

# **EcoGrid EU** **- Demonstration of a market model for integration of flexible demand and distributed generation**

Markets, Pricing & Smart Grids  
Workshop in Aarhus

31 January 2013

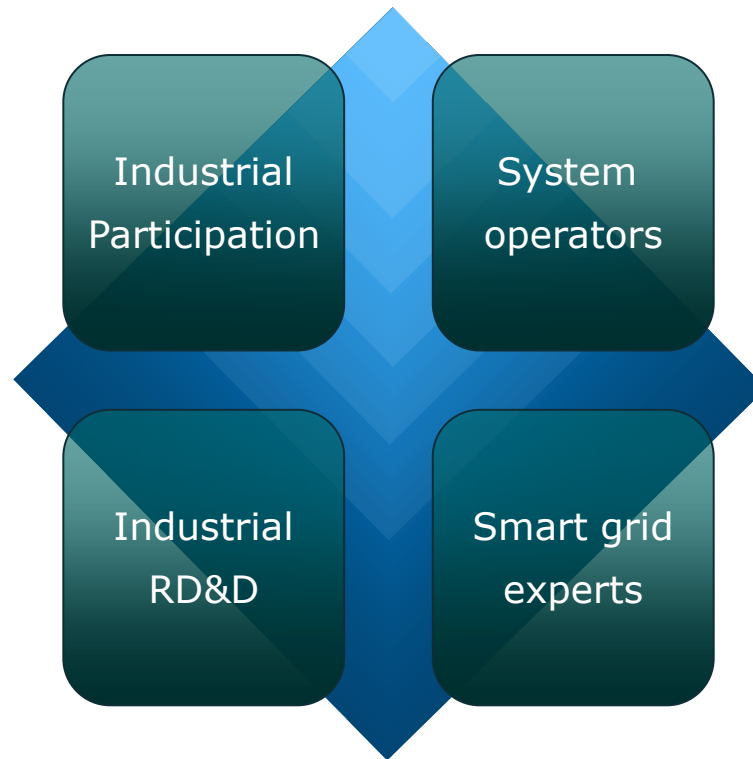
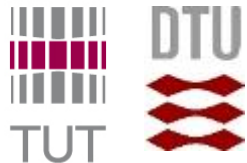
Preben Nyeng



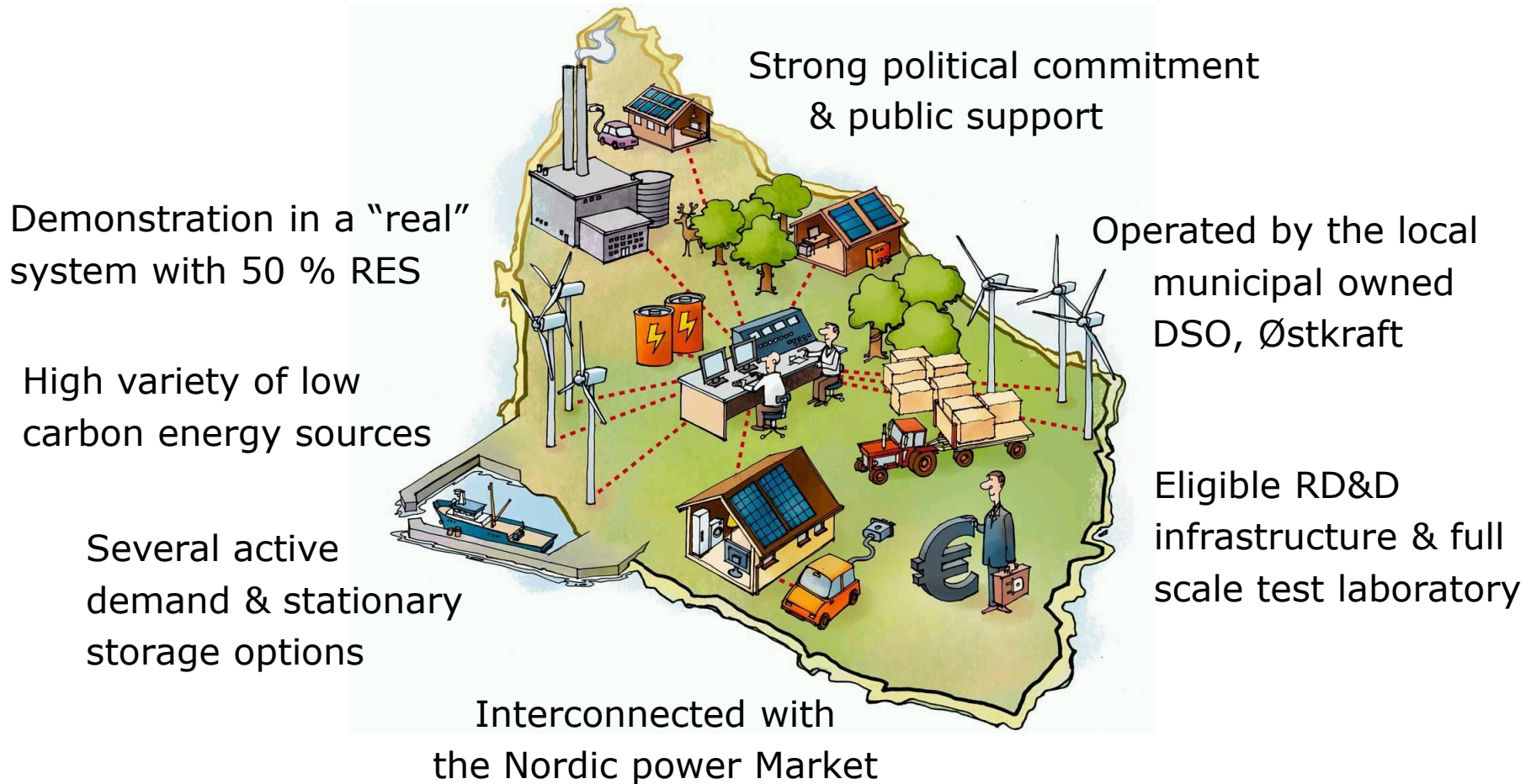
## EcoGrid EU in brief

- Full title: "Large scale Smart Grids demonstration of real time market-based integration of DER and DR"
- Project granted under EU's FP7-Energy-2010-2-TREN
- Total budget: 21 million EUR (EU funding: 12.7 million EUR)
- 16 partners: TSOs, DSOs, technology providers, research institutes, universities
- Demonstration of a power system with more than 50% renewable energy
- 2000 participating customers
- Market design, ICT infrastructure, customer products, ...
- Preparation for a fast track towards European real-time market operation of DER & DR
- More information at <http://www.eu-ecogrid.net/>

