MINISTÈRE
DE L'ÉCONOMIE,
DES FINANCES
ET DE LA SOUVERAINETÉ
INDUSTRIELLE ET NUMÉRIQUE

Liberté
Égalité
Fraternité

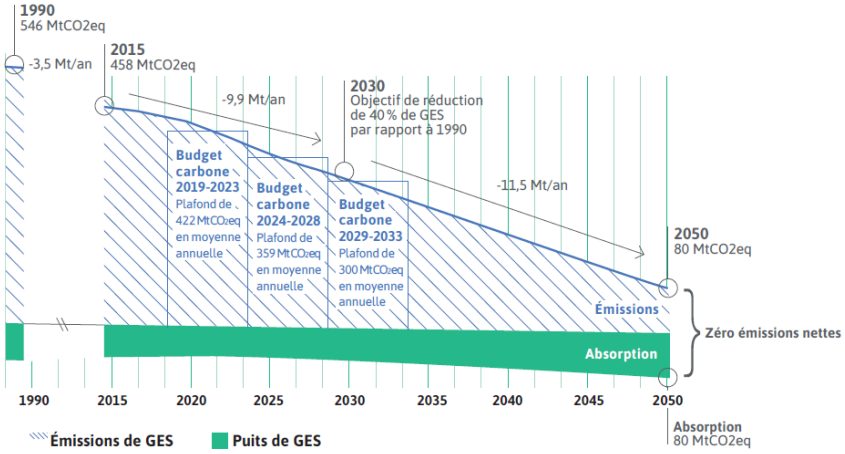
SECTORAL INTEGRATION IN FRANCE

REGULATORY FRAMEWORK AND STRATEGY

France's Plan for Net Zero Emissions

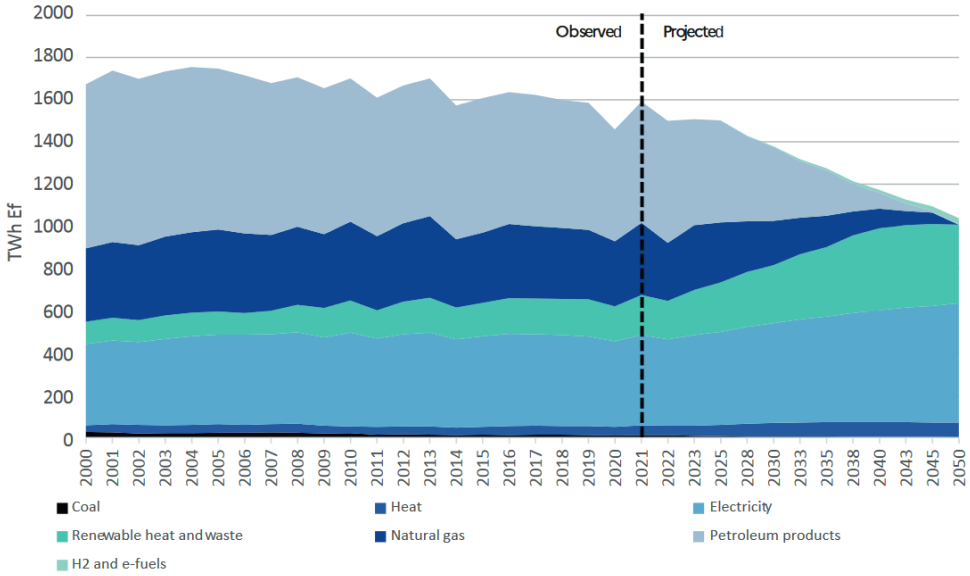
Strategy for Net Zero in 2050 (SNBC) + precise plan for the energy mix over the next 10 years (PPE).
Designed thanks to a thorough scientific effort, supported by RTE for the electricity sector modelling.

- Modelling, sector by sector, the impacts of potential public policies on the environment, economy, natural resources and energy.
- Full model integration with balancing checks (e.g. GHG emissions, electricity, biomass) allowing for an iterative improvement of the model.
- Finally: Definition of a planned trajectory to reach Net Zero in 2050, with carbon "budgets" every 5 years for each sector.



