

Markets for Demand Side Management

1st International European
Demand Response Center (EDRC) Workshop
Graz, February 16, 2012
T. Gobmaier, S. von Roon,
D. Bernhard

The results were compiled as part of the joint research project KW21.
Funded by E.ON Energie AG, BStMWFK and BStMWIVT.

1. Markets for Dynamic Demand
2. Market Requirements
3. Earnings
4. Decision Criteria
5. Examples for Suitable Markets
6. Conclusion

Flexible energy consumers can offer different services :

- Peak load management,
- Assistance in the integration of renewable energies,
- Support for power plants,
- Compensation of forecasting errors,
- Functional energy storage,
- Grid stabilisation,
- ...

→ But: Each facility can only be used for one service at a time

Which field of application will benefit from the expansion of switchable loads?

- Energy markets
 - EEX day-ahead (D, F, A, CH)
 - EEX spot intraday 1-hour (D, F, A, CH)
 - EEX spot intraday 15-minutes (D)
 - PV for own consumption (PV Eigenverbrauch, D)

- Load Markets
 - Primary Control (TSO)
 - Secondary Control (TSO)
 - Minute Reserve (TSO)
 - (Capacity Markets)

- **EEX day ahead:** Purchase / sale of electricity (hours or blocks of hours) on the previous day. Use of the price spread between two hours, if possible.
- **EEX intraday (hours):** Purchase / sale of electricity (hours) a few hours earlier. Short-term use of the price spread between two hours.
- **15-Minute Contracts:** Purchase / sale of electricity (15 Minutes) from 2 hours to 45 minutes before supply. Very short-term shift of services possible.
- **PV for own consumption (PV-Eigenverbrauch):** If electricity from a new EEG promoted plant is used by the owner himself, the promotion is reduced by 16.38 Ct/kWh. If more than 30 % of the energy is used for own consumption, the reduction is 12 Ct/kWh. Very economical for homeowners, often economical for commerce. Rising electricity purchase prices increase the attractiveness.

Markets for Dynamic Demand: Load markets

- **Primary control:** Weekly auction for the period of a week, one week before supply. Plants must have the ability to be switched on and off steplessly and to hold the power equal for the entire week. Automatic control by mains frequency.
- **Secondary control:** Weekly auction for a week, one week before supply. Switching must be in discrete steps. Subdivision in HT and NT blocks of time, and positive and negative power. Plant must be able to hold the service over the entire block. Automatic control via TSO.
- **Minute reserve:** Daily auction for the next day by 4-hour blocks with distinction of positive and negative power. Plant must be able to maintain the power throughout the entire block. It must be possible to run discrete power levels. Activation so far via telephone calls, on-line activation will be introduced soon.
- **Capacity markets:** In discussion. The marketing of electricity via the stock market results in the reduction of generation capacities. Consequently a capacity market may be useful in future. Currently, only investment grants for new facilities are planned.

- **Over the counter (OTC):** All products traded on the markets as well as others can also be traded directly between two stakeholders. Because the stakeholders orientate themselves on the market, the prices correspond to market prices.
- **Pooling:** Plants that do not meet the market criteria can be combined together to a pool in order to participate in the market. This also changes the suitability for different markets.

Categorization of Flexible Consumers

- Direction of energy flow into the public grid
- Cost per call
- Usage frequency of the system
- Modulating
- Reaction speed, load gradient
- Maximum/minimum call duration
- Predictability
- Displacement: a few minutes, hours or days

Requirements of Plants for Market Participation

	Direction of power	Tolerable switching effort	Daily use of plant	Modulating	Reaction rate	Maximum call duration
Primary control	pos. & neg	very low	Plant must operate permanently, throttled 24 h	continuous	High (15 s), usually only possible when plant is already running	1 week (hydro plants 4 h)
Secondary control	pos. or neg	low	- / -	discrete levels	Fast launch possible (30 s to 15 min) or system is already running	12 to 60 hours
Minute reserve	pos. or neg	moderate	- / -	discrete levels	Start in 15 minutes	4 hours
Day-Ahead	Purchase or sale pos.	low	low, demand occurs on many days	no	Only at scheduled times, performance within 15 minutes	min. 1 hour
Intraday hours	Purchase or sale pos.	low	low, demand occurs on many days	no	Few hours to 45 minutes before performance schedule	min. 1 hour
Intraday 15-minute	Purchase or sale pos.	low	low, demand occurs on many days	no	Two hours to 45 minutes before performance schedule	min. 15 minutes
PV self consumption (Household and Commercial)	negative	low	low, demand occurs often	no	- / -	- / -
Capacity market	positive	high	Plant must be shut down until it is called	no	low, several hours or days to service delivery	Days to weeks

- Entelios AG is currently building a pool of switchable consumers for minutes reserve,
- The tender period of primary and secondary reserve was already reduced from one month to one week, further simplifications to attract new market participants are expected.

