EPRG Spring Seminar – Fit for net zero: Energy policy & regulation

The future of network regulation – Using flexibility to optimise networks – Case study of France

Presented to:

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UNIVERSITY OF CAMBRIDGE
Energy Policy Research Group

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COMPASS LEXECON

1.

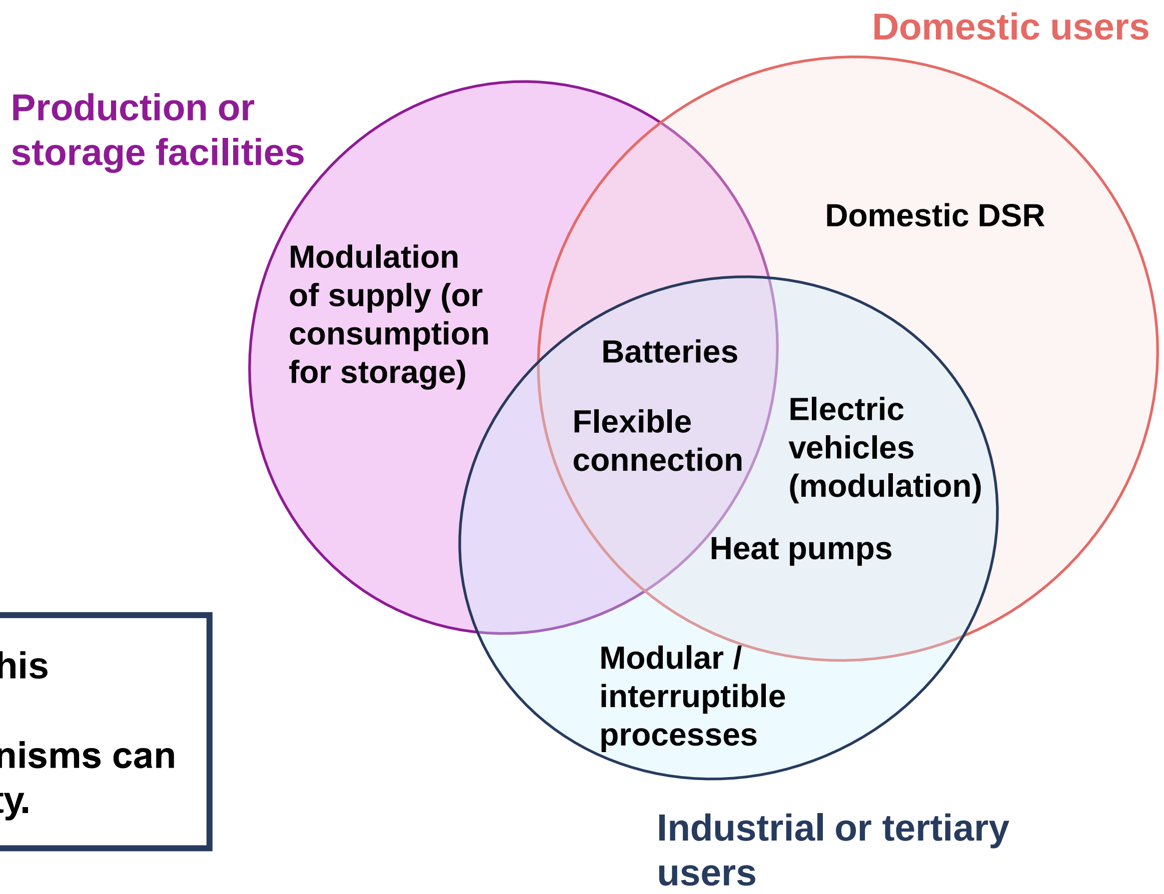
Definition and key challenges for the development of flexibility solutions

Flexibility is a complementary tool that can be used in various ways by network operators to efficiently manage their networks

- For network operators, aside from balancing, flexibility can be used in a number of ways, such as:
  - Defer or **limit network investments**
  - Optimize the **integration of renewable generation**
  - Resolve **short-term congestion** at least cost
  - **Limit the use of expensive means** (for increased generation, load shedding or avoiding curtailment)
  - Increase **resilience in case of incidents** or works
- Different types of flexibilities can answer to different network needs, depending on their characteristics

Flexibility has a range of value-creating applications, and this presentation focuses on network applications (congestion management, reinforcement decisions…). Different mechanisms can be used to best harness these different sources of flexibility.

