



NEW CHALLENGES IN ELECTRICITY MARKETS

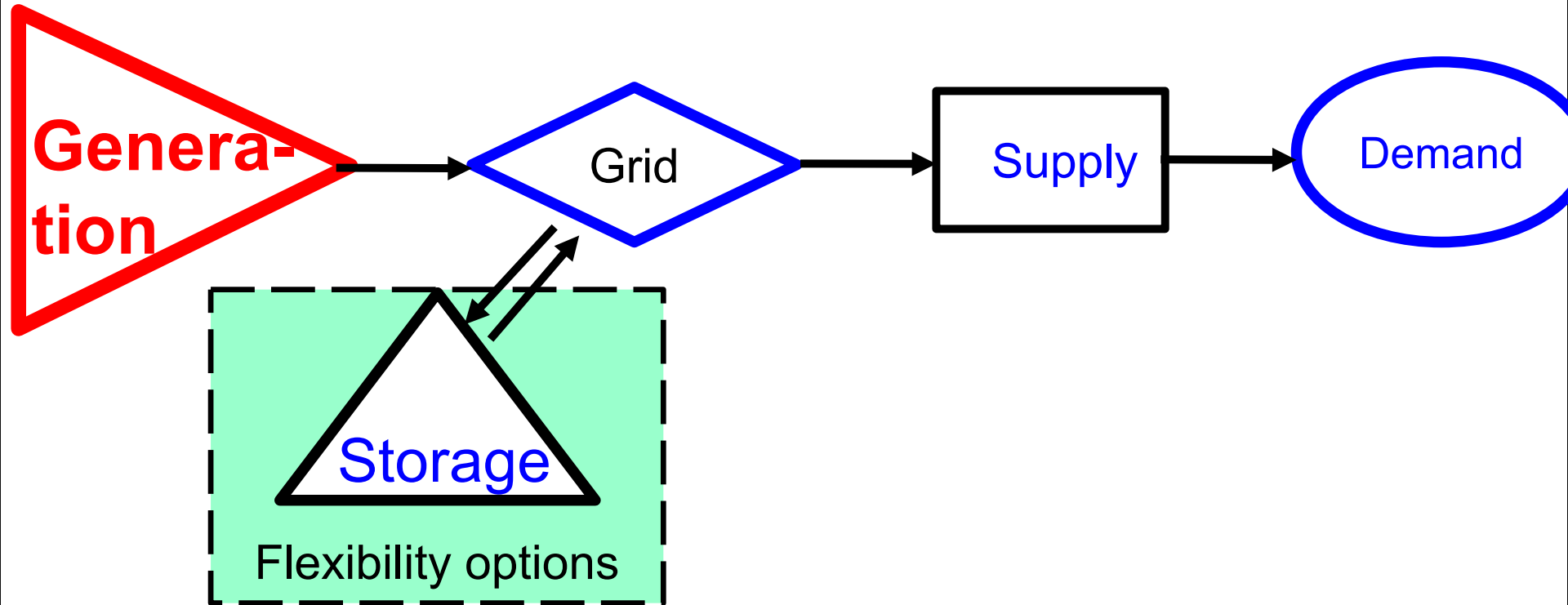
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TU Wien**

CZ-AT summer school, June 2020

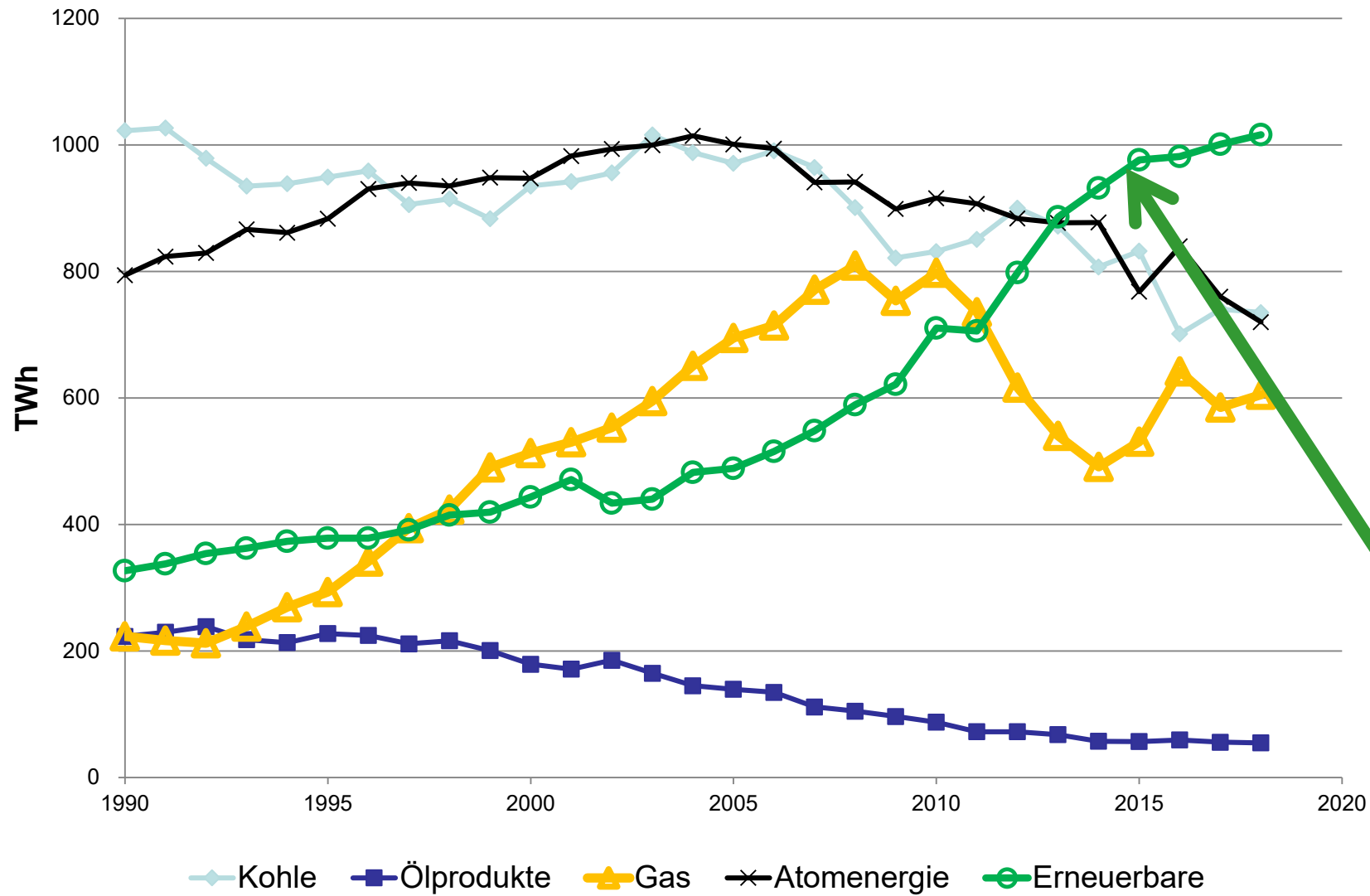
- 1. Introduction: Recent developments**
- 2. How prices come about in electricity markets**
- 3. Impact of variable renewables on prices**
- 4. Need for new market models**
- 5. Flexibility**
- 6. Heading towards prosumagers**
- 7. Conclusions**

