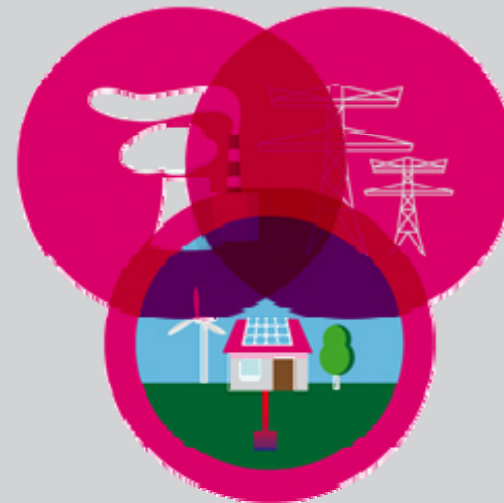


# Multi Goal Optimization of Demand Response and Local Generation



September 15<sup>th</sup> 2011

**Higher efficiency in the supply chain**



Ger Kempen

# Agenda

- Introduction of Essent
- Major challenges for the electricity sector
- The role of demand management
- Conditions for demand management (virtual power plant)
- Power Matching City Hoogkerk I & II
- Next steps

# Essent

- Essent is part of RWE
- Largest energy company in the Netherlands
- 2,4 million customers for gas, electricity, heat and energy services
- More than 90 years of experience in electricity producing and supply
- Largest producer of sustainable energy in The Netherlands
- The Netherlands is the home market, and the company has a large market share in Belgium



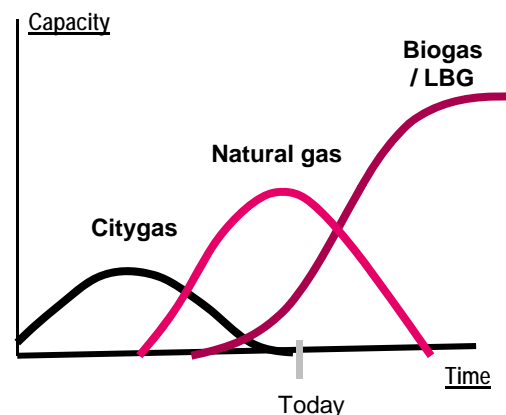
# Biomass Chain Innovation

## Goals

- Remain being Europe's leader in biomass co-firing by extending and optimizing Essent's biomass business

## Activities 2010/2011

- Bio-based economy: develop the value chain for bio-based applications throughout different industrial sectors
- Technical focus:
  - Torrefaction
  - Pyrolysis
  - Bio-Methane
  - AlgiCoat



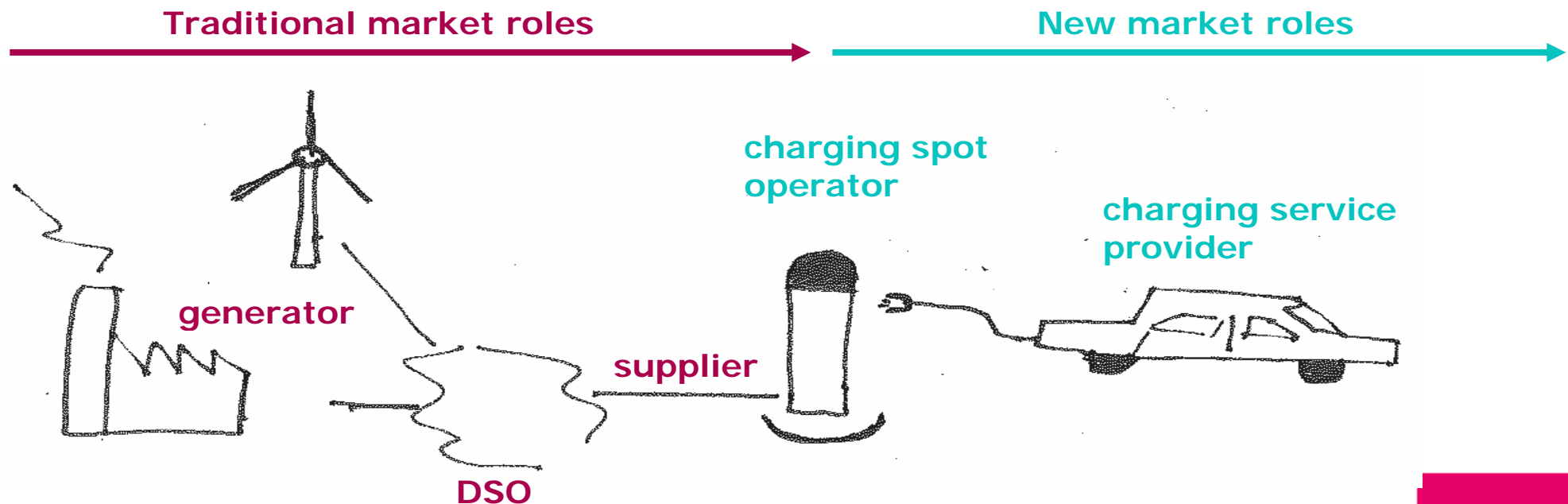
# Electric Transportation

## Goals

- Develop new sustainable business by stimulate market developments and develop charging solutions

## Activities 2010/2011

- Developing public charging infrastructure
- Develop charging services



# Energy Management & Smart Markets / Smart Grids

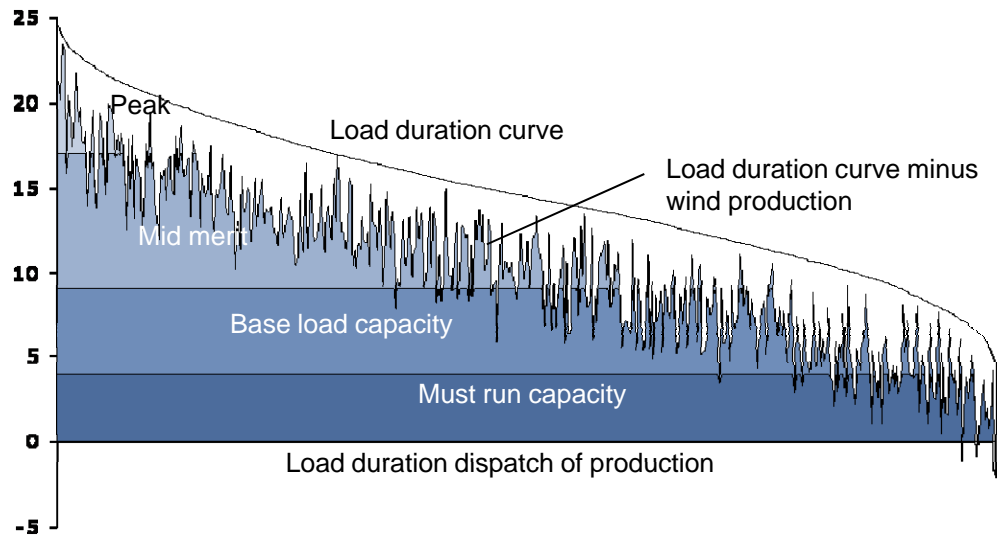
## Goals

- Provide added value to customers
- Create flexibility in the power system

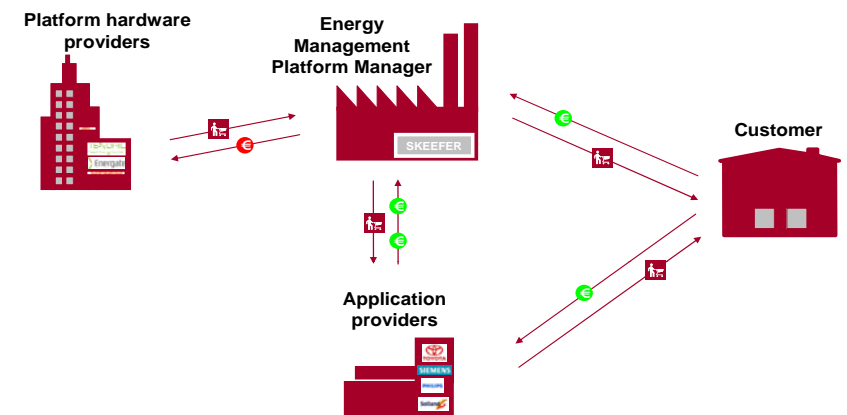
## Activities 2010/2011

- Develop energy management services
- Develop PowerMatching City II
- Participation Dutch Smart Energy Collective (SEC)

Large quantities of intermittent power sources will demand more flexibility in the power system



Different roles in value chain



# Agenda

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# Challenges for the electricity sector

While reaching for a sustainable, affordable and reliable energy system

## I. Substantial changes for grid companies

- a) Increase of distributed sources
- b) Increase of capacity constraints in the infrastructure
- b) Shift focus DSO's from technological risk towards financial risk