Earnings in the Markets

	Earnings	Assumptions
Primary control	560 €/(day·MW)	Base: Feb. to Aug. 2011, 3.900 €/(week·MW)
Secondary control	260 €/(day·MW)	Averages 2008 to 2010 based on surcharge on all auctions, without commodity price, 96.000 €/(year·MW) for positive, 93.000 €/(year·MW) for negative secondary control
Minute reserve	95 €/(day·MW)	Base 2008 to 2010, based on surcharge on all auctions, without commodity price
Day-Ahead	8 .. 27 €/(day·MW)	Shifting 1 MW from the most expensive hour of the day (11 a.m.) to the cheapest (3 a.m.) results in revenues of 27 € (Based on: EEX average 2010). Shifting from 11 a.m. to 7 a.m. revenues 9 €, from 6 p.m. to 10 p.m. revenues 8 €
Intraday hours	similar to Day-Ahead	
Intraday 15-minute	market since Dec. 2011	
PV self consumption (Household and Commercial)	56 .. 100 €/MW	EEG 2012, plants smaller than 30 kW peak, 22 Ct/kWh purchase without PV
Capacity market	investment grants in discussion	

- Pooling reduces the yield for each plant according to the number of plants and the complexity of the information technology.

Decision Criteria for the Type of Use of DSM-Systems Functionality

The user/owner of a facility reaches the decision, whether and how their plant will be used for Demand Side Management or Demand Response, based on various criteria. Parameters are

- Expenditure for information and decision
- Investment costs for communication
- Effort in switching, organizational costs, lost benefit
- Risk (higher probability of failure, shorter operational life span of plant)
- Earnings for switching
- Environmental protection, assistance for the integration of renewable energy sources

→ Decision to participate (PV for own consumption, market, pooling)

Suitable Markets for Dynamic Electric Loads

	Primary control	Secondary control	Minute reserve	PV self consumption	EEX Day-Ahead and Intraday
Industrial load reduction					
Electric steel load displacement	x	x	x		
Paper load displacement		x	x		
Cement load displacement	x	x	x		
Zinc electrolysis shift load	x	x	x		
Aluminum electrolysis shift load	x	x	x		
Chlorine electrolysis shift load		x	x		
General displacement (cooling, stored goods, storage)		x	x		
Industry plant shutdown					
Electric steel production stop			x		
Paper production stop			x		
Cement production stop			x		
Electrolytic zinc production stop			x		
Aluminum electrolytic production stop			x		
Chlorine electrolysis production stop			x		

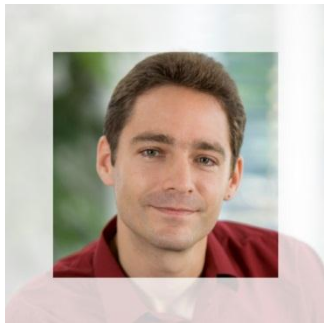
Suitable Markets for Dynamic Electric Loads

	Primary control	Secondary control	Minute reserve	PV self consumption	EEX Day-Ahead and Intraday
Household load displacement					
Washing machine			x	x	
Dryer			x	x	
Dishwasher			x	x	
Fridges & Freezer	x				
Circulation pump	x				
Electric storage heaters				x	x
Heat Pumps			x	x	
Hot water supply				x	x
Loading of traction batteries (ESF)				x	x
Micro-CHP system					x
Commercial, retail and service load displacement					
Fridges & Freezers houses and cabinets	x				
General Displacement (stored goods, storage)			x		
Hot water supply					x
Ventilation, air conditioning			x		
Traffic load displacement					
Heating / cooling of trains			x		
Power reduction for trains			x		

Conclusion

- Most switchable facilities can earn more on load markets than on energy markets, because load markets already pay for the willingness to switch
- The shutdown of industrial plants is only of interest for minute reserve
- Households can earn the most by own consumption of PV
- Loads with continuous energy consumption (eg refrigeration units) are suitable for primary control
- Energy markets are only interesting for facilities that have to cover a defined consumption for several hours on a daily basis (eg, electric vehicles, electric water supply)
- Only a few consumers will participate in the day-ahead electricity market

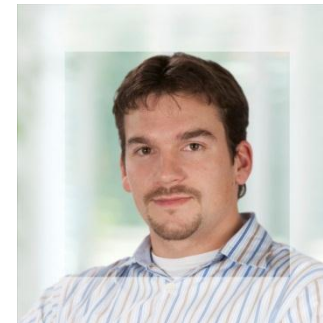
Thanks for your attention !



Dipl.-Ing. Thomas Gobmaier
tgobmaier@ffe.de



Dipl.-Wi.-Ing. Serafin von Roon
sroon@ffe.de



Dipl.-Ing. (FH) Dominik Bernhard
dbernhard@ffe.de

Forschungsstelle für Energiewirtschaft e.V.
Am Blütenanger 71
D-80995 München
+49 89-158121-0
<http://www.ffe.de>