# Roles of the partners



## Bornholm – a unique test site



## 2000 participating customers in the demonstration



### Type I Statistic Control Group

- 200 households with smart meters
- No access to specific information or “smart” equipment



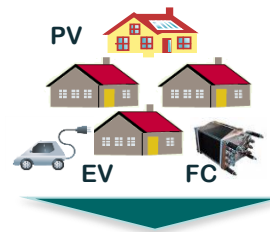
### Type II Manual Control

- 400-500 households with smart meters
- Receiving simple market price information
- Must move their energy consumption by themselves



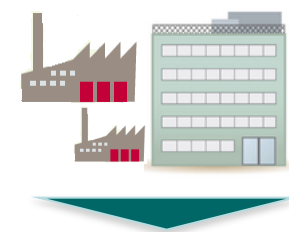
### Type III Automatic Control

- 700 automated households with IBM Green Wave Reality equipment and smart meters
- All houses have heat pumps or electric heating - responding autonomously to price signals



### Type IV Automatic Control

- 500 automated households with Siemens equipment and smart meters
- All houses have heat pumps, or electric heating – all responding to aggregator control



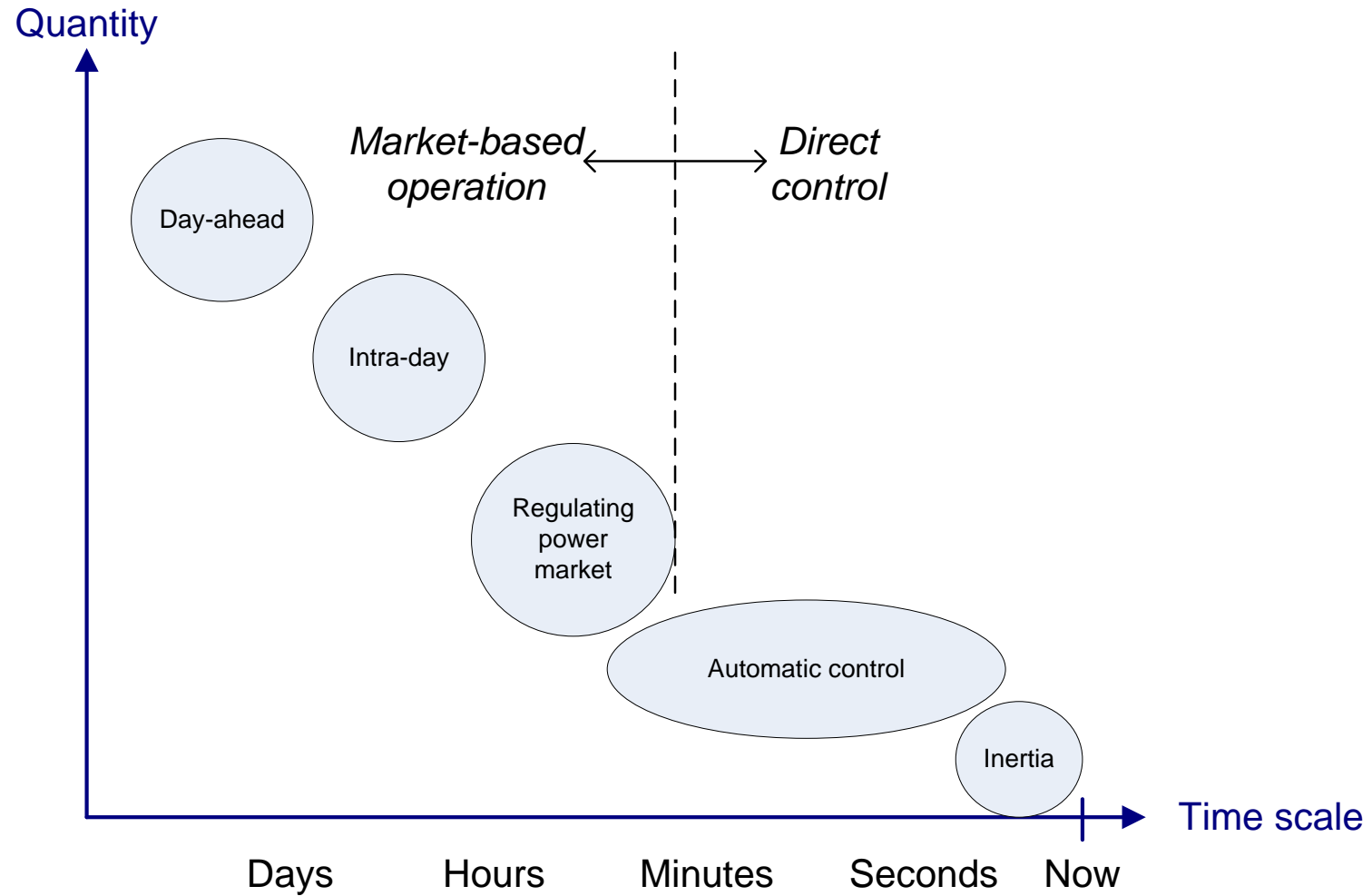
### Type V Smart Businesses

- Up to 100 commercial with smart meters
- Include also small business and public customers
- Connected smart appliances responsive to control signals