Motivation:

- * Climate change → Paris agreements
- * Targets for renewables
- * Europe: The clean energy package → energy communities
- * It is not possible to force variable renewables into the system
- * A strong desire of some customers to participate in electricity supply

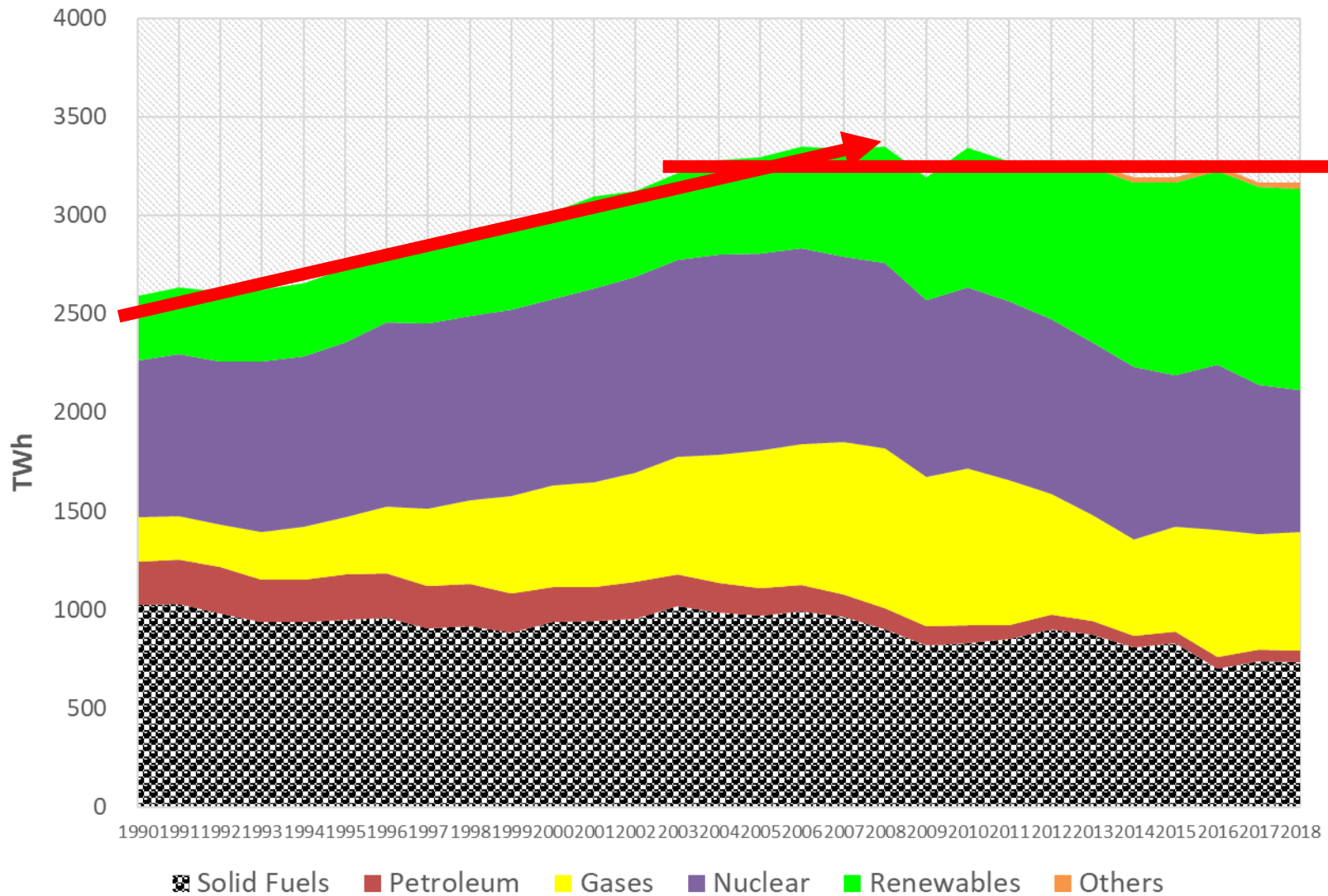


Electricity generation EU-28