## II. Substantial changes for electricity producing companies

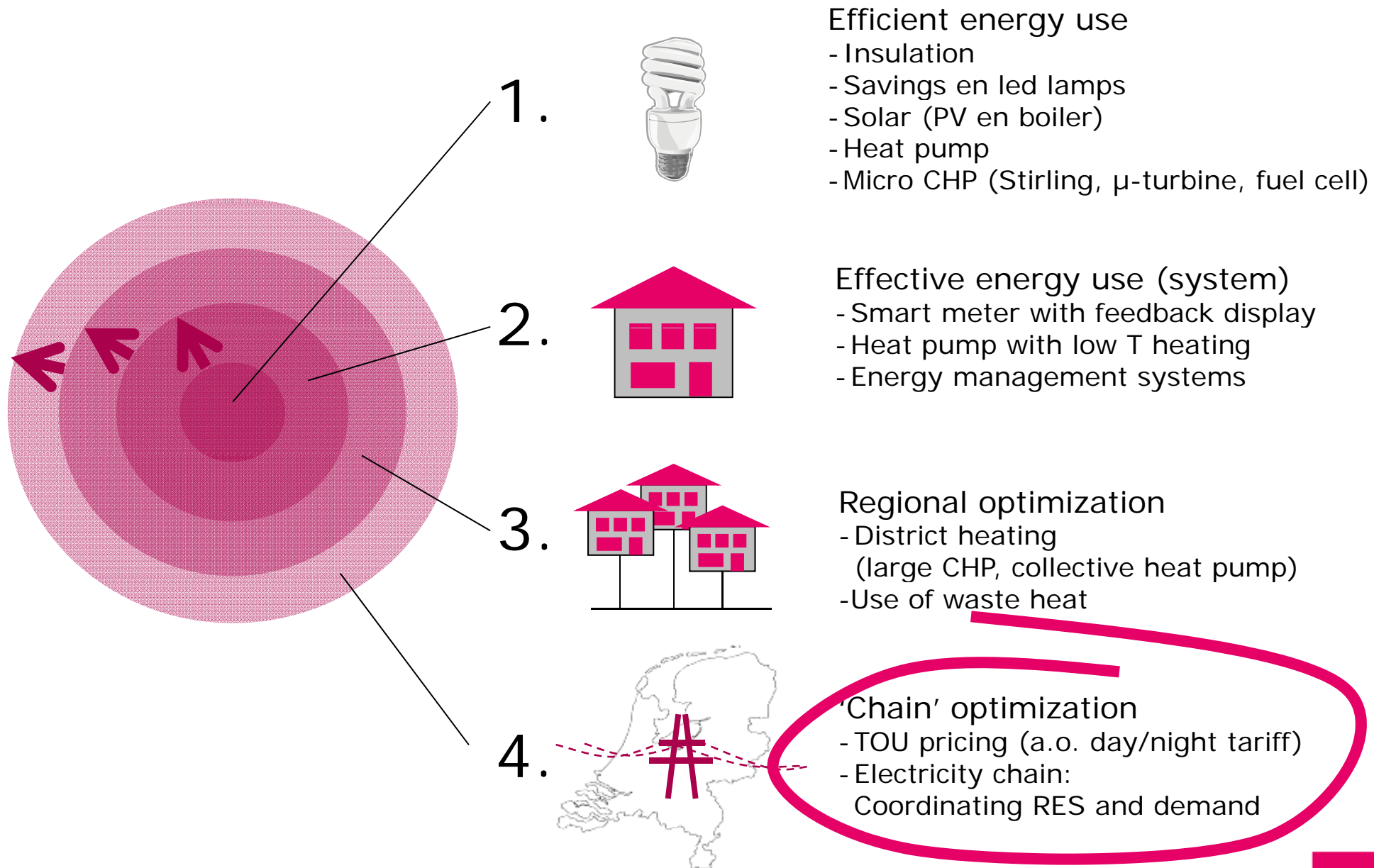
- a) Increase of intermittent sources
- b) Less stable environment for commercial investments
- c) Commoditization of energy and the search for new products



# Agenda

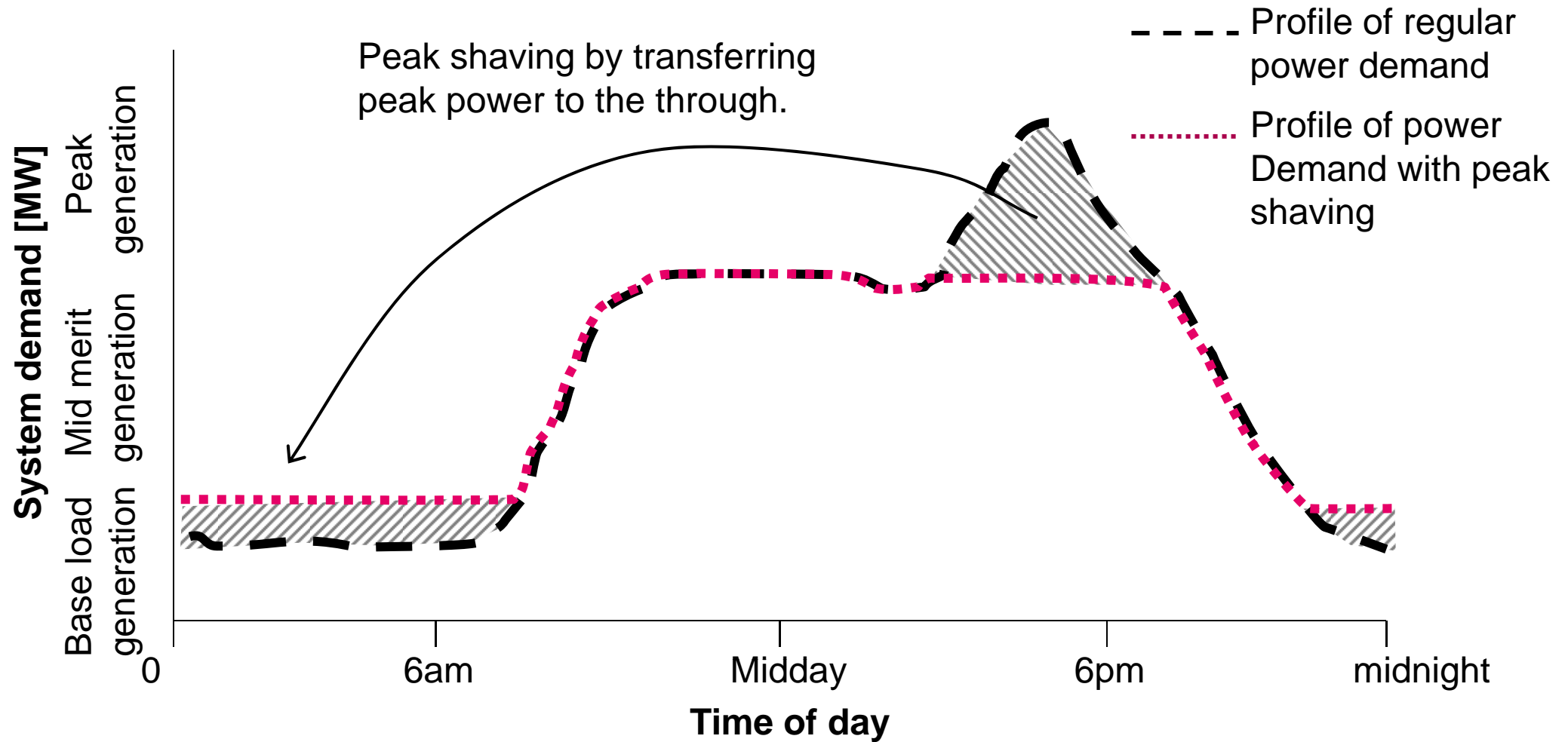
- Introduction of Essent
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# The role of smart grids from a suppliers viewpoint: Optimization of the energy supply starts on the demand side