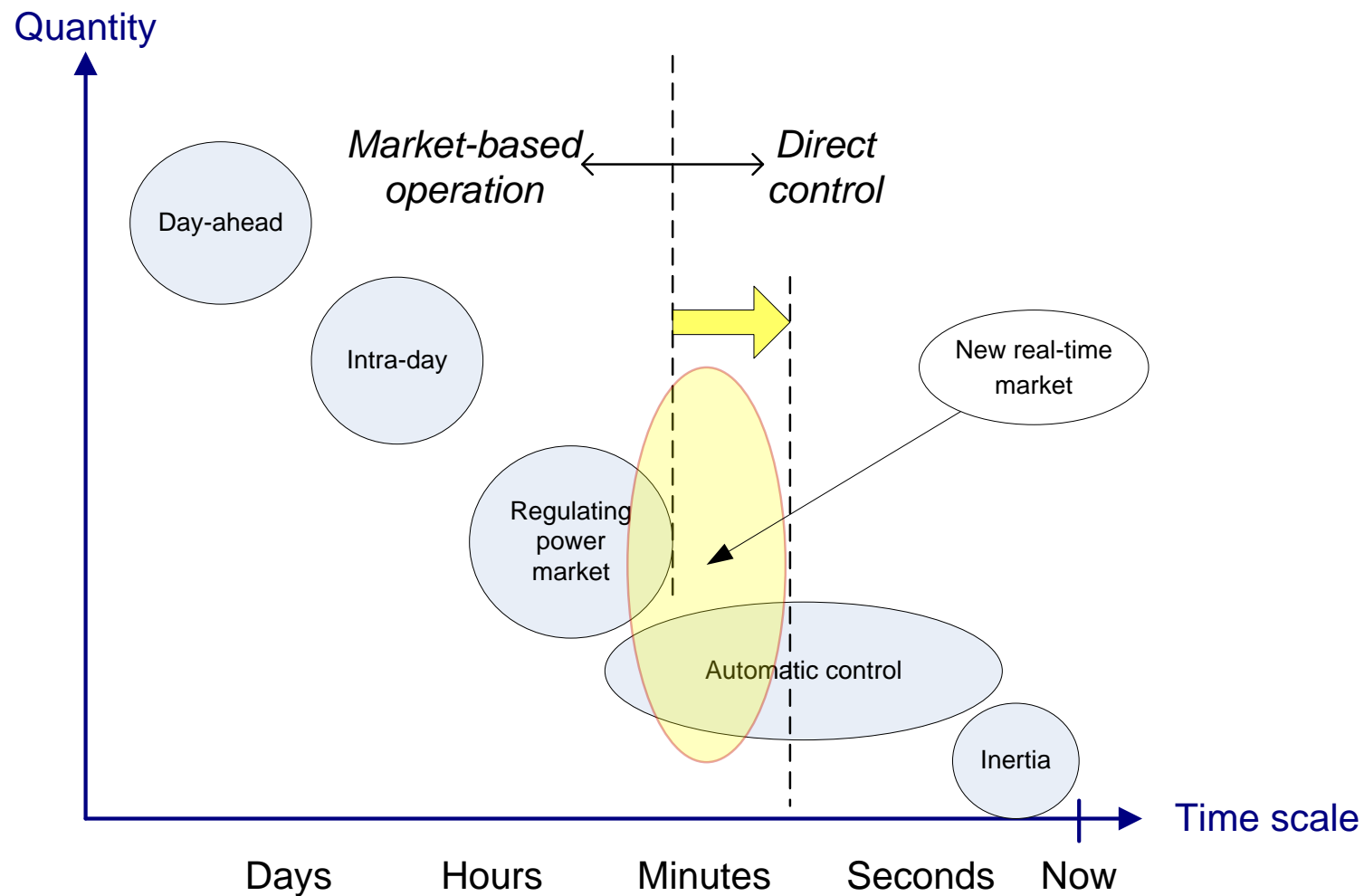
## Why a real-time market?

- An efficient way to meet the future challenge of balancing, i.e.
  - High(er) demand of flexible consumption/production
  - High(er) volatility
  - High(er) balancing cost
- An efficient instrument to wide spread adoption of small-scale end-users and prosumers in the power market(s)
- Increasing competition on the power market(s)
  - Small scale end-users can attain economic benefits
  - TSOs get access to alternative balancing resources

# Markets meet system operation

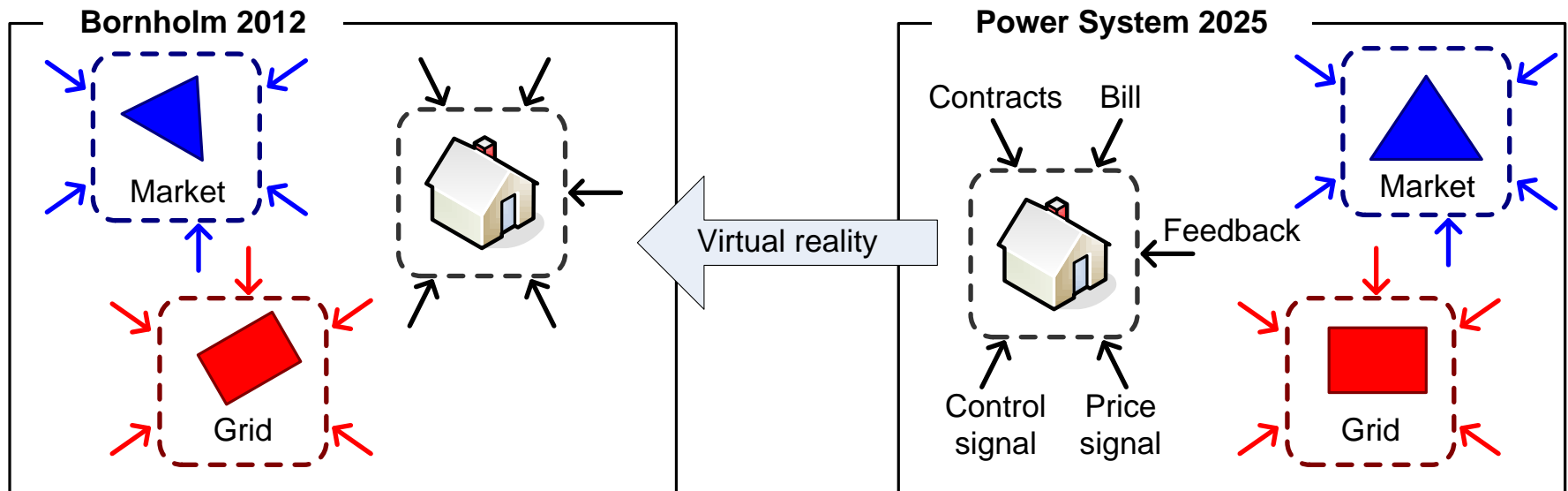
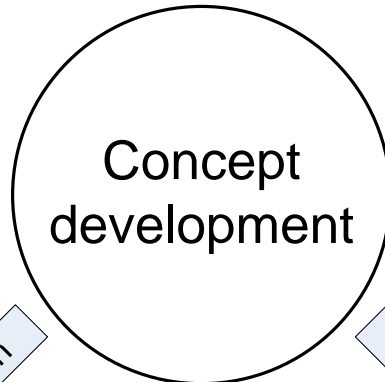