2017 und 2018 preliminary

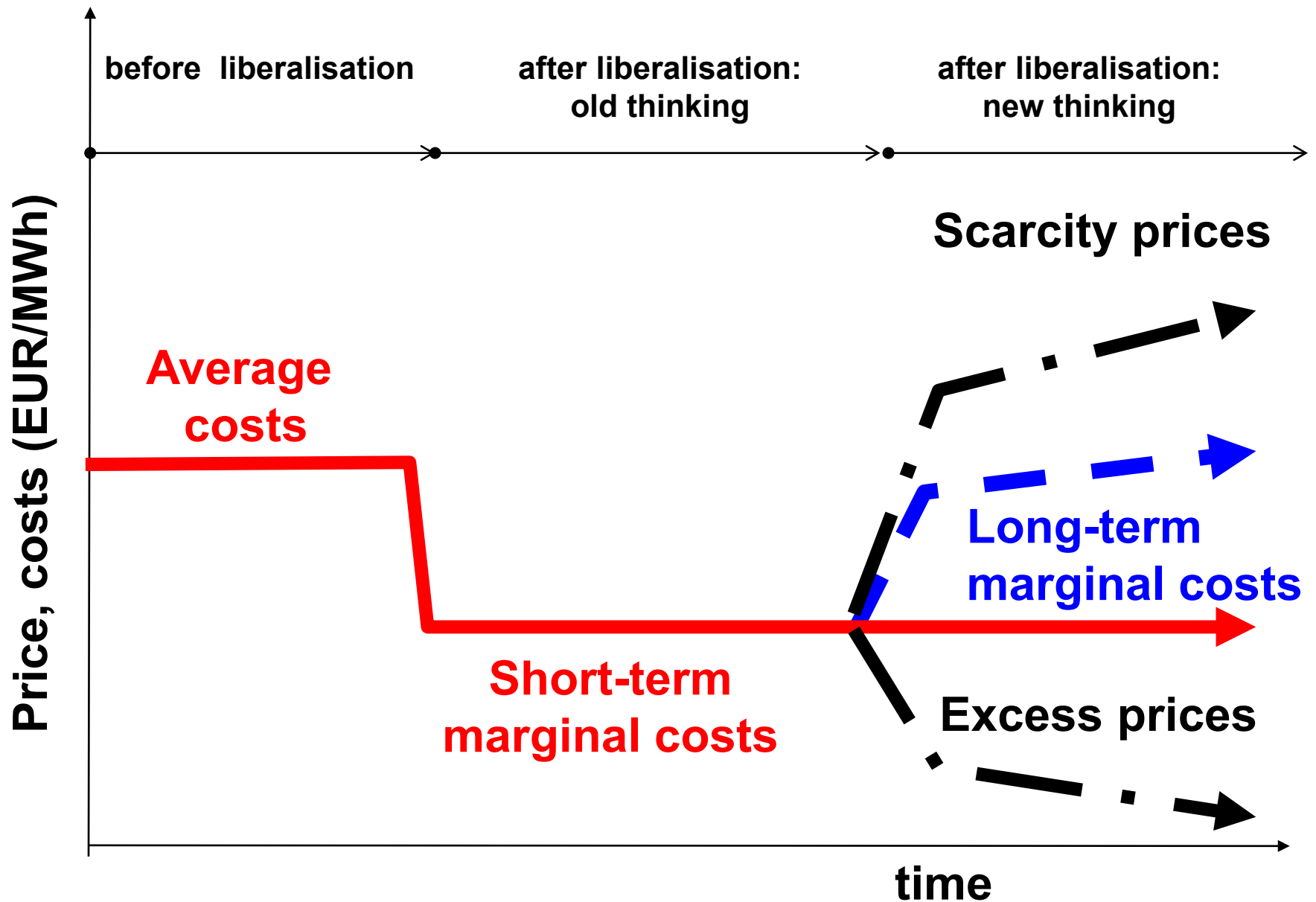
Electricity Consumption EU-28



Structure of the Package



2. How prices come about: Three periods of market design



... to identify the major boundary conditions to integrate even larger amounts of variable renewables into the electricity system

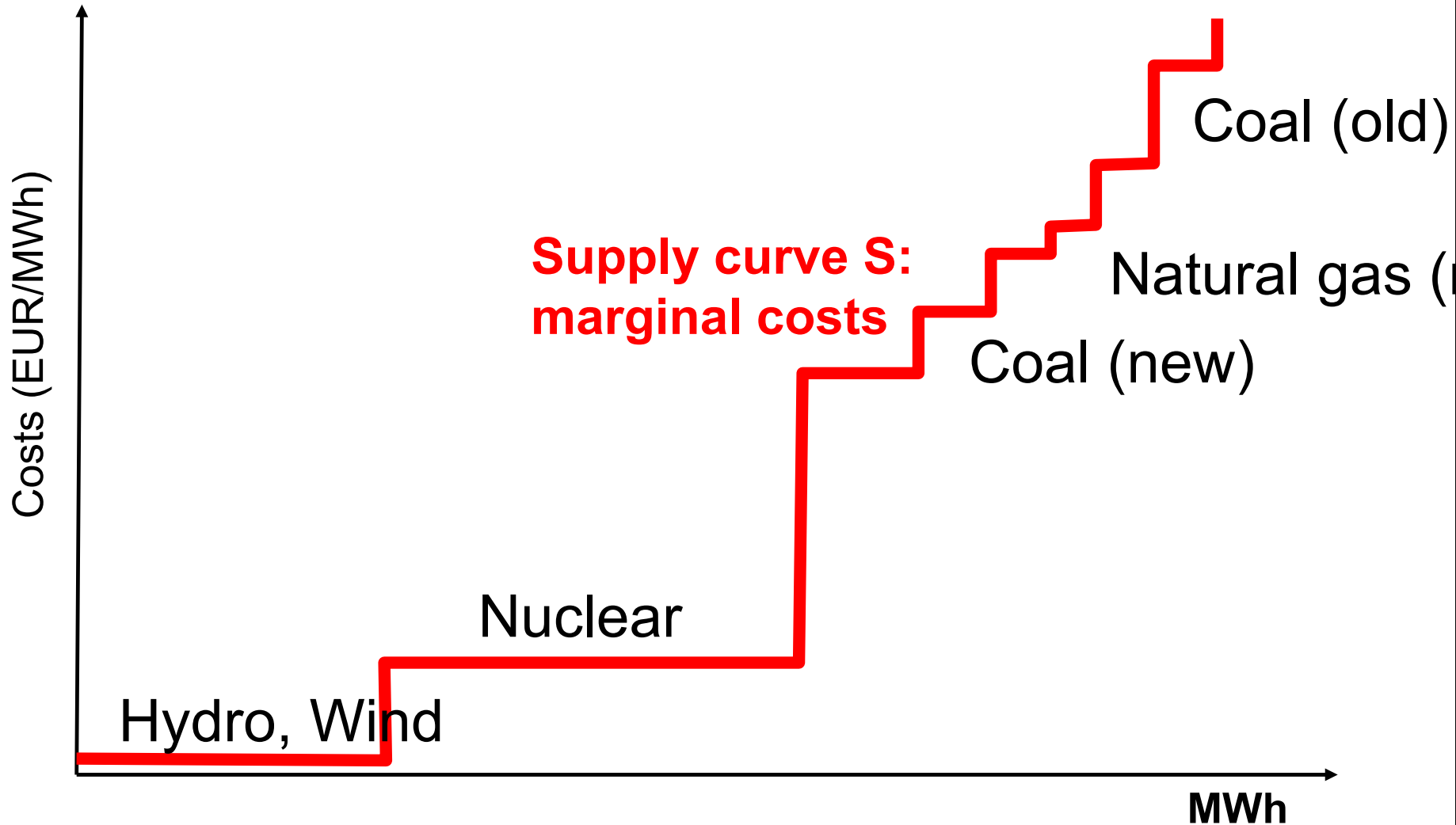
Very important:

