The needs for demand response in Finland

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Topics of the presentation

- Aims and benefits of demand response
- Definitions
- Forms of demand resoponse
- Factors affecting the need of demand response
- Demand response in Finland: case 2020
- Conclusions

Aims of demand response

- socio-economic viewpoint
  - balance management in a system level
  - decrease of CO2-emissions (efficient use of energy)
  - better electricity market
    - more stable electricity prices for market players
    - avoiding market failure
- consumer viewpoint:
  - lower cost of electricity
  - more reliable power supply
  - (saving the planet)

Benefits of demand response

Due to improved power system balance management:

- less investments on reserve power capacity
- less investments on generation capacity (generation adequacy)
- lower use of existing reserve power capacity -> reserves more available for other needs

Other benefits:

- less (or postponed) investments on grid
- saves energy and environment

Definitions

Demand Side Management (DSM)

- covers load management, energy efficiency, demand response, strategic conservation and related activities.
- aims to reduce the demand for energy and to shift demand from one time period to another

Demand Response (DR)

- the ability of electricity demand to respond to control signals, energy consumption limitations or variations in electricity prices in 'market' or 'real' time

Source: SGEM Glossary

Forms of demand resoponse 1/2

Different ways to classify DR:

- by speed of activation
  - fast (from seconds to few minutes): activated automatically by system frequency change
  - slow (from minutes to an hour): activated in certain level of electricity market price
    - manually or automatically activated

- by duration of response
  - short: from seconds to minutes
  - long: from hour to several days

Forms of demand resoponse 2/2

- by source of load
  - households, industry (smi, or large consumers), others (shopping centers, electric traffic; trains, trams, EVs, etc.)
- by type of control
  - market-based (automatic or manual), agreement-based (automatic or manual), emergency control (automatic)
- by impact of response
  - decreasing a load, shifting a load in time, increasing a load

Factors affecting the need of demand response 1/3

Electricity genaration mix in the future

- large generation units require more reserves
- flexibility/controllability of generation
  - high cost of flexible generation
- variability of (RES-)generation

Variation of load in the future

- flatter load profile or more/higher variations (e.g. the impact of EVs)
- correlation of load and variable generation in time

Predictability of load and generation

Factors affecting the need of demand response 2/3

The cost of demand response

- technical potential and costs depend on the characteristic of the needed demand response
- the more fexibility in the market the less attractive it is to bid new DR
- market design, business models and regulation affect the incentives to bid DR to the market

