EU Parliament, 30th of May 2017

BEST PRACTICES ON HOW TO MAKE ELECTRICITY CONSUMERS ACTIVE AND EFFICIENT MARKET PARTICIPANTS AND HOW TO REWARD THEM FOR THEIR FLEXIBILITY – EXAMPLES FROM THE NORDIC MARKETS

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DEFINITION OF DEMAND RESPONSE

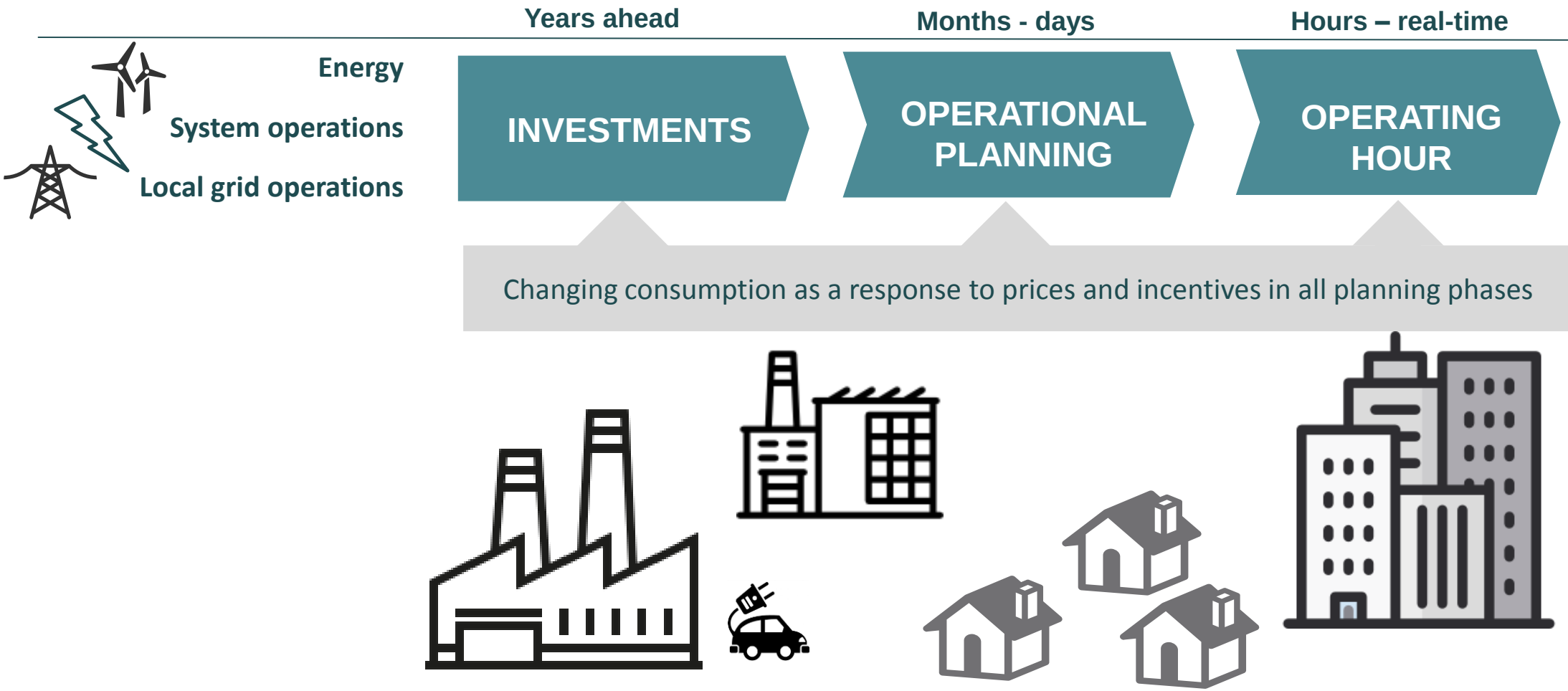
Changes in electric usage by demand side resources **from** their **normal consumption patterns** …

… in **response to** changes in the **price of electricity** over time …

… or to **incentive payments** designed to induce lower electricity use at times of high prices and system stress