Main categories of flexibility providers and sources



***Notes**: Size of circles/areas not representative of potentials. These categories are not completely separate, some actors are at the border of two categories (e.g. small professionals, electro-intensive industrialists)*

2.

Accessing network flexibility

TSOs and DNOs can access network flexibility from third parties through a range of channels

Category	Description	Signal to flexibility users
Rules based/ direct interventions	Codes and rules (as in the EU Demand Connection Code for instance), which impose detailed flexibility requirements on network users. Users can be curtailed under certain technical circumstances.	No price signal
Non-firm connection agreements	Non-firm connections can be used to fit new grid users at reduced connection cost and in shorter time frames, against possible curtailment in predefined time periods and under certain conditions. We can consider non-firm connections as a one-off upfront capacity payment for flexibility, with no activation cost.	Administered price signal
Network tariffs	With temporal or locational differentiation of charges, network tariffs can provide incentives for efficient usage of the grid to network users. This can contribute towards limiting or postponing network investments and solving or avoiding congestion situations for instance.	Administered price signal (could be market-based: nodal)
Market-based procurement	In a market-based setting, network companies could negotiate bilaterally or participate in organised market places with network users offering their flexibility, or interact with service providers acting on their behalf, defining and trading desired products.	Market price signal

Sources: CEER, ENTSO-E, Compass Lexecon

Flexibility mechanisms have different characteristics, and can be used in combination

Category	Advantages	Disadvantages
Rules based/ direct interventions	▪ Potentially lower costs for network companies ▪ High effectiveness/ guarantee of response ▪ Situational solution of network bottlenecks	▪ Loss of control for the grid user ▪ Curtailment may not be the economically most favourable / optimal option ▪ Distortion of the incentive structure for efficient grid expansion
Non-firm connection agreements	▪ Low cost for network companies and grid users ▪ Shorter connection times reduce bottlenecks for LCTs ▪ Incentives to grid users to adapt to the grid capacity available ▪ Depending on the depth of connection charges, wider grid users could have lower costs	▪ Present bias could lead to non-optimal connection contracts ▪ Potential for non-optimal activation of non-firm connections ▪ Difficult to appreciate future curtailment costs ex-ante ▪ Potential discrimination for grid users (e.g. later connected)
Network tariffs	▪ Flexibility at no cost for network companies ▪ Potentially high cost reflectivity	▪ No controllability of the flexibility response ▪ Granular signals are complex to implement (e.g. distribution) ▪ Depends on whether grid users actually see the signal ▪ Tariffs could be sending inaccurate signals, for example not at the right granularity level
Market based procurement	▪ Incentive structure for efficient grid expansion ▪ High cost reflectivity ▪ Situational solution of grid bottlenecks ▪ Incentive for grid customers to provide flexibility, as remunerated	▪ Comparatively high transaction costs ▪ Possible discrimination against inflexible end users ▪ Market procurement is vulnerable to market failures (market power, complexity/ information overload etc.)

