 2023 aimed at opening up third-party financing to the State, its public establishments and local authorities to promote energy renovation work.

94 Law on "emergency measures to protect purchasing power", known as the "MUPPA law".

6.2.1.1. Preventive measures

ENERGY RENOVATION

A number of energy renovation support schemes place particular emphasis on low-income households and aim to get rid of "energy flaws":

→ The Energy Savings Certificates scheme requires energy suppliers to finance a certain volume of energy renovation work among French households, including some among households in fuel poverty. From 2016, when the "energy poverty" obligation was created, to 2022, around €6.7 billion worth of work[95] has been financed under the "energy poverty" CEE scheme, 23% of it since the beginning of 2022. The CEE obligation has been increased by 25% for the 5th period 2022-2025, bringing it to 3,100 TWhc (including 1,130 TWh for the most vulnerable households).

→ In 2024, 73% of households benefiting from assistanceMaPrimeRénov' concerned low-income and very low-income households, out of a total amount of assistance distributed of €3.3bn for renovation[96] energy. Since 1 January 2024, households have been able to carry out major renovations under a supported scheme, using a progressive funding scale that is open to all income groups. For example, a very modest household wishing to renovate an energy sieve with a gain of more than 4 DPE classes will be able to claim up to €70,000 (excl. VAT) in assistance under the MaPrimeRénovRenovation ' Supported Scheme. The continued roll-out of France , the public home renovation serviceRénov', the long-term funding of this service from 1January 2025 and the ramping up of Mon Accompagnateur from 1 January 2024 Rénov' will help to improve the identification of households in fuel poverty and the provision of advice to all households, with a particular focus on low-income and very low-income households,

→ Energy decency criteria in the rental market, introduced by the Climate and Resilience Law in 2021, encourage landlords to undertake energy renovation work to ensure that homes are energy decent. In the private rental sector, 38% of the stock (as it currently stands) is affected by the gradual extension of energy decency criteria by 2034. More specifically since 1 January 2025, homes rated G, i.e. 6.9% of the stock, are no longer considered to be decent when they are renewed or rented out. In January 2028, a further 9% of homes (label F) will be affected, before an extension in 2034 to a further 22% of homes (label E)[97] . In addition, the energy decency criteria (and their extension to 2025, 2028 and 2034) also apply to social housing, where 26.9% of the stock will gradually be affected .[98]

→ financial aidMaPrimeRénov' , with a total amount dedicated to energy renovation work of €3.29bn in 2024 (see *below*, §6.5.1.), particularly targets precarious households: in fact, 73% of the projects funded were aimed at low-income or very low-income households[99] . This targeting is made possible by a high subsidy rate for major renovations for low-income and very low-

95 1358 TWhcumac of "fuel poverty" CEE registered on the national CEE .register

The term cumac (for cumulated and discounted) takes into account the energy over the lifetime of the action concerned (product, equipment, etc.), for example 15 years for a freezer or 30 years for the insulation of a house. 100 TWh cumac is equivalent to the consumption residential energy one million French people over 15 years.

[96] The grant MaPrimeRénov' is used to finance energy renovation "by gesture" (insulation, changing the heating system, installing ventilation, carrying out an energy audit) and major energy renovation associated with the intervention of a "Mon Accompagnateur operator.Rénov'"

[97] Observatoire national de la rénovation énergétique, December 2024. The housing stock by energy performance class on 1st January 2024.

[98] 0.4% (G+), 1.9% (G excluding G+), 5.8% (F) and 18.8% (E). Source: Le parc de logements par classe de performance énergétique au 1er janvier 2023 | Données et études statistiques (developpement-durable.gouv.fr), additional data.

[99] Key figures for Anah, 2024 edition (anah.gouv.fr)

income households (subsidy rates of 60% and 80% respectively, and up to 100% for very low-income households with local authority support) and an energy sieve exit bonus corresponding to a 10-point increase in the initial funding rate.

→ In order to better finance the remaining costs and make it easier for households to access bank loans, the State has introduced a number of regulated loans. Firstly, since 2009, creditworthy households have been able to take out a zero-rate eco-loan (éco-PTZ) for up to €50,000, repayable at regular intervals. Then, from September 2024, households with less creditworthiness can take out a mortgage loan of up to €50,000, known as a prêt avance rénovation (PAR+), repayment of which is only due when the renovated property is transferred, and the interest on which for the first 10 years is paid by the State via a tax credit. What's more, these loans can be covered by a government guarantee of up to 75% of any losses incurred, under the Fonds de garantie pour la rénovation (FGR).

THE WINTER TRUCE AND THE MINIMUM ELECTRICITY SUPPLY SERVICE

During the winter truce, between 1 November and 31 March, energy suppliers are obliged to maintain the supply of natural gas and electricity to their customers in arrears. Electrical power may be reduced, however, except for the most householdsvulnerable , defined as those eligible for the energy voucher scheme. Outside the winter truce, if a supply cut-off is envisaged, its implementation is subject to strict controls for all households (reminder letters, deadlines, notification of social services by the supplier if the supply has not been restored within five days of the cut-off).

In addition, since 1 April 2023[100] , a minimum 60-day electricity supply period has been in place for beneficiaries of the energy cheque and the housing solidarity fund, prior to any disconnection in the event of unpaid bills, including outside the winter truce. During this period, the electricity supply is maintained at 1kVA, to give the consumer and the supplier time to find a solution to the household's situation.

6.2.1.2. Support measures

HELP WITH PAYING BILLS: ENERGY CHEQUES

Generalised in 2018, the energy voucher is a government subsidy for low-income households to help them pay their energy bills, whatever their heating method (electricity, gas, wood, fuel oil, LPG, etc.) or energy renovation work. State aid earmarked for household energy expenditure, this is the tool that helps to mitigate the cost of the transition on low-income households and is an essential element in ensuring a fair transition.

Based on the income and composition of the household (all the people living under the same roof), it is granted according to the reference tax income per consumption unit (RFR/ UC). Until 2023, households did not have to take any steps to obtain it; it was sent to them automatically on the basis of data held by the tax authorities. By 2023, 5.6 million households were receiving energy cheques, for amounts ranging from €48 to €277. Nearly 84% of them used it.

In 2024, households receiving energy cheques for 2023 automatically received an energy cheque in April. 5.5 million households benefited.

100 Article 35 of law no. 2022-1158 of 16 August 2022 on emergency measures protect purchasing power and decree no. 2023-133 of 24 February 2023 on the minimum electricity supply period and amending decree no. 2008-780 of 13 August 2008 on the procedure applicable in the event unpaid electricity, gas, heat and water .bills

For households whose 2022 situation enables them to be eligible for the energy cheque, or to have a cheque for a higher amount, a specific application window has been set up.

Following the abolition of the taxe d'habitation, the French contains provisions to ensure that the energy voucher Finance Act for 2025 scheme continues to provide the protection it deserves, as well as its advantages over other approaches (free choice of supplier, neutrality between energy sources, incentives to reduce consumption).

In any event, in order to provide more information about the scheme and support for beneficiary households to make it easier to use the energy voucher and the associated rights, the energy voucher has been integrated into France Services areas since 2024.

6.2.2. Ensuring that everyone is informed and transparent about energy costs and prices

Knowing and communicating energy prices and the various cost components that make them up is an important transparency issue. Since 2020, the energy markets have been marked by a succession of shocks to demand and supply, due to the health crisis and then the war in Ukraine, which have had a major impact on the prices paid by consumers. In addition, the promotion of energy sobriety aimed at reducing energy consumption and the resulting emissions means that households and businesses need to be helped to understand prices, so that they can take responsibility for their own consumption.

The website of the Ministry of Energy provides the public with an annually revised guide to energy taxation, as well as oil product prices, which are updated weekly, and the major components of these prices (Brent crude oil prices, refining costs, transport and distribution costs), which are updated monthly or annually.

In order to encourage the use of alternative motorisations, the Ministry of Energy carries out a quarterly comparison of the cost of purchasing the fuel needed to travel 100 km using alternative fuels (LPG-c, electricity, natural gas for vehicles and hydrogen), E10 petrol and diesel. These costs must be displayed at all major service stations.

Lastly, the website www.prix-carburants.gouv.fr gives the public real-time access to the prices charged by most service stations, with a geolocated search function for stations charging the lowest prices around a given road.

In the case of electricity and gas, a free public offer comparator is available to everyone on the website of the National Energy Ombudsman (https://www.energie-info.fr). This comparator enables consumers to find out about all the gas and electricity supply offers available, so they can choose the one that best meets their needs.

Furthermore, in the event of a dispute with their energy supplier (electricity, natural gas, LPG gas in bottles or tanks, fuel oil, wood or heating networks), the distribution network operator or their electricity purchaser (in the case of individual self-consumption), consumers or their representatives (consumer associations, lawyers, etc.) can refer the matter to the National Energy Ombudsman free of charge to help them settle the dispute. The consumer may be an individual, a micro-business (with fewer than 10 employees and a turnover of less than €2m) or a non-professional (co-ownership, association, etc.). Complaints may be made to the ombudsman within a period of between 2 months and one year following a written complaint to the operator. Complaints may be submitted by post or electronically.

Commercial communications play a powerful, day-to-day role in influencing consumer behaviour and, beyond that, their lifestyle aspirations and desires. Through advertising, companies can help to

promote products or modes of consumption that have a lesser impact in terms of greenhouse gas emissions, air, water and soil pollution, waste production and the use of raw materials. Several recent regulations provide a framework for commercial communications in the context of the ecological transition: since 1 January 2023, carbon neutrality claims for products and services have been heavily regulated by Article 12 of the Climate and Resilience Act. To be used, these claims must comply with a strict regulatory framework in order to combat greenwashing. Another example: vehicle advertisements are required to communicate the importance of soft and active modes of transport, and to show the greenhouse gas emissions of vehicles. Finally, climate contracts have committed a number of companies to responsible communication.

In addition to providing a framework for commercial communications, the French strategy for energy and the climate aims to enable a fairer and more inclusive transition. By improving the framework for energy supply offers and supply authorisations, it will provide greater guarantees for consumers and greater resilience for suppliers, to the benefit of their customers.

Finally, in order to achieve the objective of ending the consumption of fossil petroleum products for energy purposes (excluding international) by 2045, any public support from the State will have to ensure a cost differential that is unfavourable to the fossil fuel solution compared with decarbonised solutions.bunkers

6.3. Industrial issues

The industrial sector is essential to the implementation of the ecological transition, through its own decarbonisation and its key role in producing the technologies needed to decarbonise other sectors of the economy. We need to continue and step up the pace of industrial recovery to prepare France for the future, support economic development and strengthen our sovereignty. Re-industrialisation also benefits the climate by reducing France's carbon footprint (by ensuring that re-industrialisation does not increase production emissions by more than the reduction in imported emissions, and by controlling rebound effects), taking advantage in particular of France's largely decarbonised electricity mix.

The decarbonisation of industry and reindustrialisation must be supported by the entire energy system, and in particular requires a substantial increase in the production of low-carbon electricity, while maintaining prices that ensure the competitiveness of industry, in a context of growing competition in certain sectors from production in China or the United States. Tomorrow's energy mix, and in particular the electricity mix, is based on a reindustrialisation scenario that has been incorporated into the baseline scenario of this multi-annual energy plan.

Various business support programmes and schemes, such as France Relance and France 2030, aim to make France a leader in the technologies needed to decarbonise the economy. In addition, the Green Industry Act aims to boost France's industrial attractiveness, skills and capacity for innovation.

Low-carbon energy production, transport and consumption industries need to be strengthened across the entire value chain - from raw materials to equipment production and recycling, right through to residual waste treatment - to meet energy targets while reducing dependence on the international market. This development is being carried out with public support to guarantee a sustainable base and growth, and to ensure a *level playing field*. It also requires the use of tools to ensure the conditions for the development and sustainability of green industries, particularly in the context of the European *NetZeroIndustry Act,* by making greater use of resilience, cybersecurity, environmental and social criteria in invitations to tender, in line with France's international commitments.

In addition, a "green industry investment" tax credit (C3IV) was introduced in 2024 to provide support for productive investment in factories producing solar panels, wind turbines, heat pumps and batteries, as well as the key sub-components and materials needed to manufacture them.

6.4. Ensuring competitive energy prices

6.4.1. Electricity system costs OBJ

In its document Energy Futures 2050[101] and then in the update for its 2023 - 2035 Generation Adequacy Report[102] , RTE estimated the future costs of the various electricity generation sources. The main results obtained in 2021 in the Energy Futures 2050 study (before the energy crisis), expressed in terms of full cost for each type of generation, are summarised below.

However, it is important to note that the comparison of full production costs in €/MWh (also known as LCOE) is not sufficient to define the optimal choice of production mix. The comparison of electricity mix choices must be assessed **at the scale of the electricity system**, by integrating the full costs of the entire generation-flexibility-grid chain; this is the approach that RTE has applied to the assessments of Energy Futures 2050.

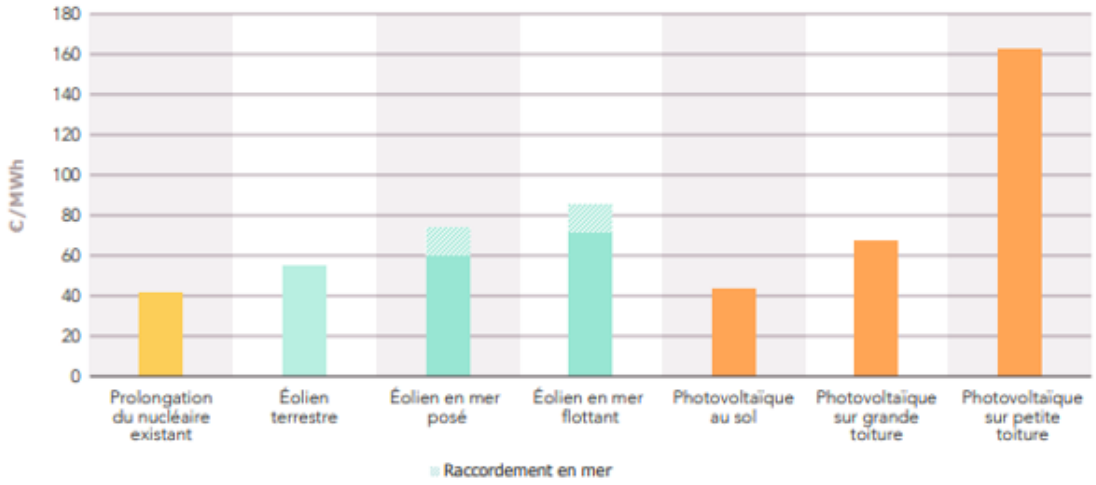


Figure32 Comparison of full annualised costs (OPEX and annuities due) for the various capacities in operation by 2030 in the average of the six mix scenarios studied in Energy Futures 2050 (p. 577, figures in €2020), excluding costs incurred for the electricity system.

In the 2023 Generation Adequacy Report, RTE assessed the investment needed in electricity generation and flexibilities (excluding network infrastructure) to achieve the public targets (the "scenario A-ref" is close to the trajectory described in this EPP 3): it should triple by 2030-35 and

[101] https://www.rte-france.com/analyses-tendances-et-prospectives/bilan-previsionnel-2050-futurs-energetiques#Lesdocuments

[102] https://www.rte-france.com/analyses-tendances-et-prospectives/les-bilans-previsionnels

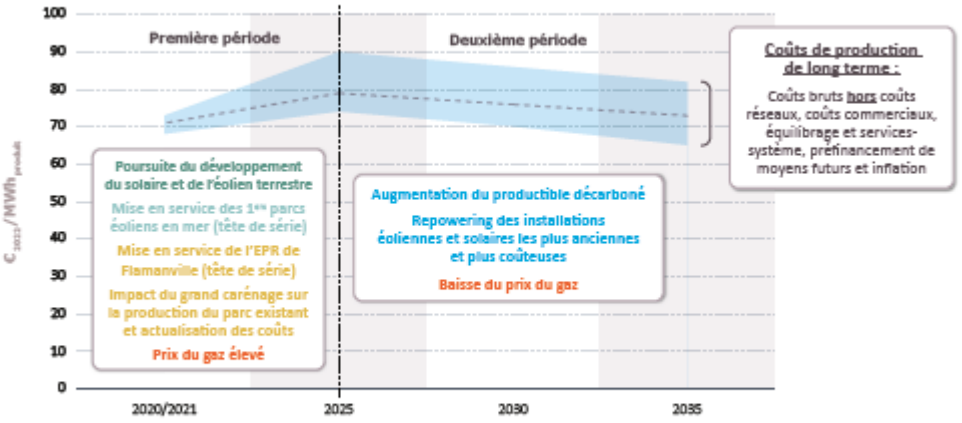
Chapter 9 on the economics of the electricity system in particular: https://assets.rte-france.com/analyse-et-donnees/2024-07/Bilan%20previsionnel%202023%20Chapitre%209%20Economie%20systeme%20electrique.pdf

represent an annual rate of around €25 to 35 billion by 2035, or nearly €300 to 350 billion over 15 years.

RTE has also evaluated the full annualised cost of the system (excluding the network), taking into account the amortisation of investments over the lifetime of the infrastructure. It amounts to around 50 Md€ per year in 2035, an increase compared to previous evaluations, taking into account updated costs, changes in supply conditions and new constraints on the siting of renewable energy farms (in particular constraints on the siting of offshore wind projects - far from the coast - and photovoltaic projects).

However, in relation to the volume of electricity produced, the full cost of producing the system (excluding the grid) will increase only slightly over the next few years. The cost of producing electricity will stabilise between 2025 and 2035 at around €75/MWh (under favourable macroeconomic financing conditions).