Source: FERC

PURPOSE OF DEMAND RESPONSE:
TO IMPROVE THE FUNCTION OF THE POWER SYSTEM AND LOWER COSTS



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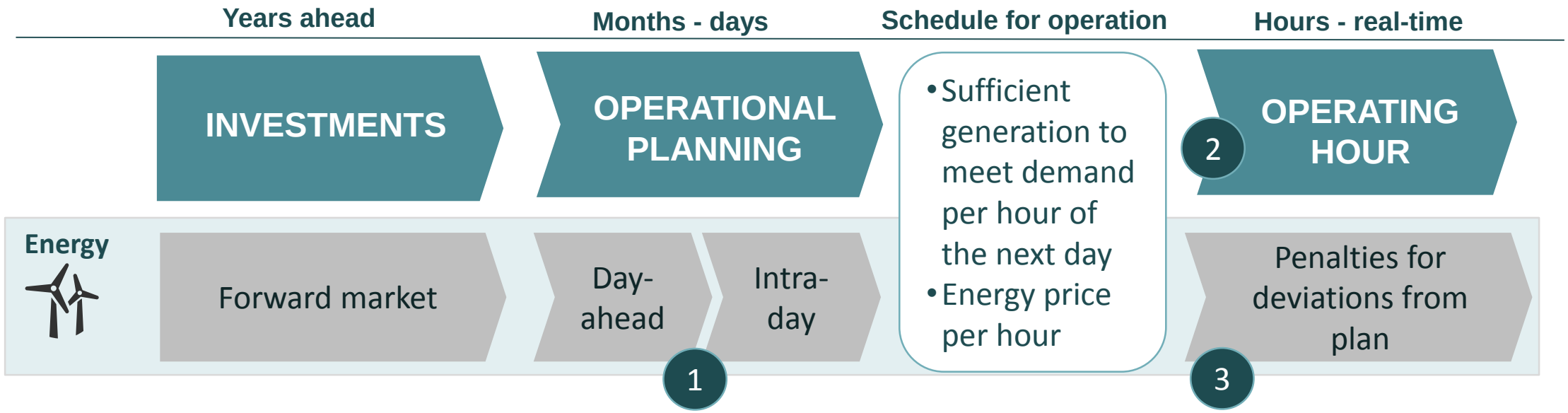
BEST PRACTICE IN ACTIVATING THE POWER CONSUMER IN THE ENERGY MARKETS

- Avoid trouble in the operating phase
  - Give incentives for the demand side to plan their consumption the day and hours before operation
  - …since demand response in real-time is more expensive
  - Reward is not the only incentive: Deviation from plan results in a fee (imbalance costs)

- Markets are «big data» - take advantage of them
  - Allow the demand side in all markets
  - Allow markets to do its job to engage consumers – do not cap prices
  - This will reduce peak demand and increase demand response

THREE STEPS FOR DEMAND RESPONSE IN THE ENERGY MARKET – PLANNING IS CRUCIAL



1. **Large consumers and suppliers (on behalf of small consumers) will inform the market how much they plan to consume per hour the next day.** The plan (volume) may depend on the price – you then show your price sensitivity before the operating hour.
2. **Small consumers may respond to prices** – reduce their consumption in hours with high prices and increase in hours with low prices. Suppliers will learn from this behaviour and include it in their plan.
3. **Large consumers (and suppliers) will (normally) have to pay a fee if they deviate from schedule**

DEMAND REDUCTION IN PERIODS WITH HIGH MARKET PRICES

TWO EXAMPLES

- 16 % of the demand is price dependent
- For this hour the price ended at 158 EUR/MWh – cutting off 8.300 MW demand
- **This demand cut represents 12 % of peak load***

Price range [EUR/MWh]	14 December 2010		23 January 2015	
	MW	Per cent of total	MW	Per cent of total
-200 – 0	695	1.22 %	1 285	2.07 %
0 – 50	2 755	4.83 %	3 222	5.19 %
50 – 100	4 981	3.73 %	482	0.78 %
100 – 150	333	0.58 %	289	0.47 %
150 – 200	199	0.35 %	233	0.38 %
200 – 250	130	0.23 %	77	0.12 %
250 – 300	176	0.31 %	173	0.28 %
300 – 400	214	0.37 %	439	0.71 %
400 – 500	114	0.20 %	242	0.39 %
500 – 1 000	160	0.28 %	229	0.37 %
1 000 – 2 000	46	0.08 %	199	0.32 %
2 000 (price inflexible)	47 246	82.82 %	55 166	88.93 %