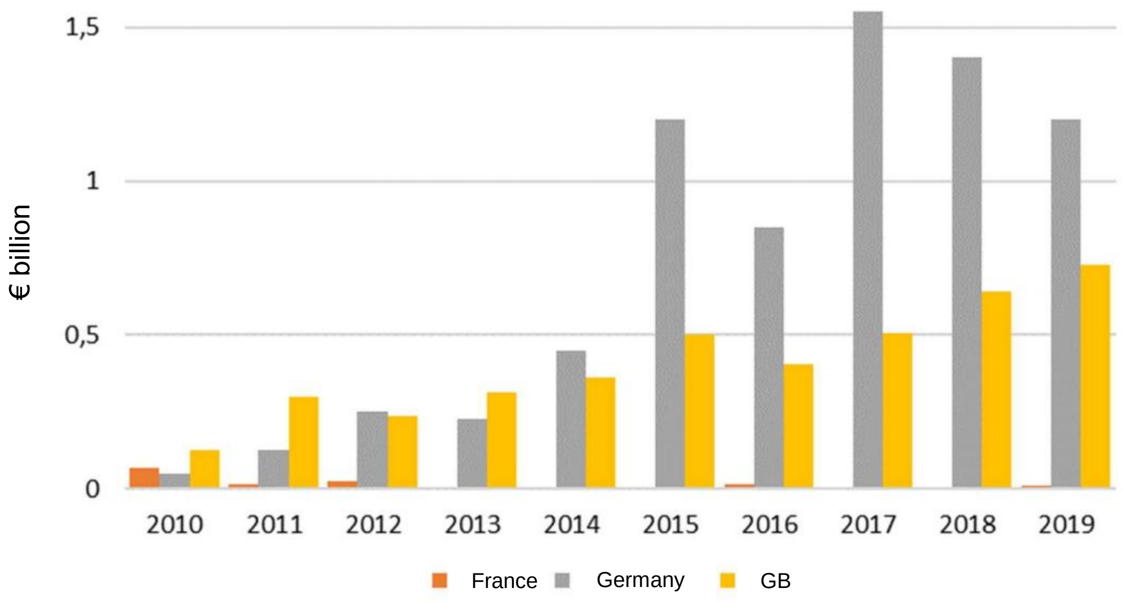
It is key to understand how the multiple mechanisms overlap, to organised in a coherent package unlocking network flexibility

3.

Case studies of flexibility mechanisms in France

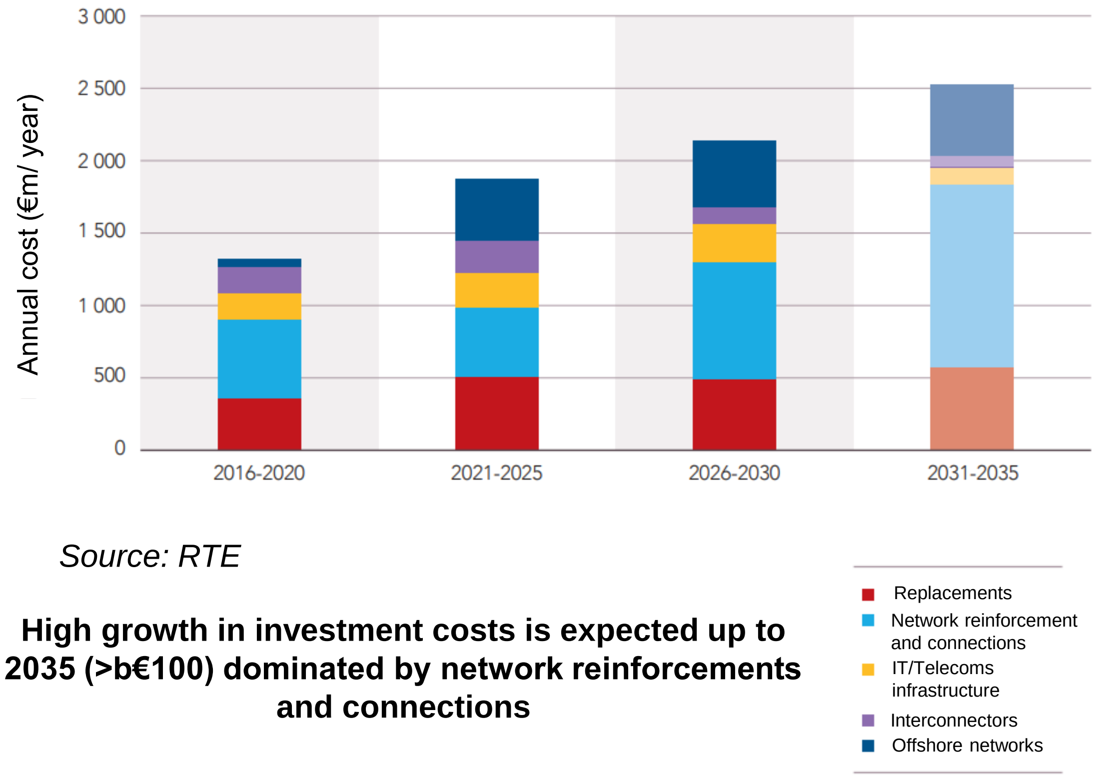
The French electricity system is facing a different situation than GB or Germany regarding network congestions, but substantial grid reinforcements will be needed for the energy transition

