'22 PORTUGAL RENEWABLE ENERGY SUMMIT

Panel | Interconnections and Grid access and capacity

Vincent THOUVENIN | RTE

APREN Associação de Energias Renováveis

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Panel | Interconnections and Grid access and capacity

Vincent THOUVENIN

RTE
Deputy Secretary General
Executive Director in charge of European Affairs Division

Challenges of a high share of RES for the power system – The French case

The main challenge: Achieving carbon neutrality by 2050 in a context of energy crisis

Climate Law

April 2021

Carbon neutrality by 2050

At least 55% CO_2 reduction by 2030

EU Green Deal

Fit for 55% Package

Binding EU target of **40%** RES in gross final energy consumption

RePower EU

Binding EU target of **45%** RES in gross final energy consumption

- **French NECP (2020)**: **33 %** of RES in the gross final energy consumption by 2030. Update 2023.
- **PPE**: **36%** of RES in the electricity generation by 2028.
- **LTECV: 40%** of RES in electricity generation by 2030.

- **Loi d'accélération des ENR**

Public consultation on 2050 scenarios led by RTE

2019	2020	2021

Mid-2019 — *Q1 2021* — *Q4 2021*

Phase I: Framing of the study and characterisation of scenarios (Mid-2019 – Q1 2021)

Phase II : discussion of results and finalisation (Q1 2021 – Q4 2021)

Framing of scenarios

(launch of consultation)

Scenarios 100% RES by 2050-2060

Scenarios RES + nuclear

27th January 2021

RTE-IEA report (technical feasibility of system with a high share of RES)

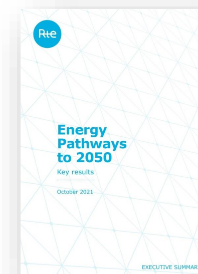
+

Public consultation on scenarios

Rte iea

Fall 2021

Long term *Bilan prévisionnel*: "2050 energy futures"



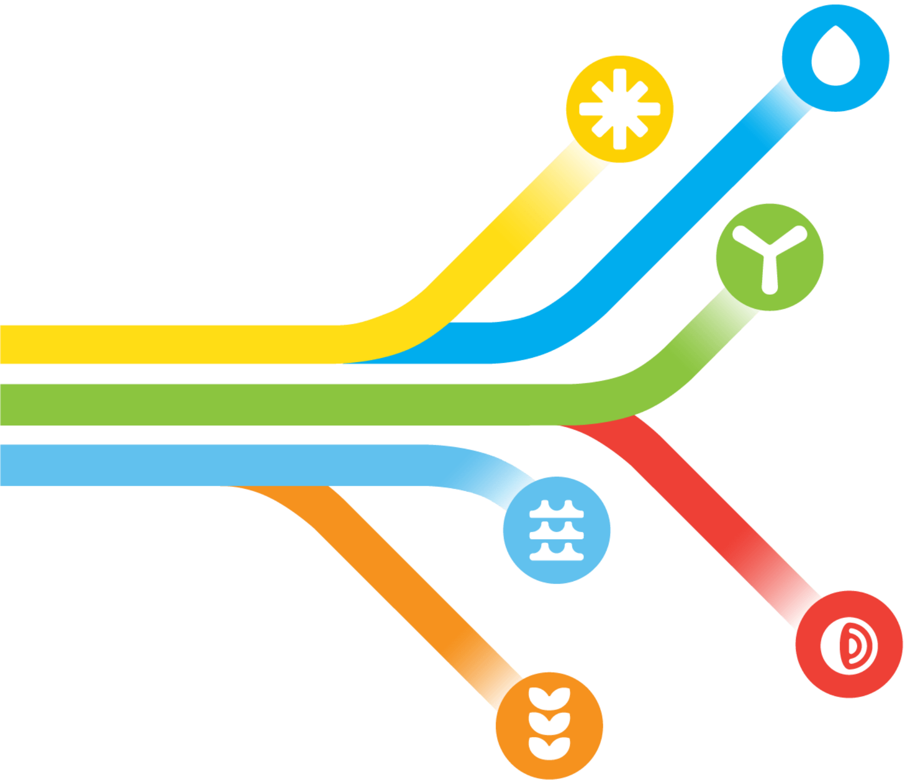
EIGHT SCENARIOS

+

NUMEROUS VARIANTS

+

4-AXIS ANALYSIS FRAMEWORK (technical, economic, environmental, societal)