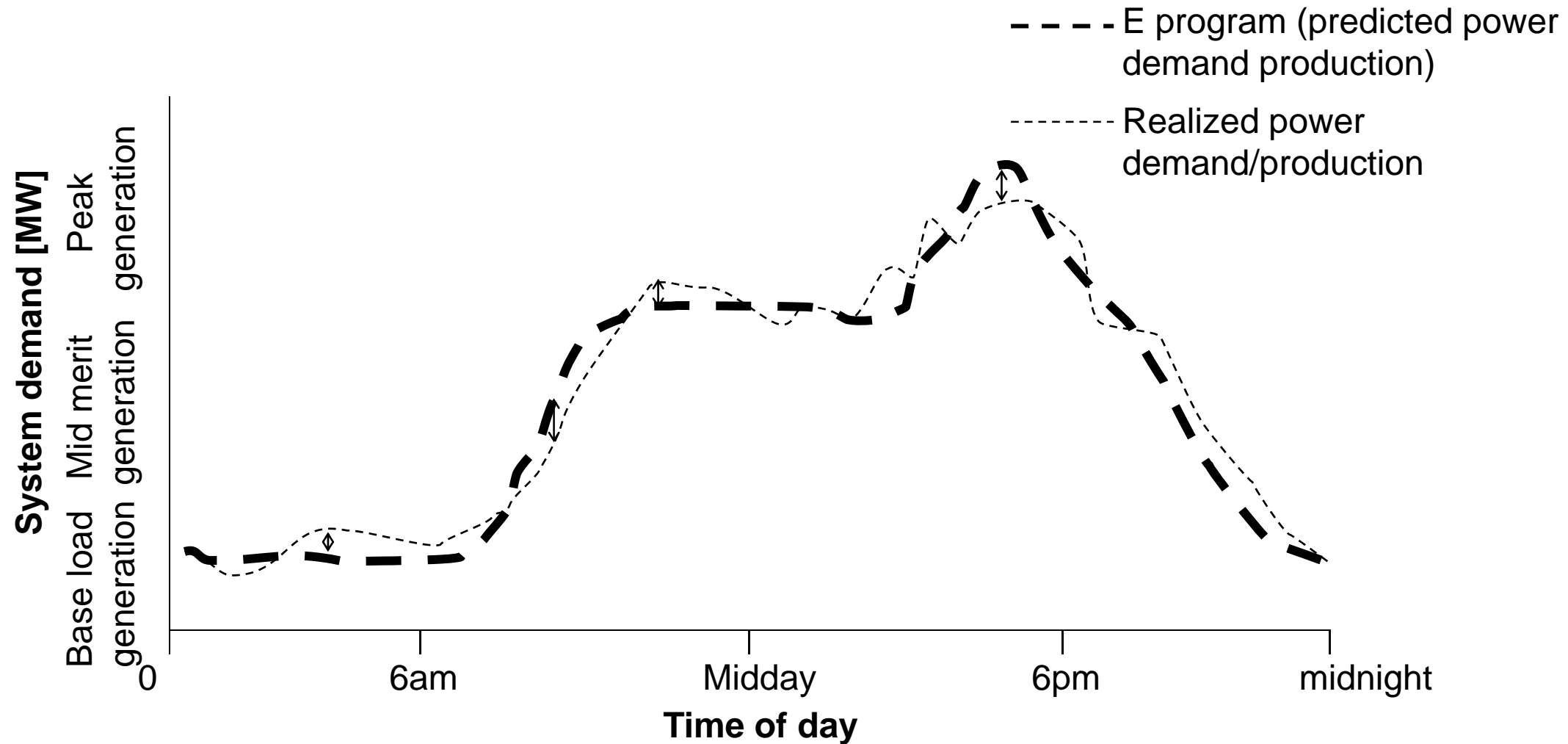
# Chain optimization

## - Peak shaving



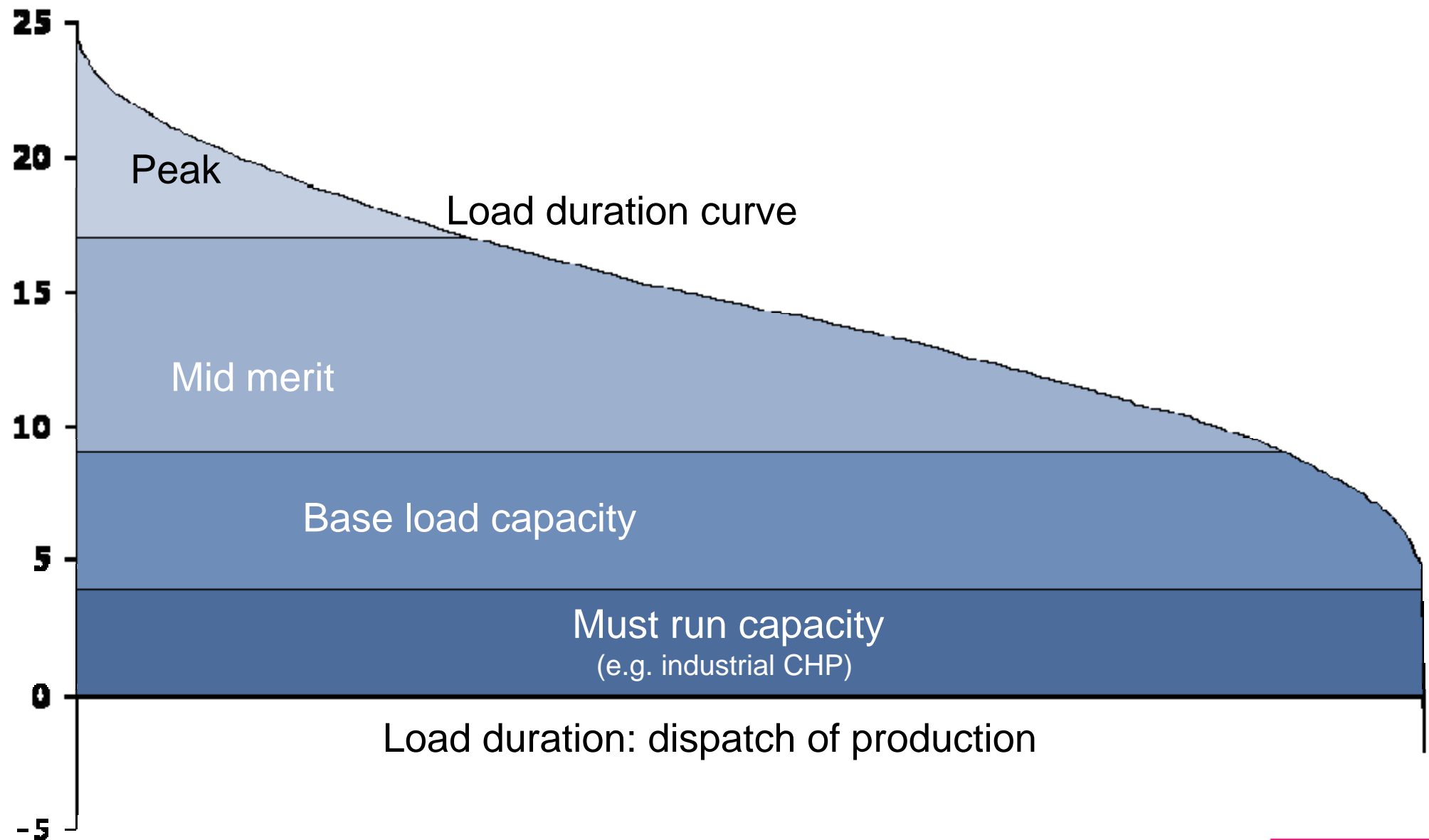
# Chain optimization

- Balancing/regulating power



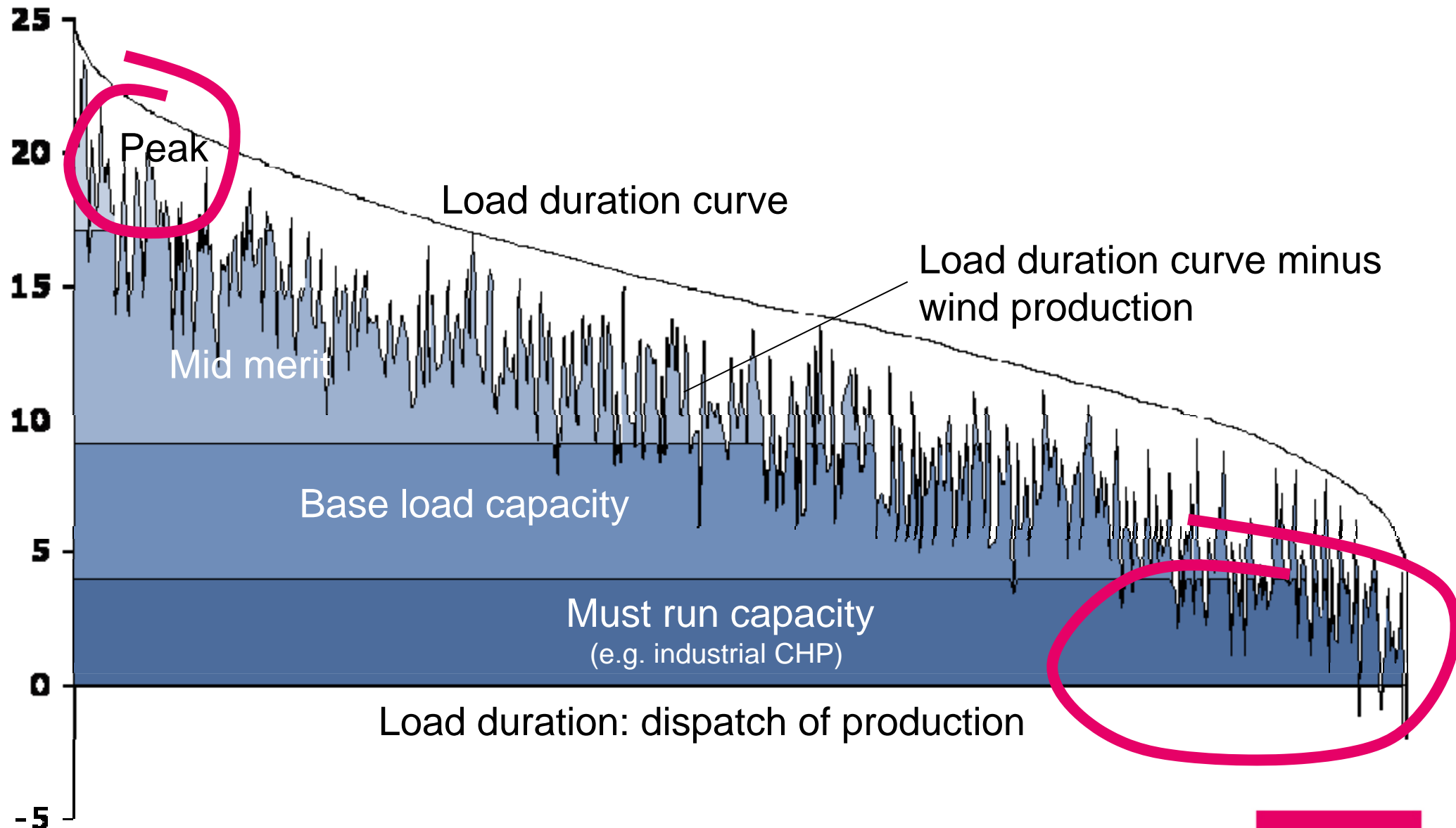
# Chain optimization:

- Integration of intermittent sources



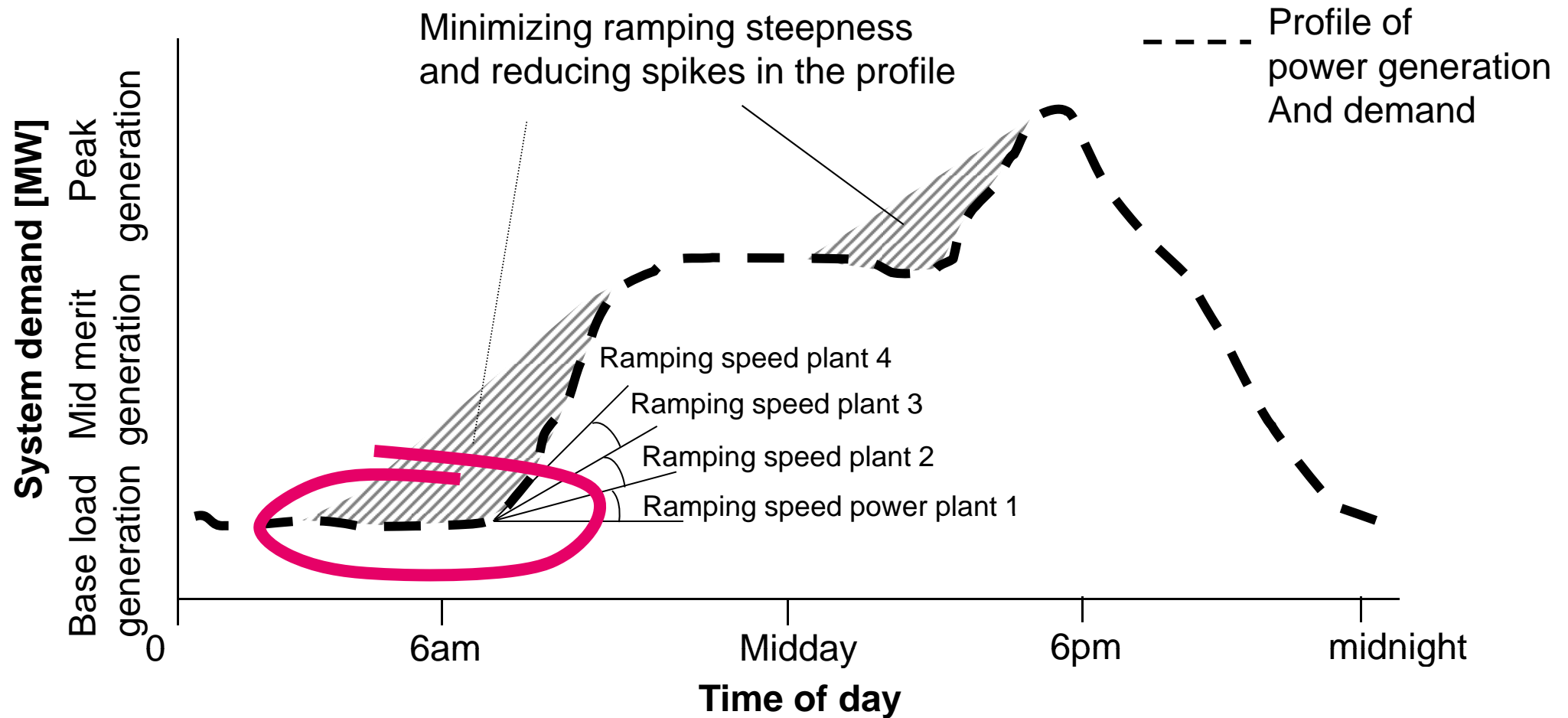
# Chain optimization:

Intermittent sources need flexibility through flexible production, storage or flexible demand



# Chain optimization

- Reducing ramping steepness





# Challenges for the electricity sector



# Agenda

- Introduction of Essent
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# Criteria for a successful technology:

1. Ability to weigh and value the interest of all stakeholders  
Very clearly and transparently
2. The system should be automated  
To capture the needed flexibility and avoid unnecessary scarce customer attention
3. Very fast or Inherent 'feedback' of local production and demand  
In order to avoid synchronous behaviour
4. The system should be generic  
Able to connect and aggregate both household appliances, EV's and local generation
5. The system should be scalable and possible to be implemented gradually  
Synchronizing investments with revenues and make use of increased understanding during the implementation
6. Open infrastructure.  
To create standardization and avoid lock in effects

# Criterion 1: A market mechanism to weigh and value the interest of all stakeholders

## Production/ energy supplier:

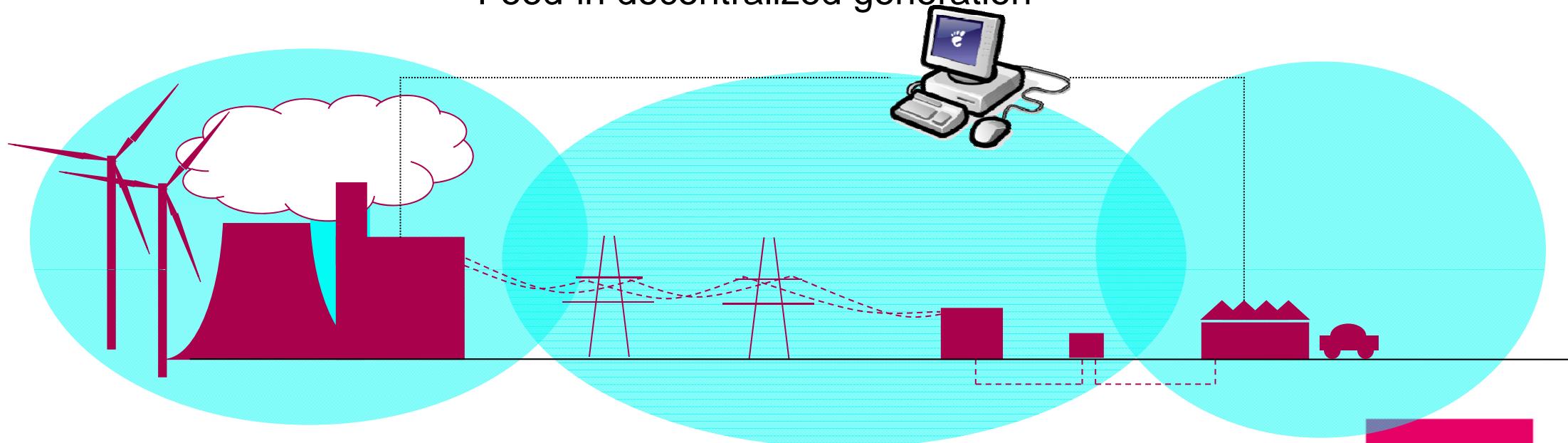
- Peak shaving
- Increasing need for flexibility
- Balancing/ regulating power

## Grid manager:

- Avoiding congestion
- Optimal use of grid capacity
- Feed-in decentralized generation

## Energy consumer/ owner distributed generation

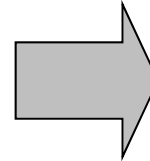
- Maintain comfort level
- Low energy bill
- Privacy
- Not restrict behavior
- Support sustainability
- ...



Criterion 2: A system should automatically optimize primary for the consumer/producer

### **The ideal energy supply**

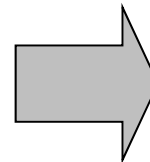
- Affordable
- Available
- Sustainable



Energy is a commodity

### **Chain optimization**

- Balancing
- Integration of intermittent sources

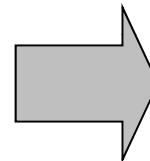


Control cycle on minute scale

### **Customer (owner/user)**

- Maintain comfort level
- Low energy bill
- Privacy
- Freedom of action

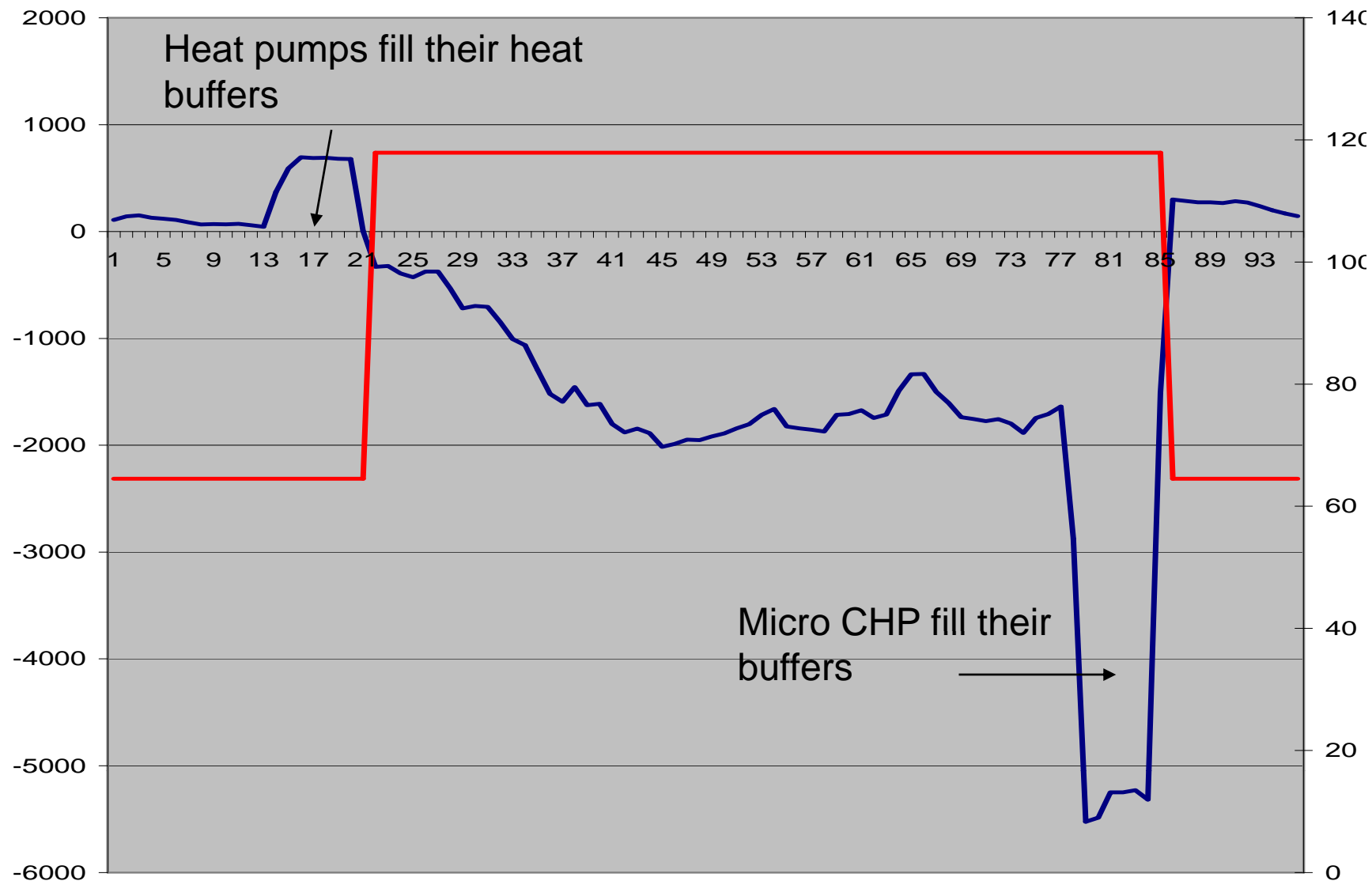
...



Controlled assets need energy storage:

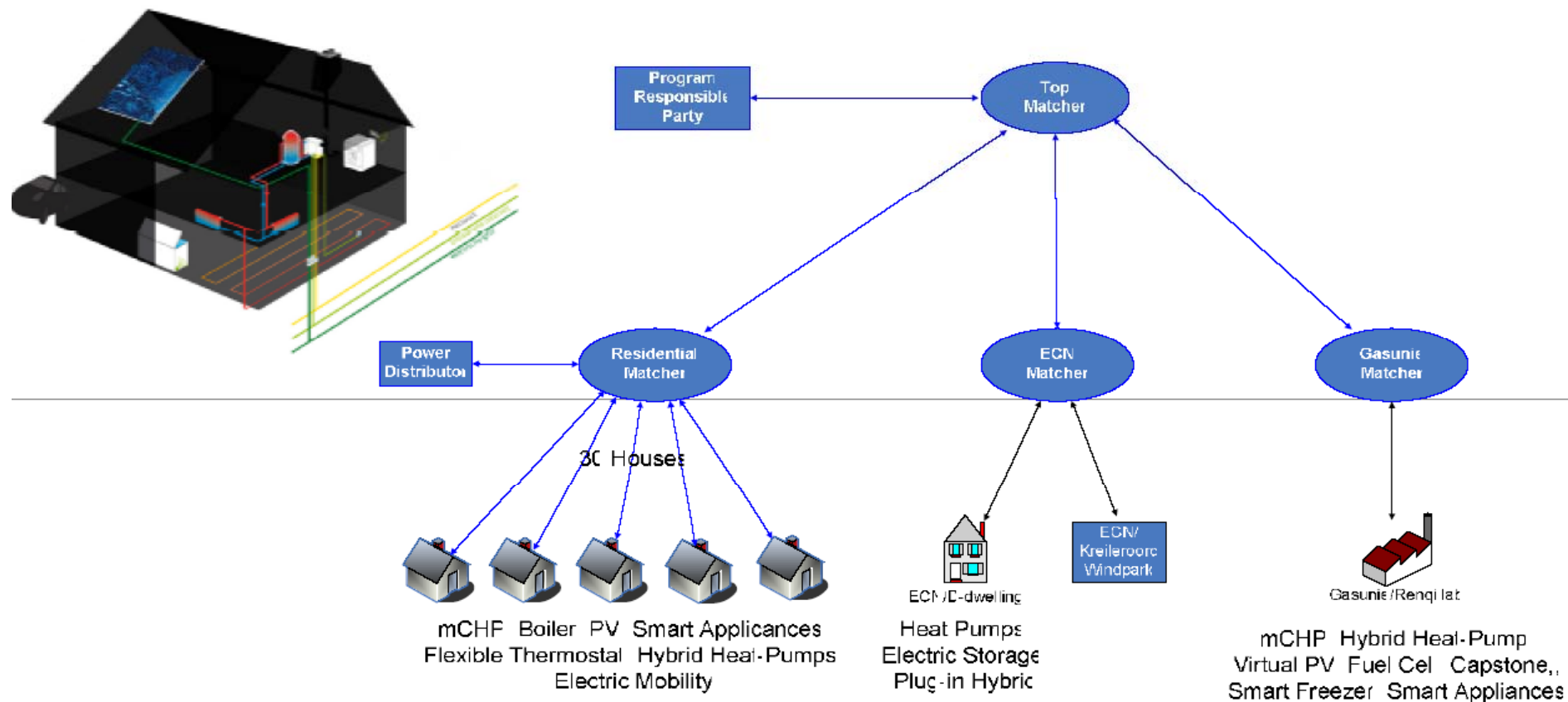
- Electric (hybrid-)car
- Micro CHP
- Heat pump

# Criterion 3: Very fast or Inherent 'feedback' of local production and demand



Conclusion:

# An agent based supply and demand mechanism?



- System optimizes automatically for the 'customer'
- Ability to weigh conflicting interests
- Avoid simultaneous behavior
- Scalability and gradual implementation



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# Hoogkerk

## PowerMatching City



Energy Research Centre of the Netherlands



**HUMIQ**

Advanced Software

**KEMA** 

**-essent** 



# Powermatching city Hoogkerk



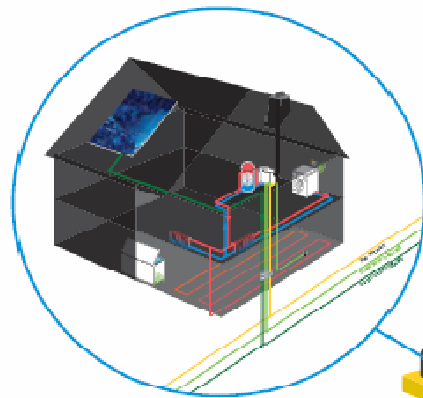


# Powermatching city Hoogkerk

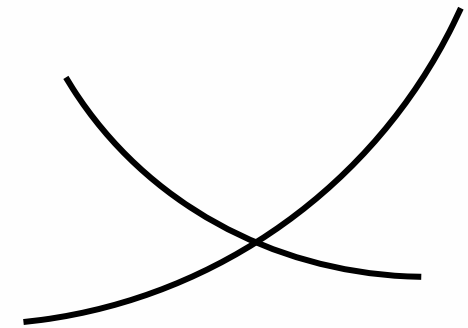
## Electric vehicles



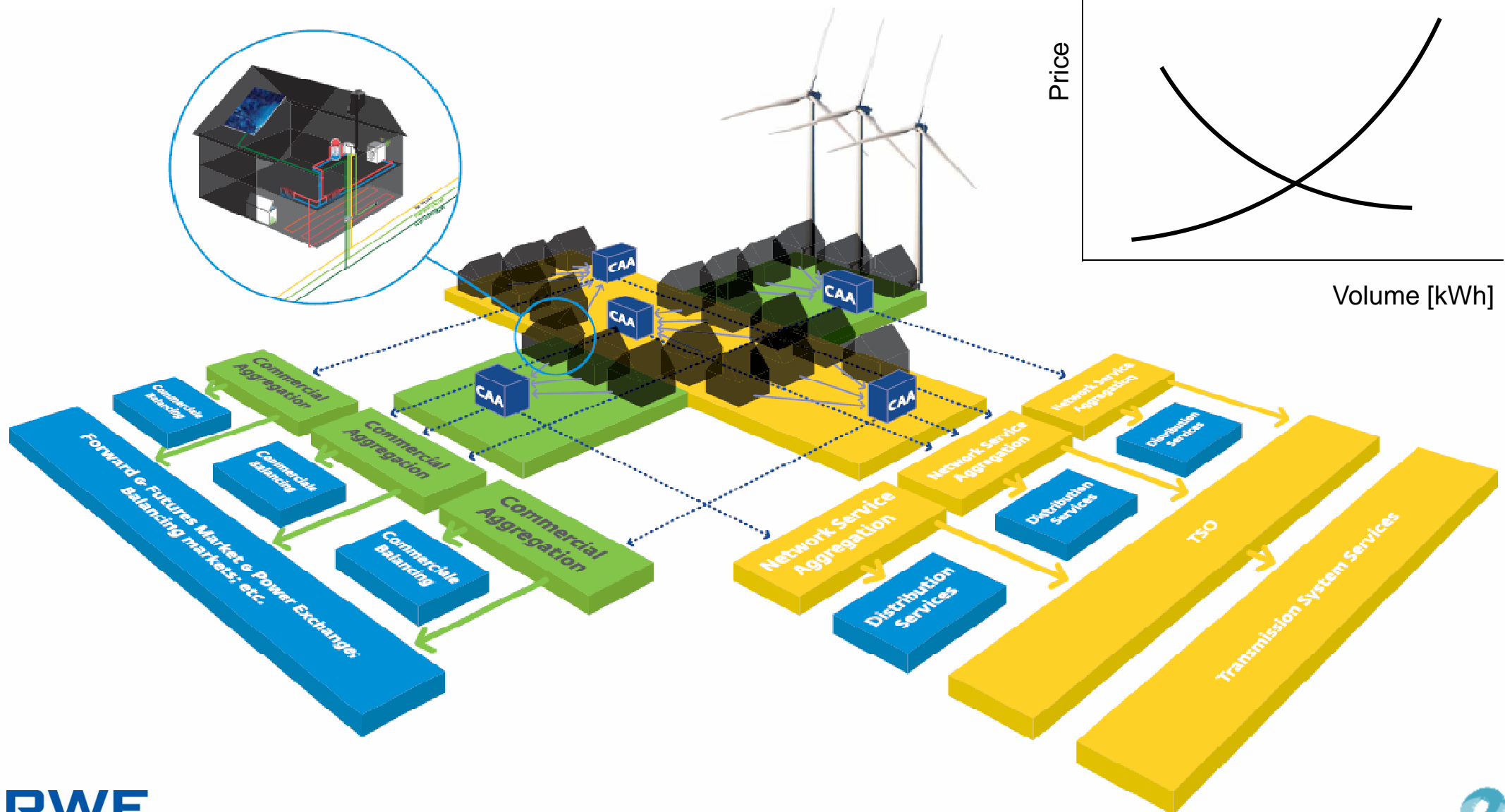
# Configuration of the project: Multi goal optimization



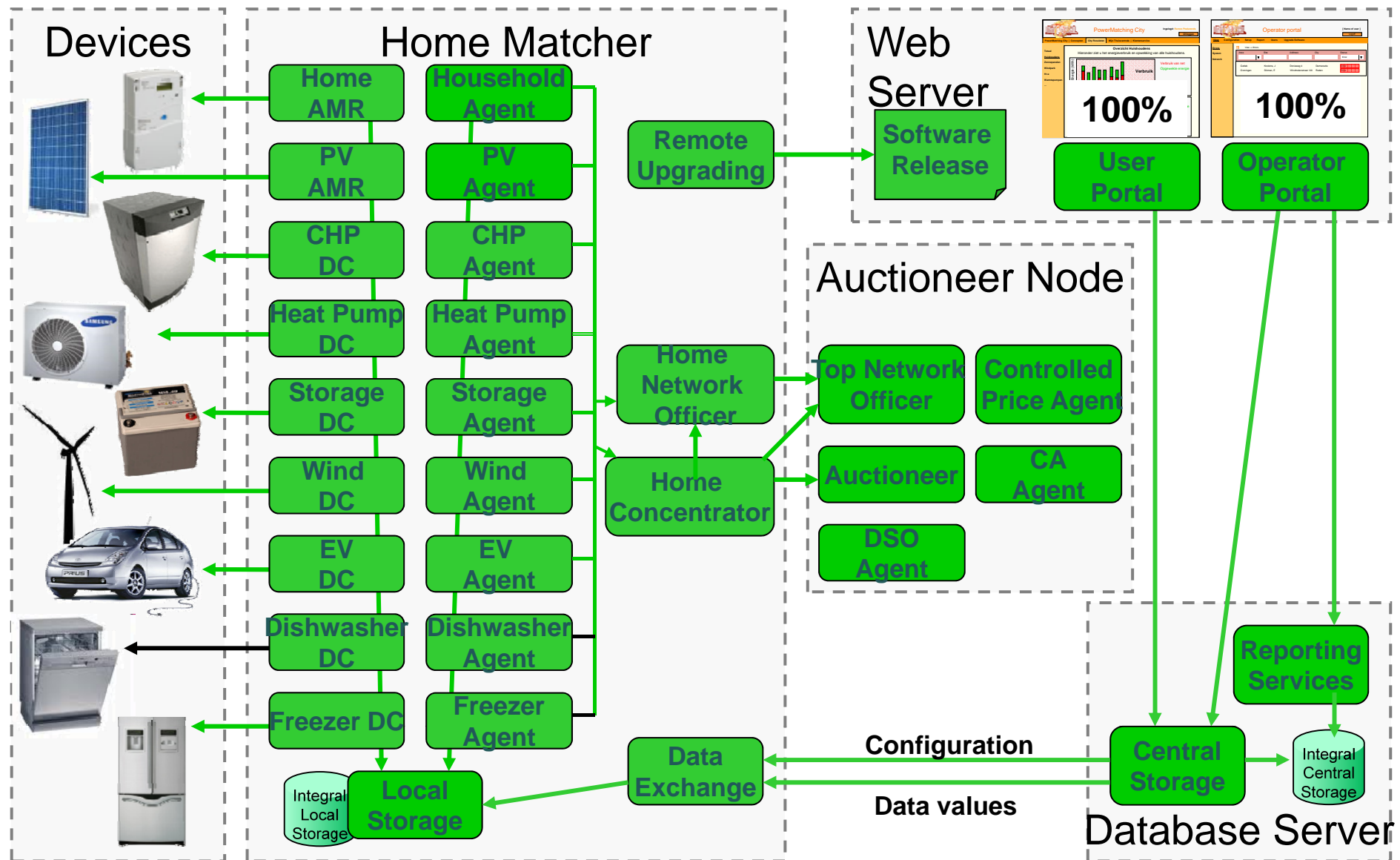
Price



Volume [kWh]