The availability of (rotating) reserve power

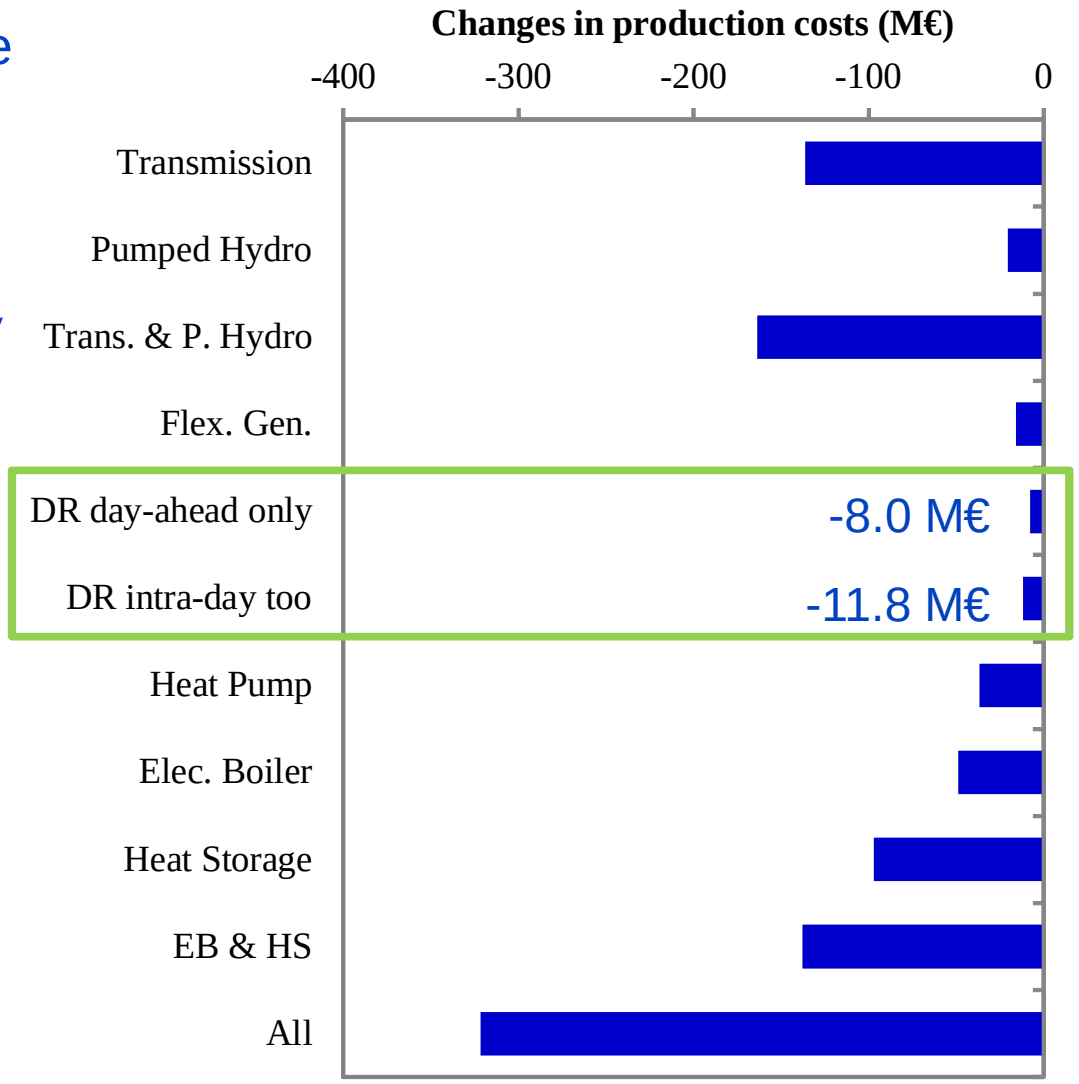
- e.g. higher reserve prices due to decreased import from Russia

Factors affecting the need of demand response 3/3

Other solutions (and their cost) to improve the power system balance management

- energy storages (electricity, heat, kinetic, potential...)
- increased transmission capacity
- better control of variable generation

A study: benefits of DR to reduce generation costs (peak shaving) compared to other sources of flexibility (see the figure)



Source of the figure: Kiviluoma et al - Economic comparison of technical options to increase power system flexibility, VTT, WIW-2012, Session 6C, Lisbon14.11.2012

Demand response in Finland: case 2020 1/2

Assuming that in 2020 in Finland

- need for reserve:
  - 100 - 200 MW activated in 5 s (to compensate lower inertia due to wind power)
  - 300 MW in 30 s (freq. contr. disturb. res.)
  - 150 MW in 3 min (freq contr. norm. oper. res.)
  - 1300 MW in 15 min (fast distrurb. res.)
- need for power control
  - wind power can vary 1500 MW in 6 hours

Demand response can be partly used to cover the above mentioned needs

Demand response in Finland: case 2020 2/2

Requirements for DR when used for system balance management

- if used to replace reserve power capacity
  - the planned capacity must be reliably available at any time
  - must be possible to activate any amount between zero and the the planned capacity
  - requires information about availability in each moment of time
- if used to decrease the use of reserve power capacity
  - must be possible to activate any amount between zero and the predicted capacity at any time
  - requires information about availability in each moment of time

Conclusions

- The need of DR depends on various factors
- DR is needed to save the environment, improve the functioning of electricity market and ease the system balance management
- Important for DR from the system point of view:
  - fast frequency-based demand response downwards
  - high reliability and availability of demand response

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