Study | Conditions and Requirements for the Technical Feasibility of a Power System with a High Share of Renewables in France Towards 2050

January 2021

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4 technical conditions to be met:

1. Compensation of RES variability
2. Frenquency stability
3. Set up reserves to control the network in real time
4. Reconfiguration of the transmission network

Overall learnings for France:

- Significant development of uses electrification and RES in all scenarios
- The 4 technical conditions can be met and overcome
- Industrialisation, large-scale demonstration and deployment of technological solutions
- Industrialisation and deployment challenge proportional to the share of RES

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Condition 1 - compensation of RES variability:

- The massive integration of variable RES requires the development of a combination of flexibility resources

2035

RES: ~45%

Nuclear: ~50%

No need for additionnal flexible capacities beyond those planned in the French Multi-Annual Energy Plan

2050

High / very high share of RES

Need for flexibility

40 to 60 GW of additional flexible capacities to cover peak load

Examples :

- Interconnections
- Demand-side flexiblity
- Storage
- Hydrogen-fired power plants

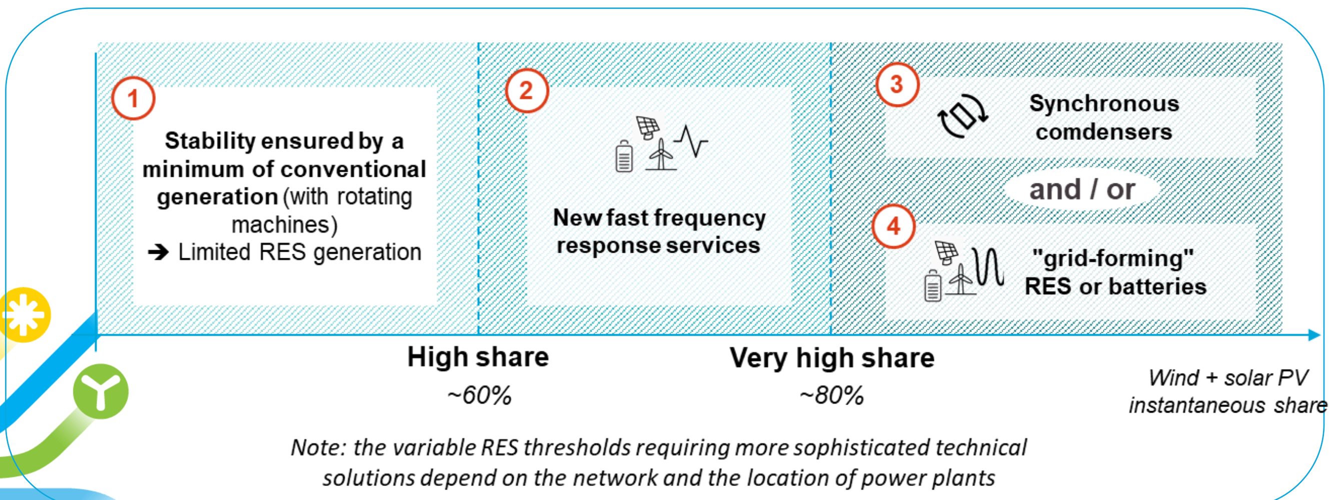
➢ **An in-depth assessment of flexibility needs and associated costs / impacts in the future study carried out by RTE.**

• Condition 2 - stability:
new solutions to be tested and developed

- **Expert debate**

  "Fewer nuclear & thermal power plants = fewer rotating machines to stabilise the system"

- **Consequences:** new solutions to be developed to ensure stability



- Challenge : R&D
- **Stability roadmap with demonstration**

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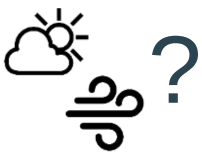
• Condition 3 - reserves:

reserves sizing can be re-examined in the light of massive RES development



- **Reserves, an issue not much in the debate**

  "More variable RE production ➔ more uncertainties / contingencies"