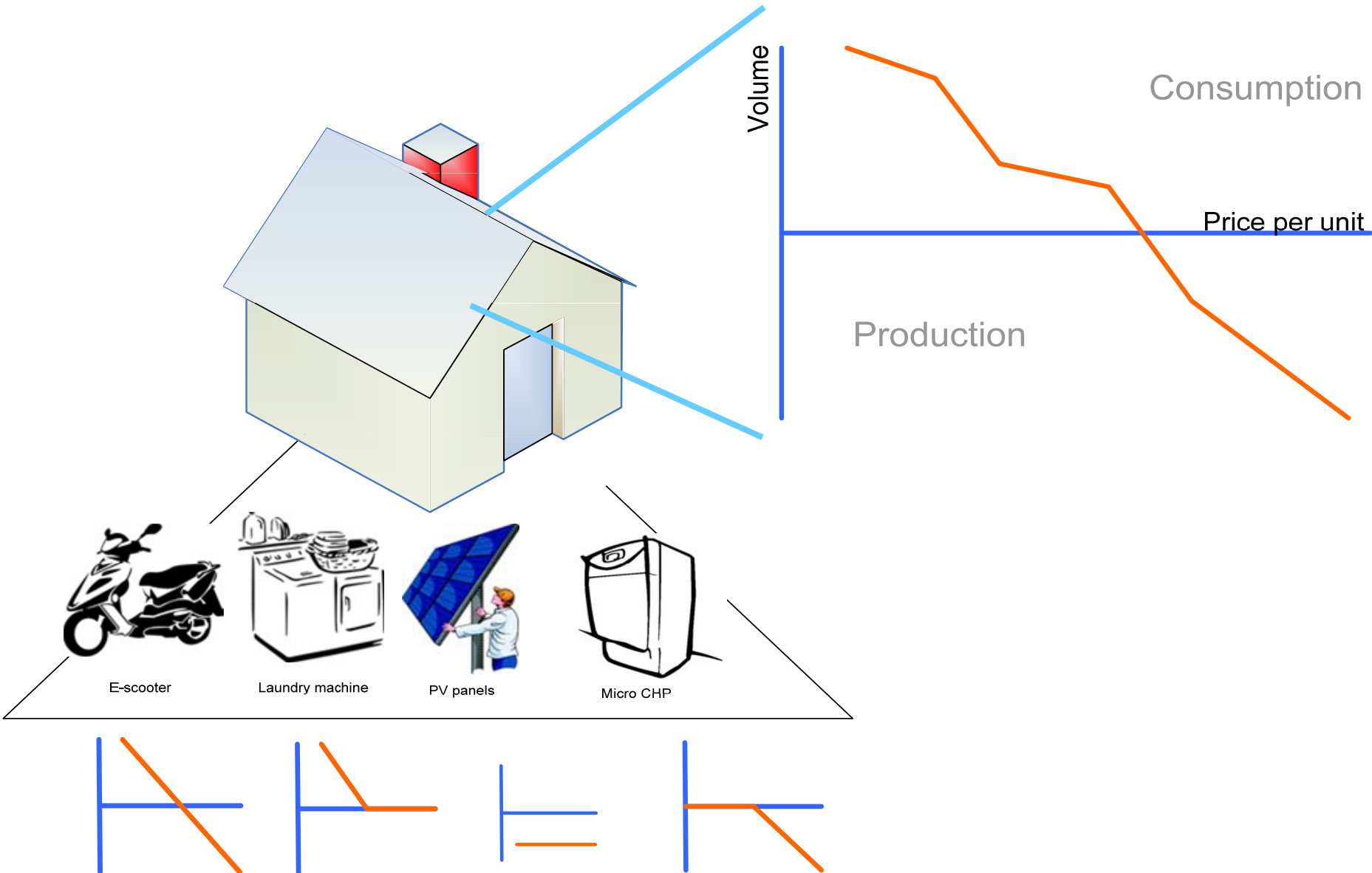


# ICT Architecture



# Coordination principle

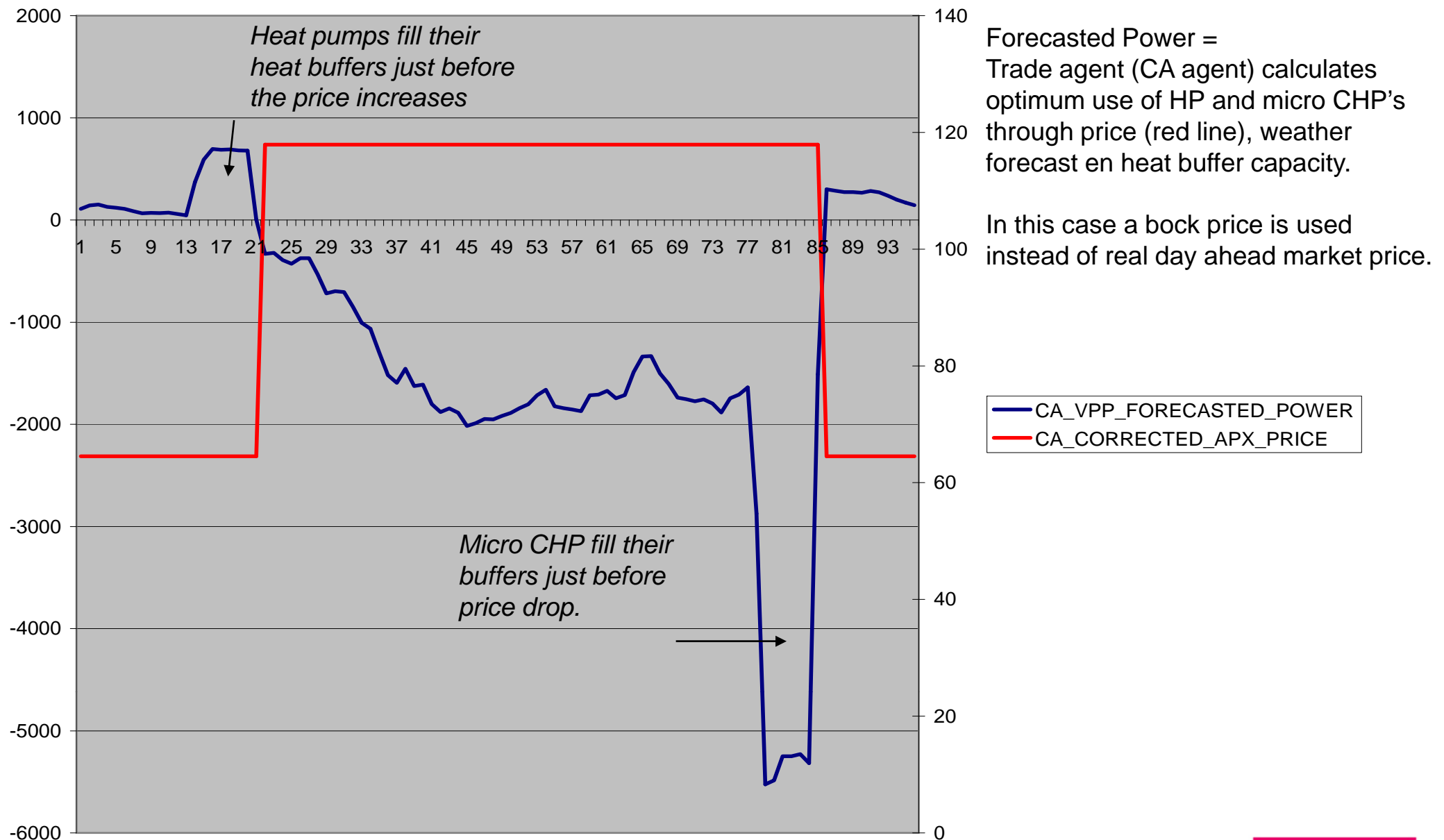
Powermatcher: Economics meets process control