- 9 % of the demand is price dependent
- For this hour the price ended at 53 EUR/MWh – cutting off 3.200 MW demand
- **This demand cut represents 4.5 % of peak load***

Source: THEMA (2015): Capacity adequacy in the Nordic Electricity market. Based on bidding data from Nordpool Spot

** Peak load being 71.000 at Nordpool Spot*

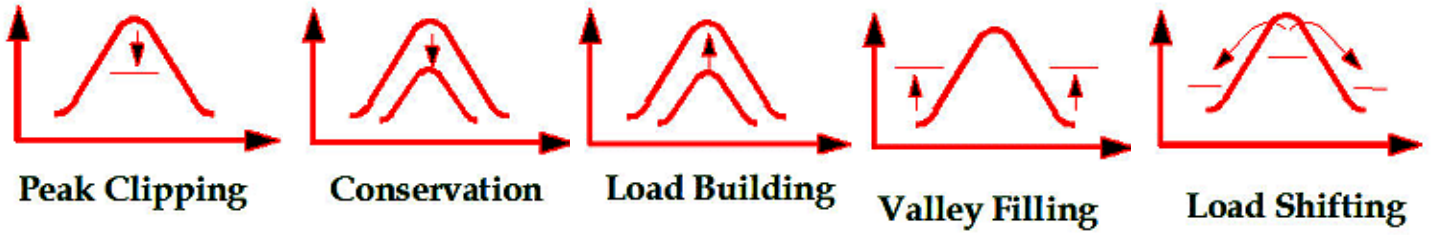
SMART METERS, PRICE INCENTIVES, AVAILABLE MARKET AND CONSUMPTION DATA ARE NEEDED TO ENABLE DEMAND RESPONSE FROM SMALL CONSUMERS

- THE NORDIC MARKETS ARE GETTING THERE

	Norway	Sweden	Finland	Denmark
Smart meter roll-out	2019	2009	2015	2020
Metering time resolution	Technical: 15 min Use: Hourly	Hourly / monthly New meters: 15 min	Technical: 15 min Use: Hourly	Technical: 15 min Use: Hourly/ 15 min
Share of spot price contracts (2013)	32 %	25 %	8 %	5 %
Data hub	From 2017	From 2020/2021	From 2019	Yes
Capacity grid tariffs	Mandatory for large consumers, may also be for small consumers	No regulation, limited use	No regulation, limited use	No regulation, but TOU-tariff is recommended from 2016
Real time data availability	Mandatory	Mandatory for new meters	Mandatory	Mandatory
Market participation	Allowed on all markets, mandatory participation in energy markets. Providing demand response in the range of 3-10 % of peak load (2016 estimates)			
Aggregators	Market uptake is increasing slowly. Minimum volume and high costs are challenging. Balancing responsibility is mandatory to participate in markets.			

Source: THEMA (2015): Capacity adequacy in the Nordic Electricity market, THEMA (2014): Framework for demand response and micro generation in the Nordics, ACER/ CEER (2014): Anual report on the results of monitoring the internal electricity and gas markets in 2013

IF ALL PRICES ARE «RIGHT» CONFLICTING SIGNALS WILL NOT BE A PROBLEM – BUT IT WILL BE IF PRICES ARE NOT



Will load changes due to energy price challenge grid limits?

Grid tariffs: incentives for reduced peak when capacity is challenged – neutral if not

Will load changes due to grid tariffs challenge energy markets?

