



Demand Side System Services

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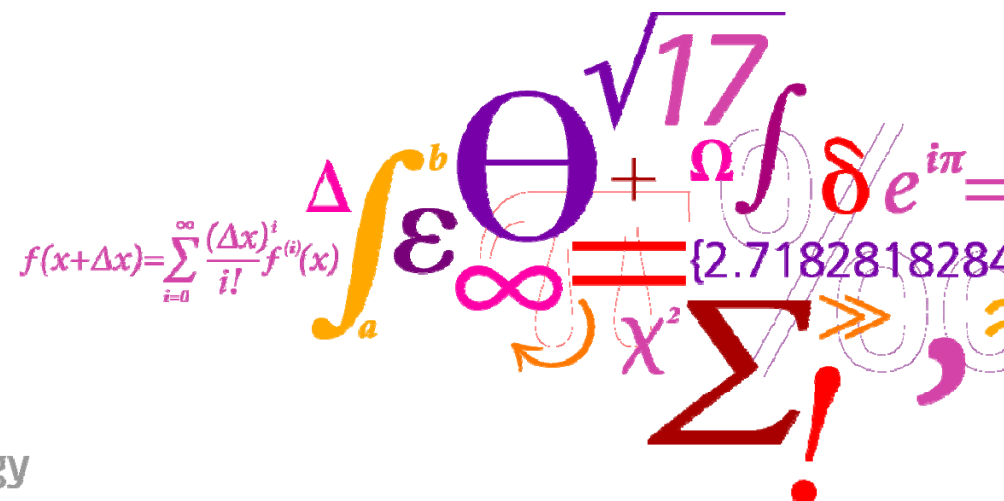
Demand Side System Services

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Content

- Background
- Why involve the demand side?
- Power system services
- Related projects
- What can the demand side do?
- How can it be made deterministic?
- What will be included in the project?

Background

- Increasing wind penetration
- Flexibility is needed to balance the wind power fluctuations
- Reduce the number of large power plants running at low load only providing grid services

Why involve the demand side

- Many types of loads can be shifted in time
- The demand side is already getting more and more intelligent and flexible (home automation systems)
- Bi-directional communication is becoming cheaper
- The demand side has the potential of supplying grid services at a competitive cost

Which services are needed?

- Frequency response
- Reserve power
- Reactive power
- System Security
 - Black start
 - Fault handling

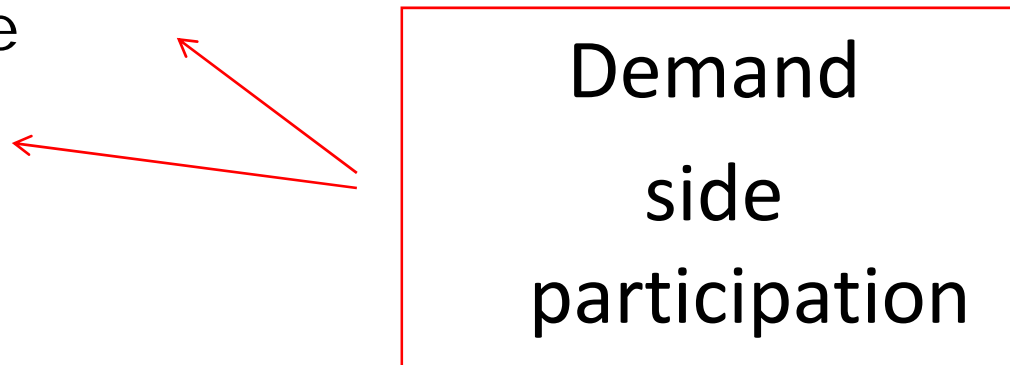
Who can provide these services?