Our reflections apply in principle to every electricity system world-wide

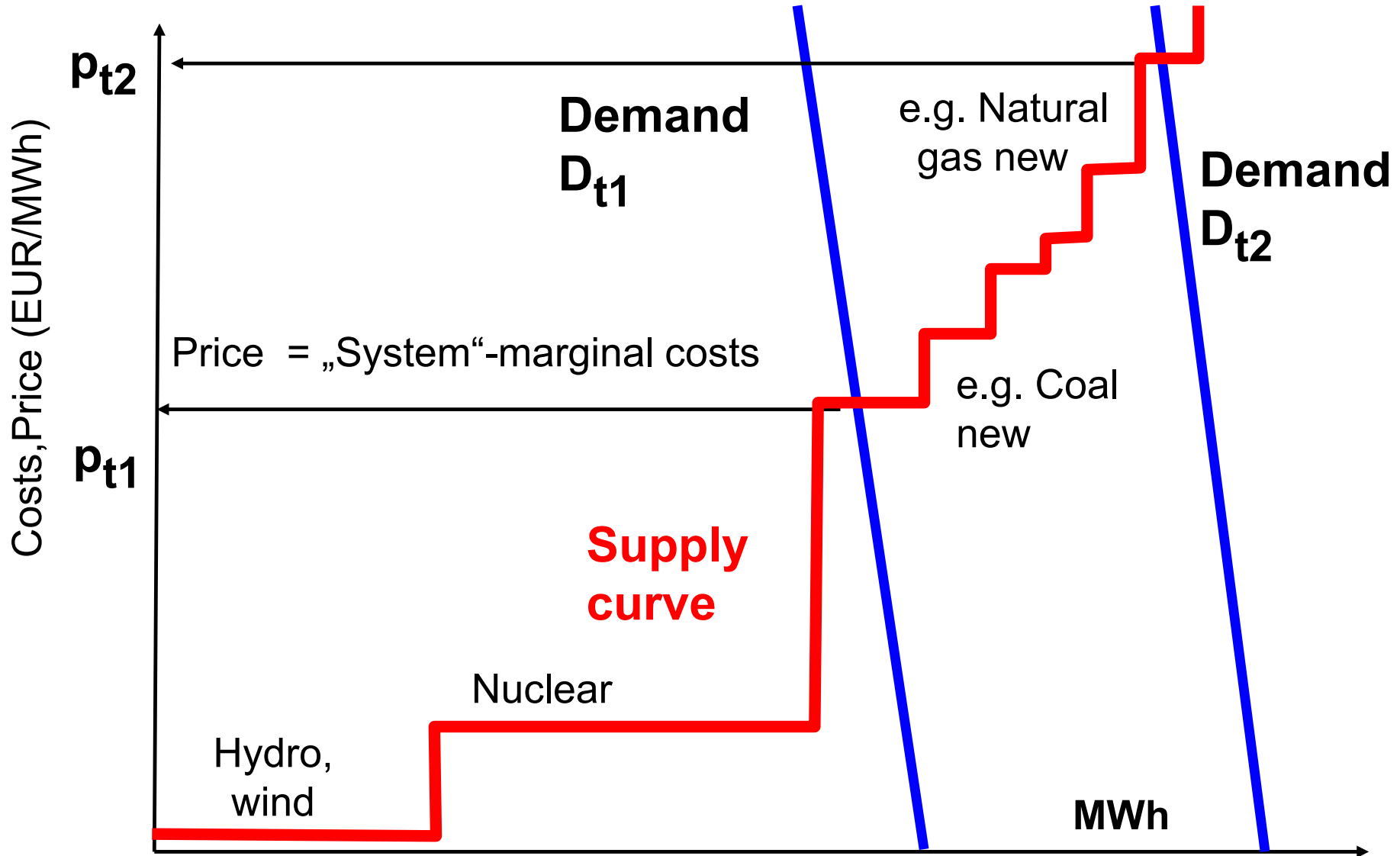
.... are based on **electricity economic** point-of-view

The *MERIT-ORDER* curve of supply

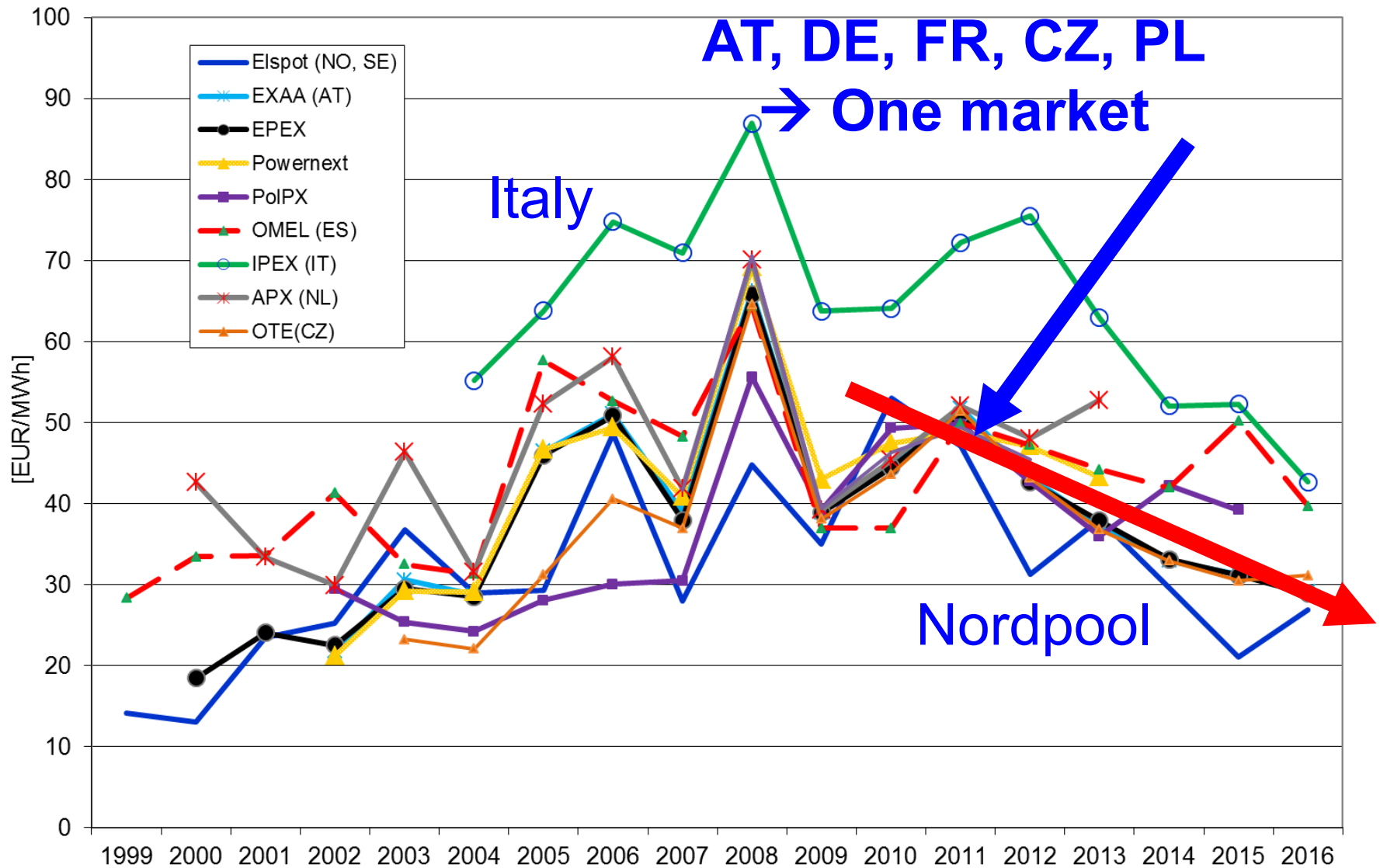
based on short-term marginal costs (MC)