# Markets meet system operation





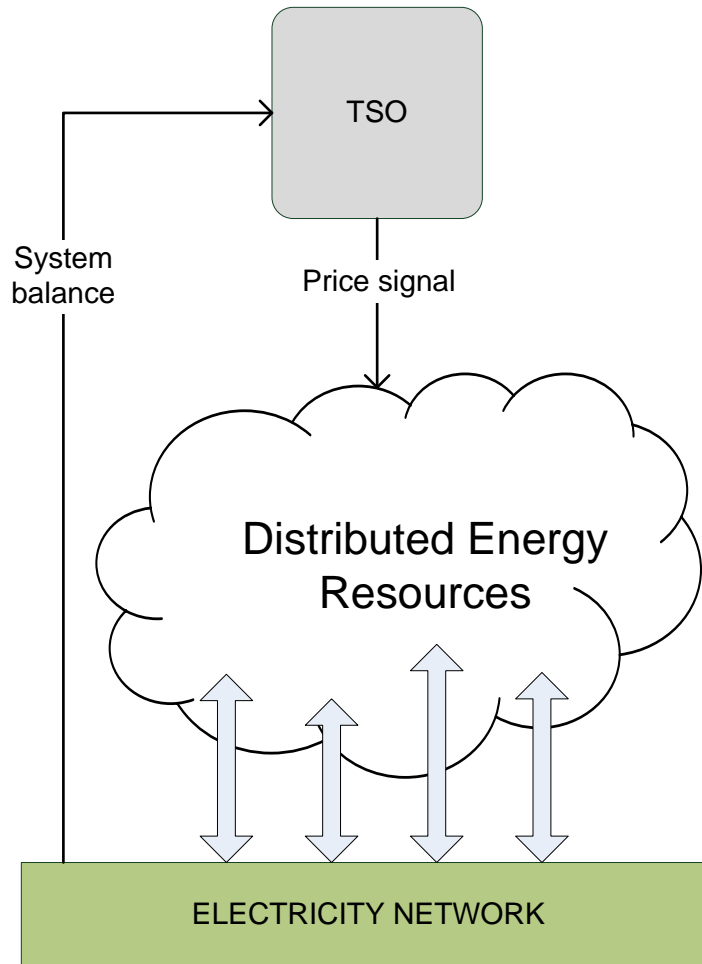
# Two tracks in the project



# Key requirements to the EcoGrid EU market concept

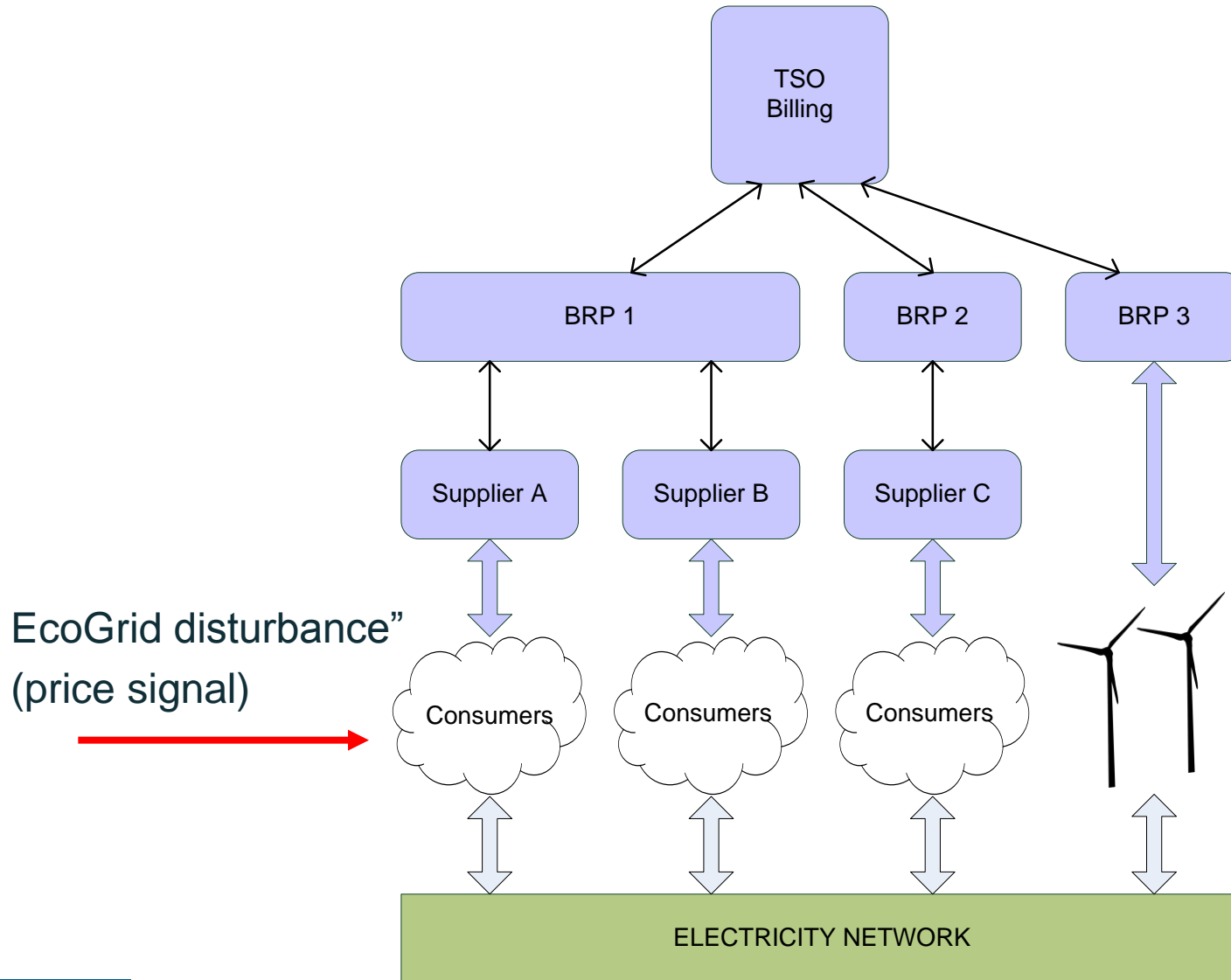
- Economic efficiency
  - Provide the right incentives based on marginal cost – in real-time
- Transparent
  - Provide a trust-worthy benchmark price for retail products to enable demand-side price elasticity
- High time resolution (5 minutes)
  - Handle rapidly fluctuating intermittent energy sources
- Price set near time-of-delivery
  - Handle forecast errors
- Local pricing
  - Handle congestion due to increasing electricity demand

