Le réseau de transport d'électricité

ESIG
ENERGY SYSTEMS INTEGRATION GROUP

RTE's Long-Term Load Forecasting for System Planning

15 June 2023

Laurent Dubus, Senior Scientist

Thanks to Maxime Chaillet & many other colleagues

SOMMAIRE

Outline

Introduction: prospective studies

Mid-term scenarios under consideration

R&D Activities

Summary

SOMMAIRE

Outline

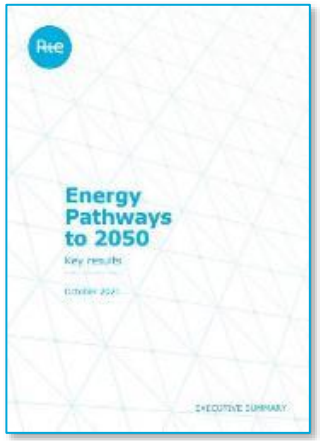
Introduction: prospective studies

Mid-term scenarios under consideration

R&D Activities

Summary

A strong need to link long-term and medium term prospective

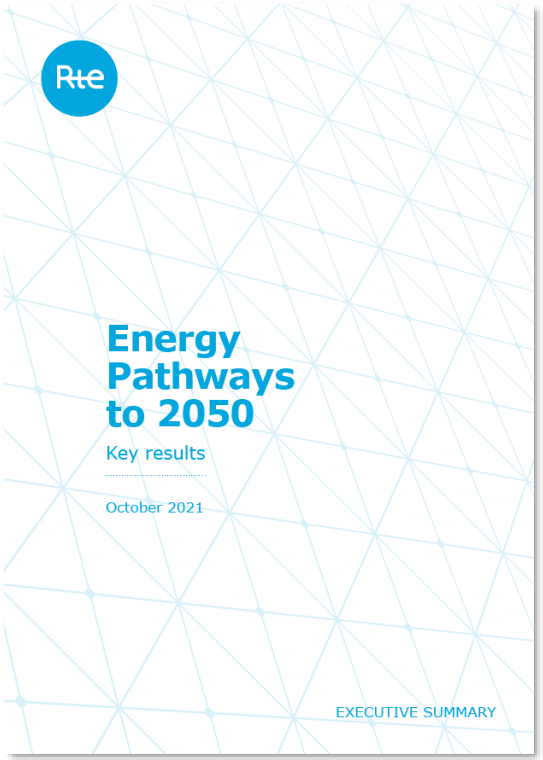


- The « *Energy pathways to 2050* » report published in 2021 looked at mixed scenarios **to reach carbon neutrality**
- Together with ADEME's scenarios, they are the basis for the preparation of the new **French Energy-Climate Strategy**
- The 2050 horizon assumptions and results remain valid, but the **2030-2035 horizon needs to be revised, which is the target of the next Mid-term adequacy report.** Needs motivated by:
  - New EU climate ambitions (« Fit for 55 »)
  - Energy independence and re-industrialization of France
  - Latest geopolotical changes
  - Revised technical assumptions

SOMMAIRE

Outline

Long term load forecasts from last year's report



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	180 TWh 134 TWh 113 TWh 99 TWh 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)	160 TWh (-20 TWh) 111 TWh (-23 TWh) 95 TWh (-18 TWh) 77 TWh (-22 TWh) 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)	239 TWh (+59 TWh) 134 TWh (0 TWh) 115 TWh (+2 TWh) 99 TWh (0 TWh) 87 TWh (+37 TWh)

The 2030-2035 adequacy report is a multi scenario exercise

Prospective exercise

Scenario A
« Successful acceleration »
(achievement of the Fit for 55 objectives)

Detail the electrical system (with different possible configurations) to achieve the objectives of the public authorities

Risk analysis exercise

Scenario B
« Partial impairment »
(a few years late)

Establish what the electrical system could be in a scenario where the objectives are not achieved