BASIC PRINCIPLE OF COMPETITION: PRICE = MARGINAL COSTS



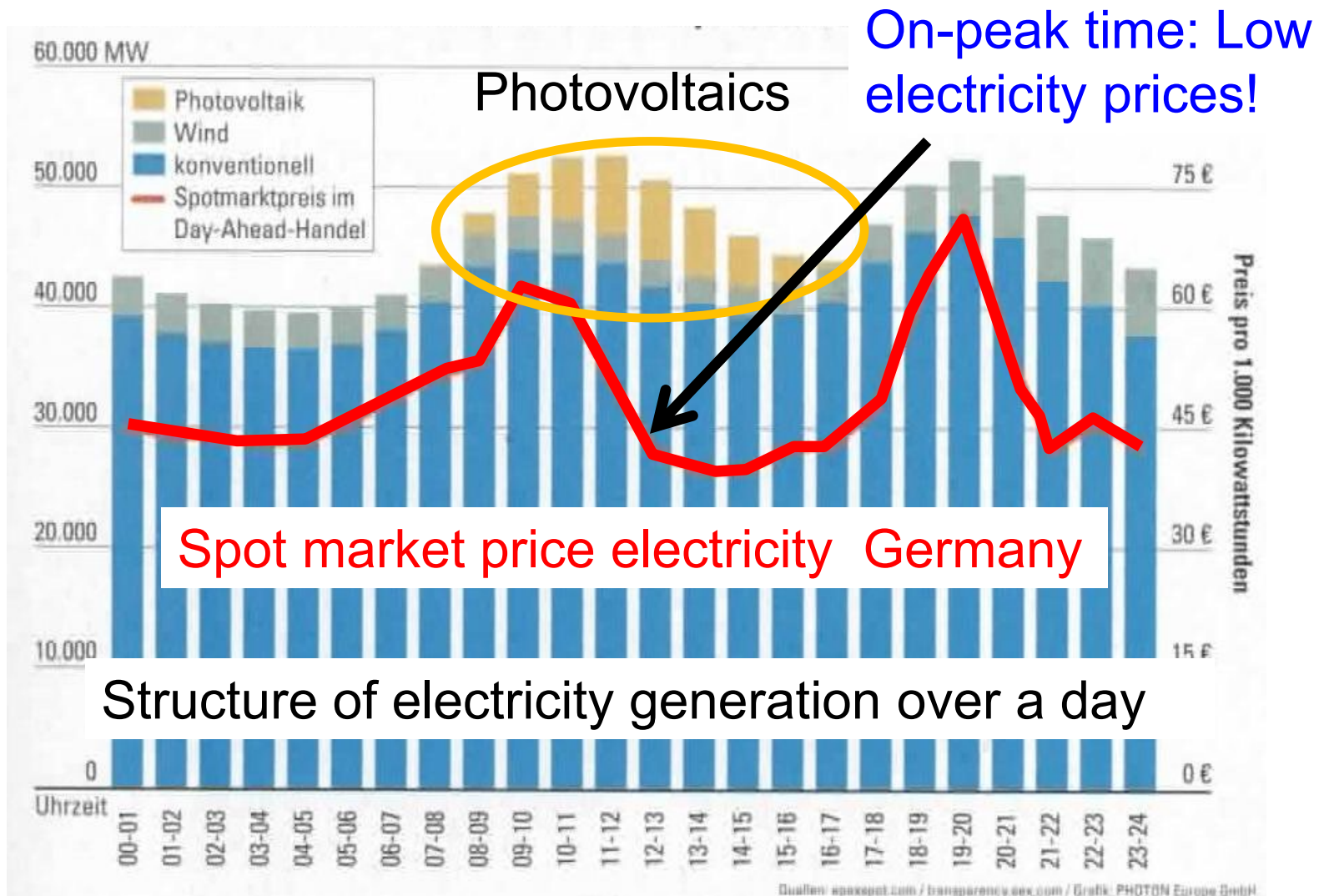
Development of electricity prices in Europe up to 2016 (1)



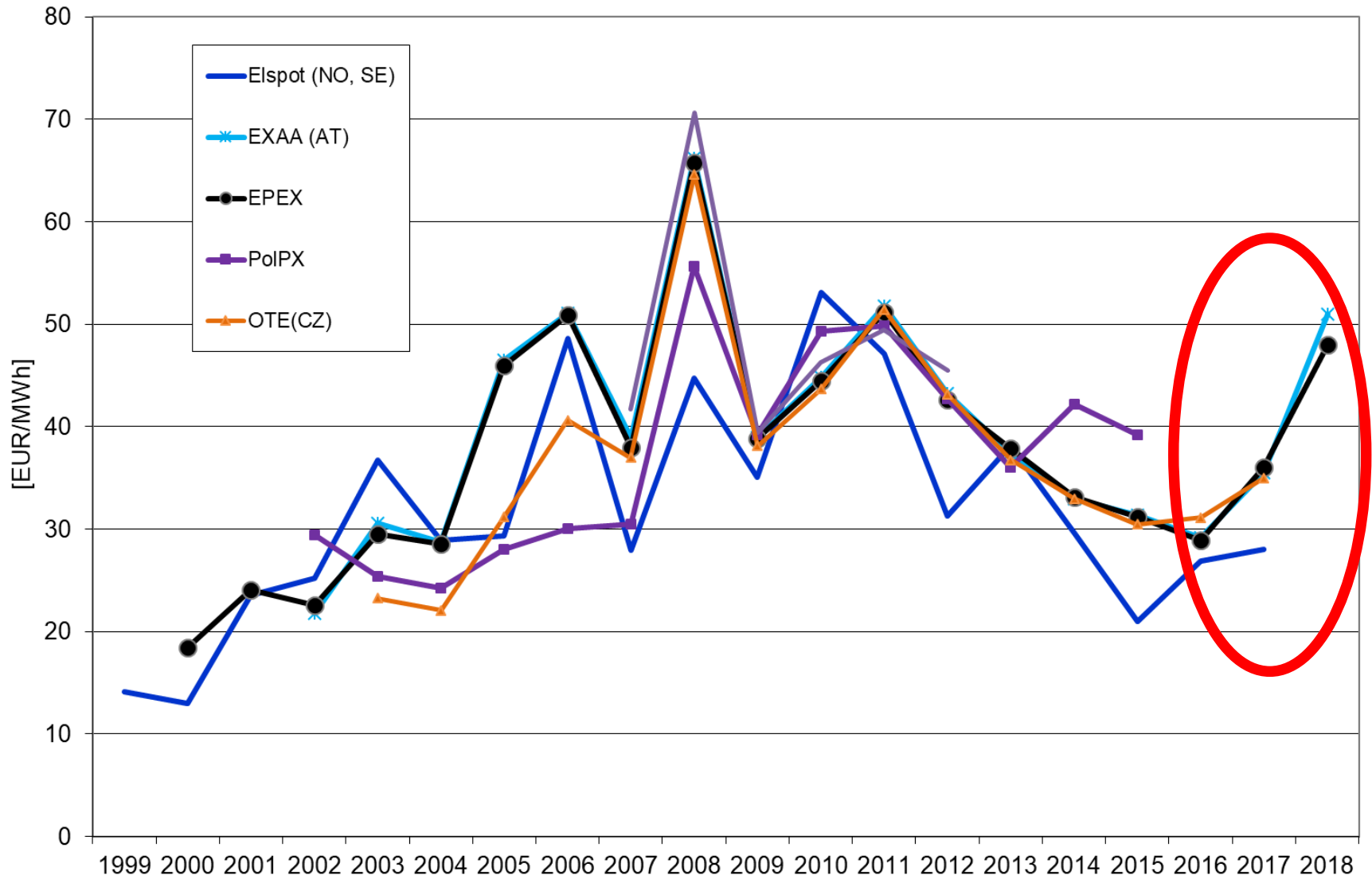
WHY?

