

Power system flexibility: the ability to manage change

Solutions providing advances in flexibility are of utmost importance for the future power system. Flexibility is not a unified term, instead flexibility is used as an umbrella covering various needs. In an over-all system view, flexibility needs can involve: stability, frequency & energy supply. In a local/regional view, flexibility needs can involve: transfer capacity, voltage & power quality. To support operation and planning, flexibility support may be required in the timescales of:

Fractions of a second: stability and frequency support

Minutes and hours: thermal loadings and generation dispatch

Months and years: seasonal adequacy and new investments

This complicates the discussion on flexibility and craves for differentiation to enhance clarity.

Categorisation of flexibility needs

In the report on *Flexibility needs* prepared by ISGAN Annex 6, flexibility is categorised based on the needs in the power system. The categorisation is intended to provide increased understanding of the flexibility concept, to assist identification and selection of the most suitable solutions which can support the flexibility needs.

Flexibility for Power

Need Description: Short term equilibrium between power supply and power demand, a system wide requirement for maintaining the frequency stability.

Main Rationale: Increased weather dependent power supply in the generation mix.

Activation Timescale: Fractions of a second up to an hour.

Flexibility for Energy

Need Description: Medium to long term equilibrium between energy supply and energy demand, a system wide requirement for demand scenarios over time.

Main Rationale: Decreased fuel storage-based energy supply in the generation mix.

Activation Timescale: Hours to several years.

Flexibility for Transfer Capacity

Need Description: Short to medium term ability to transfer power between supply and demand, where local or regional limitations cause bottlenecks resulting in congestion costs.

Main Rationale: Increased utilisation levels, peak demands and peak supply.

Activation Timescale: Minutes to several hours.

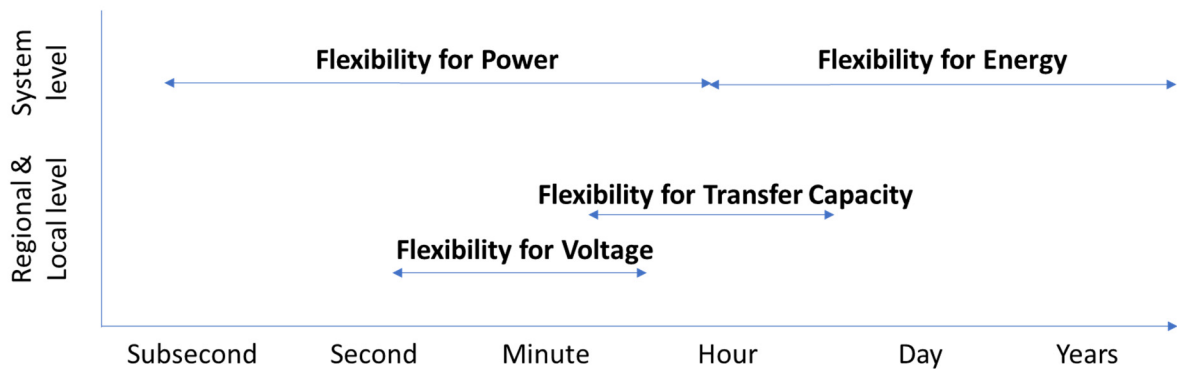
Flexibility for Voltage

Need Description: Short term ability to keep the bus voltages within predefined limits, a local and regional requirement.

Main Rationale: Increased distributed power generation in the distribution systems, resulting in bi-directional power flows and increased variance of operating scenarios.

Activation Timescale: Seconds to tens of minutes.

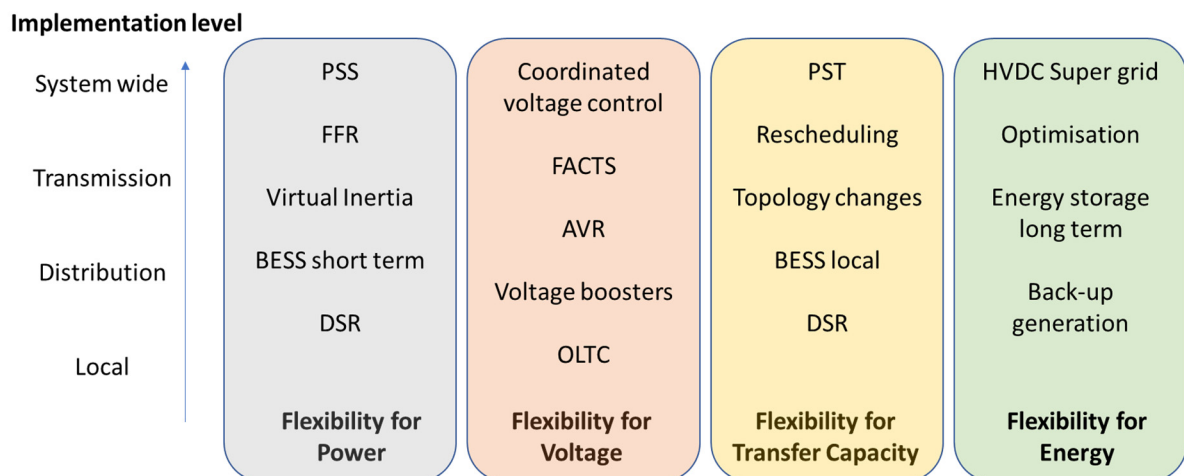
Flexibility needs in time and space



Interrelations in space illustrate how the flexibility need categories are separated between local, regional and system wide levels of the power system.

Interrelation in time is illustrated by the specific ranges of required activation time of each category. Activation time requirements of the flexibility needs are influenced by regulation and the physical behaviour of the power system.

Flexibility providers



Supporting flexibility needs may involve solutions, including for example:

System services: Fast Frequency Response (FFR), Virtual Inertia,

Control-based responses: Power System Stabiliser (PSS), Demand Side Response (DSR), Automatic Voltage Regulator (AVR), On-Load Tap-Changer (OLTC),

Operational procedures: Coordinated voltage control, Rescheduling, Topology change, Optimisation,

Implementation of new power components: Battery Energy Storage System (BESS), Flexible AC Transmission System (FACTS), Voltage booster, Phase-Shifting Transformer (PST), HVDC, Back-up generation

Solutions are implemented on different hierarchical levels in the system, from local through distribution and transmission, to the system wide implementation level, and may provide support to several of the flexibility need categories.

For further reading, download the full ISGAN Annex 6 report:

iea-isgan.org/flexibility-in-future-power-systems