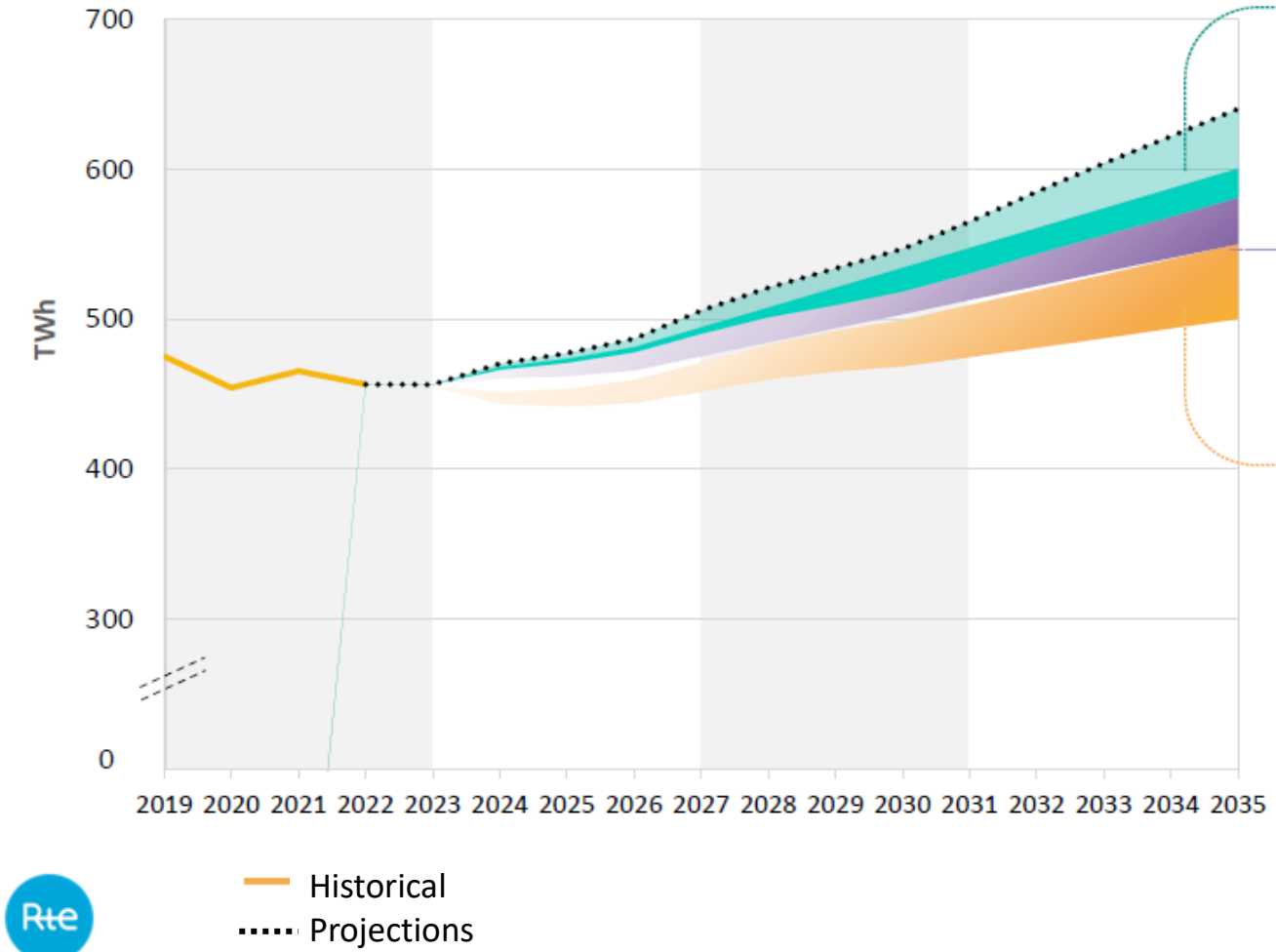
Scenario C
« Thwarted globalization »
(adverse context)

Study the effects and possible adaptations of the decarbonization strategy in a degraded context

What are the consequences of not achieving the objectives in terms of CO2, costs, security of supply, resilience, etc.

It envisages different trajectories for consumption

Evolution of electricity consumption in the different scenarios by 2035



Scenario A
Targets are reached

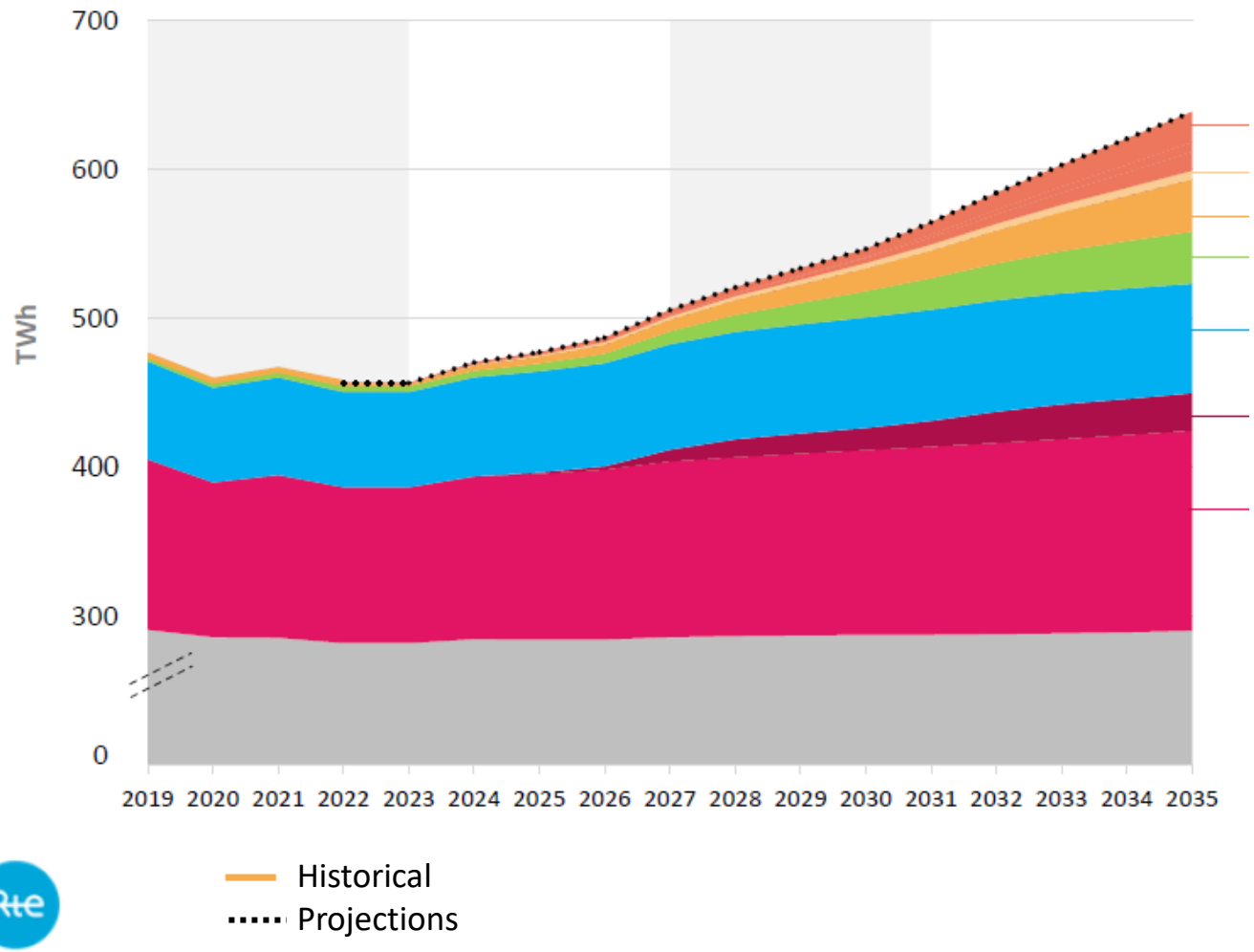
Scenario B, *partial achievement*
Lower consumption level (delays in electrification)