# The fundamental idea of the EcoGrid EU Concept

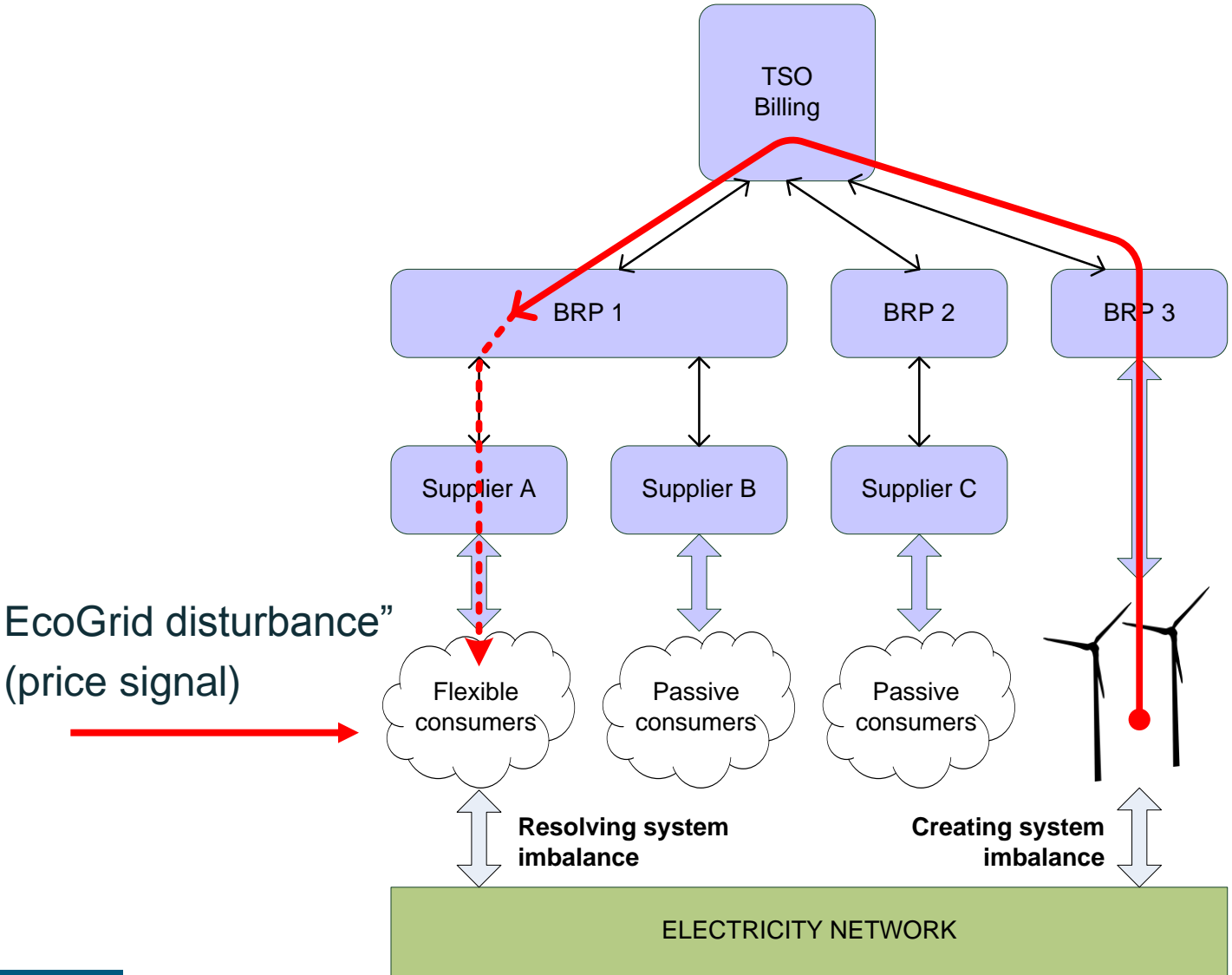


*The market concept allows regulation of DER through price signals without direct measurement of the individual DER response*