If there are bottlenecks in the grid, they will restrict the market

- Grid tariffs should only limit markets at times without sufficient grid capacity
- If the grid tariff is giving incentives at the right time and strength – conflicting signals are OK
- TSO-DSO coordination will be needed

SERVICE PROVIDERS HELP CONSUMERS BE ACTIVE

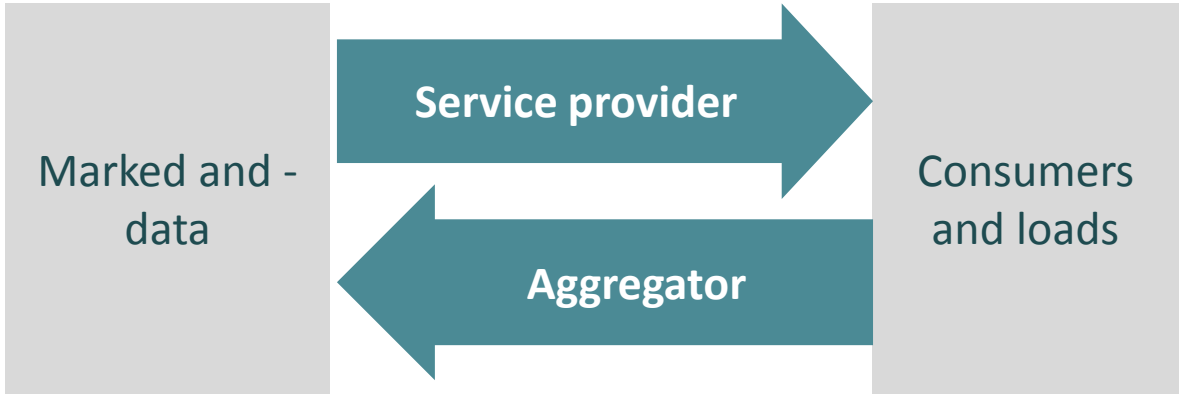
SMART METERS ARE ENABLERS, BUT NOT SUFFICIENT

Service providers: «Bringing the market to loads»

- Optimize loads based on marked information and information on electricity usage
- Predicable load changes – will be included i the planning phase

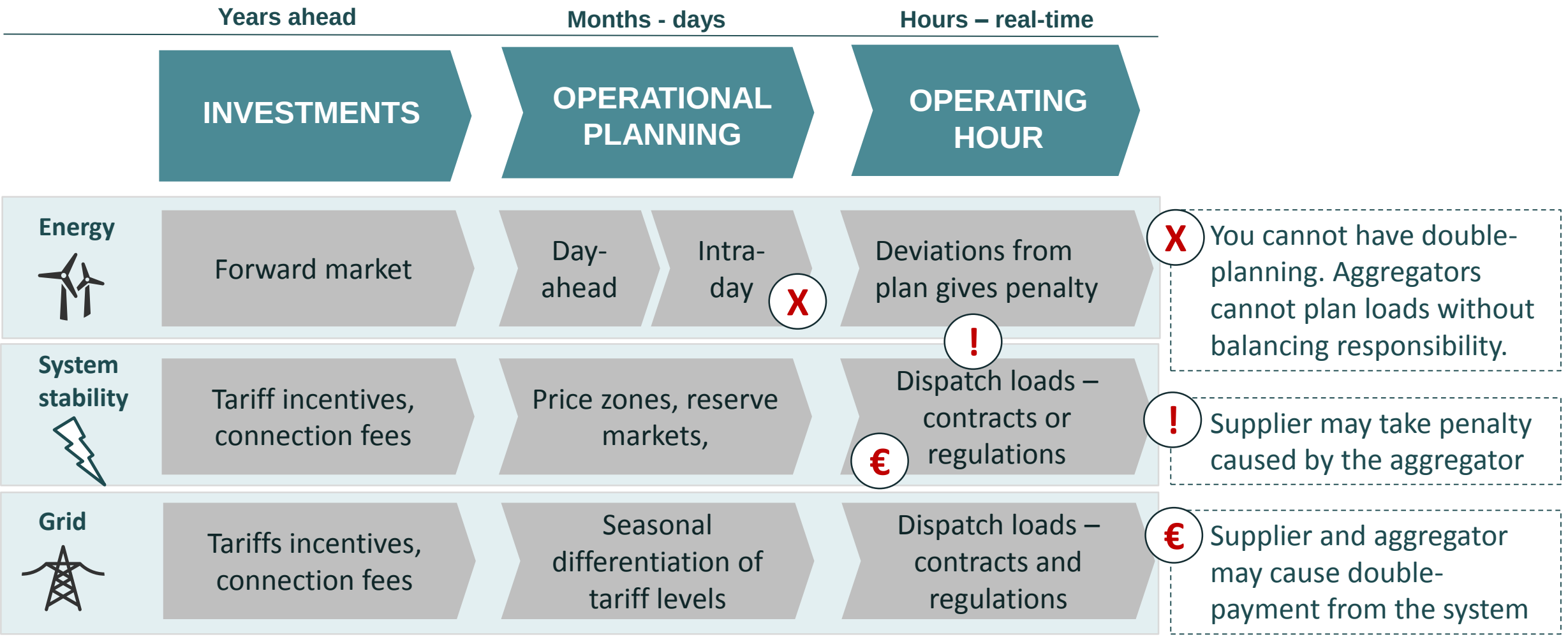
Aggregators: «Bringing loads to the market»