Scenario C *Thwarted globalization*
different shape of the trajectory (stall at beginning, stronger growth after)

Contrasting consumption trajectories are being studied as part of the Assessment Forecast 2023

In a scenario of achieving climate objectives and reindustrialisation, a growing prospect of increased consumption

Domestic electricity consumption broken down by use (example in the highest trajectory)



Focus on four sectors/uses concerned by major changes:

- **Transportation**
- **Digital**
- **Heating**
- **Industry**

Necessary transformations on the industrial and daily life plan

SOMMAIRE

Outline

Introduction: prospective studies

Mid-term scenarios under consideration

R&D Activities

Summary

R&D Activities

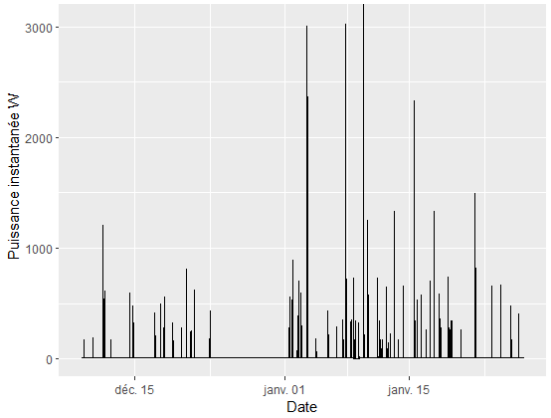
Pride: Power consumption predictions, the historical expertise of R&D

Different sources of load data

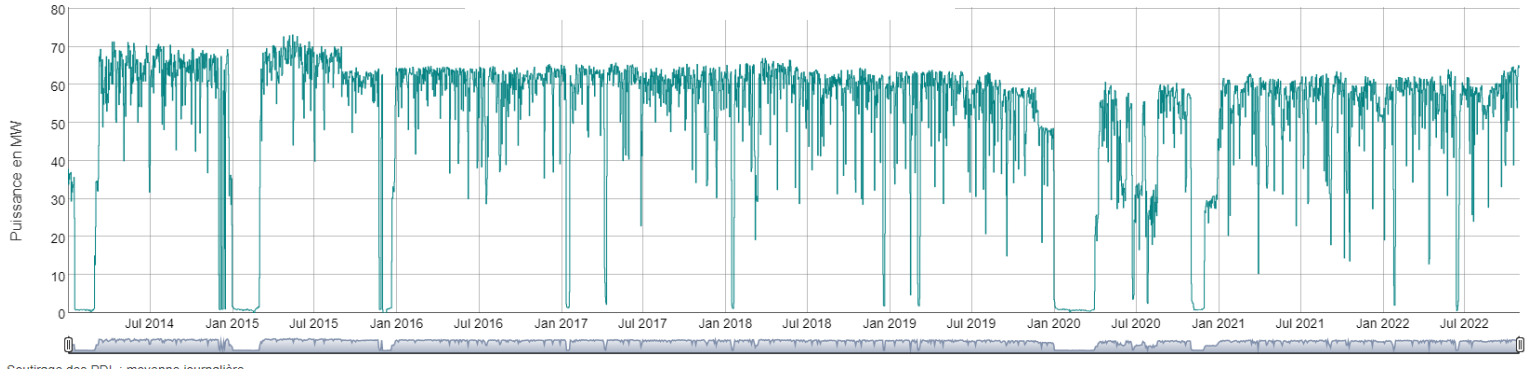
Use of panels and load metering

Residential	• Panel ELECDOM (100 households / individual power plugs / time step=10 minutes)
Tertiary	• Panel ELECTER (creation of a representative sample of tertiary consumers)
Industries & co	• Extraction of data from industrial customers, SNCF, large tertiary sites
Transport	• Displacement profiling (Moverte tool)