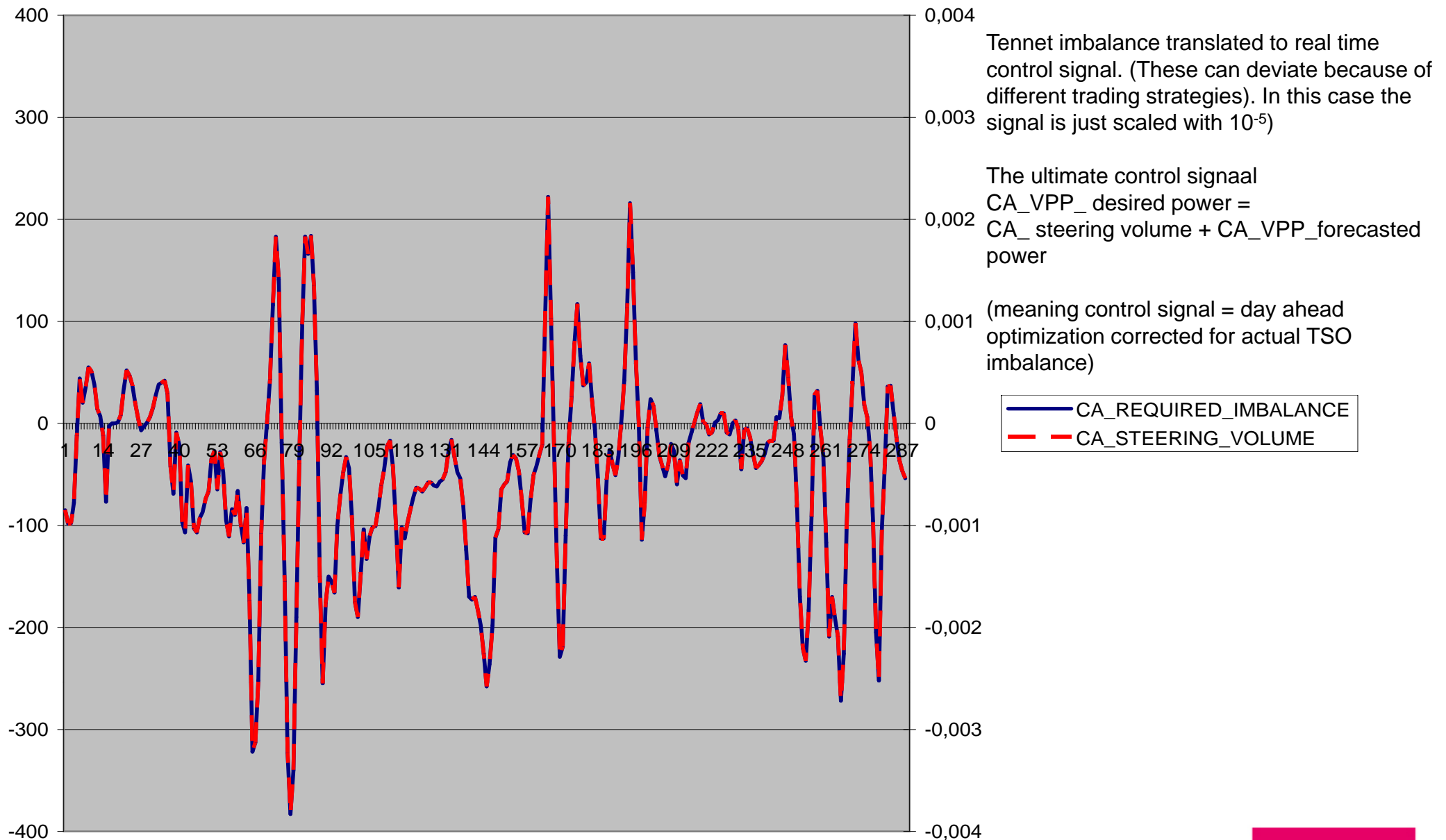
# Optimization of the cluster (DSO's nightmare scenario)

Using synthetic day ahead block price + weather forecast



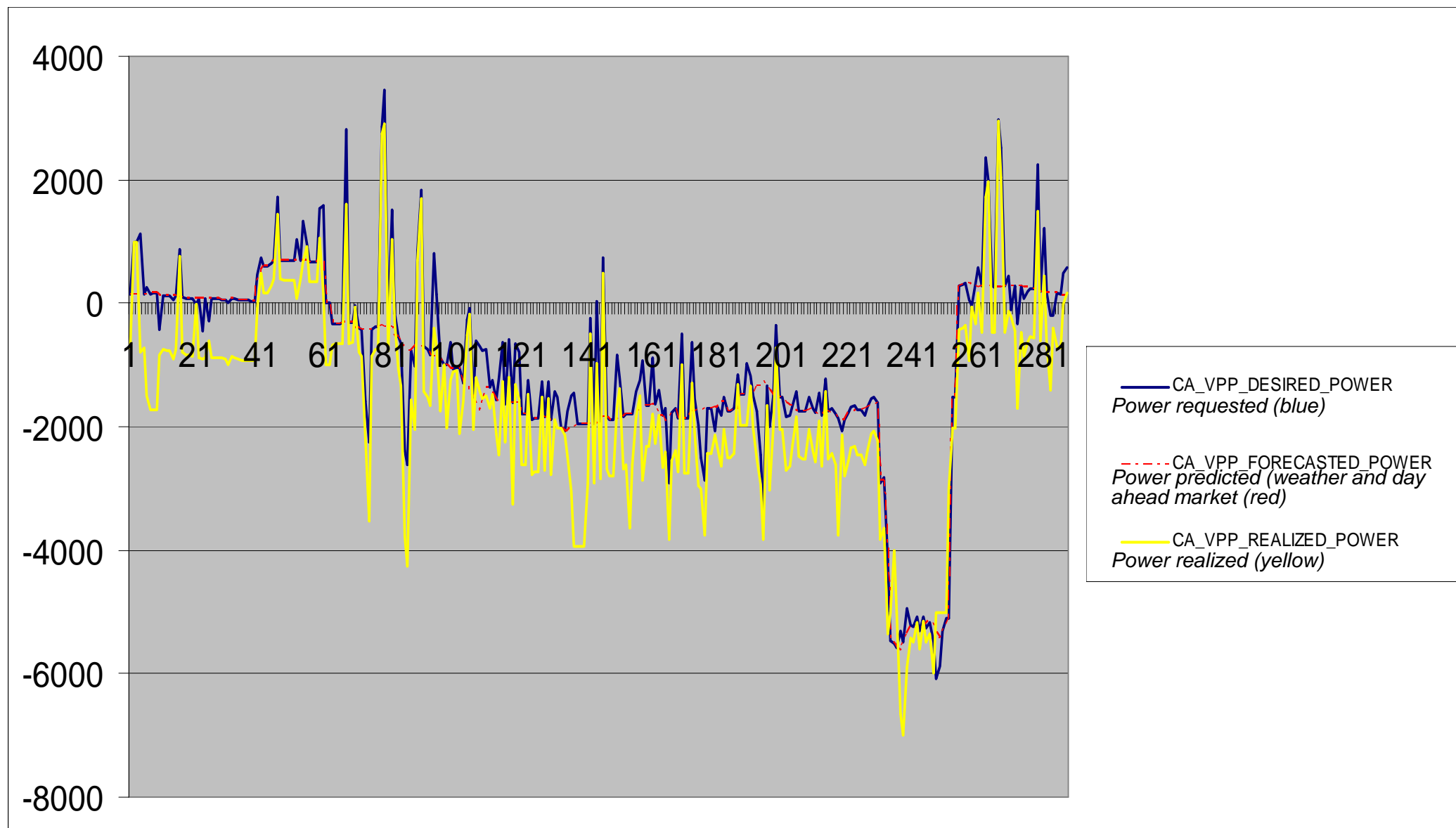
# TSO balancing signal to real-time control signal

(This signal added to the day ahead forecast gives actual control signal to cluster)

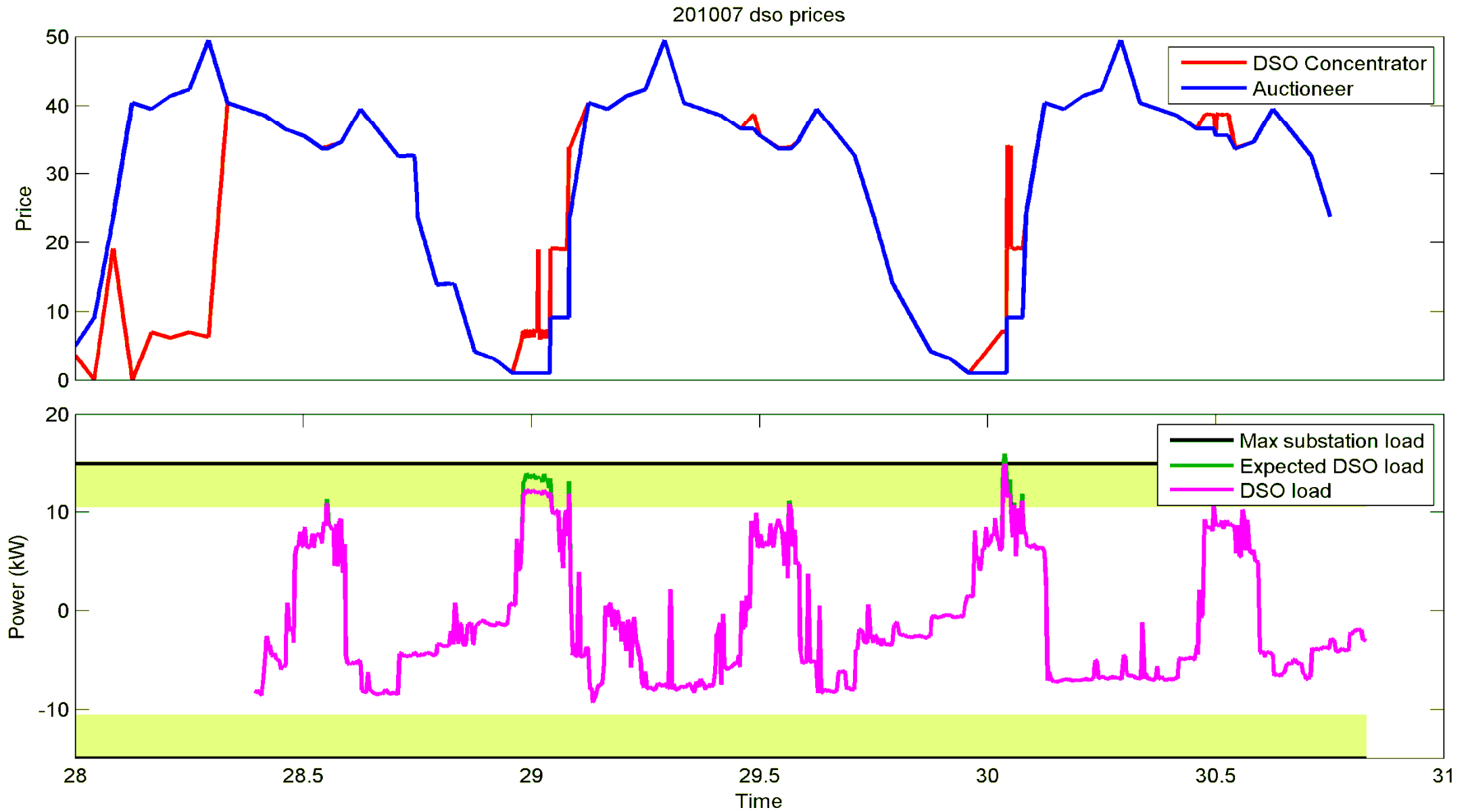


# Controlling the virtual power plant:

## Desired volume vs. realized volume



# DSO concentrator

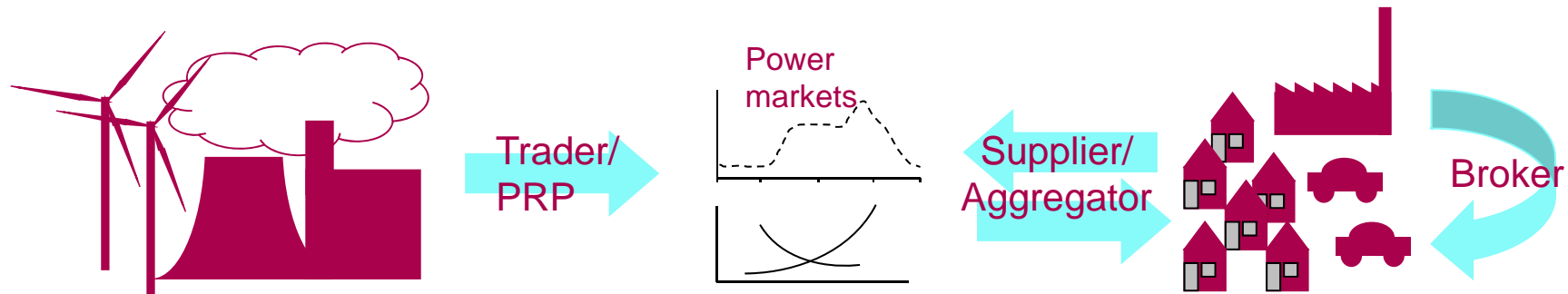


# Agenda

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# PowerMatching City II

Integrate smart markets in the electricity system



*Project*

*Goal*

PowerMatchingcity I

Value creation and control

*System*

*Prosumer*

PowerMatchingcity II

Value Settlement  
(allocation/reconciliation)