Figure 9.14 Indice de compétitivité de la production d'électricité en France dans les scénarios du contexte macroéconomique favorable (A et B)



Note : l'indice de compétitivité de la production d'électricité correspond au coût brut de long terme de l'ensemble de la production électrique et des flexibilités en France, cumulant l'ensemble des technologies. La plage d'incertitude correspond aux variantes sur les prix des commodités et les coûts unitaires des différentes technologies de production (coût plus ou moins élevé pour le nucléaire, fourchettes de coûts pour les nouvelles installations de production éolienne et photovoltaïque) appliquées aux scénarios A et B. S'agissant d'un indicateur de long terme, les fortes variations de court terme sur des prix des combustibles autour de 2022 n'apparaissent pas sur ce graphique.

Figure33 Competitiveness index for electricity generation in France in the favourable macroeconomic context scenarios (A and B)

The full cost of the French electricity system remains stable and predictable overall, as it is largely dependent on the fixed costs of nuclear, hydro and renewable energies, and relatively little on fossil fuels. On the other hand, the market price of electricity could remain strongly correlated with that of gas[103] , which justifies regulatory mechanisms such as post-ARENH (see section 6.4.3).

Compared with neighbouring European countries such as Germany, production costs in France remain competitive at this stage.

ACTION COST.1 :

103 cf. Paragraph 9.4.2.2 of RTE's 2023 Generation Adequacy Report

UPDATING THE ASSESSMENT OF THE FULL COSTS OF THE PPE ELECTRICITY MIX SCENARIOS

- RTE, in conjunction with CRE, will update the full costs of the future electricity system and the production cost per MWh as part of its forward-looking studies, in particular the Generation Adequacy Report provided for in article L. 141-8 of the Energy Code and the Ten-Year Network Development Plan provided for in article L. 321-6 of the same code, or as part of the update of Energy Futures 2050. This assessment will be detailed by period according to the start of production of each resource (extension of the nuclear fleet, new nuclear power, photovoltaic wind power, renewable gas, STEP, etc.) and will take into account the costs associated with the networks and flexibility resources.

Evaluate the long-term economic balance of the electricity generating fleet and the impact on all sectors.

Evaluate the economic consequences of the trajectories envisaged by analysing, in particular, the evolution of market prices according to the production/consumption scenarios envisaged, the consequences on the operation and costs of the various sectors and the impact on the amounts of public support required.

6.4.2. Choosing the electricity mix: optimising costs while taking into account environmental impacts and technical constraints

The electricity mix scenario chosen for the EPP was based in particular on RTE's "Energy Futures 2050" report, published in 2021, and its 2023-2035 Generation Adequacy Report, published in 2023.

In Energy Futures 2050, RTE presents 3 electricity consumption scenarios for 2050 and 6 electricity generation mix scenarios, based on rigorous scientific and technical simulations. These simulations make it possible to cover a very wide range of possibilities and to reproduce a broad spectrum of electricity systems compatible with achieving carbon neutrality in 2050. The study explored several consumption variants, ranging from greater sobriety to major re-industrialisation leading to a greater increase in consumption; and several production variants, exploring systems ranging from 100% renewables to systems where nuclear power has a lasting presence in the electricity mix at levels of almost 50%. It makes it possible to consider the various options available for each sector, not in isolation but by integrating them into a coherent overall vision that meets the challenges described above. Finally, the study provides a detailed description of the structure of the electricity system for each of the scenarios, its costs and its environmental impact.

The "100% renewables" scenarios without the construction of new nuclear reactors require, on the one hand, a high degree of acceptability of renewable energies and, on the other hand, faster rates of development of new renewable installations than those of the most dynamic European countries today. These scenarios are not only the most costly from an integrated perspective, but they also require major technological investments.

The scenarios based on maintaining the historic nuclear fleet appear to make sense, both economically and environmentally. In fact, the addition of renewable and nuclear generation capacity will enable the electricity system to accelerate decarbonisation by 2030, by accentuating reductions in greenhouse gas emissions in the short and medium term. In these scenarios, the means of flexibility are reduced, as are the levels of investment required in the electricity networks. Extending existing reactors beyond the age of 60 also poses major technical challenges.

In the Generation Adequacy Report published on 23 September 2023, which covers the period 2023-2035, a period marked in particular by an acceleration of ambitions in terms of decarbonisation and reindustrialisation, RTE has updated its assessment by modelling several scenarios to 2035 "successful acceleration" (prospective exercise), partial achievement" scenario and "globalisation thwarted" scenario (risk analysis exercises) with trajectories of up to 640 TWh by 2035 (depending on energy savings and the actual rate of electrification), consistent with the guidelines of the PPE.

In addition to the issues of decarbonisation and security of supply, the choice of electricity mix is also based on an economic rationale, in order to limit the cost of the electricity produced and the burden on society as a whole. Furthermore, increasing the flexibility of demand will facilitate the necessary balancing of electricity supply and demand. (See also section 6.4.1).

With regard to the nuclear fleet, RTE points out the economic relevance, on a community scale, of reinvesting in nuclear power, whether through the extension of existing nuclear power plants or the construction of new nuclear production units. RTE's previous analyses (in particular Energy Futures 2050) show that it makes economic sense to continue operating existing reactors until 2030-40, a conclusion that was confirmed in the 2023 Generation Adequacy Report despite an upward re-evaluation of the full cost of existing nuclear power.

Furthermore, the analysis carried out by RTE in its 2021 "Energy Futures 2050" report shows the economic advantage of scenarios including new nuclear reactors under certain conditions, even compared with fully economically optimised renewable generation mixes. This analysis is confirmed despite the higher long-term production cost of new nuclear power compared with mature renewables, due to the lower variability of its output and its programmable nature, which reduces the need for flexibility in the electricity system.

As far as renewable electricity is concerned, all the RTE scenarios are based on onshore wind power, offshore wind power, ground-based photovoltaic power and large-scale hydroelectric power, which are considered to be technologies that produce electricity at a competitive cost, regardless of the nuclear capacity developed.

However, the government considers that certain technologies whose unit cost is identified as being higher, such as rooftop photovoltaics and floating offshore wind power, should also be mobilised in order to limit the environmental impact and technical constraints of electricity production. They make it possible to take into account the limited space available in shallow areas that are suitable for the installation of land-based wind turbines, to make use of areas that have already been developed, and to disseminate renewable energy sources in a way that makes it easier for the public to take ownership of them. What's more, the scope for developing ground-based photovoltaics has been considerably restricted since RTE's last estimates, notably as a result of Article 54 of the APER law. to mobilise other sectors, such as photovoltaics on roofs and shaded areas, as well as It will be necessary agrivoltaics.

In the light of these factors, France has chosen to prioritise the development of nuclear, offshore wind, photovoltaic and onshore wind power, while continuing to support a residual share of diffuse production, and strengthening its consultation tools to take the best possible account of issues relating to land use, industrial hazards and social and local expectations regarding projects.

6.4.3. Competitiveness of electricity supply

REVISION OF ELECTRICITY MARKET RULES

The current European market framework for electricity is based on remunerating generating capacity according to its marginal cost, i.e. the cost of producing an additional MWh by the most expensive plant in operation. For over 20 years, these arrangements have made it possible to ensure the efficient use of facilities throughout Europe at the lowest cost to ensure short-term security of supply, and the most appropriate use of interconnections between national markets, making them an important element in European energy integration.

On the other hand, this market framework did not allow for the emergence of a long-term price signal, which is necessary for producers to invest in decarbonised means of electricity production, and for consumers to invest in decarbonising their consumption.

The electricity market rules have therefore been supplemented at European level by the European market reform (legislative package Electricity Market Design published in the EU's Official Journal on 26 June 2024) with the aim of enabling Member States to better control electricity prices while decarbonising their mix. This reform promotes the emergence of a long-term price signal to trigger investment and bring the electricity prices paid by consumers closer to the real costs of the French electricity system, which will be around 95% decarbonised by 2024, by developing the following instruments in particular:

→ Direct contracts between producers and consumers (Power Purchase Agreements - PPA) ;

→ Contracts for Difference Bi-directional (CfDs), which guarantee a stable income for electricity producers by setting a floor price, and redistribute income from the sale of electricity to consumers when market prices exceed a ceiling price.

The reform also provides for a strengthening of the prudential management framework for energy suppliers, with the aim of guaranteeing a high level of consumer protection.

This package, which was adopted at France's instigation, explicitly mentions the possibility of applying long-term regulatory instruments to the existing nuclear fleet. It reaffirms that these instruments must respect fair conditions of competition between Member States.

REGULATING THE PRICE OF ELECTRICITY FROM EXISTING NUCLEAR POWER PLANTS, A COMPETITIVE DRIVER

In parallel with this European work, the French government is carrying out national work on the regulation of existing nuclear power plants.

Since 1 July 2011, the current regulation of electricity prices, based on Regulated Access to Historic Nuclear Electricity (ARENH), has enabled all French consumers to have access to the competitiveness of the existing nuclear fleet, for part of their consumption, while allowing competition to operate in the supply market. However, this regulation has shown its limitations, in particular due to the lack of incentive for suppliers and customers to enter into medium- to long-term contracts, and the fact that the regulated price at which EDF buys nuclear electricity has not been updated since 2012. The scheme will expire on 31 December 2025 and will not be renewed.

In his speech on energy policy in Belfort on 10 February 2022, the President of the French Republic stated that France would implement "*a new regulation for nuclear electricity (to replace the ARENH) so that French consumers, households and businesses, can benefit from stable prices, close to the production costs of electricity in France. This is essential if we are to reap the full benefits of the nation's historic investment and the investment we are in the process of making*".

This new nuclear regulation was included in the initial Finance Law for 2025, in accordance with the Government's announcements of 14 November 2023. The aim of this regulation is to ensure that all consumers benefit from the competitiveness and cost stability of existing nuclear power, while preserving EDF's financial capacity to maintain and renew its generating fleet.

The new organisation of the French electricity market is based on 2 pillars, as presented in the public consultation carried out by the French government in November 2023:

- On the one hand, encouraging the development of long-term contracts negotiated between market players and tailored to their needs. In order to create more liquidity on the markets in the medium and long term, in line with the reform of the European market, the Commission de régulation de l'énergie (CRE) would be given powers to monitor the liquidity and transparency of the wholesale markets,
- On the other hand, the mechanism for regulating EDF's income from its existing nuclear fleet to protect consumers in the event of high prices. This mechanism would consist of (i) deducting a fraction of the revenue from nuclear generation above a certain threshold, and (ii) redistributing this amount to all consumers. This mechanism was adopted in the initial Finance Act for 2025. The regulatory measures for applying this new system will be prepared in 2025.

This new economic regulation of existing nuclear power aims to strike a fair balance that :

- preserves EDF's ability to invest in extending the existing nuclear fleet and developing the new nuclear programme in France called for by the French President in his Belfort speech;
- strengthens consumer protection by encouraging them to take out longer-term insurance cover;
- allow the competitiveness of the nuclear fleet to be shared between EDF and consumers.

ACTION MAR.1

PROVIDE LONG-TERM SIGNALS TO TRIGGER INVESTMENT AND GUARANTEE ACCESS TO COMPETITIVE, LOW-CARBON ENERGY

→ In the context of the transposition of the reform of the European market, propose legislative provisions to bring more liquidity to the markets in the medium and long term and finalise the regulatory framework for post-NEA nuclear regulation as adopted in the LFI 2025, in order to perpetuate the exposure of all French consumers to the production costs of the French nuclear fleet ;

→ Encourage suppliers to adopt prudent, long-term sourcing practices, to strengthen their resilience to a market shock.

6.4.4. Industry: a sector whose competitiveness is sustained

Access to low-carbon, stable and competitive electricity is a major challenge for supporting reindustrialisation while pursuing strong objectives for decarbonisation and electrification of industry, particularly for the most electricity-intensive activities exposed to international competition. In addition to the measures put in place temporarily during the energy price crisis (electricity shock absorber, help desk for payment of gas and electricity bills), several schemes are helping to limit the cost of electricity for these consumers:

- Regulated to Historic Nuclear Electricity (ARENH), which allows customers to purchase a proportion of their consumption at a regulated price. This system comes to an end on 31 December 2025, and a new economic regulation of existing nuclear power has been put in place (Access *see* section 6.4.3) in compliance with the new European rules;

- compensation for the cost of indirect COemissions$_2$, which reimburses part of the cost of the European system of carbon quotas incorporated into the price of electricity for companies in the most electricity-intensive sectors exposed to international competition. In this way, it helps to combat the risks of carbon leakage and the competitiveness of these companies;
- a reduction in the tariff for use of the public electricity transmission network (TURPE) for sites that consume a lot of electricity and have a predictable and stable or anti-cyclical consumption profile, and sites that store energy for subsequent return to the network, which can benefit from a reduction in the tariff for use of the public transmission network provided they implement an energy performance policy;
- reduced rates of excise duty on electricity depending on electro-intensiveness and exposure to international competition;
- the call for interruptibility tenders, which makes it possible to manage critical situations in the operation of the electricity system: the successful bidders (> 10MW) make themselves available to RTE, which can cut them off (below a power ceiling) in less than five seconds if necessary.
- direct support for improving energy efficiency, in particular via energy saving certificates (CEE) and via France Relance and France 2030 (calls for BCIAT, projectsIndusEE and DECARBIND)

ACTION MAR.2

MAINTAINING COMPETITIVE ELECTRICITY PRICES FOR BUSINESSES OVER THE LONG TERM, ESPECIALLY ELECTROINTENSIVE BUSINESSES EXPOSED TO INTERNATIONAL COMPETITION

→ Maintain over the long term the measures that help to preserve the competitiveness of companies exposed to international competition

6.4.5. Major work is being carried out on gas networks to limit their long-term cost to consumers.

Consideration needs to be given to the development of natural gas networks in order to study the possibilities of limiting future increases in the unit amount of tariffs for using natural gas networks, and therefore in the price of natural gas for consumers. These changes to the natural gas networks would aim to reduce the overall costs associated with the natural gas networks, in order to limit the increase in the unit amount of tariffs as natural gas consumption falls ("price squeeze).

The first step in considering the future of natural gas networks will be to identify the professional consumers who are likely to continue to use natural gas, even if the price rises. Feedback from the first few years of biomethane production shows that, regardless of gas network tariffs, biomethane production costs are much higher than fossil gas supply costs, and that there is no prospect of a significant reduction in production costs. The gradual substitution of biomethane for fossil gas will therefore lead to an increase in the price of methane gas for consumers.

This identification of consumers who are likely to continue to consume gas in the long term, at a higher price, is essential if we are then to be able to study the possibilities of optimising gas networks

to continue to serve these consumers, while reducing the rest of the network. A CRE study[104] shows that, assuming a uniform fall in natural gas consumption, the natural gas networks needed to supply all consumers would remain unchanged overall despite the fall in consumption, which would lead to a further increase in the unit amount of tariffs for using the gas networks.

The final stage in the process would be to test these possibilities for optimising gas networks with volunteer local authorities, with the aim of estimating the reduction in overall costs that could be achieved, as well as the policies needed to ensure this optimisation.

6.5. Assessing the impact on jobs and skills requirements and adapting training to these needs

The energy transition is a process aimed at reducing our dependence on fossil fuels and promoting renewable energy sources. This transition is having a significant impact on the job market and the skills required in all the sectors concerned. The energy transition represents both a challenge and an opportunity for the job market. It is by assessing the impact on jobs and adapting training within the sectors that employees will be ready to meet these challenges and take advantage of the resulting opportunities. The gradual disappearance of certain jobs, the emergence of new professions, the enhancement of skills, the raising of qualification levels, the encouragement of new career paths and new bridges between professions are strategic for the lowtransition. carbon This transition will lead to a reallocation of jobs and profound changes in the labour market, changes that are sometimes inseparable from the consequences of other major transformations in the economy (digital revolution, demographic revolution, re-industrialisation, etc.), and which must be supported in order to limit their negative effects . [105]

The aim of ecological planning is to set out ecological objectives in a way that is consistent and articulated with the reality of implementing the levers to achieve them. In this context, this strategy is intended to incorporate **a decarbonised industrial dimension and a jobs and skills component**. This means identifying the underlying industrial sectors and associated value chains, identifying the investment needs in the French economic fabric and in the human resources required for this transition, and finally providing the means to attract, train, recruit and retain the people who will contribute to it. As part of the "employment and skills" workstream of ecological planning, this work of identifying and building the necessary actions has already given rise to an initial publication by the SGPE, and is continuing, for the entire spectrum of the ecological transition. The following sectors will require a very large number of jobs, some of which require specific skills:

- Energy-efficient renovation of buildings,
- Development of low-carbon energies (nuclear and renewable energies),
- The development of electric vehicles and the conversion of combustion vehicle production sites, which will require the mobilisation of new skills,
- Re-industrialisation, particularly for 'green' industries,
- Conversion and dismantling of infrastructure needed to distribute fossil fuels.

[104] Commission de régulation de l'énergie - Avenir des infrastructures gazières aux horizons 2030 et 2050, dans un contexte d'atteindre la neutralité carbone - April 2023

[105] Supporting the resentment of people negatively impacted by the ecological transition is in fact necessary for the image and *ultimately* the implementation of this transition. This means checking the consistency between, on the one hand, the measures (PSE, GPEC agreements) designed to compensate for the social shocks attributable to the ecology (in application of the principle of a just transition), and on the other hand the systems and measures designed to prevent people losing their jobs from losing confidence in society as a whole.

According to the SNBC 2 , the transformations included in ecological planning will affect around 25 to 30% of private sector jobs, and could lead to the creation of between 200,000 and 500,000 net new jobs nationwide over the next few years. [106]It should be noted that other economic models report job losses[107] . However, new jobs and the associated skills will be needed to successfully reindustrialise the country in a low-carbon way and create a more resilient and sustainable economy.