Cooking load of 1 household



Industrial load of 1 site



Profiling of uses

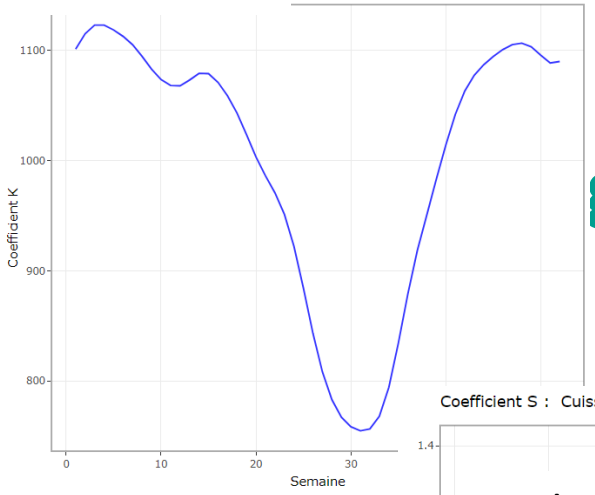
Decomposition of the load curve to increase representativeness

Weelky Coefficients : K

Daily Coefficients : S

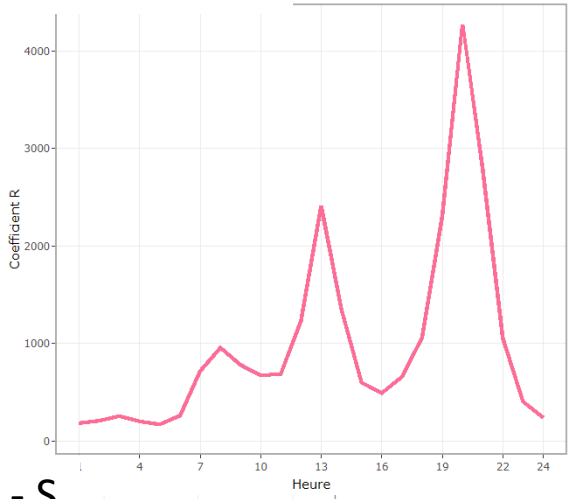
Hourly Coefficients : R

Cooking - K



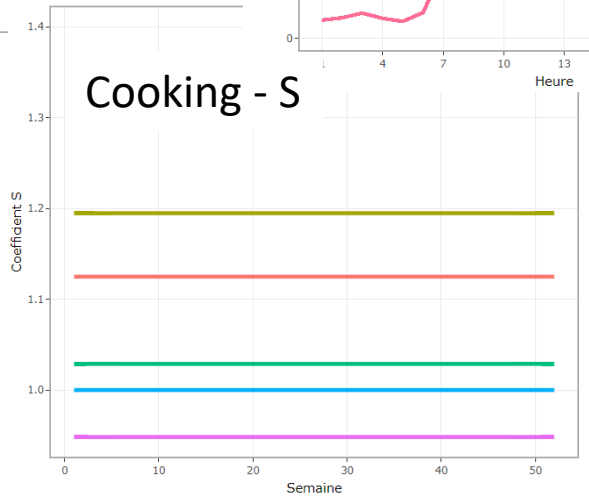
g

Cooking - R

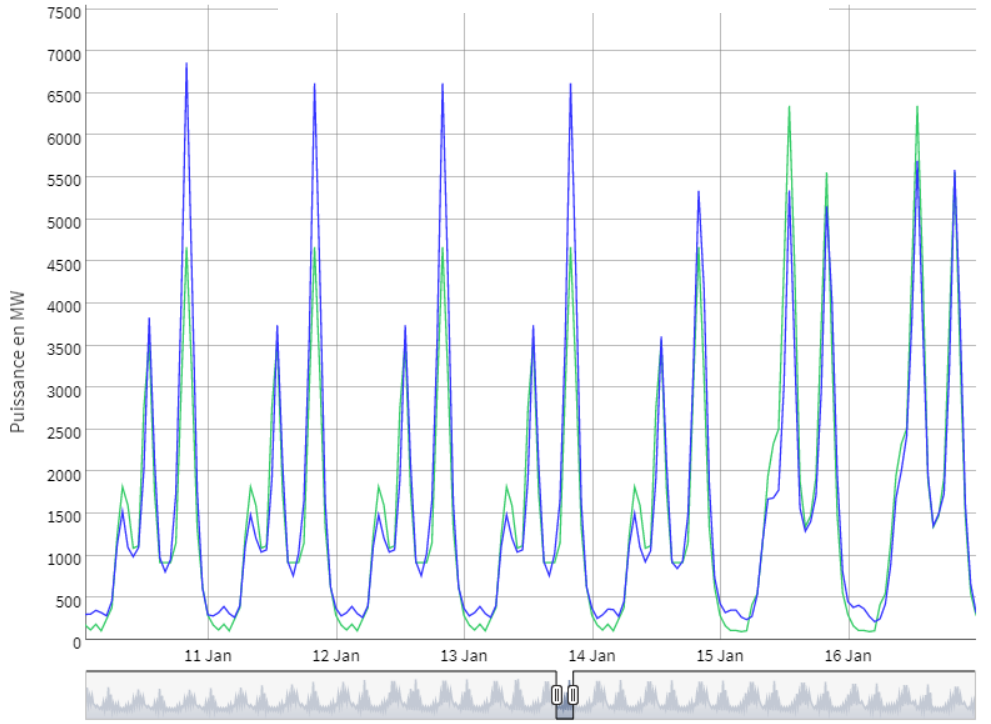


Coefficient S : Cuisson

Cooking - S



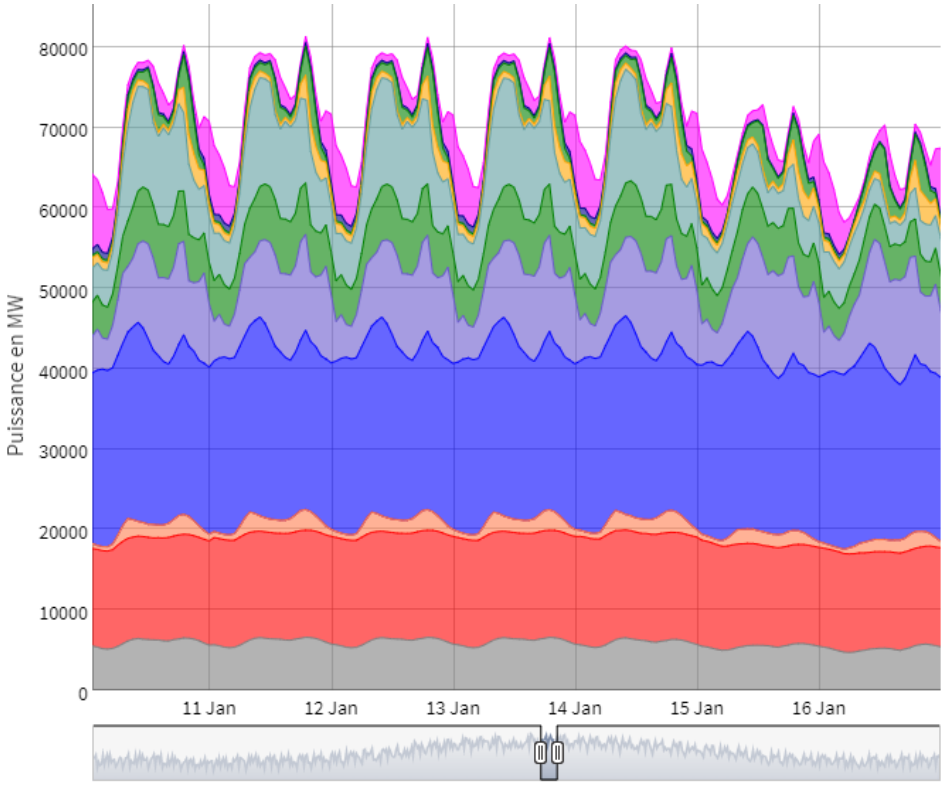
Cooking – All components



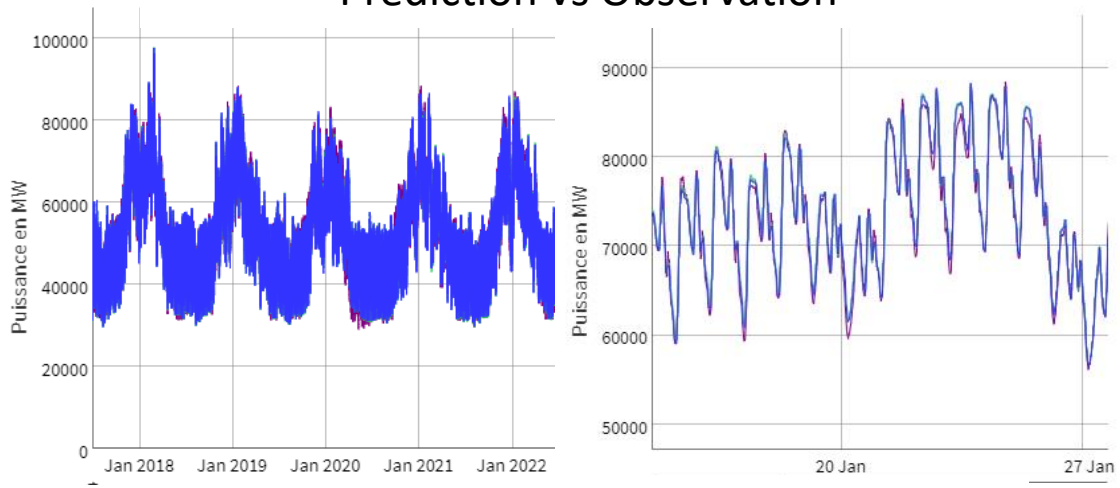
History replay and visualization

Profiling quality to predict power consumption

