



Flexibilities: because you're worth it! Scaling up renewables connection with local flexibilities

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EXTENDED ABSTRACT

In a few years from now, more renewables will be connected to the distribution network than centralised capacity is connected today to the TSO network. Connecting all these renewables facilities will require significant network reinforcements. Flexibilities have the potential to cost-efficiently reduce the need for reinforcements, be it in the form of Smart connections (~90 k€/MW for MV producers) or optimization of shared assets (ReFlex project : 30 % CAPEX savings with less than 0.06 % energy curtailment).

Introduction / background

The foremost flexibility use is with national market mechanisms, to manage supply-demand balance at any time horizon (ancillary services, balancing market, etc.). Such use of flexibilities has been a reality since the creation of the power system.

For network operators, local flexibilities are an additional lever to optimize network design and operations as they may provide solutions with a better cost/efficiency ratio for the community than “traditional” network management levers.

2 types of local flexibilities can help connect faster and or cheaper renewables to DSO networks:

1. **For an individual benefit, the Smart (or conditional) Connection Offer:** it is chosen by the customer as an alternative to his Reference Connection Offer (100 % capacity guaranteed at any time). The customer benefits from a cheaper and faster connection. In return, the customer agrees to temporarily curtailment on demand and without compensation from the DSO. The customer arbitrates between the reduced connection costs / delays and the impact of these limitations on its industrial process and its contractual commitments (especially with his Balance Responsible Party).
2. **For the benefit of the community, to optimize network design** (e.g optimization of shared assets such as the transformation capacity of a primary substation). Opting for a flexibility service requires that it provides greater value than “traditional” levers. The power modulation on demand by DSO by one or more grid users and selected by DSO for a collective benefit must be remunerated or compensated. DSO shall ensure that the effects of its activations are neutralized within the perimeter of balancing responsible parties and more globally within the entire community of Balance Responsible Parties.

Methodology

Enedis and the French Association of Electricity Distributors published in 2017 the report “[Economic assessment of smart grids solutions](#)”. This report assesses value of smart connections for MV producers, taking into account reinforcement costs and savings, curtailment energy cost, cost of substitution energy and instrumentation costs.

In France, connection of DER renewables is TSO-DSO jointly optimized and anticipated on the medium term through regional DER hosting schemes (Schémas Régionaux de Raccordement au Réseau des Energies Renouvelables aka.

S3REnR). In the first step of this design method, TSO surveys potential renewable DER pool on the medium term (localized within a 20*20 km grid and detailed by technology (solar, wind ...). Second step, TSO-DSO jointly optimize the network design to connect the whole potential pool to yield the Regional DER hosting schemes (list and cost of forecasted reinforcements, reserved capacity per primary substation, and unitary proportionate share X €/MW). When a project applies for connection of a Y MW generation capacity, it pays a connection fee X * Y regardless of actual reinforcement work. DSO & TSO trigger investment when needed.

The ReFlex project is so far unique in Europe. It aims at permanently embedding flexibilities in S3RENr to further optimize the overall design. Its alternative design considers that PV and wind farm do not produce at full capacity at all time, and considers a better balance between production and demand load curves. Further, it departs from 100 % capacity guaranteed at all times, that is allows production curtailment and further optimizes it (balancing the cost of curtailed energy, avoided reinforcement, and transformer losses). ReFlex allows thus to connect much more renewable on the same transformers than normal design, which greatly reduce CAPEX costs.

Results

Investments optimization within Regional Renewable Energies Connection Master Plans (S3REnR) is the 1st source of flexibility for Enedis public distribution network. Thanks to the ReFlex scheme, by 2035, the collective cumulative savings on the public distribution network could reach €250 million (a 30% cost saving on the considered assets, i.e. the transformation capacity of primary substations). Average curtailment of production will be less than 0.06 %. On the current network, 2.5 GW (equivalent to one year's generation facility connection) of additional capacity could be immediately made available. Market-based flexibility procurement will be the preferred approach to compete with generation curtailment, which is technically accessible, controllable, and at a capped and controlled cost.

Enedis started in 2021 a real scale experiment on 10 primary substations. There, the ReFlex design adds more than 210 MW connection capacity, and saves two 80 MW and two 36 MW transformers addition, and two 36 MW transformer upgrades.

Smart Connection Offers for MV producers have a more modest target, estimated at around 50 MW of generation capacities / year, that is about 1 out of 20 connection applications. Collective savings amounts to about 90 k€/MW. Such connection is relevant for medium size assets (to be able to connect without network reinforcement), and for assets far enough from the primary substation (saving the cost of a new feeder is a good incentive)

Conclusion & discussions

Smart connections for MV producers are part of Enedis Technical Reference Documentation since October 2021. It is the result of a 7-year collaboration with the Ministry of Ecological Transition, the French Regulator (CRE), producer federations, and the Union Française de l'Electricité (UFE).

The French S3RENr framework constitutes a medium term global optimization to connect DER, which enables to reduce overall cost to connect renewables DER, to anticipate needed work to connect DER, and to provide an even playing basis for each DER project. The ReFlex projects, which aims at permanently embedding flexibilities, is a further tool to reduce the cost of DER connection.

Flexibilities to help solve constraints on MV/LV secondary substations have an almost zero net present value, due to the cost to command and control such flexibilities. Flexibilities for the LV network, be it to solve LV constraints or MV or even HV constraints, are a matter of active R&D and demonstrators to assess the technical and economical perspective.