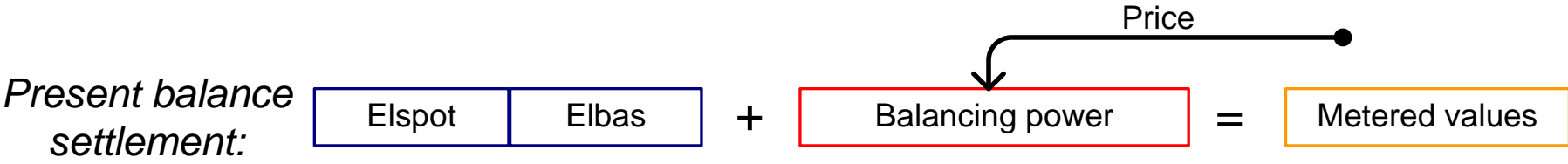
# Settlement framework (present situation)



# Value flow



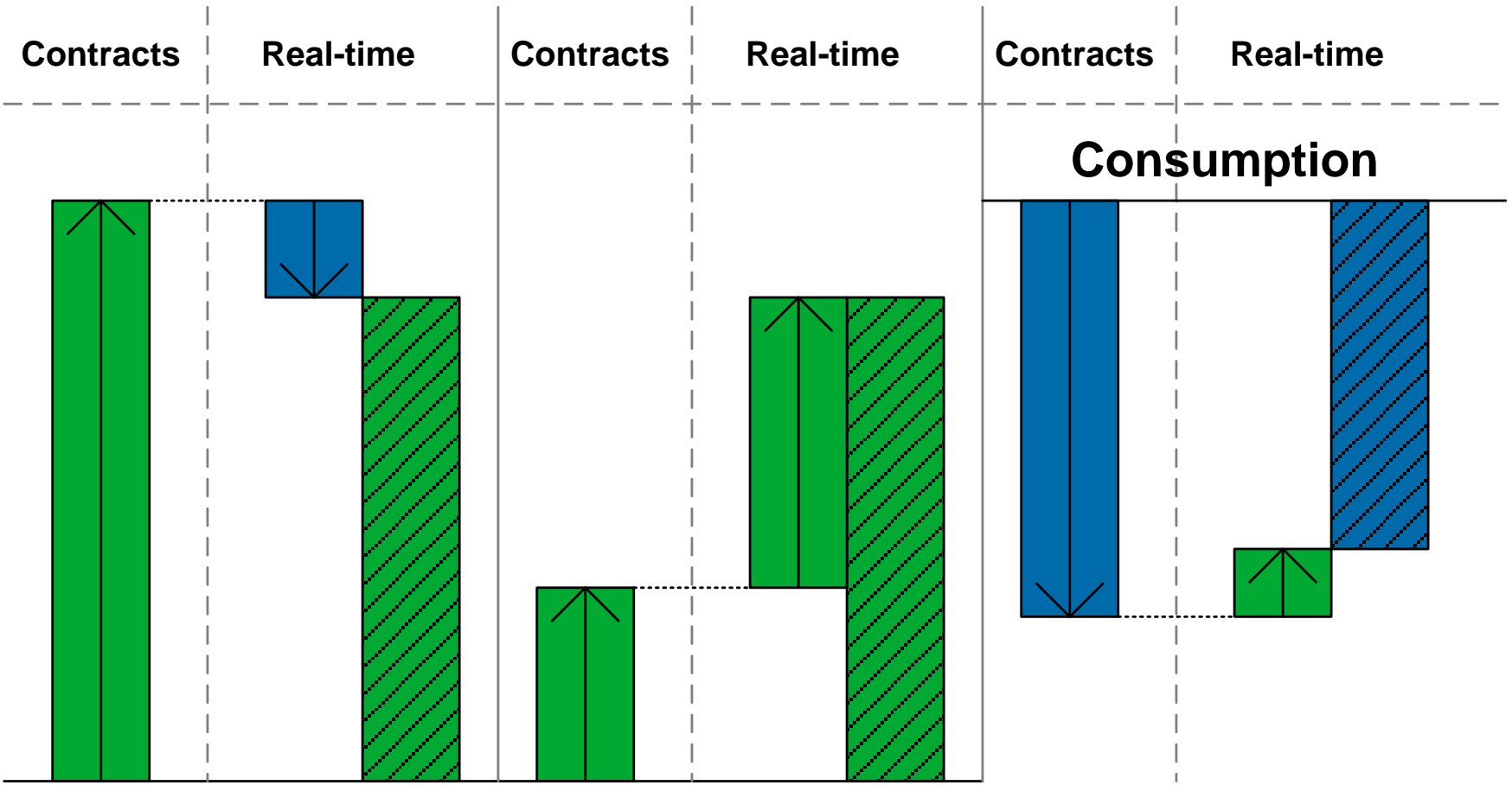
# The EcoGrid concept in the wholesale market



Trade  
(scheduled/contracts)

Operation  
(unscheduled/real-time)