- **Consequence:** need for more reserves to compensate for contingencies in real time

- **Levers to moderate or cover the need to increase reserves**:
  - **Improving the quality of RES generation forecasting and / or improving the real-time generation monitoring**
  - **new solutions are used to compensate uncertainties in real time,** e.g. electric vehicle batteries or other flexible capacities

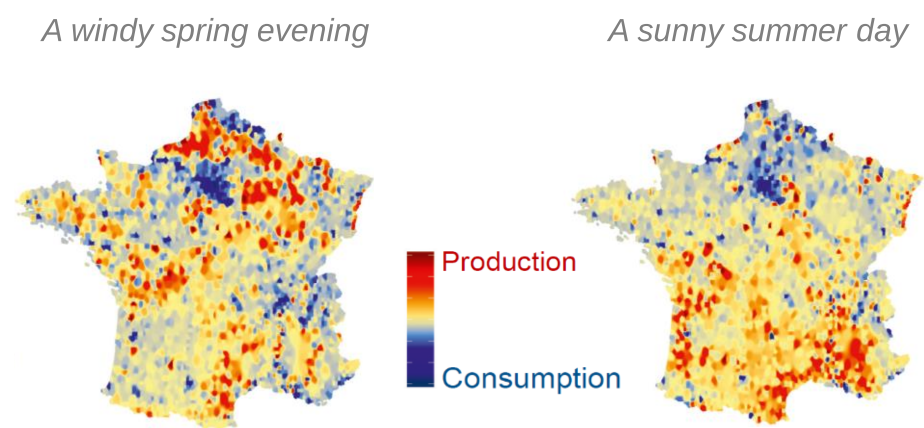
• Condition 4 - grid:
electricity grids will have to adapt to the evolution of energy flows and the new location of generation units

- **A geographical distribution of generation :**
  - different from today
  - highly variable over time

- **Need for a resized network**

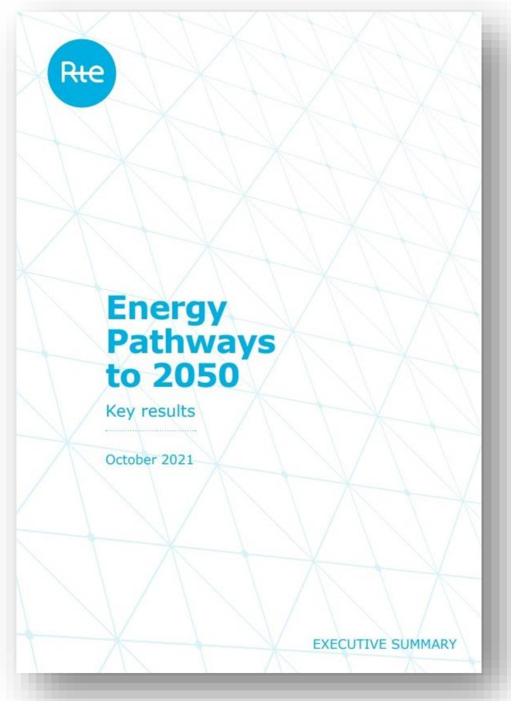
- **Mainly societal and environmental stakes**

Example of typical geographical distributions of generation and load in 2035



Energy Pathways to 2050

October 2021



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Obrigado!
Thank you!

