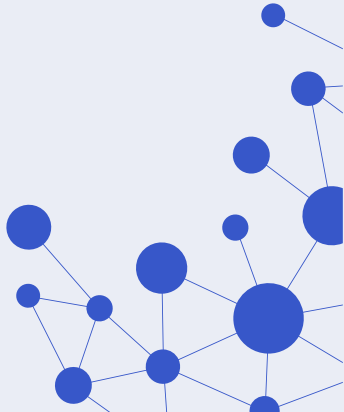


How can the system efficiency be increased by using the flexibility potential?

Dr. Turhan Demiray

October 30, 2018

IEA Networking Event, Switzerland



ISGAN in a Nutshell



Created under the auspices of



The Implementing Agreement for a
Co-operative Programme on Smart Grids



An initiative of the Clean Energy Ministerial
(CEM)

Strategic platform to support high-level government knowledge transfer and action for the accelerated development and deployment of smarter, cleaner electricity grids around the world

International Smart Grid Action Network is the only global government-to-government forum on smart grids.

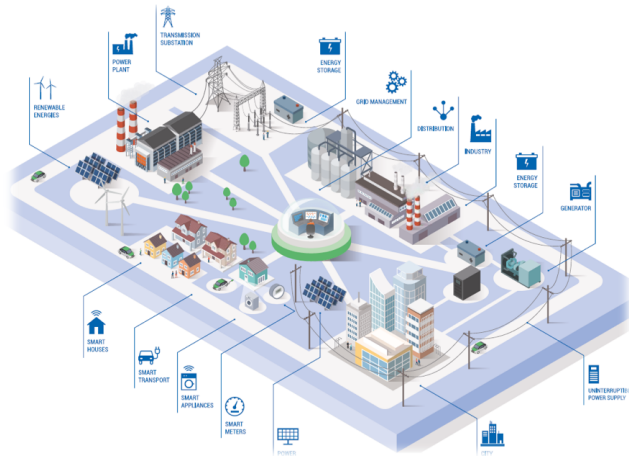


Annex 6 in the ISGAN World

Power Transmission & Distribution Systems

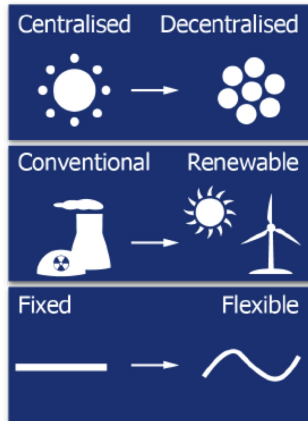
Main Objectives

- **Improve understanding** of Smart Grid technologies
- Focus on potential **system-related challenges** in the development of future smarter grids
- **Promote solutions** to maintain and improve security, reliability and quality of electric power supply

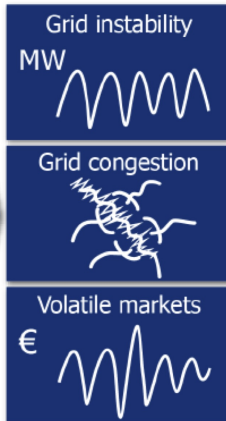


Current Focus of Annex 6 Activities ...

TRENDS



OBSTACLES



SOLUTIONS



KEY



What is flexibility?

- Several definitions, Council of European Energy Regulators propose: „***Flexibility is the capacity of the electricity system to respond to changes that may affect the balance of supply and demand at all times***” (CEER 2018)
- Flexibility has both **technical** and **commercial** dimensions, where the technical capabilities may be utilized to support the grid and the system in accordance to the commercial capabilities of the markets and their regulations.
- Flexibility may be provided and handled by several parties:
Supply, Transfer, Demand, Storage, Market

Flexibility in Supply

■ Rationale:

- Maximise RES integration, Frequency & voltage stability,

■ Conventional:

- Use of conventional generation for frequency & voltage support

■ Semi-Conventional:

- RES dispatch
- Increased operational flexibility of thermal units (min load, ramping, start- up time...)

