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ERANET project DiGriFlex: Description of ancillary services provided within and from distribution grids

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Background

The increase of distributed generation (DG) sources penetration in LV networks implies several challenges that grid operators were not used to manage in the past.
Among these challenges there is the need to manage power flows in low voltage grids, as well as flexibility provision to upstream networks.

Objectives

The description of ancillary services provided within (local services) and from distribution grids (export services) and the definition of relative costs and benefits of operational and scheduling options for distribution grids are the objectives for this project part.
The expected result is a formulation capable to compute if the use of a flexible system in replacement to classical solutions is convenient, in order to help the development of control methods to ensure efficient and secure operation of distribution grids, main objective of the project.

Ancillary services definition

Local services

Balancing

Achieved with: short-term reserve for local balancing positive and negative, including demand response.
Value: the cost of an eventual network reinforcement.

Congestion management

Achieved with: node voltage, line loading, transformer loading or peak demand management.
Value: cost of the network reinforcement.

Voltage control

Achieved with: reactive/active power control, as well as control of voltage quality.
Value: cost of tap changer and/or voltage regulator.

Continuity of service

Achieved with: black start and/or islanding capability.
Value: the eventual cost of interruption of commercial services.

Export services

Frequency control

Achieved with: classical frequency reserves, synthetic inertia and V1G/V2G in the future.
Value: historical prices of aFRR and mFRR.

Congestion management

Achieved with: load levelling, using the same congestion management systems for the local services.
Value: Cost of reinforcement of the upstream network reduced or cancelled.

Voltage control

Achieved with: reactive/active control power in distribution grids.
Value: tariffs for voltage management according to Swissgrid (only relevant for NL1).

Flexibility evaluation approach

At the moment, a simulation plan to evaluate the grid reinforcement necessity and cost in different scenarios is proposed (figure 1).

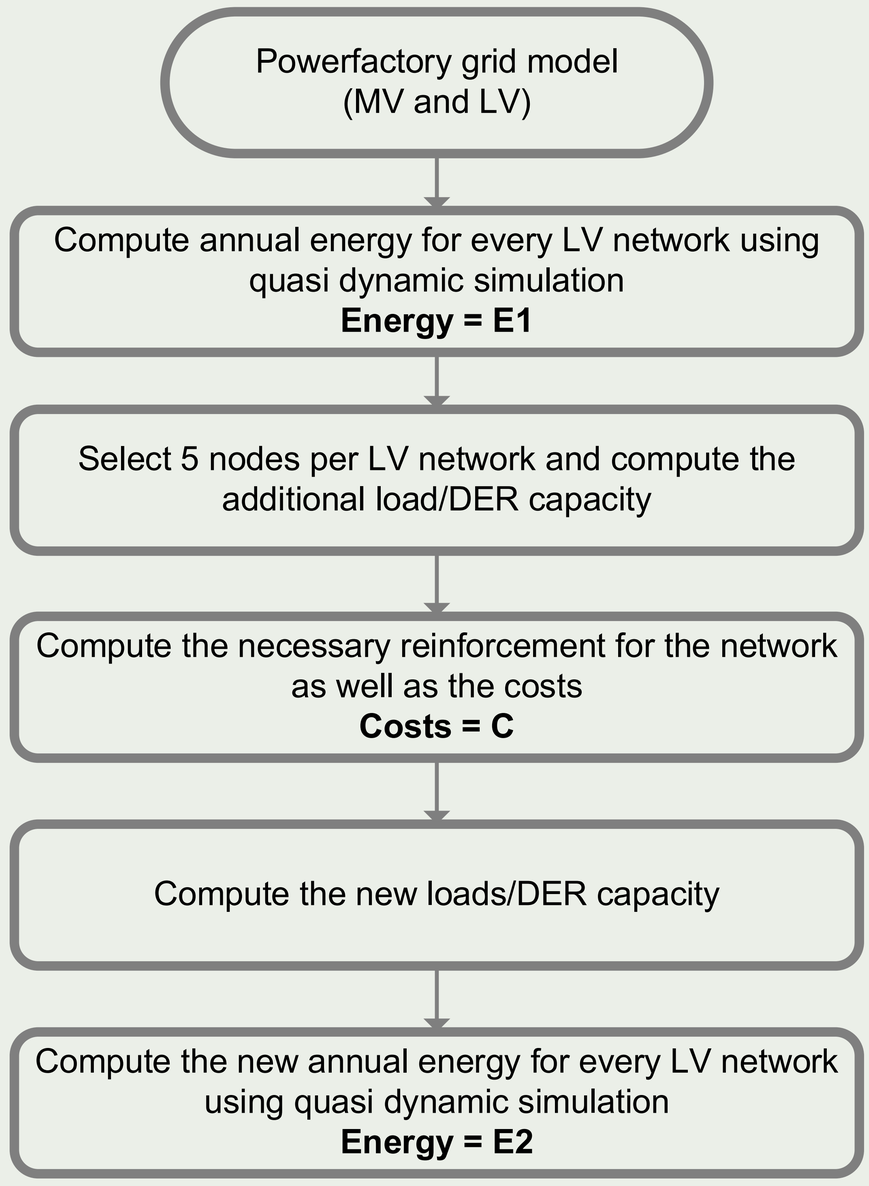

Fig.1 Simulation workflow

Using the simulated energies (E1, E2) and costs (C), it is possible to determine a value per kilowatt-hour of the reinforcement cost. This will represent the flexibility value (equation 1). The annuity value per kilowatt-hour can also be calculated (equation 2).

$$C_{kWh} = \frac{C}{E2 - E1} \quad \textit{(eq. 1)}$$

$$C_{kWh-y} = \frac{C_{kWh}}{n_{years}} \quad \textit{(eq. 2)}$$

The value of the annuity gives a direct indication of the cost-effectiveness of using flexibility.

Conclusion and future work

The definition of auxiliary services made it possible to discriminate which services were relevant to the proposed study. An idea to calculate the potential relative value of flexibility was subsequently developed.
Future steps include the development and validation of simulation models and a summary of the differents outputs to give a definition of the value of flexibility.

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