Optimization of transmission grid infrastructures through flexibility solutions

OFATE – CEEM

27 september 2018

Energy transition : a challenge for the transmission grid ?

• The French energy system is involved in a important energy transition









- The energy transition is a major challenge for the power system :
 - Adequacy/back-up
 - Short-term flexibility
 - Adaptation of networks



- Evolution of flows and constraints and adaptations required for the transmission grid ?
- Contribution of smart flexibility solutions to optimize the transmission grid ?

Energy transition scenarios

• RTE is legally mandated to elaborate a set of scenarios of possible evolutions of the power system

 Four scenarios to depict contrasted, plausible and economically consistent futures

Rie

Bilan prévisionne



Selected scenarios for the public debate on the multi-annual energy plan

3

 These scenarios based the analysis on the transmission constraints evolutions and the adaptation of the transmission infrastructure



Key parameters for scenario building

The energy transition already impacts the transmission grid

The purpose of the transmission grid is evolving

Historically, the "national" (400kV) transmission grid evacuate and mutualize the different energy generations and the regional transmission grid dispatch energy generated in order to supply consumers.

This delimitation fade with the development of RES generation : the direction of energy flows can change.

• The use of the transmission grid is evolving

Historically, energy flows are stable and correlated with energy consumption

Energy flows are more fluctuacting and correlated with RES generation



The massive development of RES will generate new congestions



Une reduction de la production nucleaire au rythme du développement effectif des énergies renouvelables

- RES development will create congestion on the regional network
- Regional network have to be adapted quickly to face the development of RES generation



The massive development of RES will generate new congestions

Une réduction de la production nucléaire au rythme du développement effectif des énergies renouvelables

• New energy flows between regions, due to

RES development Interconexions/exchanges

Generation decomisioning

• 400 kV network have also to be adapted

A range of smart/flexibility solutions to optimise the transmission infrastructure

 The transmission grid have to be adapted to allow the energy transition but flexibility solutions can contribute to contain investments costs/optimize the dimensioning of the infrastructure

Flexibility solutions can avoid or defer grid reinforcement/expansion

• A large range of smart flexibility solutions is already technically operational :

| Demand side management | Energy storage (stationary or EV) | Redispatching | RES limitation /curtailment | Dynamic line rating |
|---------------------------|--------------------------------------|---------------|--------------------------------|---------------------|
| management | (stationary or EV) | redispatering | /curtailment | |

• Historically, flexibility (on generation assets) are already used in order to optimise the transmission infrastructure

The Balancing mechanism allows the optimal use of flexibility for both balancing and congestion management

• RTE takes into account "new" flexibility solutions for the adaptation of the transmission grid

Benefits of flexibility solutions

RES limitation/curtailment : important benefits for limited energy spilled

With automatic real-time management on limitation/curtailment of RES generation, it is possible to reduce the need for grid guaranteed capacity with only limited RES energy spilled

- Generation duration curve profile
- Possibility of curative treatment of congestion via combination of :
 - Temporary capacity (~ minutes) to tolerate overload flows
 - Real-time automatic activation of RES curtailment
- **Dynamic Line Rating : taking benefit of** correlation between wind generation and transmission capacities

Flexibility solutions : a major contribution to control the grid cost of energy transition

A significant impact on investment with less than 1% of energy spilled

The RES controllability in real-time is a major issue to optimize the costs of energy transition

• The cost structure between OPEX and CAPEX is expected to evolve

 These solution are based on IT/numerical technologies. The transmission grid is getting hybrid "IT/numerical" + "hard" grid

The « time value » of flexibility solutions under uncertainties

- The operational implementation of flexibility solutions can be faster than traditional assets
- Under uncertainties on the energy transition and the evolution on congestions on the existing grid, flexibility solution have a « time value »
 - Flexibility solutions can allow "wait and see" strategies
 - Investment in traditional assets are thus only engaged if the congestion are certain

Traditional network + flex development strategy

Example

- Long-term uncertainties :
 Demand growth
 RES development
 Generation decommisionning
- Implementation time : Fexible solution << grid assets

Conclusions

• An ambitious energy transition will have a significant impact on transmission grid congestions and reinforcement needs

The magnitude of the congestions and reinforcements depends significantly on the scenario of energy transition

• The integration of flexibility solutions will have a major contribution to control the grid costs of the energy transition

Flexibility solutions can defer/reduce reinforcment investments and allows « wait and see » strategies

RTE already integrates this optimization in the dimensioning of the transmission infrastructure

 These solutions are based on a numerical/IT infrastructure transmission grid is getting hybrid

The transmission grid is getting hybrid "soft" and "hard" grid.

- The cost structure OPEX/CAPEX of the grid will evolve
- The network development plan, to be publish by the end of the year will provide detailed impact assessment of energy transition scenarios on the transmission grid

Thank you for your attention