STMC = 0!

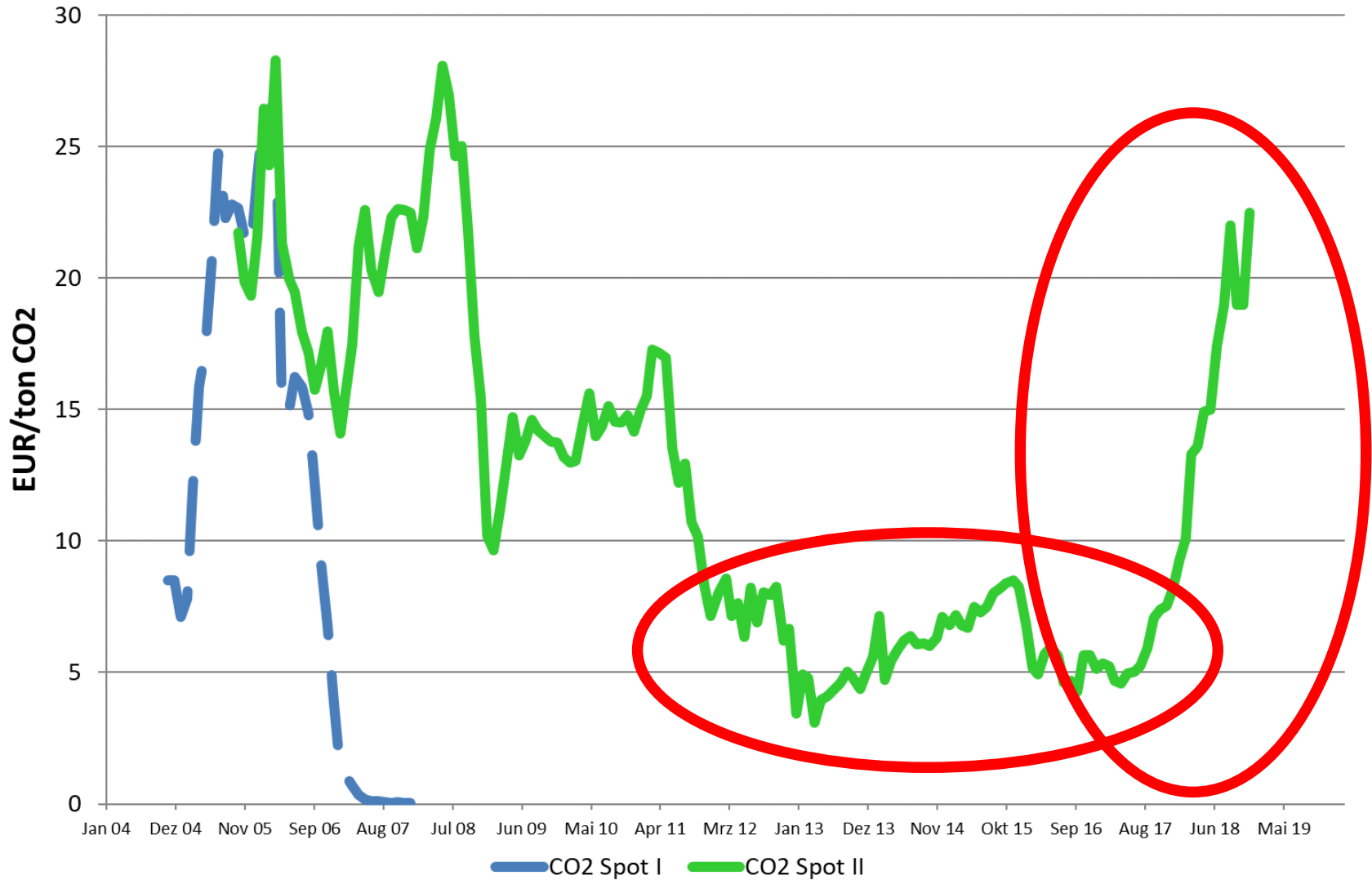
PV AFFECTS THE ELECTRICITY MARKET PRICE IN GERMANY



Development of electricity prices in Europe up to 2018 (2)