Evolution of the cost of internal constraints of the transmission network in France, Germany and Great Britain (2010-2019) in € billion



The costs of grid constraints, still moderate in France, have risen sharply in countries where the integration of renewable energy is more advanced

Estimated capital expenditure on the TSO network by 2035 (PPE scenario – SDDR reference trajectory)



Source: RTE

High growth in investment costs is expected up to 2035 (>b€100) dominated by network reinforcements and connections

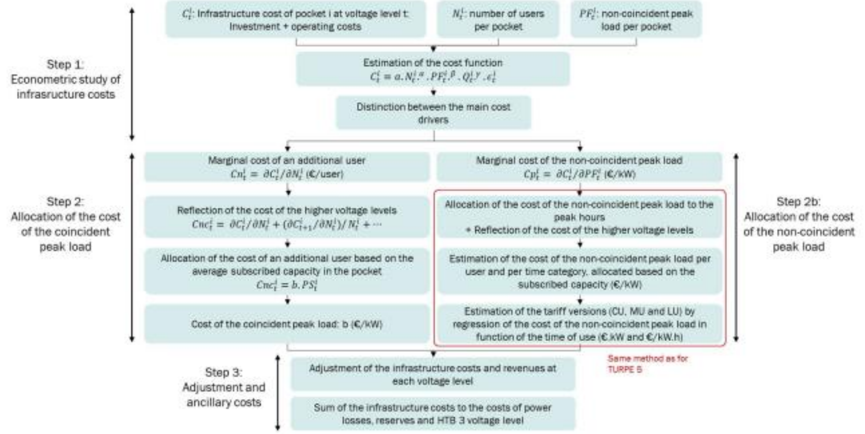
In theory, network tariffs should be able to reflect marginal costs induced by a certain use of the network and therefore provide adequate incentives for grid users to use their flexibility

- For the ongoing tariff period, the regulator analysed network costs in detailed and assessed marginal costs to develop a **marginal-cost network tariff structure likely to provide better price signals for grid users**:
  - – Decomposition of the network into small zones
  - – Analysis of the costs in each zone
  - – Econometric assessment of the relation between costs and drivers
  - – Derive “local” marginal costs
  - – Compute national marginal costs considered dimensioning rules of the SOs
  - – Ensure overall cost recovery