- Generators
 - Large production units
 - Backup generators

- Demand side
 - Large loads
 - Aggregation of smaller loads

Demand side services

- Frequency response
- Reserve power
- Reactive power
- System Security
 - Black start
 - Fault handling



Related projects

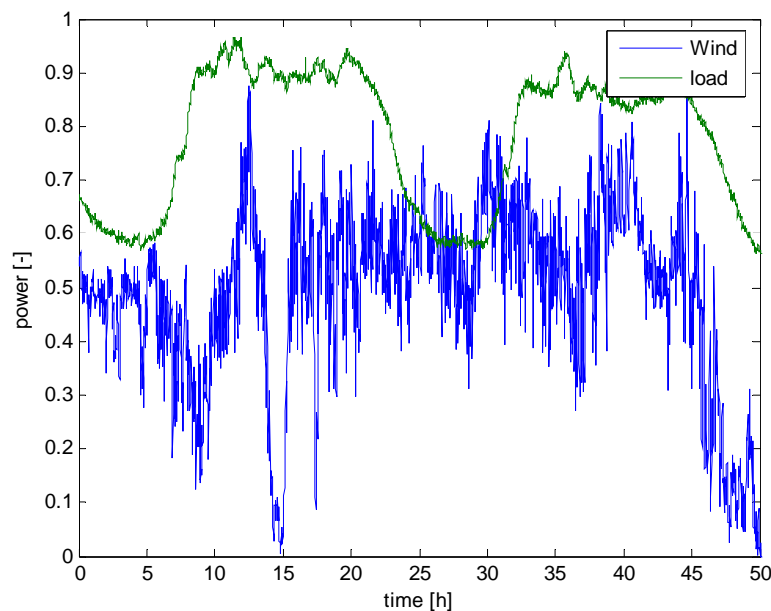
- Demand as Frequency Controlled Reserve
- Pacific Northwest GridWise projects

Focus on:

- Response to system frequency
- Load shedding functionality
- Thermal loads

Fluctuations from wind production

- Distributed wind production causes power fluctuations in the distribution system
- Services from loads are practical to locally neutralize these fluctuations



Response types from demand side

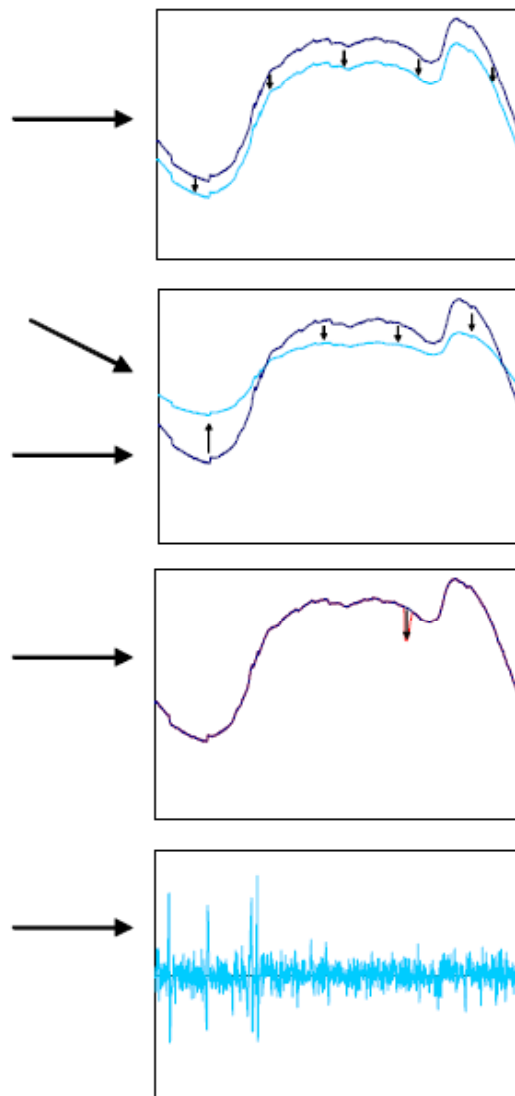
- **Energy Efficiency** reduces overall consumption and often reduces peak demand

- **Price Response** moves consumption from high demand time(day) to low demand time(night)