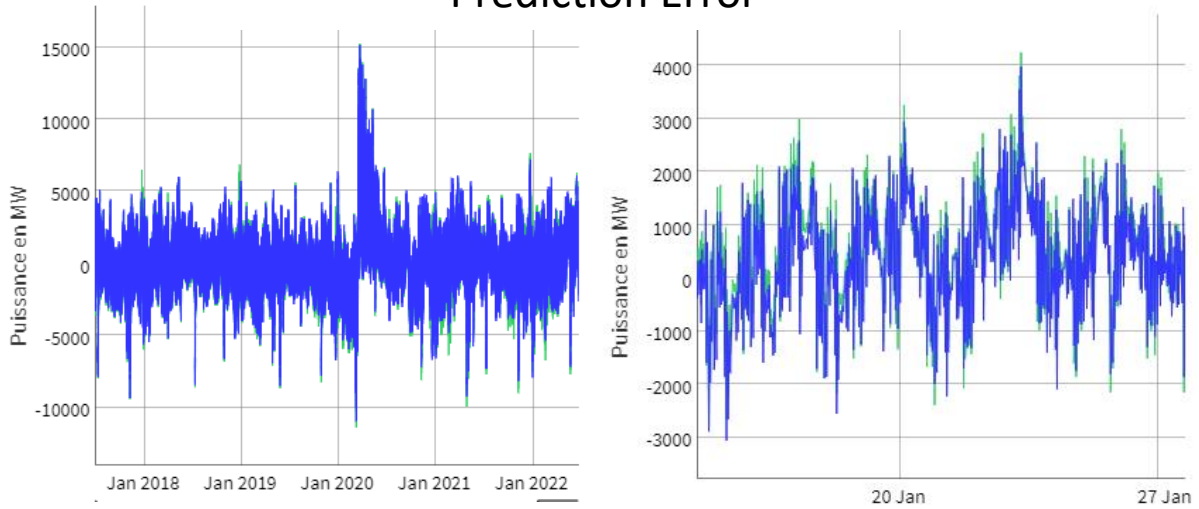
New profiles @ normal temperature



Prediction vs Observation



Prediction Error



R&D Activities

Humility: the (difficult) art of prediction

To err is human, so are dreams

A little humility in the art of forecasting

New York dung forecast

Late 19th century: 175,000 horses with a daily production of 3M pounds of manure per day

Prediction: 10m height horse dung across Manhattan with expected growth

Reality: cars!

Neo-malthusianism post-apo

1968 : Paul R.Ehrlich, Stanford : The population bomb