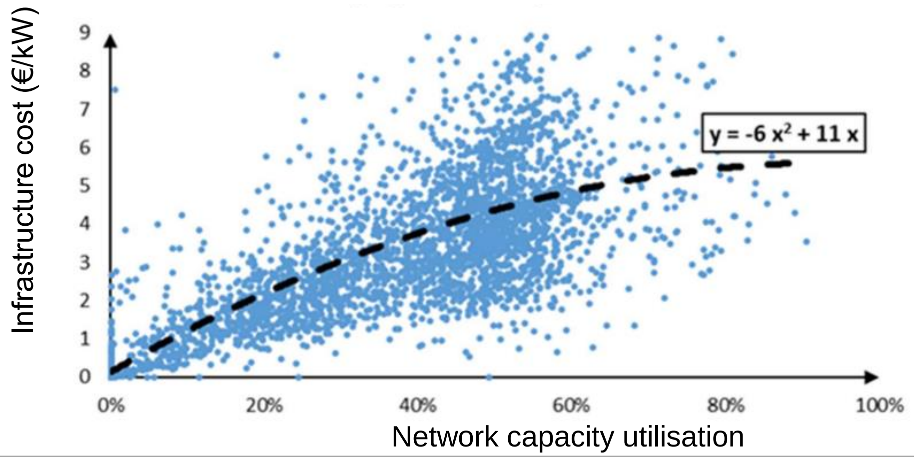
Key takeaways

- Significant improvements to cost reflectivity and incentives.
- However, still a few issues:
  - – **Backward-looking**: may not fully grasp the impact of future changes
  - – “Péréquation”: **no geographical differences** in network tariffs for consumers with similar characteristics
  - – Required **simplifications**: adapted to standard usages
  - – What about **generation**?

Network tariff structure methodology



Infrastructure costs (€/kW) per user for winter peak hours for the 63-90kV network zones depending on zonal capacity utilisation



Sources: CRE

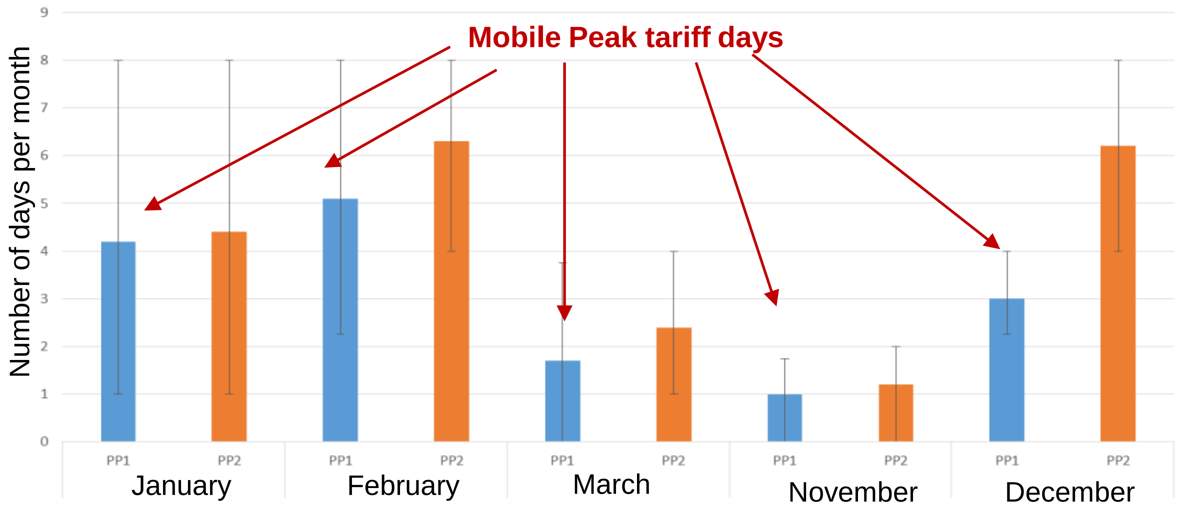
In France, temporal differentiation has been re-introduced in network tariffs, however localised signals are not present beyond connection prices

- In **the 1980s, EDF introduced time-of-use tariff options** as well as **critical-peak-pricing tariffs (EJP-Tempo)**: very high prices on specific days were inducing significant consumer reaction.

- After liberalisation, **network tariffs were separated from the supplier's part of the price for consumers**. CPP regulated prices proposed by EDF were no longer covering costs, potentially due to the absence of CPP in the grid tariffs.

- CPP was introduced in distribution tariffs under **'mobile peak' principle** – peak hours defined for a pre-set number of days, notified a day in advance, but only for MV consumers: CRE considered that the synchronicity of peak at national and local level was sufficient in MV (65%) but not in LV, where it could create re-synchronisation issues.

Average distribution of 50 scenarios of mobile peak days -PP1- for 2022



Key takeaways

- CPP in grid tariffs may be a good idea but it requires a level of granularity and potentially local differentiation.
- Its consistence with other price signals and the ability of suppliers to pass on this signal to consumers are also key.
- In practice, the experiment in France has not led to concrete results yet: only ~100 grid users chose this option in the first years.