Settlement with prosumer  
business model and billing

- Expanding from 25 households and cars to 50 -70
- Participation local DSO

# Smart Energy Collective (27 companies)

## Consortium Goals

- Develop and test integrated interoperable smart energy services, including technology and infrastructure
- Creating an open innovation environment in order for these services to be developed, demonstrated and tested on a significant scale in several pilot locations
- Developing a shared market for smart energy services



# Flexible Power Alliance

Establishing an European Alliance to create and promote an Open Flexible Power Standard for smart grids, automated demand management and local generation



*The Flexible Power Alliance will establish an open protocol for a seamless communication and interfacing standard covering all devices and stakeholders in the last mile of the Smart Grid electricity value chain.*

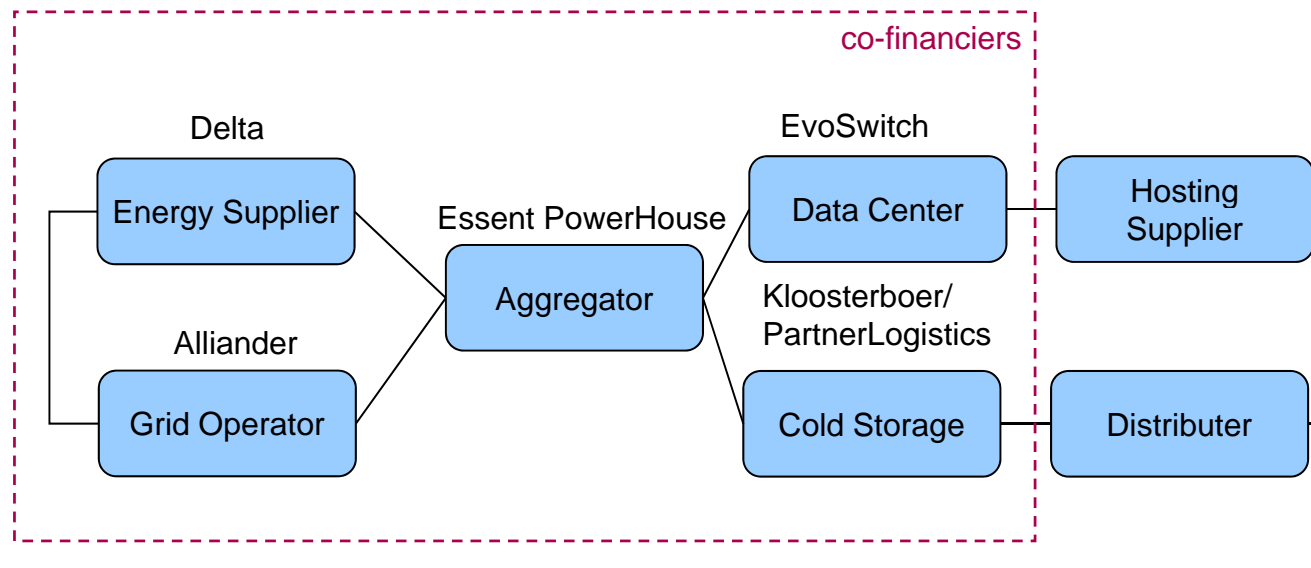
## Founding members

TNO  
NXP  
DTU  
Shaspa  
SAP  
UTInnovation  
ECRO  
Alliander  
Enexis  
IBM  
RWE/Essent

# Industrial initiatives

## Flexiquest (in corporation with TNO and Powerhouse)

- start project July 2011, ready October 2012



# Flexiquest: search for new flexibility

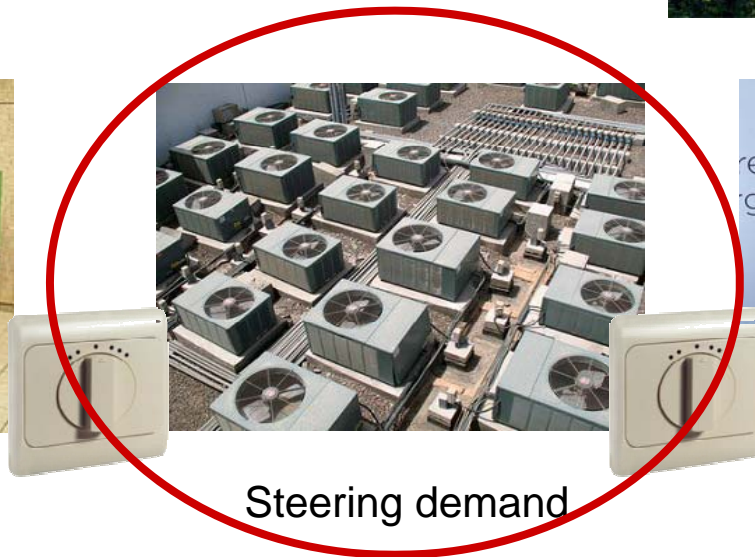
From following demand to following supply



Need for new flexibility



Steering supply



Steering demand

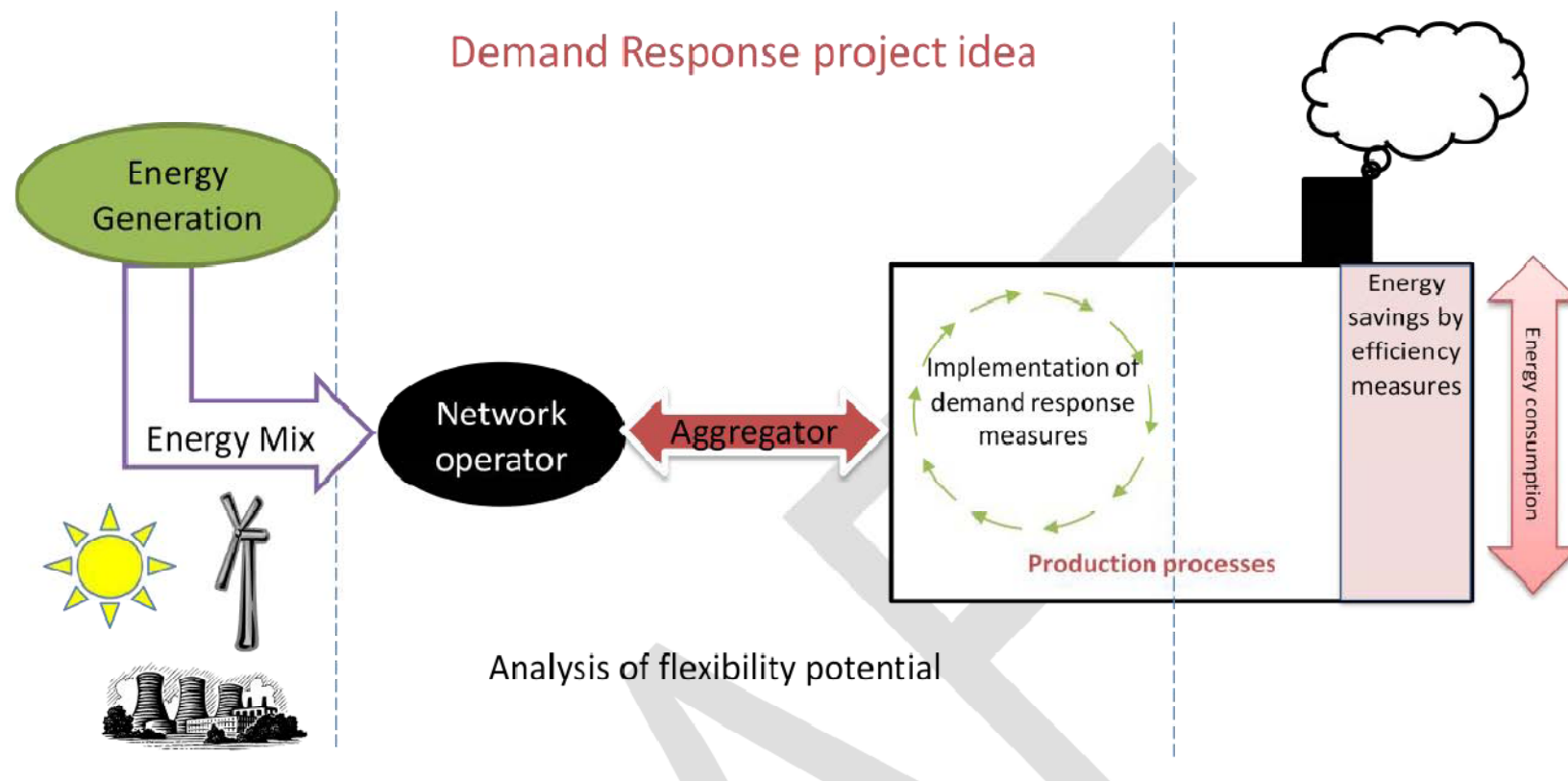


Steering storage

# Demand Response in Industrial Processes (RWE), a LIFE project



## 1: Overall approach of DRIP



# Thanks for your attention



For more information:

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