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Back-up

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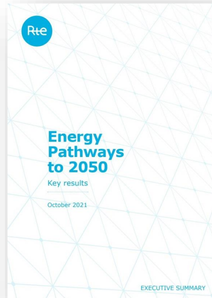
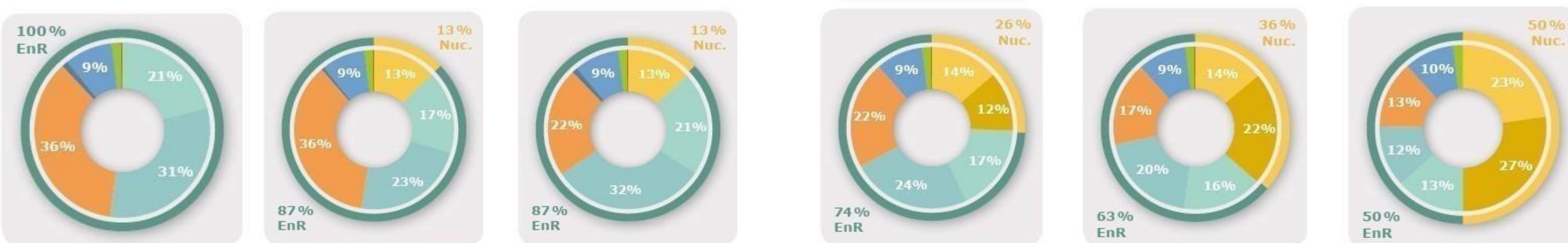


Generation: The six scenarios for the mix

M0	M1	M23	N1	N2	N03
100% EnR en 2050	EnR répartition diffuse		EnR + nouveau nucléaire 1	EnR + nouveau nucléaire 2	EnR + nouveau nucléaire 3

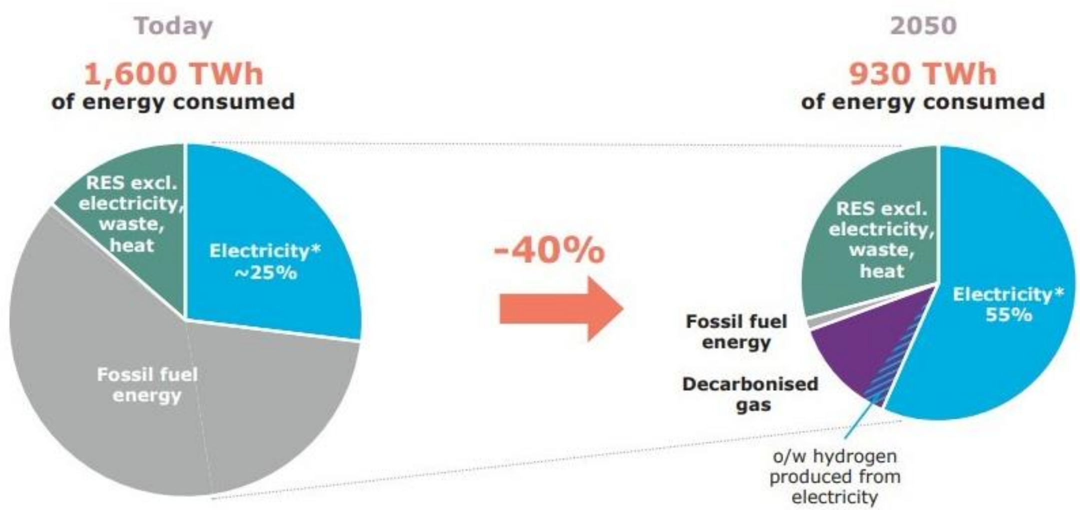


The "M" scenarios
Without new nuclear, a 100% renewables mix in 2050 or 2060

The "N" scenarios
With new nuclear

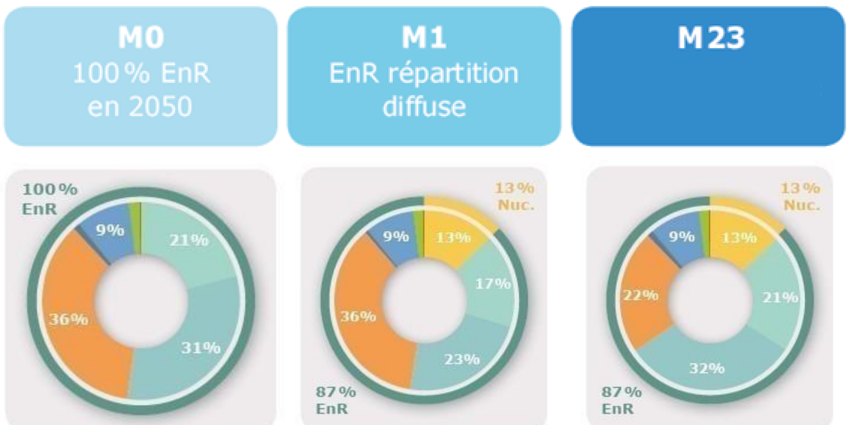
First challenge: to increase the production of decarbonised electricity in order to move away from fossil fuels and replace second-generation nuclear power plants

