Tutorial 1:

Flexibility planning: infrastructure investment and optimization

Background

In the new energy transition paradigm, distribution system operators (DSO) are expected to procure flexibility services (FS) from distributed generation, demand response or energy storage providers, and Regulators are challenged to promote the uptake of such FS, whenever such services cost-effectively alleviate the need to upgrade or replace network capacity and support the efficient and secure operation of the distribution system [EU Directive 2019/944, Art. 32]. To this end, current planning methodologies must evolve so that DSOs may consider FS as a new available resource and, as such, procure the corresponding services when these are economically efficient and do not compromise security of service.

In the new paradigm, the planning exercise consists of searching for new types of (hybrid) solutions that combine investment in physical assets with the contracting of FS, and selecting the hybrid solutions with the highest net present value (NPV) when this value outperforms the NPV of the conventional counterfactual solution that relies on physical assets investments alone.

Aim of the tutorial

This tutorial provides the background to establish an efficient demand curve to procure FS based on conventional distribution network planning exercises. Procurement efficiency is defined as competitiveness with respect to (w.r.t.) conventional optimal solutions that tradeoff investment increase with congestions cost reduction and other possible benefits from quality of service improvement and losses reduction.

The first part of the tutorial will be dedicated to the changes needed in contingency analysis in order to characterize network congestions w.r.t. magnitude, duration and probability of occurrence. Once characterized, congestions need to be monetized before being traded-off against investment costs. Monetization requires congestion aggregation per cause and solution valuation per consequence. Examples from real use cases will be provided to illustrate the main challenges in characterizing network congestions in practice, and the role of the regulator in valuing possible investment solutions.

The second part of the tutorial will address the problem of valuing congestion management offers from FS providers based on their ability to defer investment costs in network reinforcements. A method that relies on the DCF methodology to estimate the cost of FS that would make the DSO indifferent between investment alternatives with different intervention by the flexibility market will be presented and discussed. Examples of congestions aggregation, FS procurement and market equilibrium solutions will be critically analysed in the light of practical experience with flexibility auctions.

Content

1. Conventional planning and investment alternatives supported on flexibility services
2. Flexibility service efficiency as competitiveness w.r.t. optimal conventional solutions
3. Methodological changes and evolution of tools necessary to procure flexibility services
4. Service limitations and criteria to rule out alternatives supported on flexibility

Expected benefits

Participants will gain an improved understanding of:

- DSO's planning challenges in the new energy transition paradigm
- Regulator's critical role in the transition, including that of monetizing loss load expectation
- How to use the DCF methodology to estimate FS value
- Procurement typical requirements for flexibility services and market needs

Who should attend

Distribution system planners, energy regulators, and end-users interested in providing flexibility services, companies and academics working in decision-support systems development for electrical energy utilities.

Support material

A copy of all the presentation material used in the tutorial will be supplied to delegates (electronic version).

About the presenters

Pedro Carvalho : pcarvalho@tecnico.ulisboa.pt

Pedro Carvalho is a full professor at IST, University of Lisbon, and a researcher at the INESC-ID. He is the coordinator of the Energy Scientific Area of the Department of Electrical and Computer Engineering at IST and the strategic coordinator of the Energy Transition thematic line at INESC-ID, where he carries out research in energy systems planning and optimization of electricity distribution networks. He is an entrepreneur in the development of decision-support software, having developed products with international acceptance by the industry. He was responsible for INESC-ID's participation in many research and development projects in international consortia in the area of power system planning, operation and control and has actively collaborated with the Department of Electrical and Computer Engineering at Carnegie Mellon University in the USA, where he was an Adjunct Professor until 2023, and responsible for the dual PhD degree in Engineering and Public Policy with IST.

Rui Bento : ruimiguel.bento@e-redes.pt

Rui Bento is an electrical engineer with twenty years' experience in LV, MV and HV distribution networks planning. He graduated from IST, University of Lisbon, and has worked at E-REDES (the mainland Portuguese DSO) ever since. In 2018, it became responsible for the company's network studies department, with the obligation to identify efficient investments to secure demand satisfaction, improve quality of service and reduce technical losses. Throughout his long professional career, he has actively participated in the evolution from classic planning approaches based on peak load scenarios to advanced probabilistic approaches based on synthetic consumption and production profiles.

More recently, he has been responsible for the development of efficient planning approaches that rely upon flexibility.