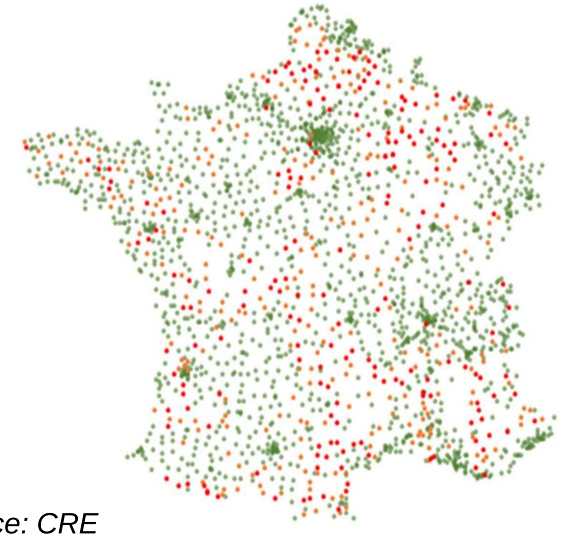
Source: RTE

Reflections took place to improve grid signals for generators and storage, both temporal and locational, but they were largely inconclusive

- The increased penetration of renewables at the distribution level and the development of new sources of decentralised flexibilities are changing flow patterns and dimensioning rules in the networks: **whereas investments were largely driven by increasing demand, they are more and more generation-driven**.

- Based on the evaluation of marginal costs at local levels, CRE envisaged a **G-charge with time and geographical differentiation**:
  - The objective was to provide incentive to adapt generation or store locally surpluses in periods of excess.
  - G-charge would apply only in zones where generation was dimensioning networks (potentially triggering additional costs).
  - This signal could provide short-term and long-term incentives.

Enedis substations categorised by the share of dimensioning hours with net positive distributed generation



Red: net generation are associated with more than 90% of dimensioning hours

Orange: between 5% and 90% of the dimensioning hours correspond to net generation

Green: less than 5% of the dimensioning hours correspond to net generation

Source: CRE

Key takeaways

- Many difficulties and drawbacks prevented this application of such a tariffication: high complexity, impact on RES development and past development, lack of forward-looking, disincentive to build storage, interaction with L-charge and potential discrimination between embedded and stand-alone generation/storage.

An "optimal dimensioning" of the network can reduce significantly investment needs through limited curtailments

RTE is implementing a principle of "**optimal dimensioning" for transmission network reinforcements**

- In this context, punctual peak shaving of generation could be carried out in specific areas and circumstances, in order to avoid building network infrastructures which usefulness would be needed only for a few hours a year.

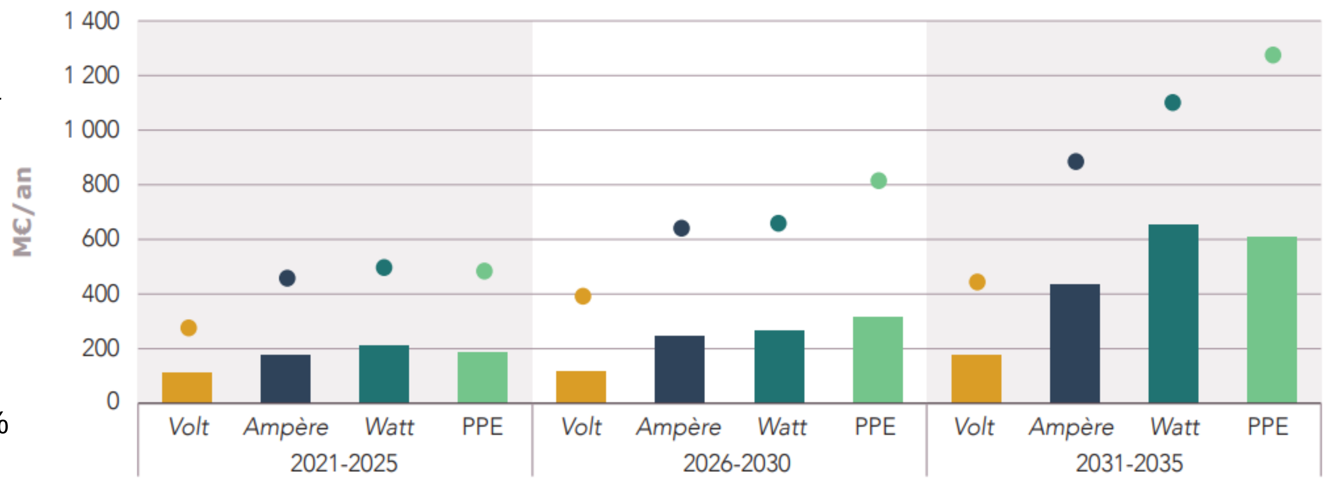
Significant network savings are expected thanks to limited curtailment of RES generation:

- In 2019, RTE estimated **€7bn savings in network investments** up to 2035 by following this principle, largely exceeding the compensation costs for the limited volumes of curtailed energy (0.3% by 2035).
- In its subsequent decision, CRE considered that the occasional use of generation modulations constituted a 'technically mature' and efficient solution to solve the constraints of the transmission network and avoid unnecessary and impactful investment.

CRE asked other sources of flexibility to be considered in network planning:

- Obligation to include flexibility solutions in investment CBA.
- Pilots for tendering flexibility.

Projection of network investments, with or without the provision of flexibilities through 'optimal dimensioning', in different scenarios



Source: RTE

Key takeaways

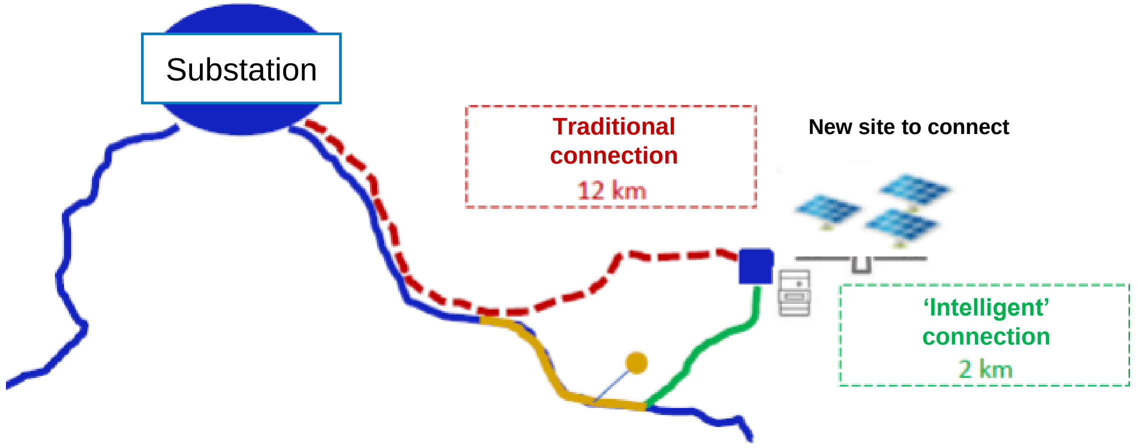
- A power system with no congestions might not be the most efficient one: an optimum can be found between new investment and residual congestions.
- Along this economic principle, RES curtailment could be considered to optimise grid development and avoid unnecessary/ costly/ hard to build investments. It could also foster and accelerate RES development.
- Cost savings could be substantial.

Different types of connections agreements can be designed to unlock flexibility while helping LCTs to connect quickly and at least costs to the network

'Intelligent' connection agreements

- In 2021, Enedis launched its flexible connection offers for renewable producers. This connection agreement makes it possible to avoid certain works for the connection.
- Enedis estimated **cost savings up to 90k€/MW** and **connection time reduction of 7-10 months**.
- In return, the producer accepts punctual limitations of renewable electricity production within **the regulated limit of 5% of the energy produced** and provided that the **possibility of injecting at least 70% of the requested connection power is permanently guaranteed**.