- Collect and handle loads – aggregate to a size that is interesting for the market
- Unpredictable load changes - > must have balancing responsibility



Source: THEMA Consulting Group

AGGREGATORS SHOULD BE BALANCING RESPONSIBLE
– TO MAXIMISE UTILISATION OF DEMAND RESPONSE AND TO AVOID MARKET DISTORTIONS



TAKE-AWAYS

- Planning is crucial: Preventing trouble in the operating hour is less risky and costly than fixing it beforehand through markets
  - But you still need to have enough resources to handle unforeseen events
- Efficient demand response: Allow (or oblige) the demand side to participate in all markets
  - Included aggregators (but on a level playing field included balancing responsibility)
- Right prices mitigate conflicting signals
  - Grid tariffs should (only) reflect the value of demand response for grid operation and planning
  - Markets are «big data» - make the most of them and do not cap prices
- Service providers and aggregators enable demand response, but play different roles
  - Aggregators bring loads to relevant markets (which require balancing responsibility)
  - Automation and service providers will help consumers respond to prices
- Enablers for demand response
  - Smart Meters are a prerequisite for demand response – to enable automation and verify response
  - Make data (prices, consumption) easily available for service providers and the consumer
  - Encourage spot-price contracts at the retail level

EXTRAS

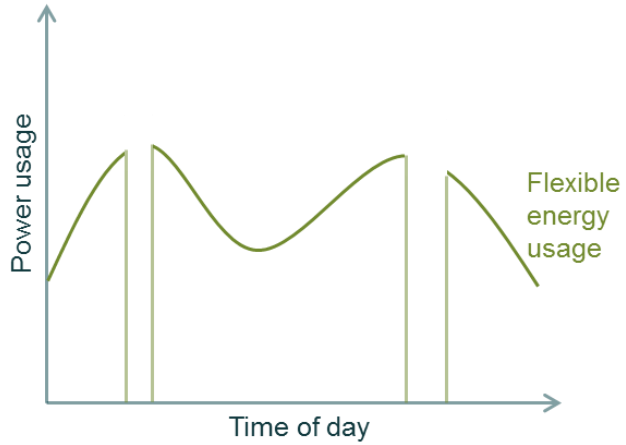
SEVERAL MEASURES SPUR DEMAND RESPONSE IN THE NORDICS

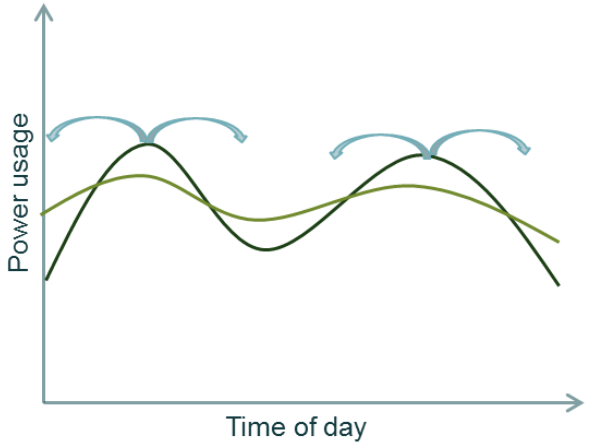
NOTE: GRID AND ENERGY ARE PRICED SEPARATELY ALSO FOR SMALL CONSUMERS

	Years ahead	Months - days	Hours – real-time
	INVESTMENTS	**OPERATIONAL PLANNING**	**OPERATING HOUR**
Energy • Sufficient energy • Acceptable prices	Forward market	Day-ahead Intra-day	Penalties for deviations from plan
System stability • Avoid black-outs • Ensure quality and energy balance	Tariff incentives, connection fees	Price zones, reserve markets,	Dispatch loads – contracts or regulations
Grid issues: • Reduce costs • Increase quality	Tariffs incentives, connection fees	Seasonal differentiation of tariff levels	Dispatch loads – contracts and regulations