[106] The EPP uses the SGPE's estimate of net job creation resulting from ecological planning, i.e. 200,000 to 500,000 jobs in France by 2030. A word of caution: there is no consensus on job creation in the economic literature, nor on the direction of the net effects of the ecological transition on employment: they may be positive or negative depending on the models used, the assumptions made and the types of environmental policies adopted. For example, an implicit carbon price, in the sense of environmental regulations, would have a negative impact on activity and employment, as it would not generate budget revenues to offset the negative effects of a rise in energy prices. Alternatively, recycling budget revenues from a carbon tax aimed at households (in the form of a flat-rate transfer) or businesses (in the form of lower social security contributions) would be more supportive of activity and employment.
These figures differ from the macroeconomic simulations carried out, for example, as part of the report "The economic challenges of the transition to carbon neutrality" produced by the DG Treasury. Final report - The economic challenges of the transition to carbon neutrality | Direction générale du Trésor

[107] Final report - The economic challenges of the transition to carbon neutrality | Direction générale du Trésor

TABLEAU 1
Exemples d'estimations récentes, pour la France

SOURCE & MODÈLE(S)	SCÉNARIO(S) MODÉLISÉ(S)	HORIZON	IMPACT SUR L'ACTIVITÉ EN 2030 (en % en écart à un scénario de référence)	IMPACT SUR L'EMPLOI EN 2030 (en milliers d'emplois en écart à un scénario de référence)
SNBC 2 (2020) Modèles : ThreeME, Imaclim	Scénario pour atteindre la neutralité carbone à l'horizon 2050 comparé à un scénario des mesures de transition prises jusqu'en 2018	2030	+0,7 % à +2,5 %	+300 à +500
Ademe, Banque de France, CIRED, Seureco (2023), « Risques de transition : analyse multi-modèles pour la France » Modèles : ThreeME, NiGEM, Imaclim, NEMESIS	Scénario de transition ordonnée par rapport à un contrefactuel sans choc	2030	-1,5 % à 1,5 %	-125 à +400
CAE (2023), « Transition énergétique : faut-il craindre pour l'emploi ? » Modèles : ThreeMe, Baqaee & Farhi	Taxe carbone de 100€/tCO2 supplémentaires, au niveau national uniquement (ThreeMe). Dans le cas d'une taxe européenne ou mondiale (Baqaee-Farhi), les effets sur la production sont plus positifs.	2030, sans redistribution des revenus de la taxe	-0,75 %	-167
		2030, avec redistribution des revenus de la taxe	+0,3 %	+92
SGPE – Stratégie emploi-compétences (juin 2024) Modèle : modélisation SGPE sur la base des Métiers 2030 (~SNBC 2) et sources sectorielles diverses	Planification écologique prévue par le SGPE	2030	Non spécifié	+200 à +500

To meet these labour needs, will need to be traineda minimum of 2.8 million people [108] in priority sectors and in all regions over the next 10 years, 90% of them in the "Bac - 3 to Bac +3" segment, which is a colossal challenge for initial and continuing vocational training and the integration of young people into the labour market. While several sectors, including energy, appear to be under pressure and short of manpower, it will be essential to help people in declining professions find new jobs. The issue of attractiveness and the need to remove the obstacles to "gendered" professions have also been identified and shared by most of the sectors and industries concerned (for the main sectors: 28% of women in 2022 for professions covered by the status of the electricity and gas industries (IEG)[109] , 29% of women in the UFIPEM petroleum branch[110] , 18% of women for the FEDENE and 1 to 2% of women in the construction sector, depending on the job)[111] . Meeting these skills challenges will require a major mobilisation of all training systems and organisations, both initial and continuing, in order to offer the new or enhanced training courses called for by the multi-annual energy programme.

Issues and actions to be included in the EPP, particularly in the area of jobs:energy
The PPE focuses on 5 issues, each with its own actions: the creation of suitable jobs and the transformation of existing or disappearing jobs (1), the identification of skills required and new needs (2), the adaptation of training and bridges between jobs (3), recruitment by raising awareness and co-opting young people and with the desire to move towards gender equality and the inclusion of women in "gendered" professions, while ensuring the attractiveness to employers (employment and working conditions) (4), governance, support for businesses and the issue of coordinating actions (5).

1. **The creation of suitable jobs and the transformation of existing jobs or those being phased out:**

The development of renewable energies, such as wind, solar and hydrogen, is creating new jobs in infrastructure design, installation and maintenance. For example, jobs in engineering, construction and project management are in high demand.

Revitalising the nuclear industry implies a 25% increase in the volume of work between now and 2033 (excluding productivity gains), which means mass recruitment.

Revitalising the nuclear industry means a 25% increase in the volume of work between now and 2033 (excluding productivity gains), which translates into a skills requirement of around 10,000 jobs a year, or almost 100,000 new recruits over ten years.

Transforming existing jobs: many jobs in the traditional energy sectors, such as coal, oil and fossil gas, are in decline. This means that we need to support the retraining of workers in more sustainable

[108] According to the SGPE, this figure is set to rise once the latest SNBC 3 data has been incorporated. According to other analyses, these projections will be based on the number of gross job creations and destructions, as well as departures.

[109] https://sgeieg.fr/ (IEG)
[110] https://www.energiesetmobilites.fr/ (UFIPEM)
[111] Electricity and gas industries = 136,000 employees in 2022, 157 companies, 28% women.
Petroleum industry: UFIPEM, 33,000 employees, 183 companies and 29% women.
FEDENE, https://fedene.fr/ the professional federation of energy and environmental services companies, brings together 6 unions working to improve energy efficiency and building services, and to decarbonise the production of heat and cooling from renewable and recovered energy sources. It represents 1,500 companies and 50,000 employees, 18% of whom are women.
The construction sector
with 1.5 million employees, including 380,000 craftsmen and 410,000 companies, 2% of whom are women, and less than 1% in certain jobs.
The shared observation is that women are under-represented in technical professions. They are represented in support and sales functions and are on the increase in managerial and executive positions.

sectors. Skills in energy management, energy efficiency[112] and green technologies are becoming essential. We note that data and projections abound, but that comparability is rather tenuous given the overlapping perimeters and divergent methods.

GPEC ACTIONS.1

ORGANISING MONITORING PROCEDURES :

→ **Create a dashboard for annual monitoring of jobs** in each energy sector[113] , recruitment needs and departures, with evaluative indicators in conjunction with ADEME and France Travail in in order to monitor the 2030 jobs projection established in conjunction with the EPP objectives (projection established excluding departures).

→ **Consolidate an integrated vision of employment needs**, including a territorial component for the PPE 3 (in conjunction with the creation of France Travail's Observatoire 4.0, the work of CSF NSE and ADEME, and the updating of EDECs, particularly for electricity), in conjunction with the SGPE and the DGEFP.

→ **Draw on the conclusions and recommendations of the report on the application of Article 28-6 of the Energy Efficiency Directive 2023/1791** forthcoming on the "jobs and skills" aspect (ADEME).

Jobs by energy sector at the end of 2022 and 2030 trajectory

Jobs by sector	Jobs in 2022 [114]	Jobs in 2023	2030 trajectory[115]
Heating networks	3 410	4 190	7 900
Cooling networks	200	250	400
Hydropower	14 940	15 130	15 000
Onshore wind	17 960	15 990	32 300
Offshore wind power	7 390[116]	8 300	12 000
Solar thermal	3 080	3 040	12 300
Solar photovoltaic	18 300	25 490	61 700
Geothermal	2 610	3 090	7 700
Biogas	6 790	3 570	19 200

[112] https://observatoire-competences-industries.fr/branches/services-defficacite-energetique/?doing_wp_cron=1736700830.6686310768127441406250

[113] Scope: heating and cooling networks, hydroelectricity, onshore and offshore wind power, solar thermal and photovoltaic energy, geothermal energy, biogas, nuclear power.

[114] ADEME study Markets and jobs contributing to the energy transition - Data, updated September 2024.

[115] According to the 2030 economic projection defined in the PPE 3 and used in the costing work of the CSPE Management Committee (CGCSPE).

[116] Data from the "observatory of marine energies" report https://merenergies.fr/, the data will be implemented in September 2025 in the ADEME data base.

Nuclear industry	125 000[117]		156 000[118]
Total Energy (excluding biofuels, hydrogen and derivatives, fossil fuels and networks)[119]	**199 680**		**325 000**

2. **<u>Identifying the skills required and the need for new skills:</u>**

The energy transition requires specific technical skills, particularly in the fields of engineering, IT (for energy management systems), building and environmental sciences. Skills in data analysis and project management are also increasingly in demand. Skills management appears to be a key issue for the energy transition. An initial diagnosis was drawn up as part of a preparatory mission led by Laurence Parisot in 2018[120] , on which the PPE adopted in 2020 was based. Since then, a number of measures have been designed to support the development of training and skills in sectors linked to the ecological transition.

For example, the diagnoses of skills and training needs funded as part of France 2030 (AMI Compétences et métiers d'avenir - AMICMA)[121] are useful. The AMI has enabled sectoral diagnoses to be carried out, estimating needs qualitatively and often quantitatively, by level of qualification and by region, and proposing possible strategies to meet them. These analyses will enable the creation of training pathways, the creation of new training places and the development of additional modules to existing training courses. In particular, we can draw on the following diagnostics: "COMED" for decarbonated energies, diagnostics "F2H-PDL" and "DEF'HY" for hydrogen, or regional diagnostics such as "Diagtase" on smartgrids, floating wind power and photovoltaics in Occitanie, or GEPECT-EOF on floating wind power in the Mediterranean. Among them, **the project led by OPCO 2i** (industry trades)[122] " Enabling the provision of skills essential to the decarbonisation of industry" is one of the winners. This training aims to create a decarbonisation culture within companies and to train experts in this field. It involves 300 companies and 20,000 employees.

Employment and Skills Development Agreements (EDEC) are annual or multi-year agreements between the State and one or more professional branches. They provide [123]**technical and financial assistance** to **anticipate and support changes in jobs and skills**, and thus **secure the career paths of people working** in the various sectors (gas, electricity and nuclear).

[117] MATCH data, focus on direct employment, projection estimated at +25%. https://www.csfn-nucleaire.org/fr/actualites/rapport-match-du-gifen

[118] The MATCH report estimates a 25% increase in direct FTEs in the industry by 2033. Extended to all 220,000 jobs in the sector in 2033, the need is for around 100,000 full-time equivalent recruitments over 10 years. We therefore assume 125,000 + 25% here.

[119] Excluding petrol and diesel biofuels (1,610 and 820 jobs in 2023)

[120] https://travail-emploi.gouv.fr/rapport-plan-de-programmation-des-emplois-et-des-competences

[121] https://www.info.gouv.fr/organisation/secretariat-general-pour-l-investissement-sgpi/cma-liste-des-diagnostics-de-formation

[122] https://www.opco2i.fr/

[123] L'engagement développement de l'emploi et des compétences (EDEC) | Travail-emploi.gouv.fr | Ministère du Travail, de la Santé, des Solidarités et des Familles

Lastly, the French government has set up a task force whose conclusions were published in July 2023[124] . Its aim is to take stock of the current situation and make recommendations for tackling the pressures on the industry's workforce and skills, with a particular focus on the role of training.

Targeted studies by area have also been launched:

For example, in **the nuclear sector**, the Groupement des Industriels Français de l'Énergie Nucléaire (GIFEN) has launched the MATCH programme[125][126] . This is a deliverable of the EDEC for the nuclear industry, and is now a dynamic steering tool to ensure thatmatch , on the one hand, there is a between capacity and, on the other, the industry's future needs and challenges. Its conclusions were submitted in April 2023.

Of the nearly 100,000 new recruits needed over the next ten years, 60,000 jobs will be in the 20 core business segments. For example, civil engineering, forging and casting, and boiler making are all in high demand. Twenty trades in particular have increased skills requirements, including project managers, welders and electricians[127] . This programme is reviewed annually. A detailed skills action plan, coordinated by the Université des métiers du nucléaire and developed jointly with the French government, was submitted to the ministers responsible for energy, industry, vocational training and higher education in June 2023. It includes concrete actions to be launched in September 2023, such as the creation of a single platform for training, internships and jobs in the industry, and the creation of new training courses or nuclear colourations of existing courses. This work is complemented by a multi-year training strategy for the nuclear industry that is being developed in conjunction with the relevant ministries, and a "training for nuclear professions" label is also envisaged.

The networks sector (i.e. the manufacture of equipment, cables, connection materials, installation, operation, maintenance, transport and distribution) currently represents nearly 1,600 companies and almost 100,000 employees in France. The industry estimates that it will need to fill around 8,600 jobs each year, including 3,300 on sandwich courses, i.e. 43,000 in 5 years in the core business and 58,000 in total. The France 2030 diagnostic report published for this sector in November 2024[128] highlights the mismatch between existing training and needs[129] . The players in the electricity network sector have therefore signed a partnership agreement on the creation of a training programme called "Les Écoles des réseaux pour la transition énergétique"[130] , with the aim of anticipating and supporting the massive recruitment needs of the sector in a context of strong growth in electricity network activities driven by decarbonisation and the electrification of uses. Studies are also being carried out in conjunction with the Ministry of Education to modify or revamp training courses.

As far as **renewable energy is concerned**, marine renewable energy currently accounts for more than 6,500 jobs. The offshore wind pact signed between the industry and the government forecasts more than 20,000 jobs in offshore wind energy by 2035. The photovoltaic and onshore wind energy sectors

[124] https://www.enseignementsup-recherche.gouv.fr/fr/tensions-sur-les-effectifs-et-competences-dans-l-industrie-et-dispositifs-de-formation-associes-93471

[125] https://www.gifen.fr/

[126] https://www.ecologie.gouv.fr/sites/default/files/documents/2023.04.21_Synthese_Match_20-04-23.pdf

[127] According to the Université des métiers du nucléaire, these twenty professions are: automation engineer, winding machine operator, boilermaker, project manager, site supervisor, certified non-destructive testing (NDT) personnel, draughtsman-project designer, electrician, foundryman, blacksmith, electrical design engineer, mechanical design engineer, welder, civil engineering project designer/BIM project designer, maintenance technician, radiation protection technician, pipe fitter, process engineer/general installation engineer, fitter, formworker-tightener.

[128] https://travail-emploi.gouv.fr/appel-manifestation-dinterets-competences-et-metiers-davenir-ami-cma

[129] This report is not yet public, but the figures can be found on the Enedis website.
https://www.enedis.fr/reussir-la-transition-ecologique/ecoles-des-reseaux-pour-la-transition-energetique

[130] https://www.enedis.fr/presse/emploi-et-formation-lancement-des-ecoles-des-reseaux-pour-la-transition-energetique

accounted for 18,000 jobs respectively[131] . The SER (renewable energy union)[132] produced a report in 2024 with renewable energy production targets broken down by region .[133]

In the building sector, since January 2024, there has been a major boost to comprehensive renovations in the private residential sector, with increased support from Anah and a sharp rise in large-scale renovations, with more than 91,000 homes receiving assistance in 2024. This growing momentum means that we need to anticipate what the market will offer in the medium term.

Launched at the end of 2023, the "plan to structure the building renovation sector" brings together, under the aegis of the Ministry of Ecological Transition, the ministries and public operators involved in initial and continuing training, business development and the building sector.

The aim of the plan is to ensure that the industry is ready, both in terms of capacity and skills, to meet the national objectives arising from ecological planning. According to the conclusions of France Stratégie and the projectBuild up Skills 2 , between 170,000 and 250,000 additional FTEs will need to be trained between now and 2030, whether through initial training, retraining or a shift from new build to renovation.

It is therefore necessary to understand the existing state of training, to develop both the initial and continuing training on offer, to design and disseminate tools to massively increase renovation, particularly global renovation, to better mobilise professionals and improve the attractiveness of the professions, particularly to young people. These discussions are being conducted at both national and local level.

To illustrate the interministerial actions taken in 2024: 19 vocational qualifications and 48 national education diplomas have been revised to include REB (renovation and maintenance of buildings), and new functions have been introduced into the national reference system for vocational qualifications to enable people to search for renovation using key words, tools have been developed for professionals, notably through the energy saving certificate programmeProfeel , support has been provided for groups of small businesses through the CEE programmeFacilaréno 2 , support has been provided for innovations that will enable the emergence of joint operators through the call for tendersOreno , and communication campaigns have been carried out to make the professions more attractive.

The energy transition in the **transport sector** also requires the development of an employment and skills strategy, focusing on several key areas: anticipating needs in terms of shortage occupations, reducing regional disparities, improving attractiveness to target groups (young people, women, employees undergoing retraining), strengthening the range of specialised vocational training, and encouraging the development of occupations to meet new needs.

By 2030, the professional sectors have identified a need for almost 370,000 FTEs to be recruited and trained across the entire transport sector, in order to meet the challenges of demographic change and the transformation of professions. The greatest needs are in driving and operations, but also in handling and maintenance, and in public works and IT engineering.

In July 2024, the SGPE published a "Jobs and skills strategy for ecological planning" aimed at assessing and anticipating the impact of the ecological and energy transition on jobs, the workforce and the need for workers to adapt their skills (responses required in terms of initial and continuing training), and establishing a national strategy to determine the challenges of this transition in terms of jobs and skills.