Figure 2 Final energy consumption in France and under the NLCS



* Final electricity consumption (excluding losses, excluding consumption related to the energy sector and excl. consumption for hydrogen production)
Total electricity consumption in RTE's baseline trajectory = 645 TWh

Carbon neutrality cannot be achieved by 2050 without significant renewable energy development



The "M" scenarios

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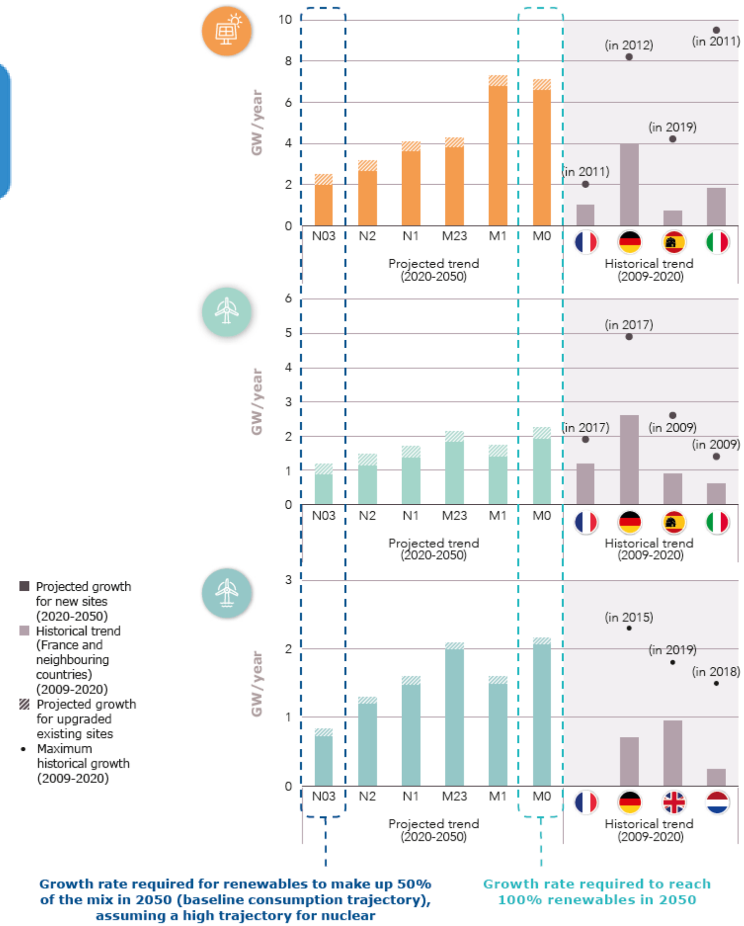


Consumption: 3 trajectories out to 2050, with an upward trend in response to the electrification of uses

CONSUMPTION TRAJECTORIES

OUT TO 2050

Final electricity consumption per sector: Industry, Residential, Tertiary, Transport, Hydrogen

SCENARIOS

	ASSUMPTIONS	LEVEL 2050	KEY CHANGES
Baseline	Gradual electrification (substitution for fossil fuels) and ambitious targets for energy efficiency (NLCS assumption). Assumes continued economic growth (+1.3% per year from 2030) and demographic growth (INSEE's low fertility scenario). The baseline trajectory assumes a high degree of efficacy of public policies and plans (stimulus, hydrogen, industry). The manufacturing industry expands, and its share of GDP ceases to decrease. Building renovation is factored in but so is the related rebound effect.	**645 TWh**	Industry: 180 TWh Residential: 134 TWh Tertiary: 113 TWh Transport: 99 TWh Hydrogen: 50 TWh