Settlement



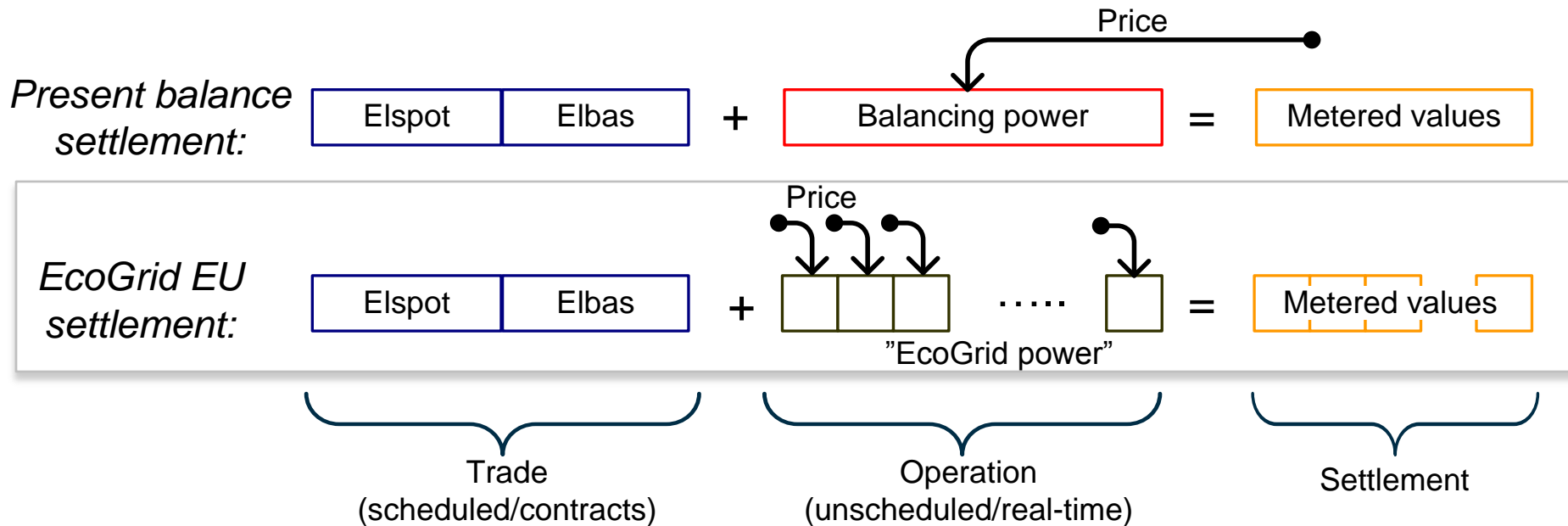
Production A

Production B

Consumption

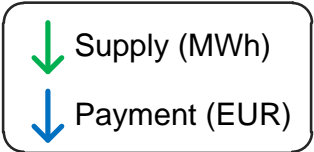
	Sell		Buy	.....	Scheduled
	Produce		Consume		

# The EcoGrid concept in the wholesale market

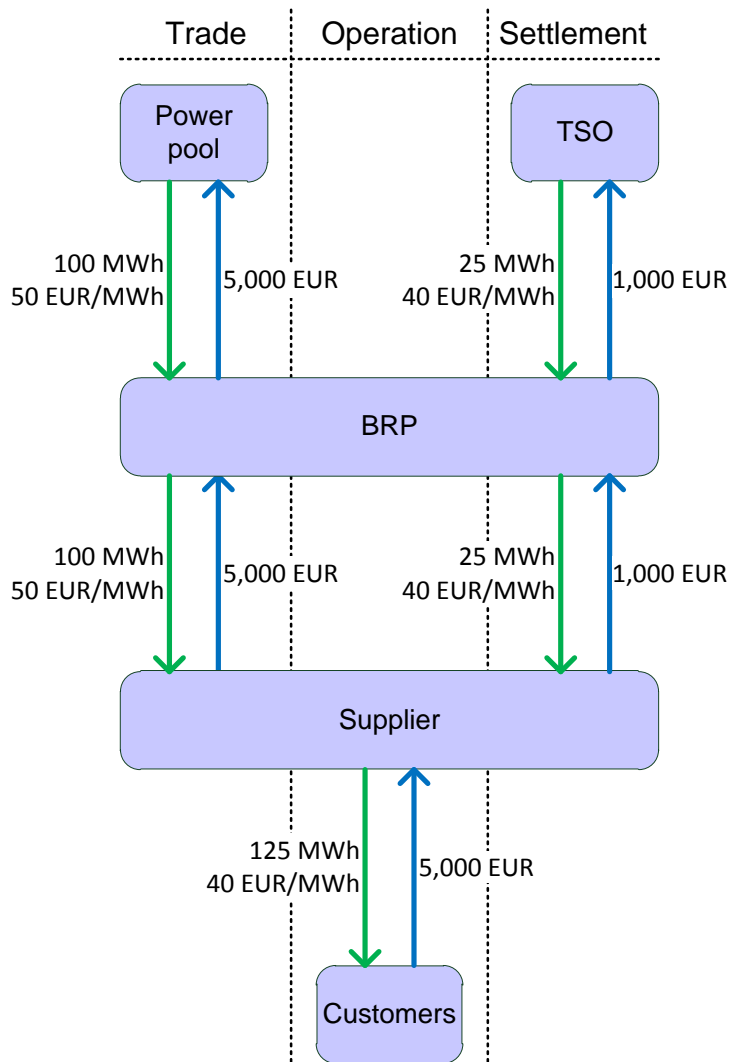


- The EcoGrid price is set by the TSO every 5 minutes
  - No bids given
  - Price based on present and expected system balance + forecast of price elasticity
- The price is published as a web service
  - Machine-readable for automatic controllers to control DER
  - Can also be presented to humans for manual control