[131] CGDD_A6_CHIFFRES_CLES_EnR_2022_v3_010922_GB_signets.pdf
[132] syndicat-energies-renouvelables.fr/wp-content/uploads/basedoc/ser-regionalisation-ppe-2024.pdf
[133] Renewable energies: Energy transition through territories: SER's regional objectives for an EPP

On the basis of this work, but also of the sectors (example: Kyu diagnosis and action plan for rail and urban transport financed by France 2030), the year 2024 has made it possible to identify a certain number of levers to support all the players, and in particular :

- Communicating the business lines to key audiences (young people, retraining, women) and promoting the sector to employment and training players
- Supporting partnerships between businesses and schools, universities and employment and training providers
- Structuring induction, apprenticeship and initial and ongoing training to make the sector attractive and build loyalty and career prospects
- Integrating the employment and skills challenges of the ecological transition into companies' CSR approaches
- Promote bridges between professions, professional retraining and secure career paths to encourage intermodality and support transitions towards key skills and jobs for the ecological transition.
- Streamline administrative processes (in particular the issuing of D permits by creating a provisional certificate before the D permit is issued)
- Updating training reference frameworks, revising professional qualifications and diplomas to cover new key skills requirements
- Create a low-carbon driving school and support the creation of training courses to complement accredited courses.
- Integrate the evolving skills required in digital technology: predictive maintenance, artificial intelligence, cyber security, etc.
- Strengthening and supporting the OPCOs on the ecological transition aspect

It is agreed that it is not easy to envisage a transfer of "brown" jobs to green or greening jobs without support and training. This is emphasised by the sectors and by a number of studies and EDECs. The work of the ONEMEV[134] also regularly stresses the absence of any communicating effect between the two. Statistics produced by the SDES and the CGDD[135] highlight the recruitment difficulties[136] and the skills shortages, as do studies by ADEME .[137]

GPEC ACTIONS.2

ANTICIPATING SKILLS REQUIREMENTS IN CONJUNCTION WITH THE SECTORS AND MINISTRIES CONCERNED :

[134] L'observatoire national des emplois et métiers de l'économie verte | Ministère du Partenariat avec les territoires et de la Décentralisation Ministère de la Transition écologique, de l'Énergie, du Climat et de la Prévention des risques Ministère du Logement et de la Rénovation urbaine

[135] https://www.ecologie.gouv.fr/commissariat-general-au-developpement-durable-cgdd

[136] The role of the Statistical Data and Studies Department (SDES) is to organise the socio-economic and statistical observation system for housing, construction, transport, energy, the environment and sustainable development, in liaison with the relevant national, European and international institutions. The SDES **acts as the statistical service for the ministries responsible for the environment, energy, construction, housing and transport.**
Recruitment difficulties persist in the green economy sector in 2022 | Statistical data and studies

[137] Markets and jobs contributing to the energy transition in the renewable and recovered energy sector - Edition 2024 - The ADEME bookshop

→ **Continue the anticipation and programming actions as** part of the coordination provided for the France 2030 projects, and be part of the interministerial trajectory that will be implemented in the follow-up to this programme, which is coming to an end.

→ **Ensure the mobilisation of dedicated resources** from the electricity and gas industries, the oil industry and the energy efficiency industry, as part of the updating of the EDECs and studies relating to the energy professions.

→ **Targeting HR support and guidance systems:** stabilising the resources available for developing the skills of employees in the professional sectors concerned, in conjunction with the sectors concerned.

→ **Identify skills requirements** and implement forward-looking skills management plans as part of a joint project between the State, the Regions and the sectors in order to attract, train and recruit the people needed to meet the objectives of the EPP.

→ **Evaluate and certify skills:** encourage and pursue the introduction of certification systems to recognise skills acquired as part of the energy transition, thereby facilitating professional mobility and helping to enhance the value of these professions, both symbolically and financially.

→ **Support inter-industry discussions on the consolidated needs** of these industries in terms of critical skills for the nuclear sector, and even all ENR sectors, in conjunction with the SGPE, the DGE and the DGEFP.

→ **Contribute to the structuring and implementation of an ENR plan** to support regions deploying an ENR industrial policy in conjunction with the SGPE, the DGE and the DGEFP.

3. **<u>Adapting training to emerging professions and building bridges between jobs:</u>**

To meet these new needs, it is crucial to adapt training programmes. This can include updating university curricula, developing specific vocational training and promoting lifelong learning. Partnerships between companies, educational establishments and governments can facilitate this adaptation.

In the electricity and gas industries (IEG), an amendment to the training and work-linked training agreement concluded on 26 May 2023 for the branch has strengthened support for employees faced with these changes by giving them the opportunity to follow a training course leading to a qualification as part of the retraining or promotion by work-linked training scheme, known as Pro-A, within their company.

Pro-A enables employees to change jobs or professions, or to benefit from social or professional advancement. This can be achieved not only through training but also through the validation of acquired experience (VAE). In addition, Pro-A can be used to acquire a foundation of knowledge and skills.

The work carried out has made it possible to list the qualifications eligible under the Pro-A scheme for each profession covered by the defined criteria. More than 100 qualifications are now listed in the RNCP (répertoire national des certifications professionnelles)[138] . This work has also made it possible to :
- Understand the different sectors of activity in the industry and the trends likely to have an impact on professions,

[138] https://www.service-public.fr/particuliers/vosdroits/R40438

- Analysing changes in skills requirements by business sector,
- Identify shortage occupations and/or occupations whose activity is undergoing major change and for which there is a risk of skills shortages or obsolescence,
- For each of these professions, determine which qualifications are eligible for the Pro-A scheme.

The Strategic Committee for the Sector New Energy Systems (CSF Nouveaux systèmes énergétiques)[139] is responsible for creating a "Schools for the energy transition" label, which will bring together the country's training offer in the transition professions. This label will help to raise the profile of existing training opportunities at all levels of study, in sectors thatstruggling to are sometimes recruit, and to encourage the creation of new initial and continuing training opportunities to support the reindustrialisation of renewable energy industries.

France 2030 will support the development of an attractive training offer, particularly in the fields of renewable energy and nuclear power. France 2030 aims to encourage the development of a French industry for new energy technologies capable of responding to the growing development of renewable energies and the electrification of uses. To this end, the PIA4 "Skills and Professions of the Future" call for expressions of interest operated by the ANR and Caisse des Dépôts aims to support the attractiveness of training in these fields and to strengthen existing training and, where appropriate, create new training channels for the fields and professions of the future that are experiencing the greatest recruitment pressure.

Table2 Estimated training needs by level up to 2030 by Stratégies France 2030

Stratégie France 2030	<=bac	bac+2+3	bac+5	> bac + 5	Formation continue	total
Nucléaire						60 000
Hydrogène	60 150	450	40 100	-	600	101 300
Décarbonation de l'industrie	12 000	25 000	25 000	-	585 000	647 000
Electronique						20 000
Recyclabilité	816	1 676	446	-	782	103 720
Technologies avancées des systèmes énergétiques	13 668	14 370	12 714	1 864	15 600	58 216
Produits bio sourcés	14 816	16 888	3 352	3 264	504	38 824
Solution pour une ville durable	10 000	5 180	1 880	-	1 600	68 660
Véhicules électrique	-	-	-	-	-	50 000
Digitalisation et déacarbonation des mobilités	3 776	2 525	2 402	-	9 130	67 833
Batteries	3 536	9 838	1 993	252	12 420	28 039
Alimentation durable	34 488	29 530	4 782	330	23 870	93 000
SADEA	46 976	19 338	9 958	294	22 435	99 000
Biomédicaments	-	5 000	4 000	6 500	500	16 000
Santé numérique	-	-	-	-	-	50 000
Industries culturelles et créatives	-	350	700	30	3 425	64 505
Aventure spatiale	1 000	5 000	8 000	1 000	5 000	20 000
Souveraineté numérique	1 000	807 400	294 408	224 880	151 460	1 589 148
Enseignement et numérique	2 360 028	50 339	185 053	103	1 090 976	3 686 499
Transversalité	-	-	-	-	-	1 000 000

Source : SGPI, bilan avril 2023.

GPEC ACTIONS.3

[139] https://www.entreprises.gouv.fr/secteurs-dactivite/industrie/les-comites-strategiques-de-filiere

ENCOURAGE THE ONGOING ADAPTATION OF TRAINING AND CERTIFICATION SCHEMES IN CONJUNCTION WITH THE INDUSTRIES AND MINISTRIES CONCERNED

TO HELP COORDINATE THE GPECS OF THE BRANCHES AND SECTORS COVERED BY THE PPE, ENSURING THE INTRINSIC QUALITY OF THE GPECS AND THEIR OVERALL COHERENCE.

- Encourage the development of training programmes: ensure the creation of specific courses in universities and technical schools focusing on renewable energies, energy efficiency and green technologies in conjunction with the relevant stakeholders and the AFPA .[140]

- Promote practical apprenticeships: Encourage work placements and apprenticeship contracts in companies and branches of the energy sector to enable students to gain practical experience. Ensure that apprentices are hired on completion of the course.

- Ensuring compliance with the obligation to negotiate on forward-looking career and skills planning and training, setting ambitious targets and guaranteeing the dissemination of best practice, building bridges between jobs within the same branch or between two affected sectors, and contributing to a better understanding and visibility of the vocational training effort of companies with more than 50 employees.

- Encouraging the development of continuing education opportunities
- less expensive or even abundant for industry and energy, accessible via MonCompteFormation,
- by targeting certifications in the National Register of Professional Certifications (RNCP), and by encouraging the development of contributions from branches and companies
- including energy and ecological transition skills in state qualifications and diplomas, in conjunction with the CGDD and the SGPE

- Help coordinate the quality of GPEC work:
Identify evaluation criteria and satisfaction thresholds (number of career paths changed, ability to take account of specific territorial features and territorial players) to ensure the effectiveness and intrinsic quality of branch and sector GPECs, as well as the overall quality of GPEC coordination for the EPP.
This GPEC coordination work could be carried out under the supervision of the IEG branch agreement extension committee (mentioned below), with the participation of the Ministry of Labour with regard to the branch agreements in the sectors it examines. Involve organisations such as the AFPA, Carif-oref[141] and Céreq[142] in this fundamental work, starting with an experimental approach in a pilot sector.

4. **<u>Recruitment by raising awareness among young people and including women in "gendered" professions, while ensuring that employers are attractive:</u>**

Work on the attractiveness and inclusion of young people and women in "gendered" professions. It is important to raise young people's awareness of the opportunities offered by the energy transition. To this end, the ONISEP is continuing its communication between jobs in energy and ecological transition and the initial training required[143] . The France Travail search engine lists more than 150

[140] https://www.afpa.fr/
[141] https://www.intercariforef.org/
[142] https://www.cereq.fr/
[143] Search for an odd - JobDD
Energy - Search for an odd - JobDD

occupations linked to the ecological transition and the associated training[144] . From 2025, a specific nomenclature relating to ecological planning will be included in France 's new operational directory of occupations Travail(ROME 4.0)[145] with the corresponding vocational training courses preparing for strategic occupations for ecological planning and industry . [146]

Recruitment strategies should also ensure that under-represented groups have access to these new training courses and jobs. In addition**, the issue of attractiveness, the employer brand and the need to remove the obstacles of "gendered" professions** have been identified and are the subject of measures and action plans in agreements relating to professional equality and direct actions aimed at schools, through communication actions within most sectors[147] . A number of measures can be implemented to encourage the employment of women in the energy transition professions, where, taking all sectors and branches together, the proportion will be less than 30% in 2023.

For the electricity and gas industries (IEG), the agreement on gender diversity and gender equality in the workplace 2024-2028 was signed on 11 July 2024. The signatories reaffirm the branch's major role in assisting and supporting companies in their gender diversity and gender equality policies, particularly in the following 3 areas:

- Analysing and gaining a better understanding of the sources of inequality between women and men: in addition to consolidating gender-based indicators, the branch produces targeted, qualitative and documented analyses to identify levers for action and progress for companies.
- Stimulating and supporting innovation within companies in the sector: the sector is the ideal forum for sharing best practice among companies. It also plays an open, watchdog and forward-looking role, by organising the sharing of resources for companies.
- Sharing, deploying and communicating: the branch communicates, in particular via the SGE des IEG website and its resource platform dedicated to the fight against gender-based and sexual violence. It also publishes materials, mainly aimed at managers, HR and staff representatives, to raise awareness and inform them about the new issues of gender equality and inclusion. This agreement constitutes the benchmark for companies in the sector, so that each of them can pursue, strengthen and implement a policy of gender diversity and professional equality between women and men.

The signatories are focusing on 3 priorities:

- **develop the gender mix in all professions, and the fluidity of career paths between these professions**, in order to aim for a balanced representation of women and men in all jobs (including positions of responsibility).
- **guarantee equal pay** and, more generally, **equal treatment** for women and men within companies in the sector.
- **take into account the issues of prevention, health, safety and working conditions** in a very broad approach to gender equality in the workplace, which covers not only the fight against all forms of violence in the workplace, but also the impact of violencedomestic and/or intra-

[144] https://candidat.francetravail.fr/metierscope/metiers-avenir/transition-ecologique
[145]https://www.francetravail.org/files/live/sites/peorg/files/documents/Statistiques-et-analyses/Open-data/ROME/ROME_Presentation.pdf
[146] Sector-specific communication initiatives have been , implementedsuch as the "navire des métiers" (maritime), the "" portal Monfuturjobauto(automotive), "Very wood métiers" (wood), www.monmetierdenfer.fr (rail) and the web series "Les Reconstructeurs" (construction).Home | Mon métier d'en-fer | Futur en train (industryrail)
[147] DARES is also on this subject: working
https://dares.travail-emploi.gouv.fr/sites/default/files/ffb86c7abea86b7af6a67b981ff7fa65/DE_mixit%C3%A9_conditions%20de%20travail.pdf
https://dares.travail-emploi.gouv.fr/publication/metiers-de-femmes-metiers-dhommes-en-quoi-les-conditions-de-travail-des-femmes-et-des

family on companies, as well as gender identity and reproductive and sexual health issues for women and men.

These guidelines are accompanied by measurable objectives with deadlines and monitoring indicators.

Finally, attention is being paid to **better targeting school drop-outs from the initial training stage, with the interesting initiatives of the Ecoles de Production**[148] (industrial, construction and environmental trades) and **those of the Réseau ETRE**[149] (ecological transition trades).

The Commission d'extension des accords de branche des industries électriques et gazières IEG (provided for in article L.161-3 of the Energy Code), managed by the DGEC, carries out the tasks of the Commission nationale de la négociation collective (National Commission for Collective Bargaining) of the Ministry of Labour with regard to the extension of collective agreements. As a result, the DGEC is responsible for examining and enforcing agreements negotiated within IEG companies on all subjects (including GPEC, professional equality, training, etc.).

GPEC ACTIONS.4

MONITOR THE DEPLOYMENT OF HR POLICIES AND ENCOURAGE RECRUITMENT THROUGH TARGETED COMMUNICATION CAMPAIGNS IN CONJUNCTION WITH THE BRANCHES AND MINISTRIES CONCERNED:

→ Monitor the branch HR policies reflected in the negotiated agreements and their implementation, and the resources allocated, through meetings with the HR departments of these companies . [150]

→ Request annual presentations and follow-up reports on GPEC/training/recruitment/actions implemented on shortage occupations and professional equality at the Boards of Directors of companies in these branches under ministerial supervision, and ensure that they are coordinated between sectors and branches.

→ Strengthen the coordination of actions implemented to increase the number of women in the professions in The energy professions, in accordance with the interministerial plan for equality between women and men (2023-2027) [151]

→ Encourage forums, networking events, conferences and workshops specifically aimed at women, to enable them to meet sector professionals and discuss job opportunities[152] **and encourage the**

[148] https://www.ecoles-de-production.com/

[149] https://www.ecole-transition.eu/

[150] These regular meetings should be extended to cover the main companies in the oil and energy efficiency sector on an annual basis, in order to address recruitment, GPEC, professional equality and training, employment and working conditions and the "employer brand". At these meetings, the DGEC (in conjunction with other specialised bodies) can promote issues that go beyond the strict legal obligations and indicators set by the Labour Code (such as mentoring schemes, job ambassadors, school initiatives, partnerships with associations to encourage the co-option of young people and women into gendered jobs, etc.) and encourage the pursuit of certification schemes to recognise skills acquired as part of the energy transition, with a view to facilitating professional mobility. Finally, request periodic monitoring reports on the objectives set out in the branch agreements on professional equality, GPEC and training. Evaluate the impact of HR policies in these areas and in recruitment, and see how strategies are adjusted to meet expectations. Invite HRDs to share their best practices with peer industries that are also affected by the energy transition, and ensure that HR policies are consistently coordinated.

[151] https://www.egalite-femmes-hommes.gouv.fr/toutes-et-tous-egaux-plan-interministeriel-pour-legalite-entre-les-femmes-et-les-hommes-2023-2027

[152] https://www.ellesbougent.com/ Women in nucleair WiN France or "femmes et sciences" Femmes & Sciences

setting up of mentoring programmes where experienced women in the sector support and advise new arrivals, helping them to navigate their careers.

→ **Encourage branches to set up support networks for women working in the energy transition,** promoting the exchange of experience and advice. Encourage and take part in events such as Women's Rights Day to share stories of women's careers in the energy industry.

→ **Raising awareness and providing information:**

- Encourage awareness-raising campaigns to promote careers in the energy transition sector among young girls and women, by highlighting female role models and success stories in this field, and to inform the public, young people, schools and workers about job opportunities in the energy transition sector and the advantages of these professions and occupational branches.

- Encourage the participation of the electricity and gas industries and other professional sectors in forums, job fairs and conferences on the energy transition to bring employers and job seekers together.

→ **Recruiting young people:** help disseminate information about the Ecological Civic Service and ensure the implementation of gateways to strategic jobs for ecological planning, in conjunction with the SGPE, the DJEPVA and the professional branches concerned. Encourage initiatives dedicated to young people (networksEtre and Production School).

5. **Governance, support for businesses and coordination of actions :**

The cumulative effect of "skill distance" means that bridges between jobs need to be put in place, with the **difficulty of creating jobs with technical skills and qualifications that are sometimes very far apart, and the lack of geographical proximity between highly localised jobs that are dying out** (e.g. the automotive and coal sectors) and **new jobs** (renewable energy) that are better distributed across the country (SER study cited above).

