Methodology for grid planning studies: French experience

Alexandre Périn, 07/06/2021

SUMMARY

French context and workflow

FRENCH STAKEHOLDERS

RTE work in transparency

	Regulator	Grid operator	Producers/ Suppliers	Public ministry of Energy
	CRE	RTE	EDF, ENGIE, Direct Energie, etc …	DEGC
Missions	▪ Check the independence of the grid operator ▪ Check and approve network developments ▪ Check the fairness of electricity's market	▪ Ensure maintenance, **development** and operations **of the network** in total independence and transparence and at the minimum cost ▪ Ensure security of supply	▪ Ensure profitability in liberalized electricity markets	▪ Enforce political decisions in term of national energy decisions
Power	▪ Can modify ten-year network development plan ▪Can take coercive actions against stakeholders		▪ Produce energy, build power plants and new services ▪ Supply final consumers at the best cost	▪ Law, decrees

RTE'S WORKFLOW : MULTI STAGE STUDIES

From market to network modeling

	National Generation Adequacy Report	Coherent and local assumptions corpus	Zonal studies	French ten-year network development plan
	Market modeling	National local assumptions set	Market & Network modeling	Network modeling
Objectives	• Build national coherent and distinct sets of assumptions • Test possible futures electrical systems • Take into account other European countries • Assess shortfall risks	• Break the national load and generation assumptions to the local scale (below the region)	• Identify network issues to the electrical zone scale	• Identify network issues to the thinness scale • Propose a development plan

Scenarios Building

GENERATION SCENARIOS : HAZARDS VS UNCERTAINTIES

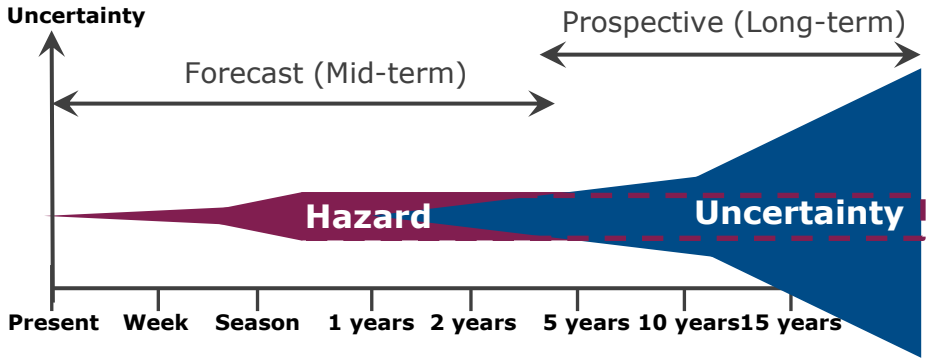
Two different unknowns

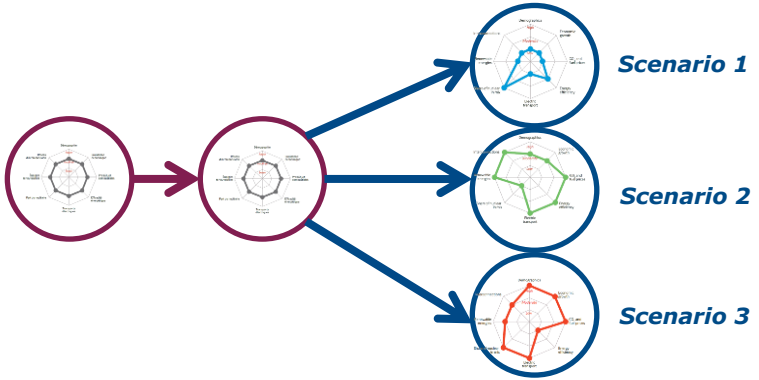
Hazards

- Unplanned outages
- Load forecast errors
- Wind and solar production
- Hydraulic storage levels
- …

Uncertainties

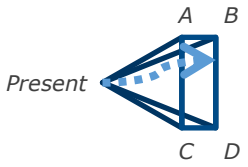
- Economic growth
- Technologies
- Interconnexion developments
- New actors
- Commodities prices
- Political orientations
- Demography
- …