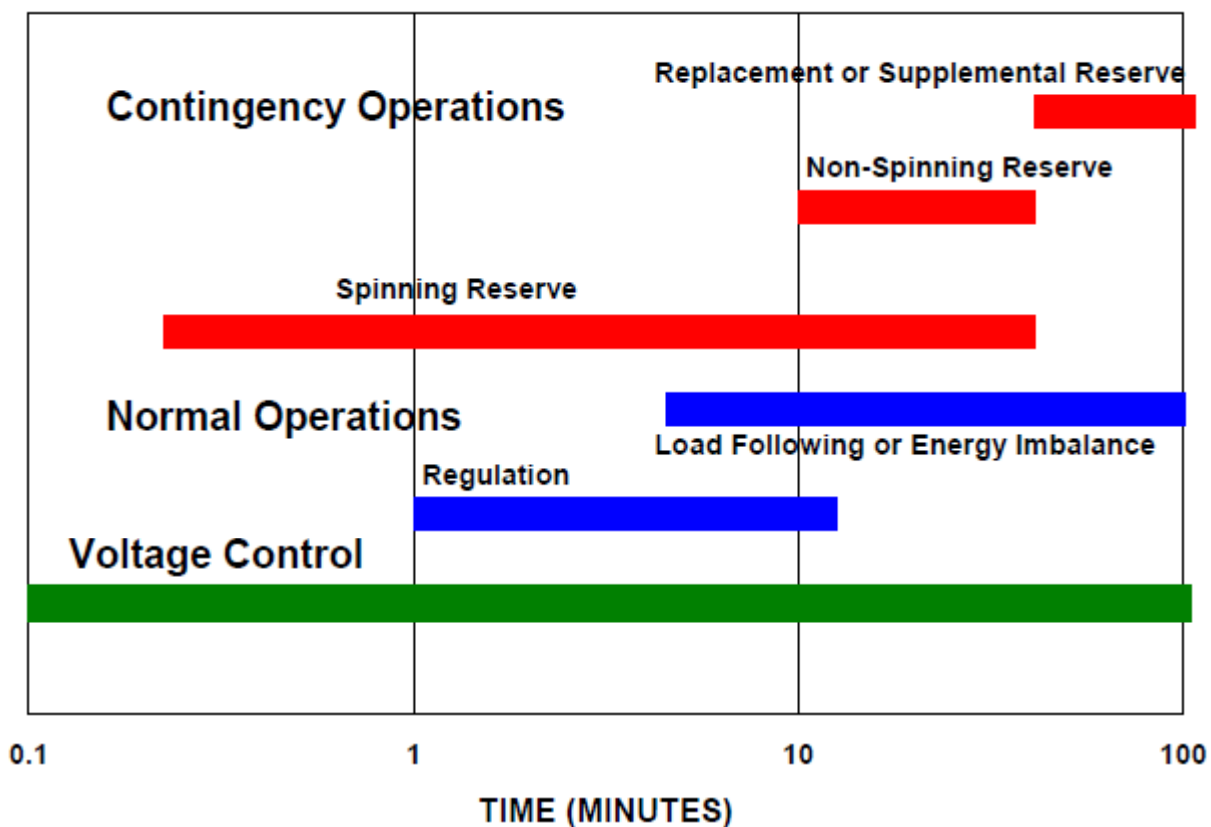
- **Peak Shaving** requires more response during high demand and focuses on reducing recurring peaks

- **Reliability Response** requires fast short duration response and only during power system events(faults)

- **Regulation Response** the continuous balancing of the power system production and demand.



Speed and duration of load response



What is the regulation capacity of the various loads?

- Electrical heating
- Freezers
- Refrigerators
- Circulation pumps
- Household appliances
- Water heaters
- Washing machines

Demand side control

- Implementation issues
- Coordination
- Determination of capacity
- Aggregation
- Statistical or deterministic approach

PhD project

- Characterisation of loads
- Available capacity from the demand side
- Control strategies for loads
- Implementation and testing in SYSLAB