"The battle to feed all of humanity is over. In the 1970s hundreds of millions of people will starve to death in spite of any crash programs embarked upon now. At this late date nothing can prevent a substantial increase in the world death rate... "

Reality: Green revolution, industrialization…

The future of Internet

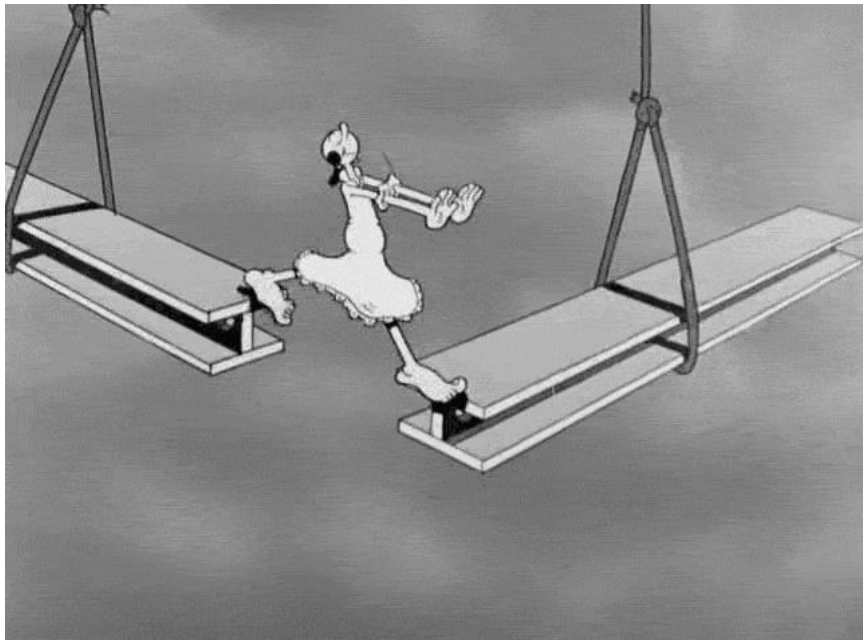
1994: Théry Report : Information Highways

"There is no means of invoicing on the Internet […] The worldwide turnover on the services it generates only corresponds to one-twelfth of that of the Minitel. The limits of the Internet thus demonstrate that it cannot, in the long term, constitute the global network of highways on its own."