■ Innovative:

- Increased flexibility regarding fault-ride-through-capability, RoCoF, etc.
- RoCoF requirements are already increasing in some power systems (e.g. Ireland)
- System services from power electronic based devices: synthetic inertia, short-circuit currents, P/Q control

Flexibility in Supply

Example

- Providing primary frequency response with PV generation (Pourbeik 2017)
- Utilising PVs at 90% of optimum \Rightarrow providing reserves for frequency response

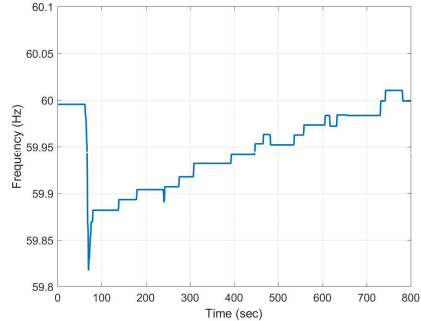
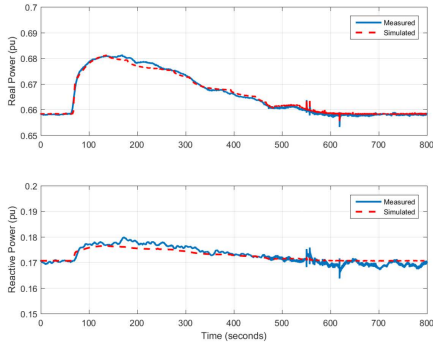


Figure: Underfrequency response for the 250 MW PV plant. Plant in Frequency responsive control

Flexibility in Transfer

■ Rationale:

- Increased transfer capacity

■ Conventional:

- Phase-shifting transformers
- Series-compensation
- FACTS

■ Semi-Conventional:

- Dynamic line ratings for Overhead Lines

■ Innovative:

- Time variable transfer tariffs to influence behaviour during preventing peaks
- Dynamic ratings and seasonal limits for cables & transformers

Flexibility in Demand

■ Rationale:

- Follow supply (frequency stability), voltage stability
- prevent bottlenecks

■ Conventional:

- Bi-lateral agreements with dedicated large customers for decreased demand if required during peak demand or extraordinary circumstances (Load Shedding)

■ Semi-Conventional:

- Hourly energy measurements and pricing to influence behaviour for peak shaving

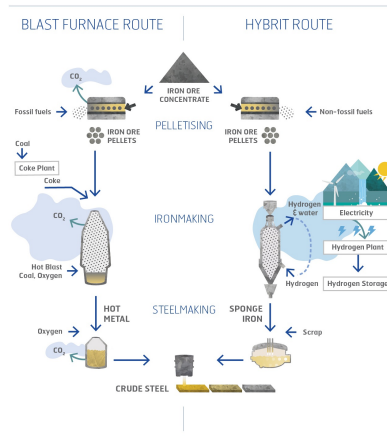
■ Innovative:

- **Demand side response**, aggregators to utilise large number of flexible
- **Broadening ranges** of acceptable voltage and frequency levels
- **Development of industrial processes** to provide flexible demand/storage/supply

Flexibility in Demand

Example - Swedish steel production with hydrogen - HYBRIT

- Changing the industrial process to become fossil fuel free
- The process utilise hydrogen production and storage
- Enabling flexibility to the power system as flexible load (depending on design of hydrogen plant and storage)
- A full scale deployment within the steel industry would reduce around **10% of Sweden's carbon dioxide emissions**
- Enable the use of about **10-15 TWh/yr** of renewable electricity (about 10% of Swedens electricity consumption)



Flexibility in Energy Storage

■ Rationale:

- Secure energy supply, frequency stability, voltage stability, prevent bottlenecks
- Utilising energy price differences to maximise profit

■ Conventional:

- Hydro reservoirs (seasonal)
- Pumped hydro (daily)

■ Semi-Conventional:

- Mechanical (Flywheel), chemical (Battery, Fuel cell), thermal (Heat)

■ Innovative:

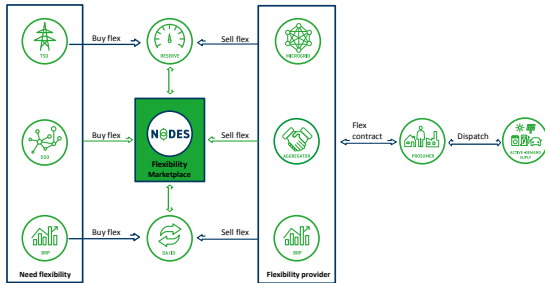
- Increased interaction between **multi-energy carrier systems** (electricity, heat, gas)
- **Ancillary services** from battery storages and other type of storages

Flexibility in Markets

Example - NODES

- Market mechanisms should enable better utilization of available local flexibility

- **Price formations:** (time and location)
- **Incentives and stimuli**
- **Avoid future grid investments**



■ NODES:

- Developed by the Norwegian energy company Agder Energi and the Power Exchange Nord Pool
- New marketplace, placing a value on flexibility, which bridges the gap between current wholesale power markets and local flexibility markets

Thank you for your attention

*... and special thanks to Operating Agents of Annex 6
Emil Hillberg and Joni Rossi for their support*

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