Avenues for responding to these constraints can be found in the EDECs (forward-looking and action plan sections) and can be generalised to sectors identified as being impacted by the transition and cross-referenced with successful GPEC T (forward-looking management at territorial level) approaches, and the work of Cereq (linking training, jobs and work)[153] . The modelling resulting from the Support for Prospective Dialogues (SDP) experiment[154] for energy renovation proposed by ADEME, which conceptualises the notion of a skills territory, should also be used as a tool in this respect. The four territorial pacts supporting the regions affected by the closure of coal-fired power stations have a systematically identified focus on skills development, with a view to adapting them to the future needs of the regions and thus facilitating the redeployment of employees in the employment areas concerned, whatever their type (energy industries, ports or subcontractors) .[155]

The transition and the major projects associated with it (EPR2, acceleration of renewable energies and energy renovation) accentuate the issue of "jobs under pressure", in a context of changing practices and the end of fossil fuels, which is difficult for some companies and employees.

The challenge of adapting initial training to renewables and access to vocational training, especially in SMEs, remains particularly acute. The situation is very different between the large companies in the energy sector (as in the case of the electricity and gas industries above, and the HR and GPEC

[153] https://www.cereq.fr/la-transition-ecologique-au-travail-emploi-et-formation-face-au-defi-environnemental
[154] https://librairie.ademe.fr/societe-et-politiques-publiques/5517-developper-l-emploi-et-la-renovation-energetique-des-logements-avec-le-support-aux-dialogues-prospectifs-sdp.html
[155] https://www.info.gouv.fr/upload/media/content/0001/07/b418420ee50dc28e5efd59bb22d6b50c222c5492.pdf

resources deployed by a company like EDF), and the more fragile subcontractors and service providers with very specific skills. The energy renovation sector is more dominated by small businesses and craftsmen, for whom the digital transition is also a challenge.

The issue of interministerial steering highlighted in the Parisot report still seems to be open to improvement. However, it is worth highlighting the establishment of the CNI's jobs/skills commission[156] , the SGPE, the discussions of jobs and skills issues before the CNTE[157] and the creation of the Comité National pour l'Emploi[158] , which are bodies where these issues can be discussed between the public authorities and the trade unions and employers' organisations.

A need to simplify the process and improve the issue of divergent timetables emanates from the needs of the branches and sectors, as does a better centralisation of access to resources. The ONEMEV fulfils this role, as does the Réseau Emplois et (Jobs and Skills NetworkCompétences), supported by France Stratégie[159] , which carries out important coordination and discussion work between public and private players, complementing the work of the ONEMEV).

The issue of improving the visibility of existing aid schemes and the legibility of possible sources of funding and the difficulty of mobilising these schemes could also be improved, depending on the professional sector. Lastly, the promotion of local initiatives that work, the ability to carry out RETEX, to model the first examples of redeployment of skills and employees and to disseminate them would seem to be other initiatives that should be supported.

GPEC ACTIONS.5

ENCOURAGE PARTNERSHIPS AND SUPPORT BUSINESSES :

→ Strategic partnerships :

- Encourage collaboration and partnerships between companies, sectors, educational establishments, the State and regional services to align skills needs with training programmes.

→ Public policy :

- Regularly monitor and assess the impact of policies implemented on employment and adjust strategies accordingly.

→ Take account of the conclusions of the forthcoming report on the application of Article 28-6 of the Energy Efficiency Directive on the "jobs and skills" aspect.

[156] https://www.entreprises.gouv.fr/secteurs-dactivite/industrie/la-commission-competences-et-attractivite-des-metiers-de-lindustrie

[157] https://www.ecologie.gouv.fr/politiques-publiques/conseil-national-transition-ecologique

[158] New governance at the service of the regions: the national employment committee and the territorial employment committees | Travail-emploi.gouv.fr | Ministère du Travail, de la Santé, des Solidarités et des Familles

[159] Roadmap 2024 of the Réseau Emplois Compétences | France Stratégie

6.6. Assessment of public resources devoted to achieving the objectives of the EPP

6.6.1. Cost of supporting energy management

In the building

Reduced VAT

To achieve the objectives of the PPE, a tax incentive is currently in force, set out in article 278-0 bis A of the French General Tax Code, in a version rewritten for the initial Finance Act for 2023: the reduced VAT rate of 5.5% for energy renovation work. The work must be carried out in residential premises, have been completed at least two years previously, and involve the fitting, installation, adaptation or maintenance of materials, equipment, appliances or systems designed to save energy or use energy produced from renewable sources. The cost of the scheme was estimated at €2.0 billion[160] in 2023 for all public administrations.

MaPrimeRénov' (MPR - ANAH grants)

The Agence Nationale de l'Habitat (ANAH) finances work to improve the energy performance of private homes. In 2024, the ANAH financed the energy renovation of 340,801 homes, thanks to the €3.29 billion in aid distributed.

In 2024, MaPrimeRenov' underwent a major overhaul to enhance its effectiveness, with the creation of two pillars:

(i) The "pillarMaPrimeRénov' Accompanied Journey" , which finances major renovation work (improvement of at least two energy classes), in addition to personalised support via Mon Accompagnateur Renov' (MAR);

(ii) the " pillarMaPrimeRenov' by gesture", which finances "by gesture" renovations;

In addition, MaPrimeRenov' Copropriétés specifically targets work carried out on communal and private areas of collective interest. The scheme requires the work carried out to achieve energy savings of at least 35%, and since 1 has included January 2024 a second level of assistance for projects that achieve energy savings of 50%.

Zero rate eco-loan (éco-PTZ)

Introduced in April 2009, the zero-interest eco-loan is an interest-free repayable loan, available on a means-tested basis, designed to help finance work to improve energy performance or renovate non-collective sanitation systems.

Since 2022, the scheme can be used to finance the remaining costs after receiving the grant.MaPrimeRénov' To this end, the certificates issued by Anah are sufficient to apply for the loan, simplifying the user process. In addition, article 71 of the Finance Act for 2024 extends the eco-PTZ,

[160] Source: Budget 2023, Ways and Means (Volume 2) (link), tax expenditure 730223. The figures in the Ways and Means section of the 2024 Budget (€1.0bn) for 2024 only concern the State (link).

until 31 December 2027, in order to maintain the support provided to households carrying out energy renovation work on their homes.

There is also a co-ownership eco-PTZ to finance energy renovation work on communal areas and equipment, or on private areas in the case of work of collective interest.

Renovation advance loans ("classic" RAP and RAP+)

The 2021 Climate and Resilience Act reformed the "classic" renovation loan, which is a mortgage loan that can be used to finance all types of renovation, with repayment only due when the property is transferred. This loan is distributed at a market rate.

Article 71 of the Finance Act for 2024 created a regulated loan with the same principles in the form of the PAR+. This loan, of up to €50,000, is subject to a tax credit that offsets the absence of interest for the first 10 years of the loan. The scheme is only available for energy renovation work, and is subject to the property being occupied by the owner as their principal residence.

Social housing eco-loan (éco-PLS)

The main incentive for energy renovation in social housing is the social housing eco-loan, a subsidised loan distributed by the Savings Fund, managed on behalf of the State by the Caisse des dépôts et consignations (CDC). This scheme is aimed at social landlords. It was introduced following the Grenelle Environment Forum (2009) and is designed to encourage the renovation of the most energy-intensive homes in the social rented housing stock.

A new agreement on the implementation of the "social housing eco-loan" for improving the energy performance of social housing was signed on 12 April 2023 for the period 2023-2027.

The objectives of this new social housing eco-loan agreement are to :

- contribute to the target of eliminating all thermal flaws from the social housing stock by 2027;
- Encourage and support high-performance renovations in line with the Climate and Resilience Act;
- to make the social housing eco-loan the leading tool for reducing energy consumption in the sector and to combine these objectives in a simple, easy-to-understand scheme for the social housing sector.

To achieve these objectives, the social housing eco-loan envelope has been set at €6 billion over the term of the agreement (2023-2027), compared with €4 billion for the previous agreement.

The social housing eco-loan is a loan of between €6,500 and €33,000 per home, available to social landlords. The amount can be increased by €2,000 per home if the work carried out qualifies for a statutory energy performance label, €3,000 per home if the building contains asbestos, €3,000 if the home achieves a greenhouse gas emission reduction of at least 70% and no gas heating system is installed after the work, €2,000 if no gas heating system is installed after the work, and €2,000 if the home is exposed to noise black spots on the road and rail networks. The amount of new social housing eco-loans signed in 2023 will reach almost €800 million, up sharply on the previous year (+29%), enabling the thermal renovation of 48,000 social housing units that same year ().

Second life for social rental housing" scheme

The "second life for social rented housing" scheme is an experiment to be launched in 2023, designed to support the major renovation of social rented housing with high energy consumption (class F and G of the energy performance diagnosis (DPE)). The cost of this measure is €15m[161] in 2023, financed by the Fonds national des aides à la pierre (FNAP). This experiment has been made permanent from 2024, with the addition of a tax incentive. For energy-efficient renovations that achieve at least class B in the energy performance diagnosis (DPE), the scheme provides for a reduced VAT rate of 5.5% on the work carried out and a total exemption from long-term property tax (TFPB) for homes renovated in this way. The latter exemption, which is not granted for the renovation of conventional housing, offers second-life projects a tax advantage similar to that of new build.

Major works - compliance and refurbishment of State buildings

The Energy Efficiency Directive (EED - now 2023/1791/EU) requires the renovation of 3% of the heated and/or cooled surface area of buildings over 250 m^2 owned by a public body.

The renovation of State buildings mobilises several budget vectors, in particular programme 723 "Real estate operations and maintenance of State buildings", which contributes to the financing of real estate projects and the maintenance of the owner within the real estate special appropriation account (CAS), as well as other Ministry support programmes. Since 1 January 2018, a new programme 348, "Performance and resilience of State buildings and its operators", with a budget of €650m in 2024, is specifically involved in reducing the State's energy consumption through the major renovation of existing buildings and the financing of targeted actions on energy performance and changes in working methods.

Support is also provided for improving the performance of local authority buildings. Programme 119 "Financial assistance to local authorities and their groupings" has been allocated €2 billion to support local authority projects, including the thermal renovation of buildings. Lastly, the Green Fund, announced in the summer of 2022 and effective since the beginning of 2023, is an unprecedented mechanism for accelerating the ecological transition in local and regional authorities. Endowed with €2 billion in 2023, just over a third of the applications accepted (for around €764 million) in 2023 concerned the energy renovation of local public buildings . [162]

Energy saving certificates

The energy savings certificate (CEE) scheme requires energy suppliers (known as obligated parties) to carry out or initiate energy savings operations based on the volume of energy they sell, particularly in the building sector (see action cons.3).

In transport

[161] Announcement of the "experimentSecond life of social rental housing" , in May 2023.

[162] Press release on the 2023 assessment of the Green Fund.

Contribution to the financing of the acquisition of clean vehicles

Programme 174 finances aid schemes for the acquisition of clean vehicles, including the ecological bonus, leasing aid for electric cars in 2024, the conversion premium (which is conditional on the withdrawal of a polluting vehicle) until the end of 2024, and the retrofit premium. The budget allocated to these schemes in the initial Finance Act was €1.5 billion in 2024 and will be refocused in 2025 on the ecological bonus for the purchase of private electric cars and the retrofit premium. Between 2020 and 2024, the ecological bonus supported the purchase of more than 1.3 million clean vehicles, including 357,000 in 2023 alone (from December 2023, the bonus will be subject to eco-conditionality and will only be granted to vehicles with the highest environmental performance). Over the same period (2020-2024), the conversion bonus will support the replacement of almost 500,000 old, polluting vehicles (including bicycles) with low-pollution vehicles. Lastly, the leasing aid scheme, launched on 1 January 2024, was a great success in its first wave, with around 50,000 electric passenger cars benefiting from the scheme.

Regulation (EU) 2023/851, adopted in 2023, sets a target for the end of sales of new internal combustion passenger cars and vans from 1 January 2035.

With regard to heavy mobility, Programme 174 has also financed aid schemes to support the deployment of heavy electric vehicles. To this end, two calls for projects (AAP) for "Ecosystems of heavy electric vehicles", managed by the French Agency for Ecological Transition (ADEME), were opened in 2022 and 2023, enabling the acquisition of 545 heavy electric vehicles (HGVs, buses and coaches) in 2022 for a budget of €65m, and more than 1,000 new or retrofitted heavy electric vehicles (HGVs and coaches) in 2023 for a budget of €60m.

For the 2024 financial year, support public was based on financing in the form of energy saving certificates (CEE). The E-TRANS programme run by ADEME, which was launched in May 2024, supported the purchase of around 2,500 heavy goods vehicles (HGVs, buses and coaches) for a total of €130m. From 2025 onwards, the CEE scheme will use subsidised standardised operation sheets to finance a number of grants for the purchase/leasing of new electric vehicles (passenger cars, light commercial vehicles, HGVs, buses and coaches, quadricycles) and the electric retrofitting of combustion engine vehicles.

Regulation 2019/1242, revised in 2024, sets a 90% reduction target for emissions from heavy-duty vehicles from 2040. It also introduces a target of 100% of new zero-emission city buses by 2035, while setting an intermediate target of 90% for this category by 2030.

6.6.2. Cost of supporting renewable energy through public energy service charges

Support schemes for renewable energies whose production is sold on the market, i.e. renewable electricity and biomethane, provide producers with secure and stable remuneration for the energy they produce. **They are adapted to the level of costs and risks involved in each sector and cover producers against changes in market prices**.

The resulting additional costs are borne by the operators responsible for purchasing the energy produced under a feed-in tariff system, or by the operators responsible for paying the additional remuneration under a remuneration supplement system. **This additional cost is compensated by the State through programme 345 as part of the public energy service charges (CSPE) assessed annually by the Energy Regulation Commission (CRE).**

The cost of support for the State is therefore **sensitive to changes in market prices**: when market prices rise, the costs incurred by these installations fall until they become negative (the situation observed at the peak of the energy crisis between late 2021 and early 2023), and vice versa.

The budget cost must therefore be assessed on the basis of the forecast costs of the sectors and the projected changes in the market selling price of the renewable energy produced. This amount is broken down between the costs already incurred prior to EPP3 and the new costs of supporting new capacity under EPP3.

The costs already incurred prior to EPP3 correspond to all the costs of supporting renewable energies that have already been committed to by the State (contracts signed before 31 December 2023 or tenders that have already been awarded), or that will be incurred between now and 2025 on the basis of EPP2.

In a letter dated 7 November 2024, the Minister for Energy referred the matter to the Comité de gestion des charges de service public de l'électricité (CGCSPE), which on 20 December issued its opinion on the budget section of the impact study for the initial draft of the EPP 3, in which it presents an estimate of these support costs[163] . In addition to incorporating the CGCSPE's recommendations, the costing has also been updated to reflect the changes made to the EPP following consultation.

6.5.2.1 Market price and production cost trajectories

Three scenarios of average wholesale energy prices were studied to estimate the costs of public support for the development of renewable electricity:

- **A low scenario with a wholesale electricity price of €50 in 2024/MWh and a wholesale gas price of €20 in 2030**.
- A median scenario with a wholesale electricity price of €702024/MWh and a wholesale gas price of €352024/MWh HCV in 2030.
- **A high scenario with a wholesale electricity price of €95 in 2024/MWh and a wholesale gas price of €50 in 2024/MWh HCV in 2030**.

The average selling prices of electricity produced by renewable electricity generation facilities in the above-mentioned sectors are lower than the average market prices of electricity, due to the correlation of electricity production between facilities in the same sector. Solar power, for example, is produced at the same time of day for all the facilities, leading to a drop in the market price of electricity during these hours, reducing the average price received by the facilities. A discount must therefore be taken into account in relation to the average market price when calculating public support for production facilities.

The following table shows the discount factors used for photovoltaic, onshore wind and offshore wind energy[164] :

Renewable energies concerned	Annual discount factor assumptions

[163] The CGCSPE's opinion on the budget section of the EPP3 impact study can be consulted on the Committee's website at the following address: https://www.ecologie.gouv.fr/politiques-publiques/comite-gestion-charges-service-public-lelectricite-cgcspe

[164] For the other renewable energies, it has been assumed that there is no discount factor.

Photovoltaic	Gradual reduction from **-20% in 2025 to -40% in 2050** and beyond
Onshore wind	Gradual reduction **from -5% in 2025 to -10% in 2050** and beyond
Offshore wind power	**-5% uniform** between 2025 and 2060

The following trajectory for the tariffs of the new support contracts for the various sectors has been taken into account in estimating the costs of public support for the production of renewable energy, assuming that the current support mechanisms remain unchanged:

Support contract tariff (€$_{2024}$/MWh)	**2025**	**2030**	**2035**
PV - AT building	110	105	100
PV - AT small floor	88	84	80
PV - AO sol	80	75	70
PV - AO building	100	94	88
Onshore wind	90	85	80
Offshore wind power - installed	55	55	-
Offshore wind - floating	100	85	-
Hydraulics	107	107	107
Marine turbines	-	160	-
Biomethane	148	133	133

In addition, a constant inflation rate of 2% has been used to estimate the cost of public support for renewable energy production.