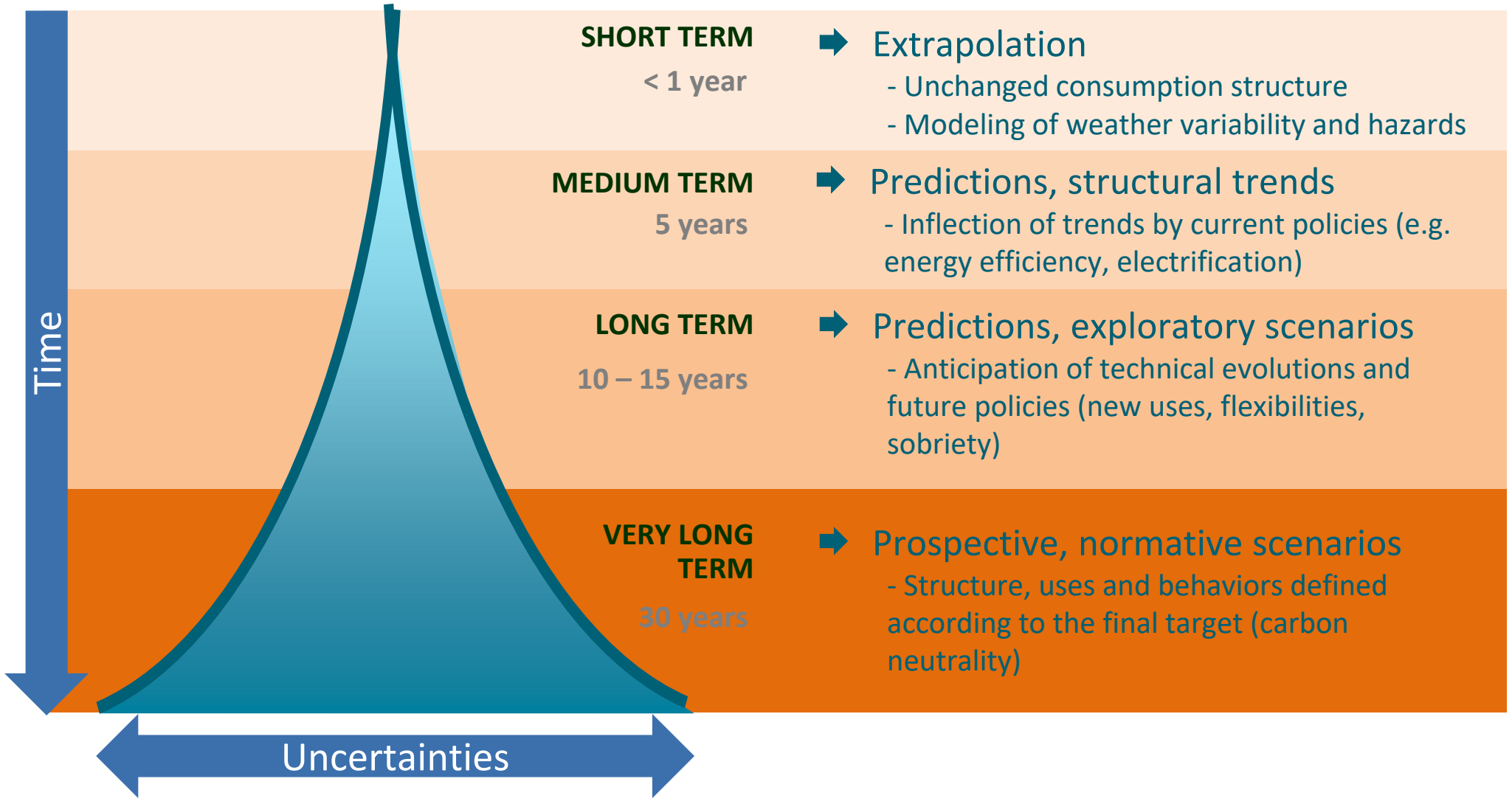
***Reality**: End of Minitel*

« I prefer an unpredictable future to an impostor future»
Maurice Schumann

How to predict the future?



The time horizon under consideration influences the method's choice



SHORT TERM
< 1 year

➡ Extrapolation
- Unchanged consumption structure
- Modeling of weather variability and hazards

MEDIUM TERM
5 years

➡ Predictions, structural trends
- Inflection of trends by current policies (e.g. energy efficiency, electrification)

LONG TERM
10 – 15 years

➡ Predictions, exploratory scenarios
- Anticipation of technical evolutions and future policies (new uses, flexibilities, sobriety)

VERY LONG TERM
30 years

➡ Prospective, normative scenarios
- Structure, uses and behaviors defined according to the final target (carbon neutrality)

Analytical representation of demand

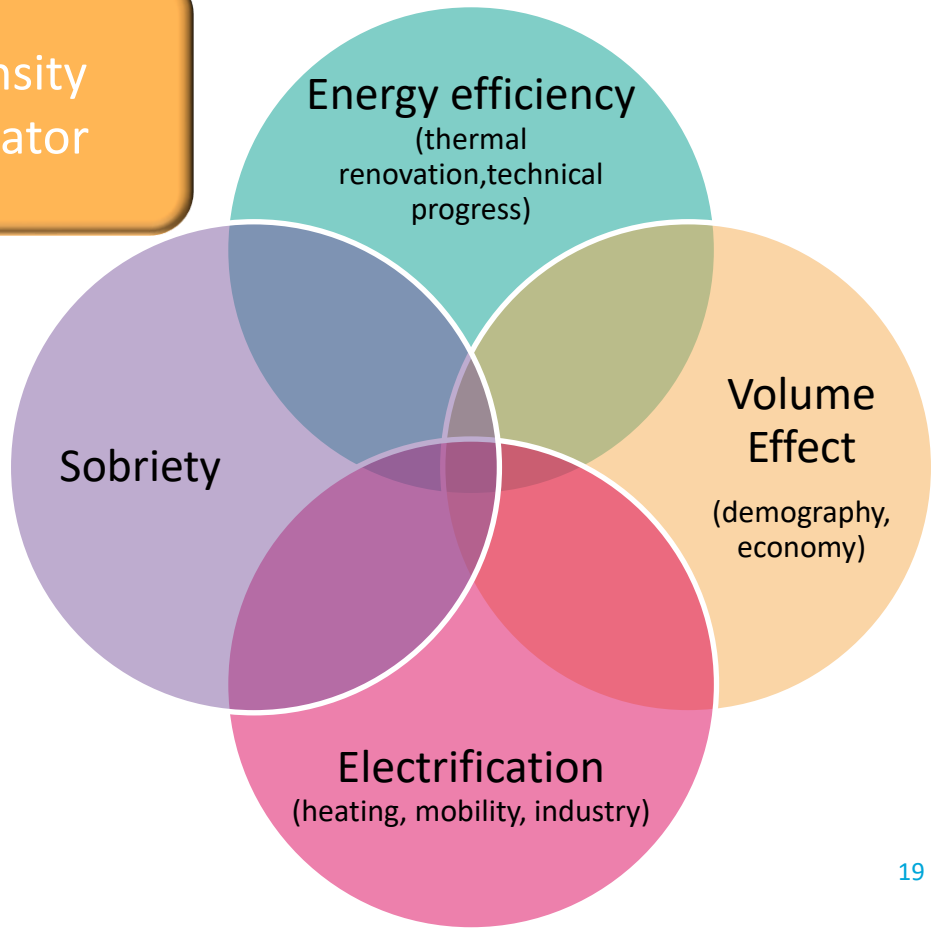
Detailed estimate for each sector and use