LONG-TERM SCENARIO BUILDING

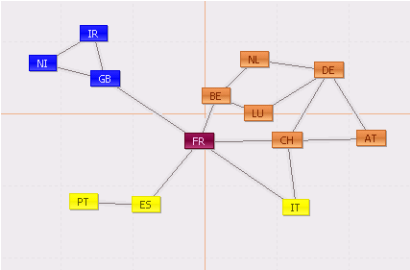
Scenarios must framing the future

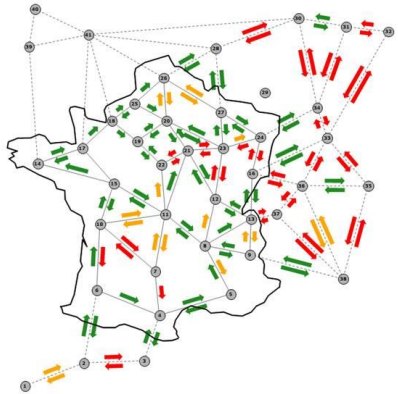
	Scenario	
	Generation	**Load**
What	• **4 scenarios**	• **4 scenarios** • Distinct by the level of consumption more than the structure
Why	• Investment decision time range of producers • Lot of uncertainties (political, economic, regulations, ...) • Possible technological impact • **Impossibility to forecast at this time range**	• Load level depending of uncertain economic growth • Change in the use of electricity (electric cars, …) • etc… • **Impossibility to forecast at this time range**
How	• **Building of coherent scenarios framing the future** • Need to be distinct to improve further sensitivity analyses	

From market to network studies

ZONAL APPROACH

Addition of an equivalent grid to the market model





Splitting national assumptions by zone (hourly step)

Model an equivalent network (Kirchhoff laws) at the scale of the zones

Identify zone with issues to optimize network studies (representative snapshot)

Each area is defined by assumptions on…

Its electrical demand and ancillary services (reserve) needs

Its generation fleet with its technical and economic characteristics

(most input data is yearly time series with a resolution of 1 hour)

PROBABILISTIC APPROACH

The best way to deal with hazards

13 countries

11 Consumption series

11 Unavailability level series

11 Renewable energy generation series

11 Monthly hydro generation series

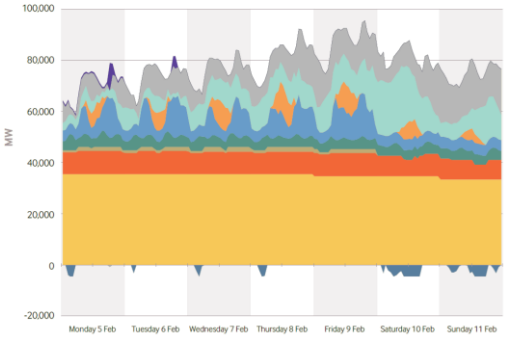
Monte-Carlo Simulations

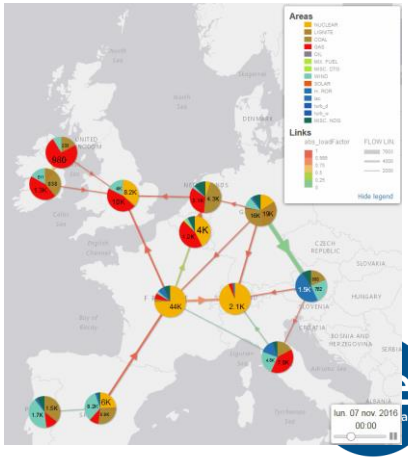
11 combinations of load and availability series

Hourly optimization

Key outputs :

- Flow on the interconnexion
- Starting plan on each unit connected to the French
- Identification of constrained areas





DC OPF SIMULATION

Accurate assessment of the congestions and their costs

For each constrained areas, detailed studies are conducted

They use a **DC Optimal Power Flow "OPF"** (i.e. Power flow only with active power), at an hourly step

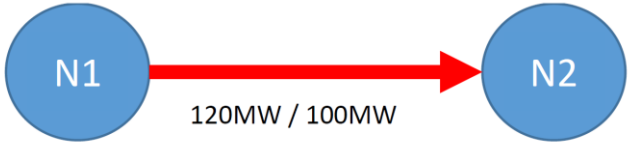
These studies use a **full representation of the grid** and take in inputs :

- The previous Antares outputs
- The cost of generation per unit
- The cost of Co2 emission and the Co2 emission rate/unit

They allow to:

- Identify congestion on the grid
- Test different network topology : N, N-1
- Solve congestion at the best prices with redispatching
- Assess the price of congestion through redispatching

Example for one time-step



Prod. 120MW
Down cost: 0€/MW
Up cost: NA (PV gen.)
CO2/MWh: 0t
CO2 cost: 25€

Prod. 60MW
Down cost: -40€/MW
Up cost: +55€/MWh
CO2/MWh: 0,49t
CO2 cost: 25€

Redispatching cost = 1345€/hour

Tel : +33 1 71 06 57 00 | Email contact@rte-international.com

Conclusions

FRENCH TYNDP IN ONE GLANCE

4 key aspects

	Key aspects	How
	**Sensitivity to several scenario**	• Building several possible coherent futures • Test the results to several scenarios to check stability
	**Technical justification**	• Network studies • Identification of main factors (network congestion, lack of power, …)
	**Economic justification**	• Economic studies • Build relevant indicators (CBA, Social Welfare, etc)
	**Transparency and validation**	• Public debates on national assumptions • Internal validation process • Regulator approves the ten-year network development plan • Public diffusion of reports

Appendices

GENERAL WORKFLOW