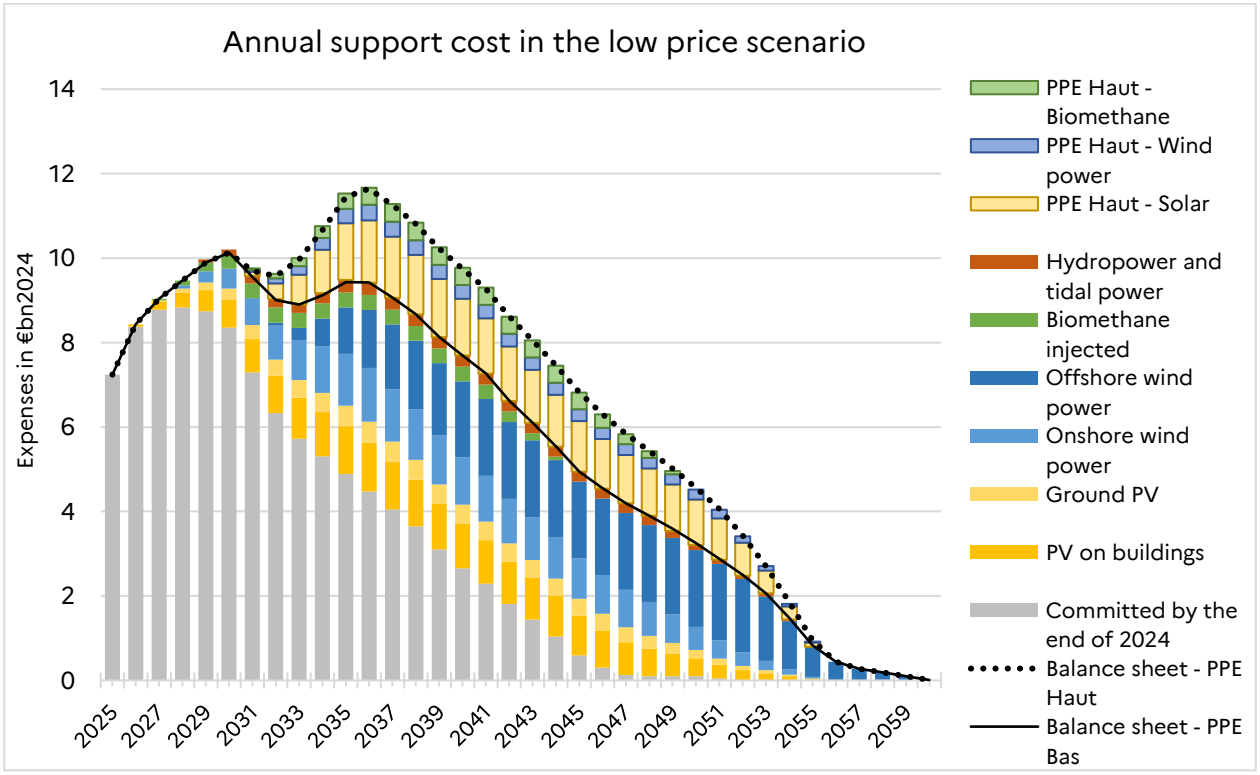
6.5.2.2 Estimated costs of public support for renewable energy production

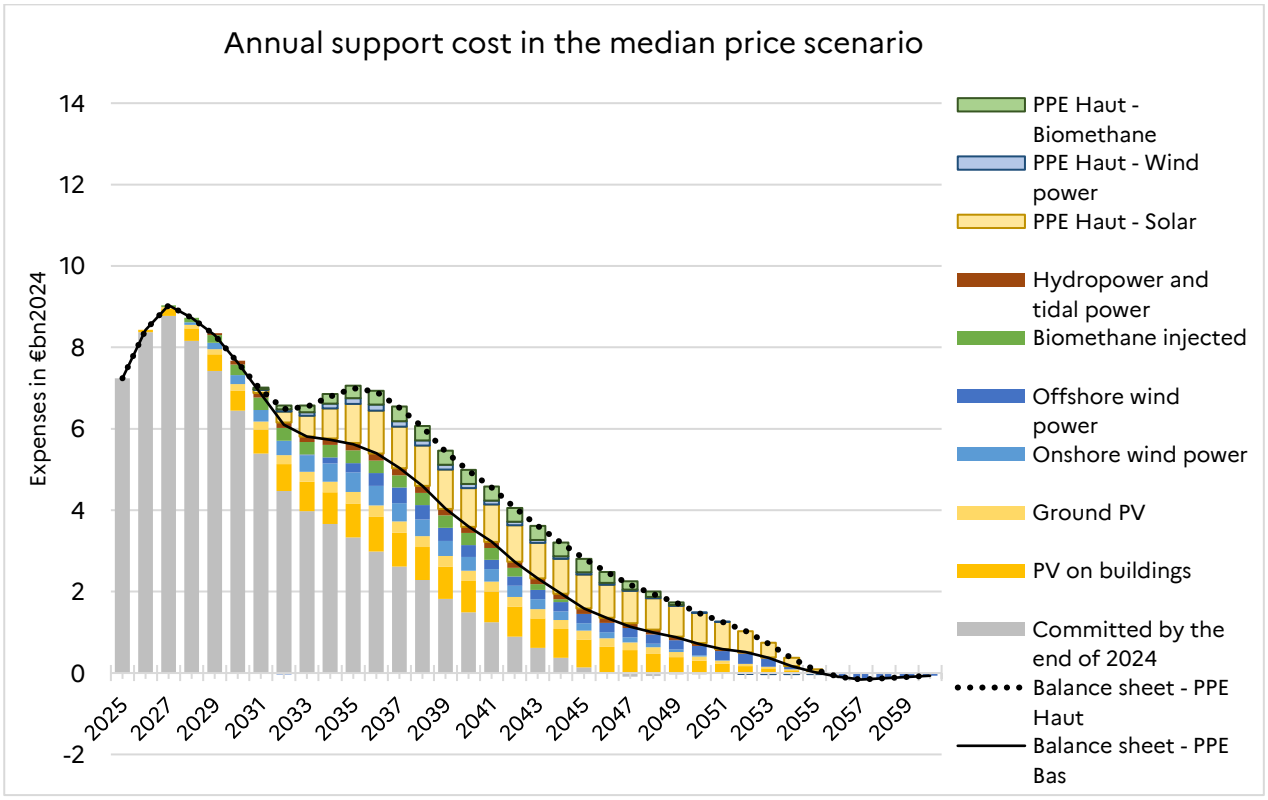
Modelling of the costs of public support for renewable energy production leads to an estimate of **€98.2bn to €135.2bn$_{2024}$** in public energy service charges under EPP3 between 2025 and 2060, in the **low price scenario**, **€38€62.7bn to .9bn$_{2024}$** in the **median price scenario** and **a negative amount of -€33.7bn to -€25.5bn$_{2024}$ in the high price scenario.**

Estimated support costs between 2025 and 2060 (€bn$_{2024}$)	**Low price scenario**	**Median price scenario**	**High price scenario**
Photovoltaic	30,1 à 55,3	20,8 à 38,4	9,4 à 17,6
Onshore wind	21,6 à 27,6	6,1 à 7,6	-16,0 à -11,9
Offshore wind power	36,3	4,5	-35,2
Hydraulics	4,2	2,2	-0,2
Marine turbines	1	0,8	0,5
Biomethane	5,0 à 10,9	4,4 à 9,4	3,7 à 7,8
Total PPE 3	**98,2 à 135,2**	**38,7 à 62,9**	**-33,7 à -25,5**

Already committed before the PPE 3	114,3	90,1	60,1
Total	**212,5 à 249,6**	**128,8 à 152,9**	**26,4 à 34,6**

The following graphs show the annual change in these costs for the three price scenarios modelled:





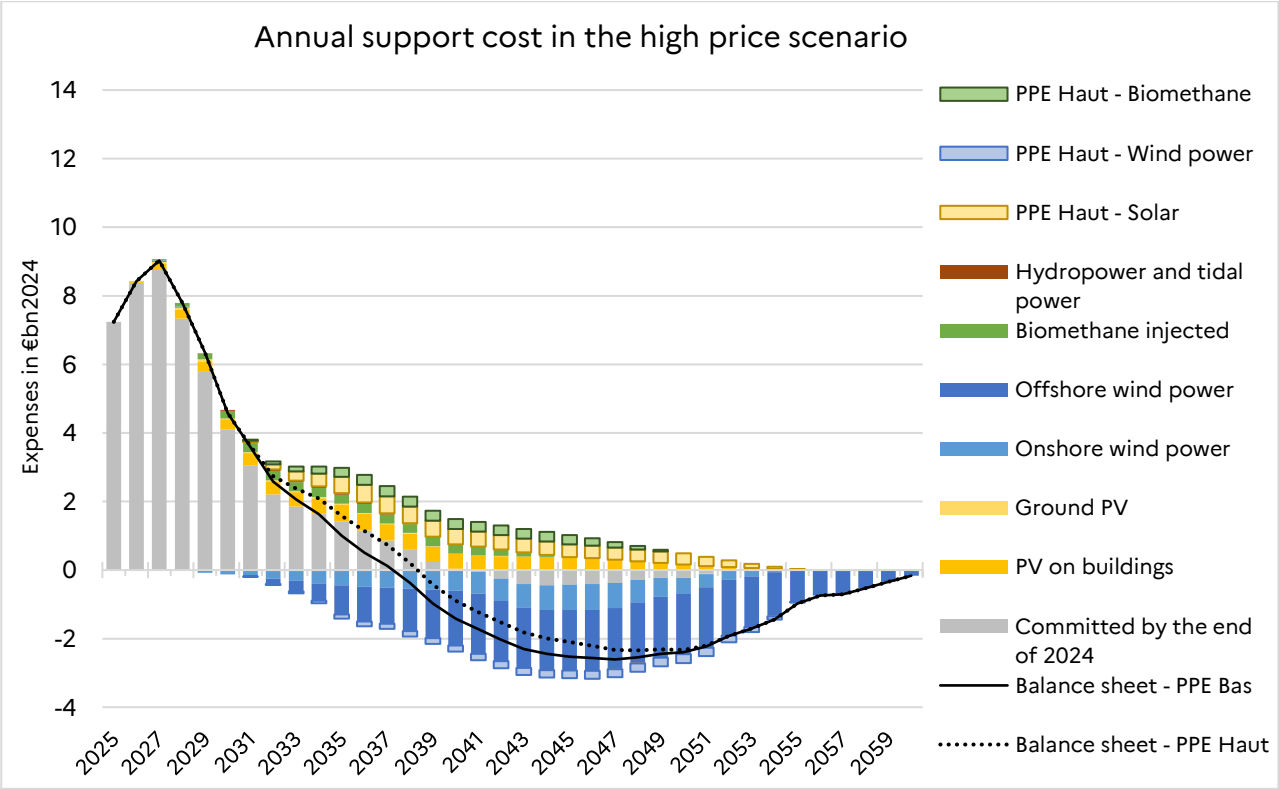


Figure34 . Annual support costs in the lowprice scenarios, medium and high

7. Involving local and regional authorities in energy planning and implementation

Local and regional authorities, with their expertise in territorial planning and sustainable development, occupy a central position in France's energy strategy. Under decentralisation laws such as MAPTAM[165] , LTECV[166] , and the lawNOTRe [167] , their ability to draw up and implement local strategies tailored to the specific characteristics of their regions has been strengthened. Local and regional authorities are at the heart of the energy transition, whether in terms of energy efficiency, renewable energies, storage or networks. The impetus provided by local and regional authorities is therefore essential if we are to respond effectively to today's energy and environmental challenges.

7.1. Territorial planning documents: strategic tools for achieving objectives

- **The regional plans for spatial planning, sustainable development and territorial equality (SRADDET)** [168]**and the master plan for the Île-de-France region (SDRIF**[169]give spatial planning its strategic role (prescriptive, integration of sectoral plans, co-construction).

The regional plans strengthen the role of the regional institution, which is invited to formulate a political vision of its priorities in terms of regional planning, sustainable development and environmental protection.

In terms of energy, the SRADDET must set medium and objectives long-termfor :

- energy management, particularly through energy renovation,
- the development and exploitation of renewable and recovered energies, in particular biogas production, wind power, biomass energy and agrivoltaics, where appropriate, by geographical area.

These objectives can be broken down into prescriptive rules with accompanying measures aimed at the other players involved in regional planning and sustainable development. As far as energy is concerned, the rules must at the very least cover measures to encourage the development of renewable energies and be consistent with the measures relating to the planning of waste included in the SRADDET (or PRPGD, depending on the region), particularly with regard to CSR heating plants and waste-to-energy plants.

165 Act no. 2014-58 of 27 January 2014 on the modernisation of territorial public action and the affirmation of metropolises, known as the "MAPTAM Act", aims to reform territorial organisation by strengthening metropolises and redefining the powers of authorities.

166 Law 2015-992 of 17 August 2015 on the energy transition for green growth, known as the 'LTECV', amends several articles of the Energy Code (articles L. 100-1, L. 100-2, and L. 100-4), and aims to strengthen the role of local authorities in mobilising their territories for the energy transition. It also reaffirms the role of the region as the leader in energy efficiency. The law also stipulates that territorial climate-air-energy plans (PCAETs) must be refocused at the inter-municipal level, with the aim of covering the entire territory.

167 Law no. 2015-991 of 7 August 2015 on the new territorial organisation of the Republic, known as the 'lawNOTRe ', aims to strengthen the powers of the regions and inter-municipalities while simplifying territorial organisation. It also reaffirms the role of the départements and communes in local management and territorial solidarity.

168 The SRADDET is defined in **articles L. 4251- 1 et seq. of the General Local Authorities Code**, supplemented by articles .**R. 4251-1 et seq. of the same code**

169 The SDRIF is defined in Articles L. 123-1 et seq. of the French Town Planning Code.

An indicative summary map illustrates the objectives of the SRADDET. In particular, this map can identify the acceleration zones defined in application of Article L. 141-5-3 of the Energy Code (see below).

In Ile-de-France, the mapping of acceleration zones for the installation of renewable energy production or storage facilities is included in a territorial master plan for the deployment of renewable energies, the SDRIF-e.

The SRADDETs and SRCAEs for the Ile-de-France region will have to be amended to bring them into line with the regional objectives of the EPP. Within six months of publication of the decree regionalising the objectives of the EPP, the region will initiate the procedure for amending the SRADDET or the SRCAE for the Ile-de-France region.

- **Territorial Climate Air Energy Plans (PCAET) , local operational tools in the fight against climate change and the energy transition.**[170]

Inter-municipal authorities with more than 20,000 inhabitants are required to draw up a PCAET. The PCAETs are the place where local authorities are invited to commit to implementing energy policy across their territory. The purpose of these plans is to define quantified targets for reducing greenhouse gas emissions, and to reduce energy dependency[171] . In particular, these plans must be compatible with the rules defined by the SRADDETs, especially as regards the development of renewable energies. They are based on a forward-looking study and a programme of actions involving all activities and players. The PCAET includes a map identifying the acceleration zones defined in application of article L. 141-5-3 of the Energy Code

Through the various regional plans (SRADDET, SDRIF and PCAET), the regions and inter-municipal authorities with more than 20,000 inhabitants are invitedto define their trajectory energy for 2050, taking into account the objectives of the SNBC, and to undertake the short-term actions needed to achieve it.

Regional government departments are working closely with local authorities to help them implement the EPP at local level. In particular, they indicate the trajectory to be followed by the region in the context of the knowledge reports and, where applicable, issues notes, prior to the drafting of planning documents.

Pursuant to Article 68 of Act no. 2019-1147 of 8 November 2019 , the State drew up [172]a report on the contribution of territorial climate-air-energy plans and regional plans for spatial planning,

---

[170] The territorial climate-air-energy plan (PCAET) is defined in **article L. 229-26 of the Environment Code**. **Articles R. 229-51 to R.229-56 of the Environment Code** set out the content of the plan, the scope of its objectives, and the procedures for drawing it up and reviewing it.

[171] Pursuant to L.229-26 of the Environment Code, the PCAET defines, for the territory of the public establishment or metropolis, "the programme of actions to be carried out in order, in particular, to improve energy efficiency, to develop electricity, gas and heat distribution networks in a coordinated manner, to increase the production of renewable energy, to develop the potential for recovered energy, including the potential for heat recovery from data centres, to develop energy storage and optimise energy distribution, to develop positive energy territories, [...]. This includes objectives relating to biogas production facilities". "This action programme may set targets for agrivoltaic installations as defined in Article L. 314-36 of the Energy Code.

172 Article 68 of Act no. 2019-1147 of 8 November 2019 on energy and climate, states that *"Within two years of the promulgation of this Act, the Government shall submit to Parliament a report on the contribution of territorial climate-air-energy plans and regional plans for planning, sustainable development and territorial equality to ecological and energy transition policies. This report includes an assessment of the support provided by the State for the implementation of territorial climate-air-energy plans and regional plans for spatial planning, sustainable development and territorial equality. In particular, this report compares this contribution with the national objectives and guidelines set out in the multi-annual energy*

sustainable development and equality to ecological and energy transition policies. This report was submitted to Parliament on 11 April 2022. In terms of energy, it shows that :

- For renewable and recovered energies, the SRADDETs set overall targets, taking up or slightly improving on the general national objective of the PPE2, which aims to achieve a share of renewable energies in gross final energy consumption of "at least 33%" by 2030.
- The majority of SRADDETs generally present targets for increasing the production of renewable energy, by sector and detailed over time. Only certain sectors are not systematically given targets, such as high-temperature geothermal energy, liquid biomass, environmental heat (heat pumps), waste heat recovery and waste (primary energy recovery).

However, the targets for "covering" energy consumption by renewable energy production vary somewhat from one SRADDET to another.

- **Through its town planning powers and the development of its Local Town Planning Scheme (PLU), the local authority also has an additional tool at its disposal to orchestrate the development of renewable energies (on a municipal or inter-municipal scaleRE), the coordination of energy networks, and the improvement of the energy efficiency of future buildings, .**
- **Lastly, the master plans enrich and strengthen this planning dynamic supported by the local authorities.**

By adopting energy master plans (SDE) or heating network master plans (SDRCU), local authorities are also demonstrating their proactive commitment to meeting today's energy challenges. These strategic tools, required by the Energy-Climate Act for heating networks commissioned between 1 January 2009 and 31 December 2019, underline the key role played by local authorities in regional energy planning. By mobilising these planning levers, local authorities are asserting themselves as key players in the energy transition, combining a long-term vision with concrete action to optimise the sustainable management of energy resources. In the same way, mobility plans, master plans for cycling facilities and master plans for the deployment of IRVEs are all tools available to local authorities that are key to the energy transition in mobility within their areas (see SDMP in appendix 1).