Residential: number of equipped households
Tertiary: equipped square meters per branch
Industry: volume production by branch

Residential: unit consumption
Tertiary: consumption per m²
Industry: electrical intensity

Consumption of a use or branch = Volume indicator X Intensity indicator

- Integration of socio-economic, technological, behavioral, regulatory changes, etc
- Sector and total demands are calculated by aggregation (“bottom-up” approach)
- Modeling particularly suited to medium and long-term analyzes



R&D Activities

Lucidity: Strong need to localize (future) load

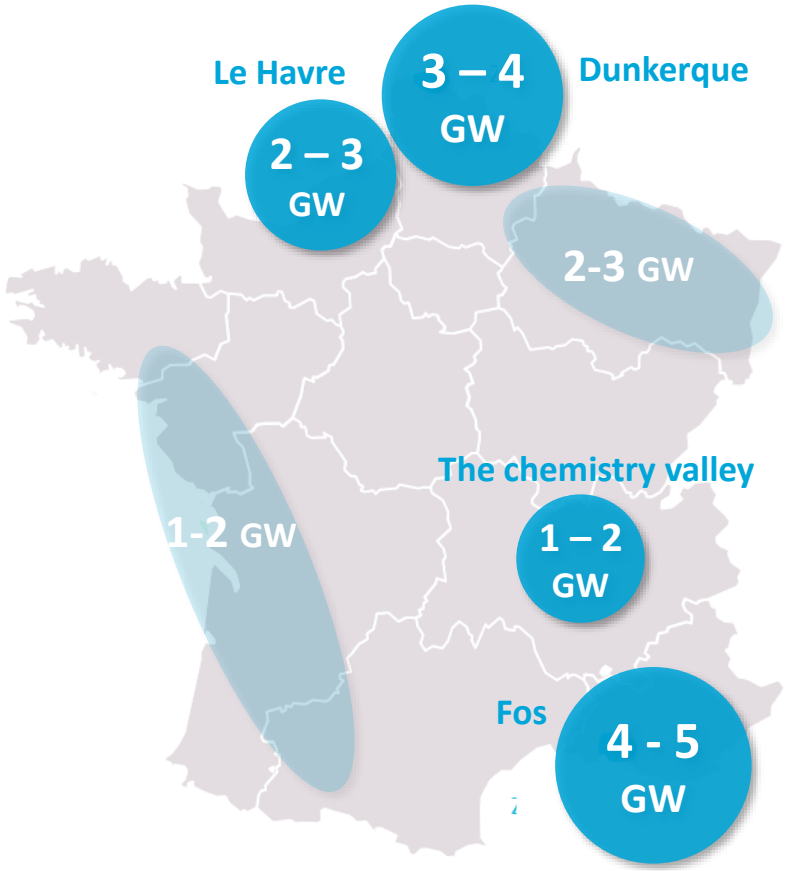
A strong need to localize future industrial load

- The prospects for an upward shift in electricity consumption are given credibility by the number of connection requests received by RTE (~15 GW).
- These requests have different levels of maturity. They sometimes lead to explicit duplicates or concern projects that are clearly in competition for the same need.

To meet these demands, **RTE has embarked on a new strategy for four major industrial-port zones (ZIP)**:

- **develop common infrastructure**
- **pool the cost for the beneficiaries**
- **benefit from administrative simplifications**
- **possibly prioritizing between projects** if the capacity is developed in a staggered manner over time.

"Geographically isolated" projects will also be able to benefit from simplified procedures (for sites emitting more than 250 ktCO2/year) and reduced connection costs.



Connection requests received at the end of 2022

Eventually, a huge amount of data to proceed

RTE internal data

- ✓ Ongoing work on **decarbonization zones**
- ✓ **Map of gas and electricity consumption** in France (consumption associated with an NAF code)
- ✓ The **work carried out internally** with the AMADEUS model in particular
- ✓ **Data on connection requests** (PTF in progress, finalized, abandoned, etc.)
- ✓ **The field knowledge** of the various regional delegates
- ✓ Current work on **hydrogen**
- ✓ **All other work to be defined**

External data

- ✓ **Consumption data** present on the ODRE platform
- ✓ **All data/information used to feed industry files** (production process, decarbonization hypotheses, industry development, etc.)
- ✓ **France Relance data** to identify future projects related to decarbonization, relocation, energy efficiency, business development, etc.
- ✓ **All other data to feed our study**

Interviews

- ✓ Interviews with **CCIs and territorial actors** to give their visions of the development of industry in their territory and the potential needs expressed by manufacturers
- ✓ **Interviews with industrial federations** to have a branch-by-branch vision
- ✓ **Interviews with development agencies** to feed the prospective vision of the study (France Business, development agency, etc.)
- ✓ **Interview with manufacturers** to refine the downscaling methodology and the data collected

Create a parametric downscaling method applicable to network studies

SOMMAIRE

Outline

Introduction: prospective studies

Mid-term scenarios under consideration

R&D Activities

Summary

Take away messages

- Long term prospective starts with load forecasts, or rather load scenarios
- Electrification of fossil uses is a game changer
- The complexity of load forecasting is increasing a lot
- Data access, collection and capitalization is key
- Don’t forget to take climate change into consideration!

Le réseau de transport d'électricité

Thank you

Contact: laurent.dubus@rte-france.com