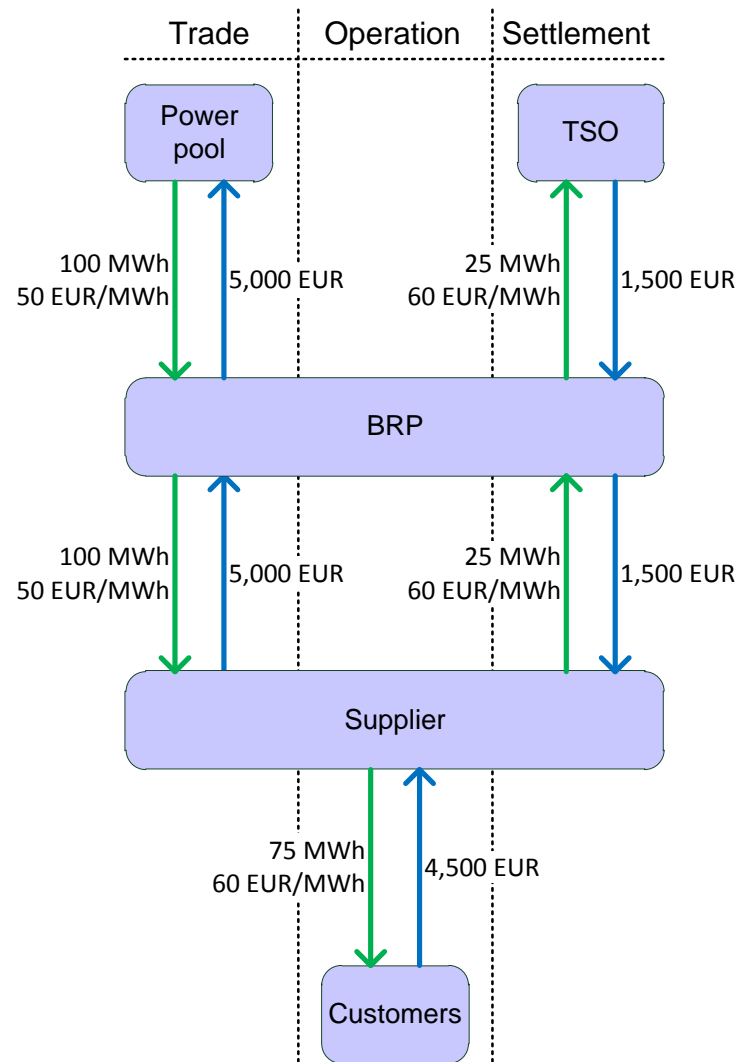




### Down regulation



### Up regulation

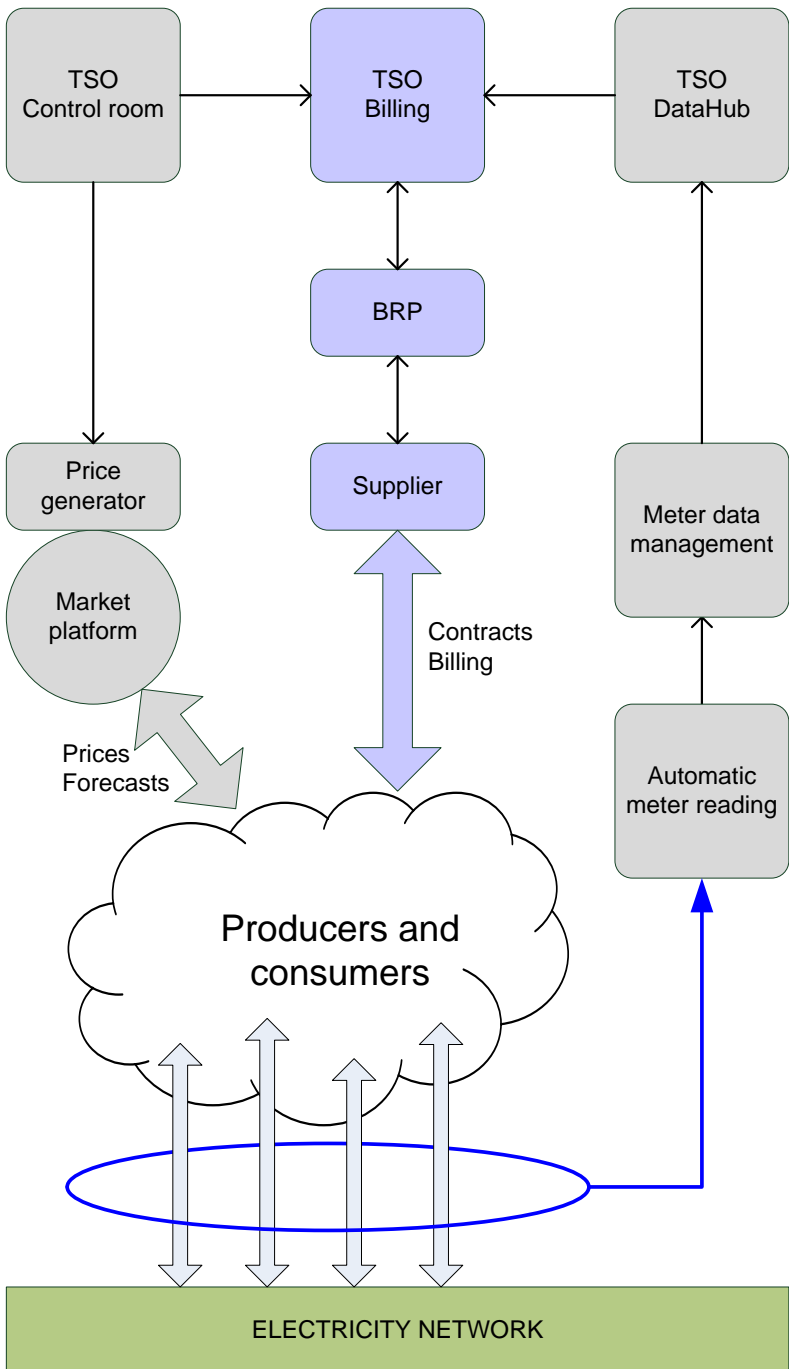


## Value creation

- Example of value creation during an up-regulating period followed by a down-regulating period (everything else equal)
- Markup is not included in the customer settlement, this is just to illustrate the principle of the value chain TSO-BRP-supplier-customer

		Up	Down	Sum
Elspot (purchase)	MWh	100	100	200
	EUR/MWh	50	50	-
	EUR	5,000	5,000	10,000
Metered	MWh	75	125	200
Balancing power (purchase)	MWh	-25	25	0
	EUR/MWh	60	40	-
	EUR	-1,500	1,000	-500
Customer settlement (RTP contract)	MWh	75	125	200
	EUR/MWh	60	40	-
	EUR	4,500	5,000	9,500
BRP balance	EUR	1,000	-1,000	0

# System architecture



## Next steps...

- Demand response demonstration on Bornholm
  - Not really possible to demonstrate the market concept at wholesale level
  - Focus on the response to price signals, customer behavior etc.
  - Recruitment and installation ongoing
- System studies
  - Interaction between the EcoGrid response and conventional ancillary services
- Replication studies
  - Adaptation of the basic concept to different market setups in Europe
  - How does the concept fit with operating practices?
  - What are the barriers?

# EcoGrid and "Smart Grid in Denmark 2.0"

## MARKETS FOR FLEXIBILITY



A **NEW MARKET** for flexibility makes it possible for the grid companies to purchase flexibility products as an alternative to grid reinforcements. The new market will be coordinated with the existing markets for flexibility, for example the regulating power market.