7.2. Reinforcing the key role of local and regional authorities in planning the development of renewable energies and in their actions to promote energy efficiency

Through the policies they can implement at local level, **the links they form with a wide range of players and the funding they can provide**, local authorities and their groupings have a number of levers at their disposal when it comes to the ecological and energy transition. Through their direct powers, local authorities can, for example, take action to develop renewable energies, recycled heat and cooling, upgrade energy networks (as "energy distribution organising authorities" and owners of electricity networks), or take concrete action to decarbonise transport and buildings in their areas. **Accelerating the energy transition will require continued strong involvement of local and regional**

programme and the national low-carbon strategy. This report was submitted to Parliament on 11 April 2022. https://ecologie-preprod.

authorities, particularly in terms of planning, and improved local governance around energy efficiency projects and actions.

- **Planning renewable energies**

To ensure the success of France's energy policy, the development of renewable energies needs to be co-constructed with the regions. Recent legislative changes - **the 2021 Climate and Resilience Act (article 83) and the 2023 Renewable Energy Production Acceleration Act (article 15) - have strengthened the key role of local and regional authorities**, and in particular the introduction of bottom-up planning for onshore renewable energies in France, to be carried out by elected representatives

Following consultation with their constituents, local authorities are invited to define acceleration zones where they would like to see renewable energy projects set up as a matter of priority. These acceleration zones can cover all types of renewable energy: photovoltaic, solar thermal, wind, biogas, geothermal, etc. All regions will be able to customise their acceleration zones according to the challenges facing their region, their potential for developing renewable energies and their political will. **The aim is for these zones to be sufficient to achieve the national and regional targets set out in the EPP**

The potential data made available by the State and the acceleration zones identified by the local authorities will serve as a basis for transposing the measures of the European " directiveRED III", which requires Member States to map the renewable energy potential needed to achieve their renewable energy development targets. Within these zones, **"reinforced" acceleration zones will have to be identified, which will be subject to a strategic environmental assessment, in order to benefit from gains in terms of project appraisal times.**

Focus: The regional dimension of the EPP and the Regional Energy Committees

Article 83 of the 2021 "Climate & Resilience" Act states that regional targets for the development of renewable energies will be established by decree for mainland metropolitan France as from the publication of the present EPP, after consultation with the regional councils concerned, to contribute to the objectives of the national EPP (article L 141-5-1 of the Energy Code). **These objectives will take into account the regional renewable and recovered energy potential that can be mobilised.**

With a view to defining these regionalised renewable energy development targets for the PPE 3, **the Minister responsible for energy will ask the regional energy committee for each region located in mainland France to draw up a proposal for regional renewable energy development targets for the region**. On expiry of a period of two months from the date of the request, the regional committee's proposal is deemed to have been drawn up.

Within six months of the publication of the decree on the regionalised objectives of the EPP, **the region will initiate the procedure for amending the SRADDET to make the plan compatible.**

A common method and indicators for monitoring the , shared between the regions and the State as well as between local authorities in the same region, **deployment and implementation of regional renewable energy development targetswill also be defined** in accordance with procedures laid down by decree.

The Regional Energy Committee (article L 141-5-2 of the Energy Code) is responsible for :

- Promote consultation, particularly with local and regional authorities, on energy-related issues within the region;

- Propose regional targets to the Minister for Energy, in line with the Multiannual Energy Programme.
- issue an opinion on the sufficiency of acceleration zones to enable the regionalised objectives of the EPP for the development of each type of renewable energy to be achieved .[173]

It can also debate and issue opinions on all issues relating to energy, energy storage and hydrogen that have an impact on the region. It is also involved in drawing up the energy section of regional plans (SRADDET, SDRIF).

In addition, the recast of the **Energy Efficiency Directive (DEE, 2023/1791/EU) requires local authorities and their groupings with more than 45,000 inhabitants to draw up local heating and cooling plans**. At this stage, it is envisaged that these plans will be integrated into the territorial climate air energy plans (PCAET), so as not to duplicate the documents that need to be produced by local authorities and their groupings.

➢ **Promoting energy efficiency**

The transposition of the Energy Efficiency Directive (EED, 2023/1791/EU) will require local authorities and their groupings to contribute to achieving the following national objectives:

- Cumulative reduction in the final energy consumption of public bodies by 1.9% per year, compared with their energy consumption in 2021 (Article 5 of the EED);
- Renovation to a high level of energy performance, each year, of 3% of the surface area of buildings over 250 m2 belonging to public bodies (article 6 of the DEE);
- Biannual update of the inventory of public buildings (article 6 of the DEE) ;

7.3. The State as a facilitator working alongside local authorities, providing support and funding

➢ **To support the ecological transition**

The French government has begun work on the territorialisation of ecological planning with the creation of regional Conferences of the Parties, known as **"regional COPs". The aim is to enable local and regional authorities to take ownership of the planning exercise and to grasp the challenges of the climate emergency**. The aim of these COPs is to enable local and regional authorities to take ownership of the ecological planning exercise, to take their share of the national objectives and to translate them into concrete projects at the level of each citizen's catchment area. At the end of these months of debate, **regional roadmaps will have to be drawn up.** These will set out the **objectives for 2030, as well as the practical means that** each region plans to use to achieve them. This shared approach to ecological planning should ensure that the objectives are effectively achieved at national level.

[173] Initial opinions on the adequacy of the acceleration zones have already been issued on the basis of the first exercises in which the communes reported their zones, compared with other regionalised objectives, in particular the SRADDET objectives, pending publication of the EPP 3 and the decree on the regionalised objectives of the EPP 3 in 2025.

In this context, the CRTE, now called "contracts for the success of the ecological transition", complete the approach by integrating the concrete projects resulting from the regional COPs. They offer **a simplified framework for contractualisation between local authorities and the State, becoming an effective tool for the detailed implementation of this territorial ecological planning.**

ACTION TER.1

CONTINUING TO PROVIDE SUPPORT AND FUNDING FOR THE ECOLOGICAL TRANSITION

- **Continuation of actions supported by the Green Fund** created in 2023 and dedicated to the ecological transition, which supports actions in the energy field (renovation of public buildings, engineering support, etc.).
- **Continue the work of the regional COPs.**
- **Continue to support local authorities in drawing up CRTEs.**
- **Facilitate access to the engineering needs of local authorities** by better coordinating the services offered by operators (ANCT, ADEME, ANAH, ANRU, CEREMA, etc.).
- **The launch of the "Mon Espace Collectivité" platform,** a tailor-made support service for local authority projects, bringing together local authorities and the State in a single location to speed up projects and their impact on the region.

➢ **<u>To support the development of renewable energies</u>**

To help local councillors take full advantage of the diversity of renewable energy sources and their positive spin-offs, the government is mobilising all its networks and those of its operators, with the aim of facilitating the process for local authorities. From now on, local authorities will have **a dedicated point of contact in the form of a prefectoral referent for the appraisal of renewable energy and industrial projects required for the energy transition**.

As part of this approach to facilitating the planning of renewable energies**, the government is making a number of operational tools available:**

- **the map portal for renewable energies,** enabling you to visualise and analyse the issues to be taken into account in the development of renewable energies
- ADEME fact sheets on these energies for local elected representatives
- a network of elected representatives able to act as relays in the regions

ACTION TER.2

ACCELERATING AND PLANNING THE DEVELOPMENT OF RENEWABLE ENERGIES

- **Continue to support the Regional Energy Committees** in defining a proposal for a harmonised method for regionalising the national targets for the development of renewable energies, which will be a priority in the implementation of the EPP 3.
- **Continue to develop acceleration zones and the mapping portal** provided by the government to identify these zones. Develop it into a territorial energy dashboard for local authorities.
- **Mobilise and strengthen the Heat Fund** to support the expected trajectory in the development of renewable heat.

- **Encourage municipalities and inter-municipal bodies that** do not have heating networks but have the potential to deploy them **to carry out feasibility studies.**
- **Strengthen local initiatives by extending the use of renewable heat coordinators**, at least one in each region, to support the projects of local authorities, businesses, etc.
- **Step up efforts to create heating networks** by providing personalised support based on new tools and by supporting renewable heating projects for private individuals as part of France Rénov'.
- **Promote the development of biomethane** by encouraging local and regional authorities to use the guarantees of origin issued by the facilities on their territory to certify the local and renewable origin of the gas consumed (as part of the biogas GO auctions, local and regional authorities can benefit free of charge from the GOs issued by the facilities located on their territory).

➢ **<u>To accelerate the reduction in energy consumption</u>**

In addition, the government has recently significantly increased the resources dedicated to funding and supporting local authorities in engineering actions aimed at reducing consumption, particularly those led by local authorities. This action should be continued.

ACTION TER.3

SUPPORTING ENERGY EFFICIENCY INITIATIVES

- **Mobilisation of CEE**[174] to support initiatives by local authorities and their groupings.
- **The Green Fund**, with a budget of €1.15 billion for 2025, is designed to help local authorities make the ecological transition , in particular by supporting the energy renovation of local public buildings and financing engineering support .[175]
- **The ACTEE+ programme** (Action des Collectivités Territoriales pour l'Efficacité Energétique), with a budget of €220 million up to the end of 2026, aims to develop energy efficiency projects for buildings through :
    - technical and organisational support for local authorities, including a support unit staffed by experts, a resource centre with standard specifications that can be used directly by local authorities, guides, training and digital analysis tools;
    - co-financing of support and project management for the renovation of local authority public buildings and public lighting.
- **The "Heating for collective residential and tertiary sector buildings" grant** encourages the connection of buildings to heating networks or the installation of a low-carbon heating system .[176]
- Under the supervision of Anah, ensure the roll-out of the new territorial pact between the State and local authorities for the roll-out of the **France public housing renovation serviceRénov'** , in particular by guaranteeing continued funding for household information and advice centres.

[174] The standardised sheets can be used for building renovation projects as well as the CEE programmes, the catalogue of which is available at this link: https://www.ecologie.gouv.fr/politiques-publiques/cee-programmes-daccompagnement

[175] Press release announcing the continuation of the Green Fund until 2027.

[176] Source : https://www.ecologie.gouv.fr/politiques-publiques/coup-pouce-chauffage-batiments-residentiels-collectifs-tertiaires

In addition, the government will step up its support for local authorities in transposing and implementing the Energy Efficiency Directive (DEE, 2023/1791/EU).

- **To support the transition in modes of transport**

The French government has also stepped up its efforts to promote clean mobility and modal shift through various programmes and plans:

ACTION TER.4

FINANCING LOW-CARBON SOFT MOBILITY AND ENCOURAGING MODAL SHIFT

- The ADVENIR programme (Support for the Development of Electric Vehicles through New Charging Infrastructures), to which an additional €200 million will be added at the end of 2023 and which will run until the end of 2027, aims to finance new infrastructure for private use in collective housing, on-street charging points and depot charging points for heavy goods vehicles;

- The ALVEOLE + and AVELO 2 and 3 programmes, with funding of €28.9m, €25m and €37m respectively, are designed to finance the installation of equipped or secure cycle spaces and to support sparsely populated areas in the planning, experimentation and management of their cycling policies, in order to develop the use of bicycles as a means of daily travel;

- In 2025, will be refocused on the ecological bonus for the purchase of a private electric car and the retrofit bonus. Local authorities are eligible for the electric retrofit bonus, as are legal entities**budgetary aid for the purchase of low-polluting vehicles** private . To support their electrification, the acquisition of new electric heavy goods vehicles (HGVs, buses, coaches), quadricycles and light vehicles (passenger cars and vans) is supported in 2025 by standardised operation sheets, financed by energy saving certificates, for which local authorities are eligible.

- Cycling plan and carpooling plan (see Annex on the Clean Mobility Development Strategy).

8. Appendix 1: Clean mobility development strategy

See separate document on the Clean Mobility Development Strategy (CMDS).

9. Appendix 2: Ponant islands not interconnected with the mainland

Article L. 141-5 of the Energy Code specifies in its IV ""The areas not interconnected to the mainland metropolitan network, with the exception of Saint-Martin, Saint-Barthélemy and the areas mentioned in I of this article, are the subject of a section appended to the multiannual energy programme mentioned in article L. 141-1, in accordance with the procedures laid down by the decree mentioned in article L. 141-6".". The year-round, non-interconnected islands of Ponant, i.e. Ushant, Molène, Sein and Chausey, are therefore covered by a section appended to the national multiannual energy plan covering 2025-2030 and 2031-2035.

These islands have a particular energy configuration since :

- They represent 1,900 customers.
- In terms of mobility, Chausey, Molène and Sein are islands with virtually no vehicles, as there are only 3 or 4 vehicles for emergency services, passenger transport and rubbish collection. The situation is different on Ushant, where there are around 400 vehicles all year round, doubling in the summer;
- Heating is mainly electric, with 72% of homes on Molène, 73% on Ouessant, 80% on Sein and 100% on Chausey. Fuel oil is little used, with 23% on Molène (28 homes), 20% on Ouessant (90 homes) and 10% on Sein (13 homes). The other homes are heated with wood.

The electricity dimension is therefore very important in these territories, especially as these islands are not connected to the mainland electricity grid and therefore have to produce their own electricity.

It should be pointed out that the Ponant islands, which are not connected to the mainland grid, are recognised within the Brittany region as pilot areas for the energy transition, where experiments can be carried out.

The unconnected islands should be demonstrators in the development of an autonomous electricity network using renewable energies, storage and smart grids to regulate consumption.

9.1. Review at 31 December 2023 of actions undertaken since 2019

At 31 December 2023, the results of the demand-side management actions undertaken since 2019 through the programme Renov'îles were positive and encouraging: 3,254 MWh of electricity had been saved, representing the equivalent of 2,530 t eq CO2. In partnership with the Association des Iles du Ponant, this programme helps local authorities and their residents to make energy savings:

- LED street lighting
- Thermal renovation of buildings
- Distribution of LEDs to private individuals
- Campaign to replace energy-guzzling household appliances.

In 2023, the electricity mix will still be largely carbon-based:

- 92% in Ushant
- 88% in Sein
- 99% in Molène

- 100% in Chausey

The electricity network operator is gradually deploying battery storage facilities and intelligent control systems across all the islands, coordinating the production of different energies and balancing electricity supply and demand by maximising the proportion of renewable energy.

9.2. The specific framework for equalisation in non-interconnected areas

Because of the constraints specific to the ZNIs, electricity production costs are much higher there than in mainland France. As a result, regulated sales tariffs are insufficient to remunerate electricity production in these zones.

To ensure national tariff equalisation, compensation for additional costs is necessary. This is calculated by the Commission de régulation de l'énergie (CRE) and included in the State budget. In 2023, the production cost for the four islands amounted to €4.4 million, including €2.9 million for fuel, while production revenue totalled €1.2 million, representing an additional production cost of €3.2 million.

9.3. Ushant

9.3.1. Situation in 2023

With its 15.58 km², 853 inhabitants and 1,028 subscribers, Ouessant consumed 6.55 GWh in 2023. Residential consumption accounts for 69% of consumption and is explained by the importance of electric heating. In summer, tourist numbers create a peak in consumption at midday, linked to catering.

Since 2018, consumption has been relatively stable:

Ushant	Consumption in MWh	Share of renewable energy
2018	6 690	0%
2019	6 816	1.1 %
2020	6 451	1.2 %
2021	7 087	1.4 %
2022	6 582	5.2 %
2023	6 555	7.6 %

The production and storage fleet breaks down as follows:

Ushant	Power (kW)	Energy in 2023 (MWh)
Thermal	4450	6 057
Photovoltaic	180	209
Marine turbines	250	289

The development of renewable energies on Ushant has enabled us to save 110 tonnes of light fuel oil and not produce 383 tonnes of CO_2[177] in 2023.

There is no denying that renewable energies account for a small proportion of the total, and that this comes mainly from PV installations. The Phares project, led by AKUO, which was based on PV, onshore wind power, tidal power, storage and an energy management system, did not see the light of day.

In addition, EDF SEI and the Association des Iles du Ponant have offered users on the island of Ushant the opportunity to take part in an experiment to shift off-peak hours using the possibilities offered by the Linky meter, at times designed to encourage the use of renewable energies:

- Fixed meridian off-peak times (to take advantage of solar energy and low consumption on the island)
- Mobile" night-time off-peak hours, predefined in advance, changing time slots each day according to the tide (cf. tidal turbine).

The trial ran from 1 July 2022 to 31 December 2022 and involved around forty participants. It demonstrated the feasibility of implementing mobile off-peak hours. In addition, thanks to the displaced consumption, it was possible to avoid capping the production of the tidal turbine for around 25 hours during the experiment. Optimisation levers have been identified to further improve this result. At the end of the experiment, because of questions about the long-term viability of the Ushant tidal turbine, work on generalising the system was suspended.

In terms of demand management, the results are as follows:

Ushant	Number of applications submitted	MWh Cumac saved
2019	20	346
2020	16	409
2021	53	839
2022	26	487
2023	23	457
Total	138	2 538

On Ushant, 61% of the demand-side management operations were carried out in primary residences and 26% in secondary residences, focusing mainly on :

- Roof insulation (49 cases),
- Installing an independent wood-burning appliance (46 files)
- Changing windows (38 files)
- Wall insulation (32 files)

9.3.2. Targets for the periods 2025-2030 and 2031-2035

Objectives	2025	2030	2035

[177] Calculation based on the amount avoided by unburned fuel oil

Controlling demand	0	2,430 MWh[178]	4,860 MWh[2]
Photovoltaic	180 kW	1,000 kW	3,000 kW
Marine turbines	250 kW	2,000 kW	2,000 kW
Wind	0	0	1,500 kW
Biomass	0	0	4,450 kW
Share of renewable energy in the mix	8 %	50 %	100 %

In terms of demand management, the programme will continue Rénov'Ile in partnership with AIP, with the aim of 27 projects and 486 MWh avoided per year (all energy sources combined).

In 2030, the 250 kW D10 tidal turbine will be replaced by two tidal turbines of 1,000 kW each, in accordance with the authorisations granted under the former "Phares" programme. This should enable renewable energies to account for around 50% of the electricity mix.