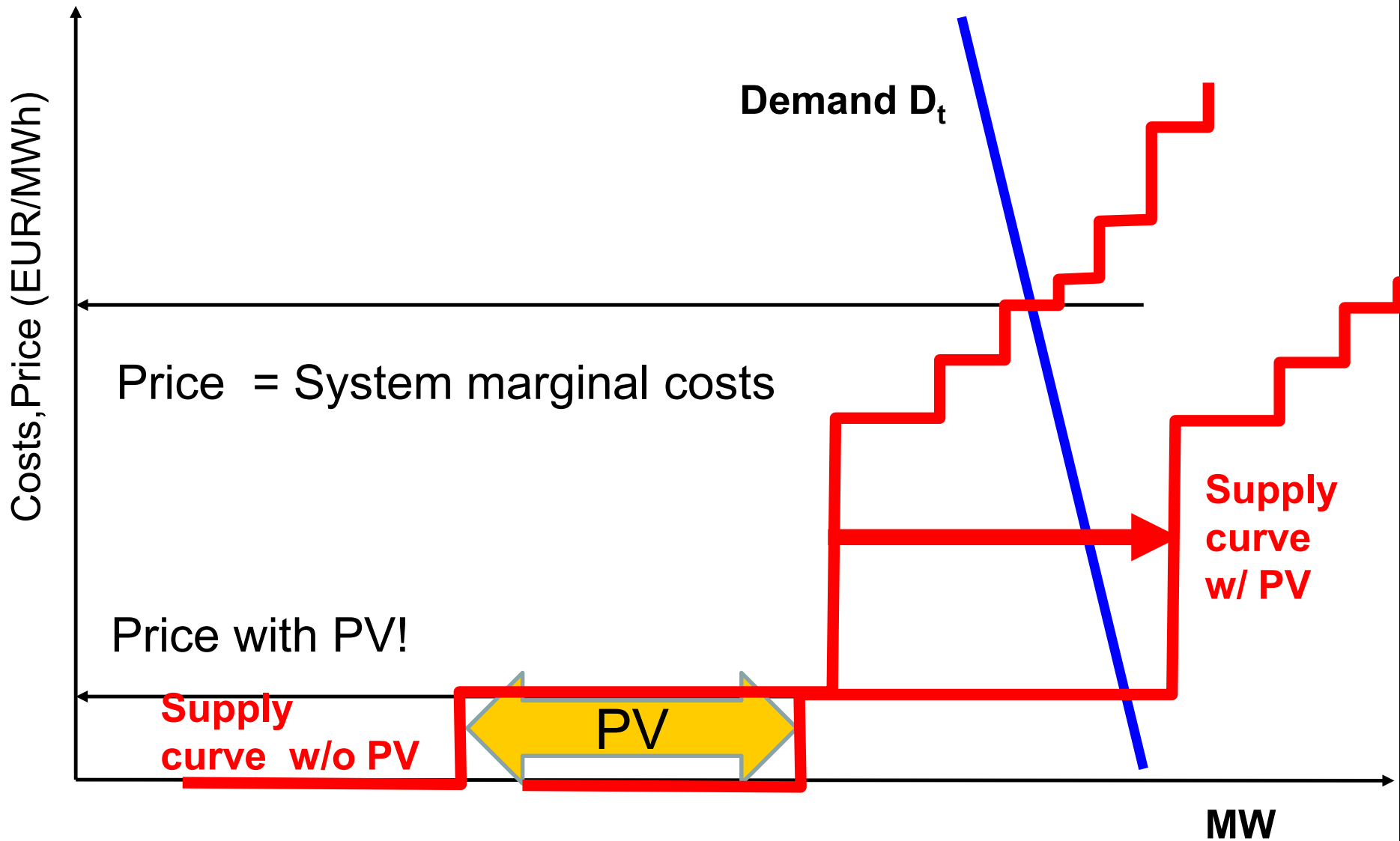


The CO2-Price



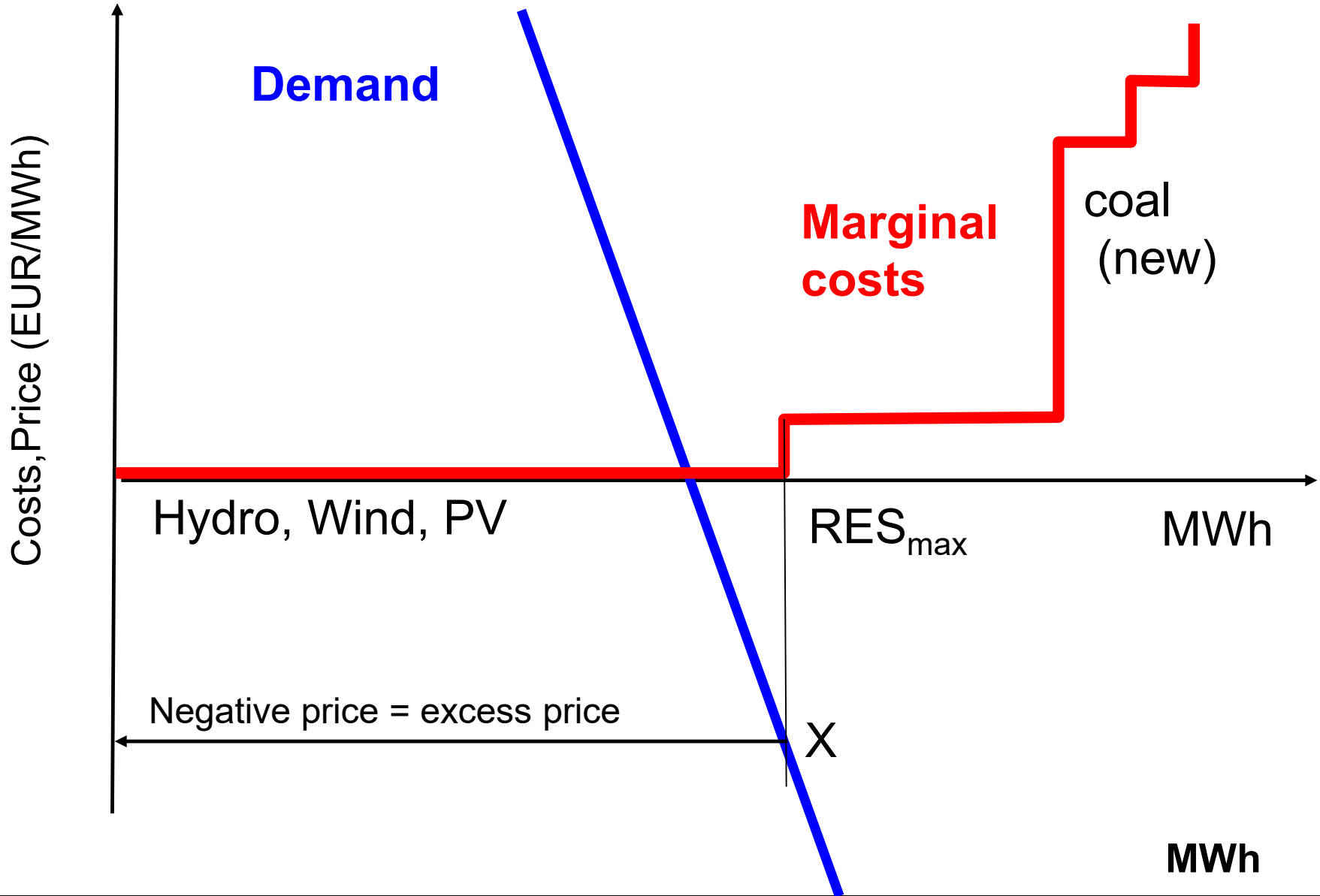
3 HOW VARIABLE RENEWABLES IMPACT PRICES IN ELECTRICITY MARKETS

PRICES WITHOUT AND WITH PV

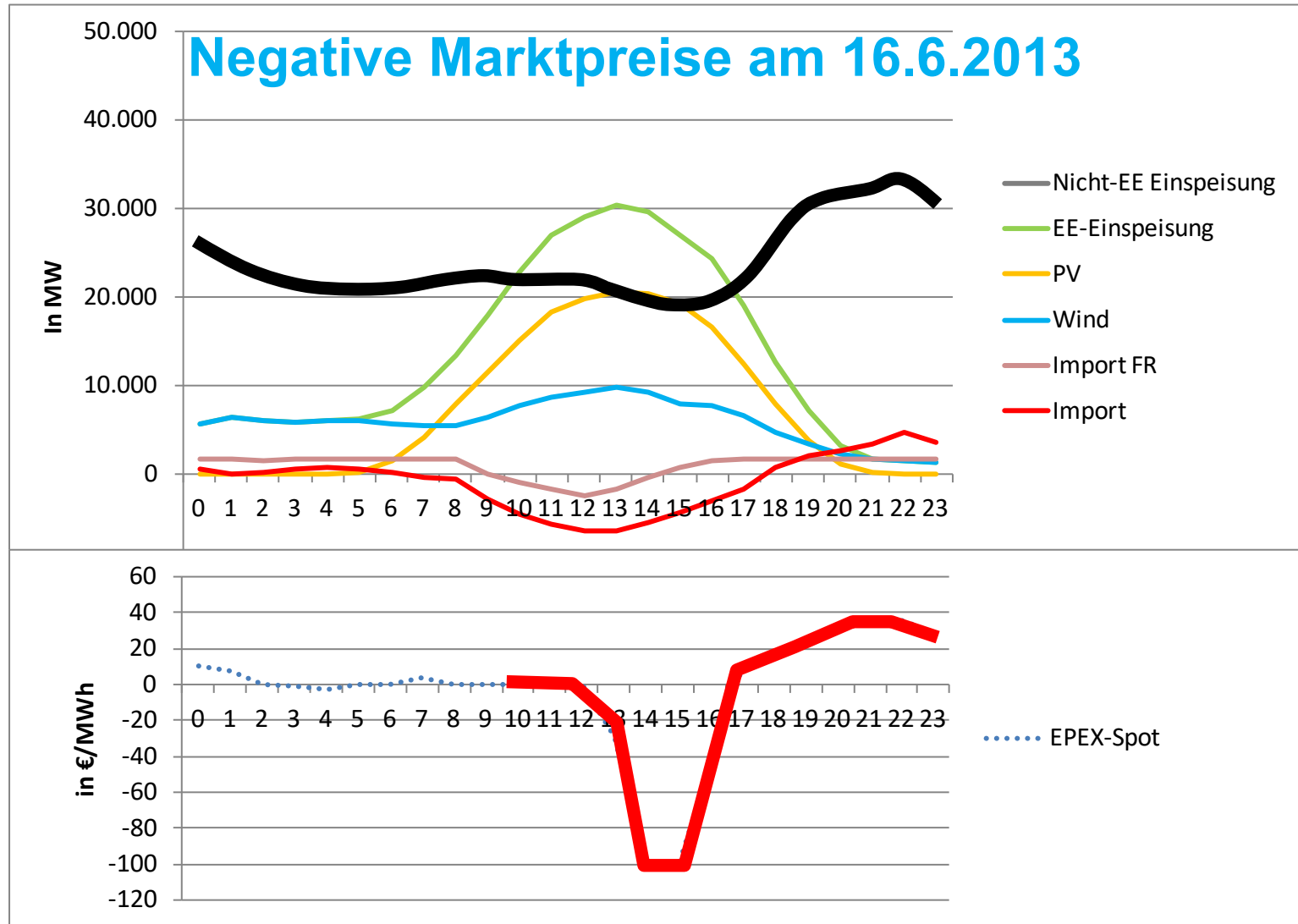