Intelligent connection agreements schematic



Source: Enedis

Key takeaways from non-firm connections

- Non-firm connection agreements can benefit both to network and new grid users. Being optional, new grid users can choose the optimal solution for them.
- Additional cost savings, triggered by impact on reinforcement needs, can exist, although they would likely not be considered in the decision of the new grid user.

French SOs launched flexibility tenders which have so far been unsuccessful due to low turn out

- On the distribution level, the French DNO Enedis has launched several pilot projects for local flexibility since 2011, and has **conducted local flexibility tenders** since 2020 to defer/ replace network reinforcement
  - Products are defined specifically to match technical needs in each tender
  - Contractual clauses differ, such as capacity/activation payment structures and contract lengths is typically one year, with potential for renewal

- The tenders have had a **very low response** from market participants.
  - In 2020, Enedis held 5 tenders, and signed two contracts with providers for one zone. The other 4 zones received no bids from providers.
  - In 2021 Enedis held 3 tenders, with no bids submitted in any of them

- **RTE is also envisaging local tenders to contract flexibility services** to resolve network constraints, complementing its dimensioning methodology. .
  - In 2021, 4 zones had been identified for localised flexibility tenders at transmission level. Three zones have been removed from consideration since then.
  - RTE is currently conducting its first tender for the remaining zone

Enedis local flexibility tender map, May 2022

Source: Enedis tender map.

Notes: Enedis is the main DSO in France.

Source: Enedis, RTE

As a result of its low response to tenders, Enedis has carried out a consultation at the end of 2021 to explore the future evolutions of their market design

Some of the issues identified included:	Some of the evolutions considered:
Tender process	
More information/ and time needed for providers to build their offer (for example detailed geographical data.)	Providing more information on geographical locations of opportunities (already implemented)
Aggregators had to finalise their portfolio of clients before submitting offers, which was a barrier to participation	Allowing aggregators to develop their portfolio of customers between the tender results and delivery period
There is no indication of willingness to pay provided to the market to provide visibility on opportunities	Providing maximum prices above which other network solutions would be considered / more profitable (risk of gaming?)
Market design	
For contracts with capacity reservation, the totality of the need had to be met with only one provider winning the tender.	Allowing multiple providers to be contracted for a given requirement
Products and contractual terms are specific to each tender zone, increasing complexity and do not provide medium/long term visibility	Contracts length going beyond 3 years, to provide revenue certainty
The minimum participation threshold was set at 500kVA	Lowering the technical capacity threshold for participation
Greater TSO-DSO coordination needed to facilitate joint access to common flexibility resources/ revenue stack-up	Allowing the assignment of flexibility contracts to a third party to develop a secondary market

Key takeaways from the local flexibility tenders

- Local flexibility tenders could be an adequate way to incentivise flexibility at local level, without complex tariff structures.
- For flexibility assets to locate and provide services though, they need visibility and to be able to stack up revenues. The tender process and market design needs to be constructed with flexibility providers to facilitate their participation.
- In these specific areas, connection modalities at transmission level may, for instance, prevent stacking-up and deter participation.
- Considering option value and whole system impacts is key to correctly value flexibility in the investment decision.

Source: Enedis

4.

Concluding thoughts

Key take-aways

The explicit flexibility procurement mechanisms may be easier to put in place compared to complex tariff structure, but the visibility and the ability to stack up of revenues are fundamental to foster participation

Other approaches, through connection conditions or ‘rule-based’, should also be considered as they may be easy to implement and may bring substantial value

However, the OPEX / CAPEX trade-off is influenced by the differences in investment characteristics, even under a TOTEX regulatory model

The incentives of network companies have to be adapted to adapt to flexibility procurement as an alternative to network solutions

To harness flexibility efficiently, flexibility signals across all mechanisms should be developed together to send coherent signals to users