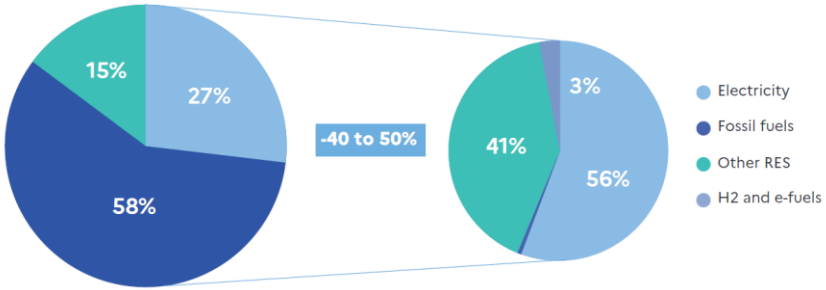
GHG emissions trajectory according to France's Low-carbon National Strategy (SNBC), defined in 2020 and currently being updated

France's Plan for Net Zero Emissions



In 2021 :
1611 TWh of energy consumption

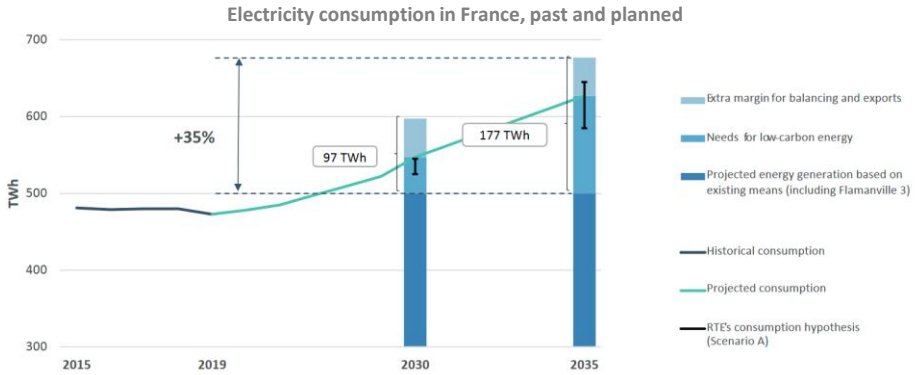
In 2050 :
~ **900** TWh of energy consumption



Final energy consumption in France, past and planned

France's Plan for Net Zero Emissions

- Transition toward clean energy sources in industry, transport, heating and agriculture
- Rapid development of renewable electricity generation
- Increasing nuclear production and new nuclear power plants from 2035
- Higher integration between energy carriers (electricity, renewable gases, heat, storage solutions)
- Energy efficiency
- Energy sobriety



INSTALLED CAPACITY (GW)	2022	2030	2035
SOLAR PV	15.9	54 to 60	75 to 100
ONSHORE WIND	20.6	33 to 35	40 to 45
OFFSHORE WIND	0.5	3.6	18

Future challenges for the power grid

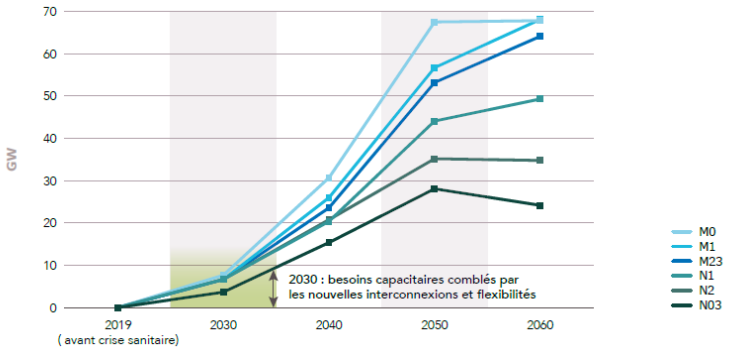
- Electricity generation becomes less dispatchable and predictable with the increased share of variable renewable production.

- Consumption will increase as well as peak demand, putting stress on the grid.

  (EVs charging, heat pumps, electrolysers…)

- At the same time, dispatchable generation with fossil fuels has to be reduced.

The power grid needs to become more flexible!



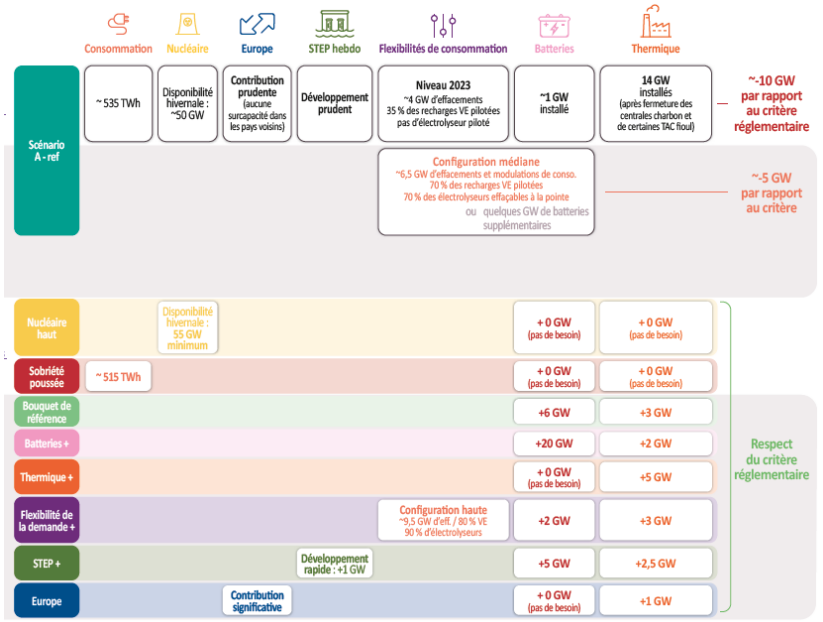
Additional flexible capacity needs, as estimated by RTE