	ASSUMPTIONS	LEVEL 2050 *(vs. baseline)*	KEY CHANGES *(+ difference vs. baseline)*
Sufficiency	Lifestyles change to increase energy sufficiency in terms of end-uses and consumption (less individual travel favouring soft mobility and mass transport, less consumption of manufactured goods, sharing economy, lower set point temperatures for heating, increase in remote working, digital sustainability, etc.), resulting in an overall reduction in energy needs, and thus electricity needs.	**555 TWh** (-90 TWh)	Industry: 160 TWh (-20 TWh) Residential: 111 TWh (-23 TWh) Tertiary: 95 TWh (-18 TWh) Transport: 77 TWh (-22 TWh) Hydrogen: 47 TWh (-3 TWh)
Extensive reindustrialisation	Without returning to the same level as the early 1990s, the manufacturing industry's share of GDP rebounds sharply, reaching 12-13% in 2050. This scenario models an investment in cutting edge, strategic technologies and takes into account the reshoring of some high-carbon production in order to reduce the carbon footprint of consumption in France.	**752 TWh** (+107 TWh)	Industry: 239 TWh (+59 TWh) Residential: 134 TWh (0 TWh) Tertiary: 115 TWh (+2 TWh) Transport: 99 TWh (0 TWh) Hydrogen: 87 TWh (+37 TWh)

If the development of electric RES is a competitive option, its full cost for society must be considered, with regard to the needs of flexibilities and network development.

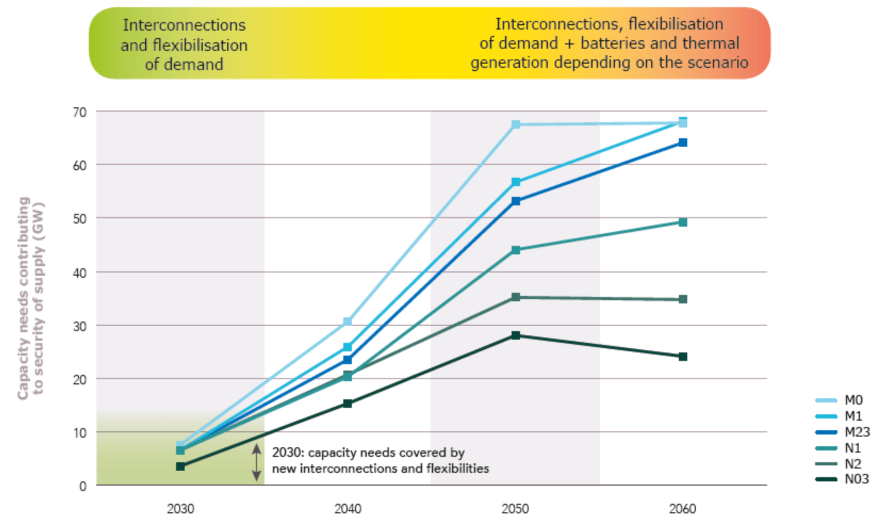
Difference between annualised full costs of the scenarios with different variants (€bn/yr):

Maintaining a high level of security of supply will require a massive development of flexibilities.

- **The need for flexible capacity increases in all scenarios**, due to the increase in electricity consumption, the decrease in controllable capacity and the increase in operational reserves (auxiliary services).

- All scenarios require massive flexible capacities, but in varying proportions depending on the electricity generation mix: **between 30 and 70 GW of new capacities are needed by 2050**.

- **Different flexibility solutions** can be developed to meet security of supply requirements:
  - **Demand Side Management**
  - **Interconnections**
  - **Batteries** to support PV
  - **Thermal power plants fuelled by decarbonised gas** (including H2), if nuclear revival is minimal.
  - **Pumped hydro storage** (limited potential)



The French transmission electricity network is becoming a transit hub

- **Increasing interconnection capacity between France and its neighbours** is an important source of savings.
- Increase to ~39 GW of exchange capacity in 2050 to pool resources on a European scale.
- Economically justified in all scenarios (CBA >0), but with **major industrial challenges and energy interdependence issues**.
- In all scenarios, France loses its status as a net exporter and reaches a balance between imports and exports. The French network becomes a transit hub, with imports and exports becoming more and more concomitant.