PRACTICAL EXAMPLES OF DEMAND RESPONSE – LOAD TYPES

Type of flexibility	*Type of load*	Example industry	Example buildings
Shut down energy usage	*Processes that may be **interrupted***	Stops in continuous processes with reduced production as a result	Electrical equipment like lightning, lifts or TVs
Shift in type of energy source	*Loads supported by **back-up** with alternative energy source*	Electrical heat boilers with alternative oil or gas boilers	Electrical heat boilers with alternative oil or gas boilers
Shift in timing of electricity usage	*Loads with **inertia***	Processes with cooling or heating	Heating, cooling or ventilation
	*Loads or processes with **storage or cache***	Grounded biomass in pulp and paper	**Batteries** and hot water tanks for tap water or heating. batteries
	*Processes or appliances with **excess capacity***	Greenhouses where lights may be shut down 4 hours per day	Dish washers and washing machines that does not run 24/7





ASSESSMENT OF POLICY OPTIONS FOR AGGREGATORS

- The interference between the retailer (BRP) and the aggregator is handled in one of these manners:
  - Policy option 1: The suppliers (with BRP) integrate aggregated DR as part of their service offering and the suppler and aggregator operate in a single portifolio
  - Policy option 2: Aggregator and BRP are not operating in the same portfolio. Their activities are thus clearly split, either through standard contract procedures and agreements or by the aggregator taking on a second balance responsibility for activated loads
  - Policy option 3: The aggregator operates independently from balancing responsibility without any compensation to the BRP

DISTRIBUTIONAL EFFECTS OF POLICY OPTIONS BY ACTOR

Actor	Option 1	Option 2	Option 3
Generators	Will lose profit on intra marginal generation at peak load	Will lose profit on intra marginal generation at peak load	Will lose profit on intra marginal generation at peak load
Network operators	Reduced need for investment – no change in profits	Reduced need for investment – no change in profits	Reduced need for investment – no change in profits
Suppliers	Potentially, reduced risks as consumers reduce peak load demand when wholesale prices are high and exceeding the retail prices.	As Option 1 plus effect from more even wholesale prices. Both gains and losses.	As Option 2 though possible larger effects on wholesale prices.
BRP	No change	No change	Will lose on extra balancing costs (increased financial risk)
Aggregators	No change	Increased business opportunities	Increased business opportunities (more than in option 2)
Consumers	Reduced electricity bill	Reduced electricity bill (more than in option 1)	Reduced electricity bill

COSTS AND BENEFITS OF POLICY OPTIONS

	Effectiveness	Efficiency	Coherence
Option 1	+	+	++
Option 2	++	+++	+++
Option 3	+++	+	-

Note: + means positive effect of increasing magnitude

COWI, THEMA, Vito, ÅF, Ecofys (2016): Impact assessment study on downstream flexibility, price flexibility, demand response & smart metering

MORE INFORMATION ON DEMAND RESPONSE IN THE NORDIC MAY BE FOUND AT

Input to a Nordic strategy for efficient use of demand response

- http://www.nordicenergy.org/publications/demand-response-in-the-nordic-electricity-market/

Capacity adequacy in the Nordic electricity market:

- http://www.nordicenergy.org/publications/capacity-adequacy-in-the-nordic-electricity-market/

Discussion of different arrangements for aggregation of demand response in the Nordic market:

- http://www.nordicenergyregulators.org/publications/publications-2016/

Regulatory framework for Demand Response and Micro Production in the Nordics:

- http://www.nordicenergyregulators.org/publications/publications-2015/

EU: Impact assessment study on downstream flexibility, price flexibility, demand response & smart metering

- https://ec.europa.eu/energy/en/studies?field_associated_topic_tid=42

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