The case for sectoral integration: decarbonising other sectors with electricity

- In end-use sectors, electricity will be either used directly or converted to other energy carriers for decarbonising. But it must be accompanied by increased efforts on sobriety and efficiency.

- In return, these new uses of electricity can provide flexibility to the grid (gas-to-power, vehicle-to-grid, heating and cooling…).

We need to think the energy system as a whole. Synergies can be leveraged.



RTE is evaluating the flexibility options to ensure security of supply of electricity by 2035.

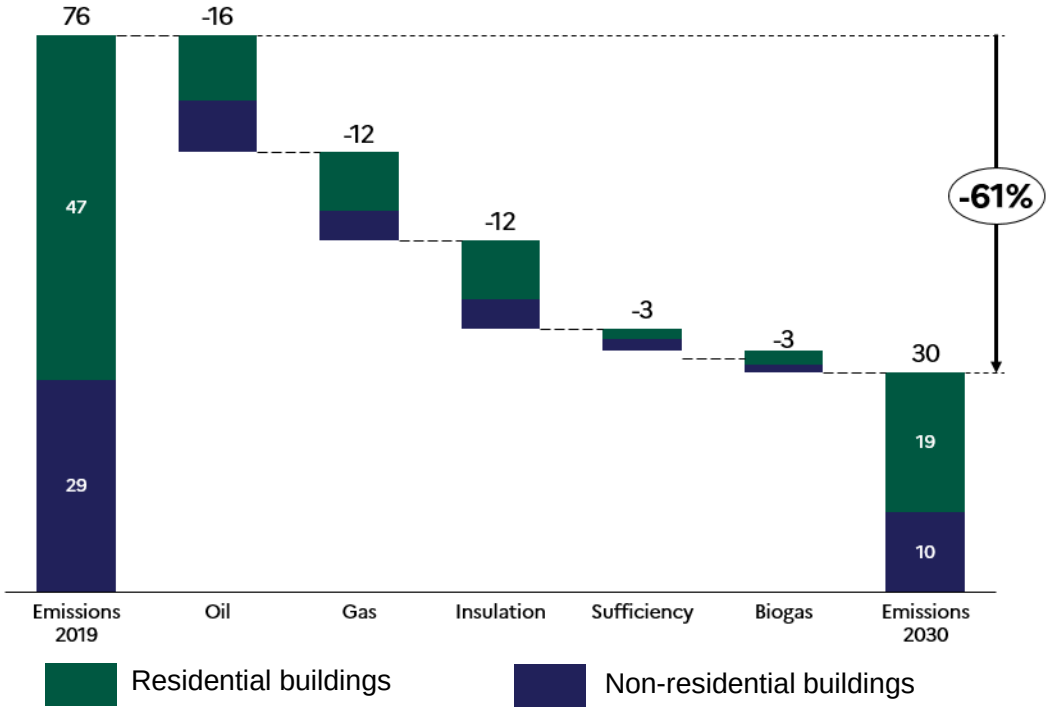
Decarbonising other sectors with electricity

- **Electricity for mobility:** development of electric vehicles:
  - Financial incentives (subsidies for vehicle changes)
  - Ban on new thermal cars in 2035 and complete exit from oil by 2045

- **Electricity for heating:** development of heat pumps:
  - Financial incentives (e.g. €4 billion allocated in 2024 to finance decarbonisation in the housing sector)
  - Ambitious targets: up to 120 TWh of heat produced with heat pumps in 2035

- **Clean hydrogen production through electrolysis**: decarbonisation of industry and transport

Example: housing sector



Main objectives :

- Replace 75% of oil boilers by 2030
- Replace 20% of gas boilers with heat pumps (incl. hybrid), district heating or to a lesser extent biomass
- Ambitious building insulation, prioritising the most efficient
- 15% of biogas in the gas network

Build and install 1 million heat pumps per year by 2027

France's National Hydrogen Strategy

This strategy, first set out in 2018 and updated in 2020 and 2024, aims to make France a pioneer of **low-carbon hydrogen** production.