In addition, the notion of demand flexibility will become essential in order to also enable the power of peak consumption to be controlled by encouraging consumption to be shifted to the cheapest times. Indeed, following the HC marées experiment, which highlighted the value of optimised positioning of consumption, the aim is to continue with the development of flexibility (HC placement, control of electric mobility recharging, connected home with use of the smart meter, etc.) making it possible to optimise the placement of consumption at the most favourable times.

In addition, the conversion of EDF's Ushant power station to bioliquids (B100) is being studied to replace the use of fuel oil in the generators. Biomass, and in particular the B100 biofuel currently being tested on Molène, will complement the electricity mix to achieve 100% renewable energy by 2035.

If the trajectory of substantial development towards energy autonomy proves unattainable by 2035, a study of the technical feasibility and cost of laying a cable between the mainland and Ushant could be relevant.

Finally, in terms of mobility, two electric vehicle charging points have been installed on Ushant, but the installed capacity is greater than the demand.

9.4. Molène

9.4.1. Situation in 2023

With its 0.72 km², 157 inhabitants and 313 subscribers, Molène consumed 1,167 GWh in 2022. Residential consumption accounts for 69% of consumption, with a peak between 8pm and 11pm, between dinner time and the time when water heaters are switched on. Molène has two special features:

- Comparable electricity consumption between the off-season and the summer, due to lower tourist numbers than on the other islands;
- Greater variations in daily consumption than on other islands.

Since 2018, consumption has been relatively stable:

Molène	Consumption in MWh	Share of renewable energy

[178] MWh avoided compared to 2025

2018	1 269	0 %
2019	1 247	0 %
2020	1 223	0 %
2021	1 307	0 %
2022	1 167	0.4 %
2023	1 149	0.12 %

The production and storage fleet breaks down as follows:

Molène	Power (kW)	Energy in 2023 (MWh)
Thermal	832	1147
Photovoltaic	9	1.3

A PV installation on the Impluvium is currently being developed with the aim of commissioning in 2025 (hydrological constraints have been encountered, ARS approval required).

In terms of demand management, the results are as follows:

Molène	Number of applications submitted	MWh Cumac saved
2019	14	198
2020	2	8
2021	5	81
2022	6	50
2023	2	16
Total	29	353

On Molène, 31% of demand-side management operations were carried out in primary residences and 45% in secondary residences, and mainly concerned :

- Roof insulation (15 files),
- Changing windows (8 files)

9.4.2. Targets for the periods 2025-2030 and 2031-2035

Objectives	2025	2030	2035
Controlling demand		300 MWh[179]	600 MWh[3]
PV	9 kW	1,000 kW	1,000 kW
Wind	0	100 kW	100 kW

[179] MWh avoided compared to 2025

Biomass	0	850 kW	850 kW
Share of renewable energy in the mix	0 %	100%	100%

In terms of demand management, the programme will continue Rénov'Ile in partnership with AIP, with the aim of carrying out 6 projects and avoiding 60 MWh per year (all energy sources combined)

In addition, a project to convert EDF's Molène power station to bioliquids (B100) is currently being tested to replace the use of fuel oil in generator sets. Biomass, and in particular B100 biofuel, will complement the electricity mix to achieve 100% renewable energy by 2035.

The network operator will also study the possibility of developing flexibilities to optimise the positioning of consumption in order to maximise the insertion of renewable energies and the stability of the electricity system.

9.5. Breast

9.5.1. Situation in 2023

With its 0.58 km^2, 257 inhabitants and 383 subscribers, Sein consumed 1,190 GWh in 2022. Residential consumption accounts for 64% of consumption and is explained by the importance of electric heating, with a peak between 8pm and 11pm, between dinner time and the time when water heaters are switched on. In summer, the large number of tourists creates a peak in consumption at midday, linked to catering.

Since 2018, consumption has been relatively stable:

Breast	Consumption in MWh	Share of renewable energy
2018	1477	8,8 %
2019	1461	9,9 %
2020	1245	11,5 %
2021	1529	8,9 %
2022	1438	12,0 %
2023	1 385	11.7 %

The production and storage fleet breaks down as follows:

Breast	Power (kW)	Energy in 2023 (MWh)
Thermal	840	1 223
Photovoltaic	136	162
Battery	297	330

The development of renewable energies at Sein has saved 36 tonnes of light fuel oil and 125 tonnes of CO_2[180] by 2023.

In terms of demand management, the results are as follows:

Breast	Number of applications submitted	MWh Cumac saved
2019	5	33
2020	7	55
2021	8	81
2022	7	75
2023	10	119
Total	37	363

In Sein, 46% of the demand-side management operations were carried out in primary residences and 56% in secondary residences:

- Installation of an independent wood-burning appliance (24 files)
- Wall insulation (7 dossiers)
- Roof insulation (5 files),
- Changing windows (4 files)

9.5.2 Objectives for the periods 2025-2030 and 2031-2035

Objectives	2025	2030	2035

[180] Calculation based on the amount avoided by unburned fuel oil

Controlling demand		350 MWh[181]	700 MWh[5]
PV	136 kW	200 kW	250 kW
Wind	0	250 kW	250 kW
Biomass	0 kW	0 kW	900 kW
Share of renewable energy in the mix	11.7%	50 %	100 %

In terms of demand management, the programme will be continued Rénov'Ile in partnership with AIP, with the aim of 7 projects and 70 MWh avoided per year (all energy sources combined).

A wind turbine project is being developed by SPV Enez Sun Energie (250 kW).

In addition, the conversion of EDF's Sein power station to bioliquids (B100) is being studied to replace the use of fuel oil in the generators. Biomass, and in particular the B100 biofuel currently being tested on Molène, will complement the electricity mix to achieve 100% renewable energy by 2035.

The network operator will study the opportunity to develop flexibilities in order to optimise the positioning of consumption to maximise the insertion of renewable energies and the stability of the electricity system.

9.6. Chausey

9.6.1. Situation in 2023

9.6.1.1. Characteristics of the island

Chausey (0.65 km^2) refers to both the Grande Île (0.45 km^2) and the archipelago.

The island is subject to significant peaks in visitor numbers during the summer holidays and high tide periods.

This island has a particular energy configuration since :

- It represents 122 customers connected to the networkelectricity .
- In terms of mobility, Chausey is an island with virtually no vehicles, with just 3 or 4 light vehicles for emergency services, transporting people with reduced mobility and rubbish collection.
- The heating system is 100% electric. Fuel oil is not used for heating. Some homes have an open fireplace, which is used to supplement electric heating.

Electricity is therefore a key issue for the region, especially as the island cannot be connected to the mainland electricity grid and must therefore produce its own electricity.

9.6.1.2. Balance sheet for electricity generation

Most of the electricity generated is thermal, provided by 4 generators with a combined output of 560 kW. Stable electricity production over the years has made it possible to satisfy 532 MWh of consumption in 2023.

[181] MWh avoided compared to 2025

Since 20 June 2024, 2 rooftop photovoltaic installations have been in operation: one on the ASCEE association's gîtes with a capacity of 22 kWp and the other on the thermal power plant with a capacity of 14 kWp.

In 2024, the year in which the photovoltaic installation is commissioned, the ratio of renewable electricity production to the island's electricity consumption is around 2%. By 2025, this ratio should have risen to around 5% (full year of PV production).

9.6.1.3. Electricity consumption

Since 2018, consumption has been relatively stable:

Chausey	Consumption in MWh	Share of renewable energy in the electricity generation mix (%)
2018	502	0
2019	564	0
2020	531	0
2021	538	0
2022	507	0
2023	532	0
2024	500 or so	2

In 2020, the SDEM carried out a study aimed at :

- draw up a list of the methods and tools available to achieve the objectives set by the PPE2 for the island of Chausey, particularly with regard to reducing electricity consumption
- prioritise these proposals for action
- prioritise the scenarios for mobilising sources of energy demand management potential

The levers for action identified in the study are divided into 3 areas:

- Save electricity by reducing consumption at source and working on equipment efficiency.
- Substitute another energy source for electricity: for example, use wood energy for part of your heating needs.
- Make consumption more flexible by synchronising it with production constraints.

They concern 7 levers: starting up water heaters, public lighting, refrigeration appliances, LED bulbs, housing / Rénov'îles, flexibility, awareness-raising, wood energy, new radiators, DHW equipment .[182]

182 *Domestic hot water*

The actions taken have had only a very limited impact on energy consumption. As energy consumers on the island are not year-round residents, specific actions need to be implemented. The SDEM, in close collaboration with EDF-SEI, now plans to implement more targeted actions (large consumers, specific needs).

9.6.1.4. Flexibility - electricity storage

The grid operator, in conjunction with the SDEM, is planning to implement flexibility measures aimed in particular at shifting electricity consumption to match consumption as closely as possible when intermittent renewable energy sources are producing at their peak.

An intelligent power system management system designed to balance electricity supply and demand by maximising the renewable share has been operational since 2024. A dashboard displays consumption levels and the origin of generation (thermal or in real time.renewable)

9.6.2. Targets for the periods 2025-2030 and 2031-2035

Objectives	2024	2030	2035
Reducing electricity consumption (reference : 2019)year[183]	0	3 à 5 %	4 à 6 %
Reduction in fossil-fired electricity generation (reference : 2019)year[184]	0	27 %	100 %
Installed photovoltaic capacity (kWp installed)	36	150	500
Electricity storage (power in kW)	0	400	400
Electricity storage (producible in kWh)	0	800	800
Share of renewable energy (PV ratio) / overall consumption	2 %	30,00 %	70,00 %

The development of photovoltaic power will have to take account of the need to protect the island's landscape, heritage and biodiversity.

It will therefore be necessary to optimise rooftop installations, particularly on public buildings.

The installation of additional ground-mounted panels will have to be limited in area and proportionate to achieving the targets set for 2035 (500kWp).

Compatibility with town planning documents must be ensured.

The development of this renewable electricity production will have to be accompanied by measures to reduce energy consumption (e.g. individual self-consumption installations, wood energy, insulation, etc.).

Eliminating the use of fossil fuels on the island could be achieved by importing biofuel to complement the production of renewable electricity. Biofuel could account for up to 30% of total consumption (depending on the amount of renewable energy produced).

Electricity production will have to be accompanied by the implementation of a storage system to regulate the operation of the thermal power station (shutdown during the day) and in line with productionrenewable energy .

183 *Reference year of the PPE 2 for the island.*

184 *Reference year of the PPE 2 for the island.*

10. Appendix 3: Summary table of actions planned under the PPE 3

Themes	Action reference	Action
Lower final energy consumption	CONSO.1	Giving priority to energy sobriety and efficiency
	ACTION CONSO.2	Reducing energy consumption in all sectors
	ACTION CONSO.3	Ensuring the long-term viability of the energy savings certificate scheme
Reducing fossil fuel consumption	ACTION CONSO.4	Reducing coal consumption
	ACTION CONSO.5	Reducing oil consumption
	ACTION CONSO.6	Reducing gas consumption
	ACTION CONSO. 7	Ensuring we meet our electrification targets
Renewable and recovered heat and cooling	ACTION CHALEUR.1	Providing financial support and backing for the development of thermal renewable energies
	ACTION CHALEUR.2	Setting up a long-term framework for the building heating market
	ACTION CHALEUR.3	Optimising the use of biomass to decarbonise heat more effectively
	ACTION CHALEUR.4	Implement the heat pump plan to produce 1 million heat pumps by 2027 and strengthen the sector
	HEAT ACTION.5	Implementing the national geothermal action plan
	ACTION CHALEUR.6	Develop and implement a national solar thermal action plan
	HEAT ACTION.7	Speeding up the roll-out of efficient heating and cooling networks
	HEAT ACTION.8	Accelerating the recovery of waste heat
	HEAT ACTION.9	Supporting the development of CSR heating plants
Liquid fuels	ACTION CARBURANT.1	Supporting the deployment of biofuels
Gas	ACTION GAZ.1	Supporting the deployment of renewable gas
	ACTION GAZ.2	Promoting the use of low-carbon hydrogen in industry in line with European ambitions.
	ACTION GAZ.3	Continuing to roll out hydrogen production, with priority given to areas close to major consumer centres
	ACTION GAZ.4	Anticipating the development of hydrogen infrastructures

Electricity	ELEC. ACTION 1	Update on the impact of climate change on the electricity system
	ACTION ENR ELEC.1	Continuing to support renewable energy industries
	ACTION ENR ELEC.2	Optimising public support schemes in the light of the need to control public spending
	ACTION ENR ELEC.3	Accelerate local renewable energy planning under the 2023 Renewable Energy Production Acceleration Act (APER)
	ACTION PV.1	Promote a balanced distribution of photovoltaics between large and small photovoltaic roofs, large and small ground-based power plants, as well as agrivoltaics.
	ACTION PV.2	Setting up gigafactories in France
	ACTION EOL TERR.1	Maintaining the pace of development of onshore wind power while maintaining high environmental quality
	ACTION ENER MARINES.1	Moving from a project-by-project development approach to overall planning for each seafront
	ACTION ENER MAR.2	Creating manufacturing and assembly centres in France
	ACTION HYDRO.1	Increase the hydroelectric capacity and flexibility of the concessionary fleet (including STEPs)
	ACTION AUTOCONSO.1	Make self-consumption part of the energy transition for the development of all types of renewable energies
	ACTION NUC.1	Continue to operate nuclear power reactors after 50 years and then 60 years, as long as all applicable safety requirements are met.
	ACTION NUC.2	Increase the available power of existing reactors and restore the highest levels of operational performance.
	ACTION NUC.3	Confirm the launch of the industrial programme for the construction of three pairs of epr2 reactors by EDF.
	ACTION NUC.4	Further study of a possible reinforcement of the nuclear power programme.
	ACTION NUC.5	Encourage the development of SMRs and small innovative reactors.
	ACTION NUC.6	Pursue the nuclear fuel reprocessing and recovery strategy and complete work on renewing downstream fuel cycle facilities.

	ACTION NUC.7	Define a new roadmap and begin work on closing the cycle and setting up a fleet of RNRs in France.
	ACTION NUC.8	Implement a European industrial process for the conversion and enrichment of reprocessed uranium.
	ACTION NUC.9	Maintaining a cutting-edge nuclear research capability across the full range of government nuclear policy priorities.
	ACTION THERM.1	Decarbonising the fossil fuel fleet
Security of supply, optimisation of the electricity system and development of networks	ACTION LOG PET 1	Monitor trends in the consumption of low-carbon fuels with a view to building up strategic stocks.
	ACTION LOG PET 2	Monitor the network of strategic stocks to ensure their distribution
	ACTION LOG PET 3	Supporting service stations in their transformation
	ACTION LOG PET 4	Monitor the network of service stations to anticipate the risk of white zones appearing
	ACTION APPRO ELEC.1	Pursue discussions and work on possible changes to or additions to the security of supply criterion, in conjunction with RTE, the CRE and at European level
	ACTION APPRO ELEC.2	Study the integration of the electrical power limitation device into the range of measures of the electricity network protection plan.
	ACTION APPRO ELEC.3	Continuing the analysis and work with all the players involved, RTE and Ademe, to identify objectives and measures relating to flexibilities and the future of the thermal fleet, particularly in line with the implementation of the electricity market reform.
	ACTION APPRO ELEC.4	Draw up a "plan for scaling up demand flexibilities" by strengthening the economic incentives to control and position consumption.
	ACTION APPRO ELEC.5	Adapting the regulatory and economic framework for the development of WWTPs
	ACTION APPRO ELEC.6	Consolidating the battery cell production industry
	ACTION APPRO ELEC.7	Continue to develop interconnections and set new targets
	ACTION APPRO U.1	Ensuring a secure supply of uranium
	ACTION BIOMAS.1	Balancing biomass supply and demand for the energy sector
Energy infrastructure and networks	ACTION CARB.1	Preparing the transformation of the liquid fuels network

	ACTION RES GAZ 1	Preparing the gas network for the drop in methane gas consumption
	ACTION RESELEC 1	Carry out the necessary adaptations to the transmission network by 2035, whatever the scenarios envisaged, and continue to implement long-term planning for the electricity network, through the ten-year transmission network development plan (SDDR) and the network development plans for the public distribution network operators
	ACTION RESELEC 2	Strengthen the tools for adjusting network operation to the growing proportion of non-controllable generation
	ACTION CARB ALT .1	Anticipating the deployment of charging points on major national roads
Socio-economic, industrial and consumer purchasing power issues and competitive energy prices	ACTION MAR.1	Giving long-term signals to trigger investment and guarantee access to competitive, low-carbon energy
	ACTION COST.1 :	Updating the assessment of the full costs of the ppe mix scenarios
	ACTION MAR.2	Maintain a competitive electricity price for businesses over the long term, particularly businesses electro-intensive exposed to international competition
	GPEC ACTIONS.1	Organising monitoring procedures
		Anticipating skills needs in conjunction with the sectors and ministries concerned
		Anticipating skills needs in conjunction with the sectors and ministries concerned
		Encourage the ongoing adaptation of training and certification schemes in conjunction with the industries and ministries concerned
		Contribute to coordinating the GPECs of the branches and industries in the field covered by the ppe, ensuring the intrinsic quality of the GPECs and their overall coherence.
		Monitor the roll-out of HR policies and encourage recruitment through targeted communication campaigns in conjunction with the branches and ministries concerned
		Encouraging partnerships and supporting businesses
Assessment of public resources devoted to	ACTION SOUTIEN ENR.1	Set up support systems tailored to the various challenges of developing renewable energies

achieving the objectives of the EPP		
Involving local authorities in energy planning and implementation	ACTION TER.1	Continuing to provide support and funding for the ecological transition
	ACTION TER.2	Accelerating and planning the development of renewable energies
	ACTION TER.3	Supporting energy efficiency initiatives
	ACTION TER.4	Financing low-carbon soft mobility and encouraging modal shift