€4 billion of public support for 1 GW capacity

6.5 GW by 2030
10 GW by 2035
of electrolysis capacity
(2.5 GW already secured)

Priorities

- ❑ Decarbonise industry and heavy-duty transport
- ❑ Development around industrial hubs
- ❑ Planification for the future hydrogen transmission network

30 to 35 TWh in 2030
50 to 65 TWh in 2050
Estimated electricity needs
Supplied with **technologically neutral solutions**

Hydrogen could provide flexibility to the grid through production modulation, thanks to storage (e.g. salt cavern)

Harvesting the potential of demand response

Demand flexibility will play a central role in meeting flexibility needs: consumption modulation in all sectors is key for the success for the transition.

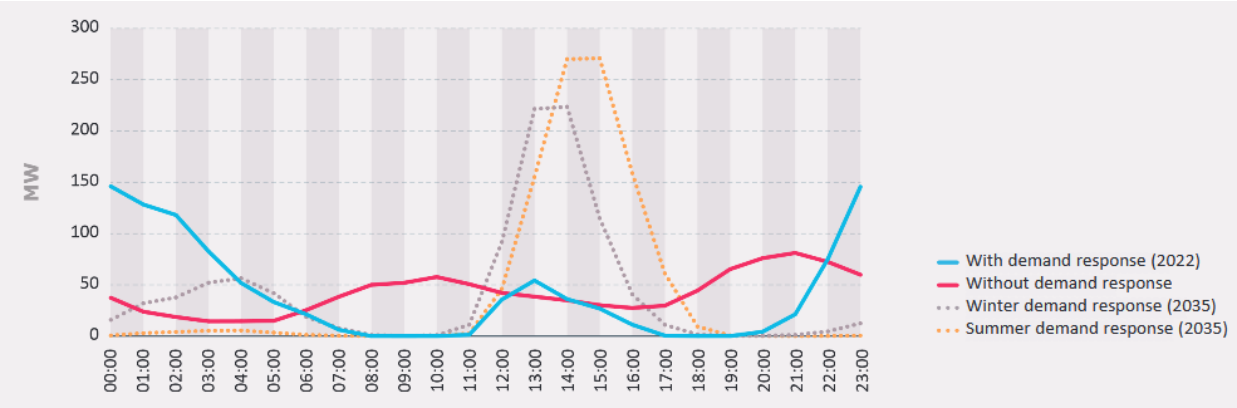
- Ambitious target for demand response: 6.5 GW by 2028.
- Financial incentives:
  - Valuation of demand response (balancing and NEBEF mechanisms…)
  - €1.3 billion of State aid provided through a call for tenders last year.
- Great potential:
  - Smart meter (Linky) near-universal deployment (95%)
  - Long tradition in France (peak/off-peak hours signal), see next slide
  - New opportunities, e.g. EVs charging, electrolysers

By shifting consumption toward periods of cheap and fossil-free electricity generation, **demand response is both economically and environmentally optimal**.

Case study: water boilers

10 GW of flexibility

Historical use of demand response in France



Evolution of the water boiler demand response for a normalised consumption profile (RTE)

Evolutions for 2035:

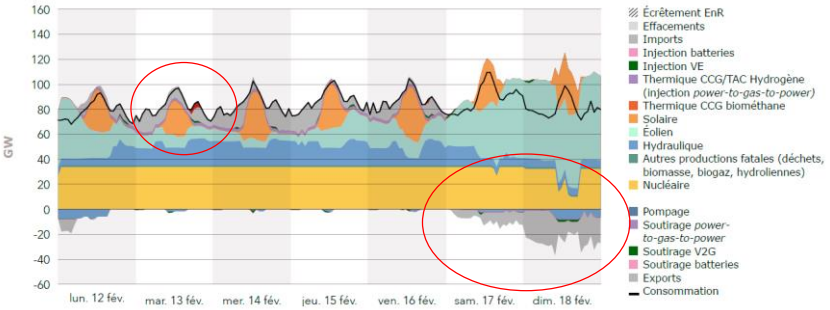
- Shift of consumption to mid-days (solar production peak)
- Leveraging smart meters for finer scale demand response
- Financial incentive included in the electricity supply contract

Could be generalised to other uses (e.g. EVs)

Supply-side flexibility: dispatchable generation and storage

- **Clean dispatchable power:**
  - Nuclear power plants: long-term operation of existing plants and building new plants from 2035 on
  - Planned conversion of fossil fuel power stations with low-carbon fue (e.g. biomass, biogas or hydrogen) by 2030

- **Storage:**
  - Development of battery capacity
  - Vehicle-to-grid
  - Pumped-storage hydropower (+1,7 GW capacity by 2035)
  - On the longer term: power-to-gas-to-power (using hydrogen or e-methane)



Weekly flexibility between high and low wind power production in 2050 (RTE)