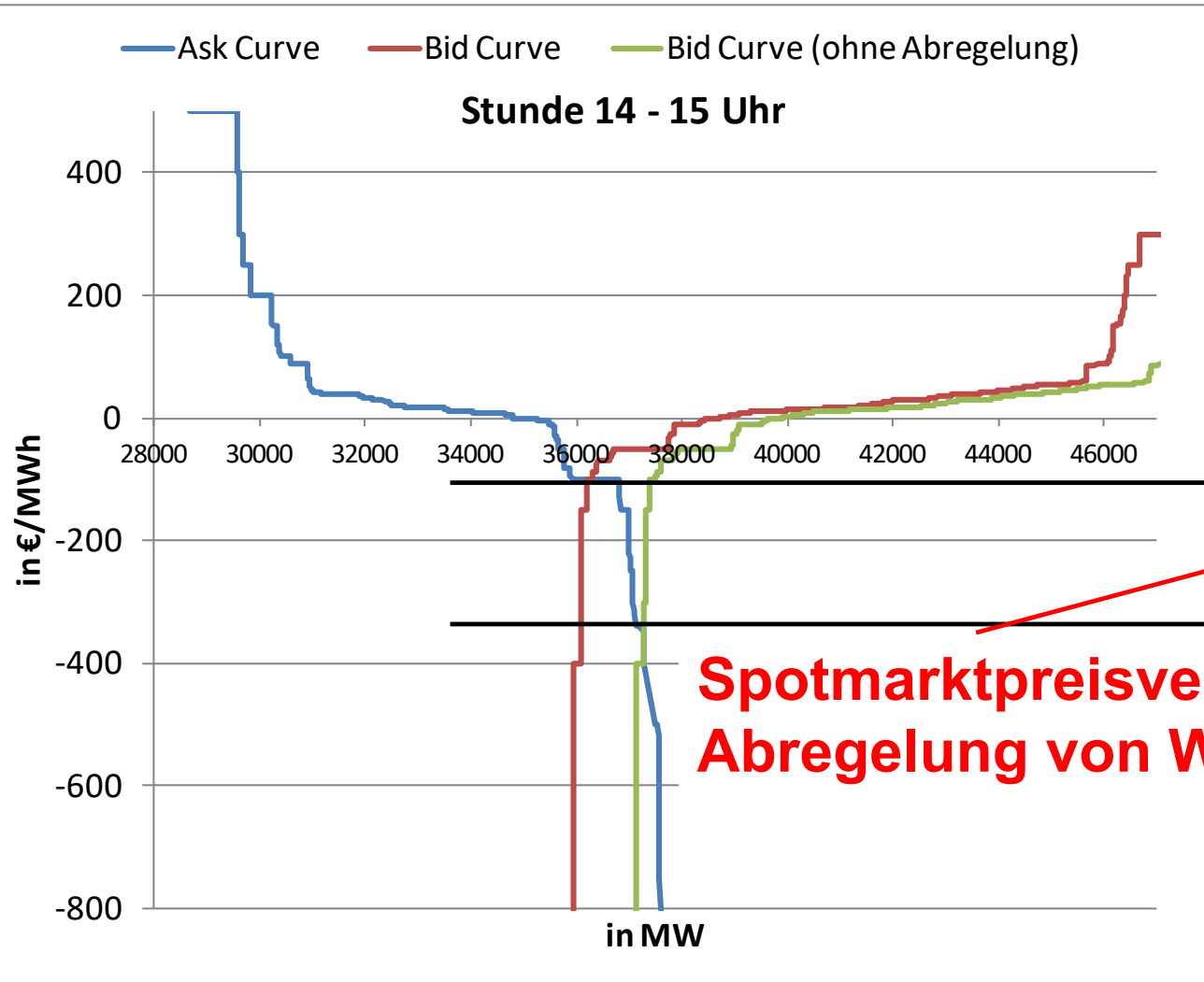
- 1. Prices decrease to Zero (or below) at a number of days;**
- 2. Lacking contribution margin to fixed costs**
- 3. On how many days will we face high and on how many days low prices?**

PRICE SETTING UNDER EXCESS CAPACITY



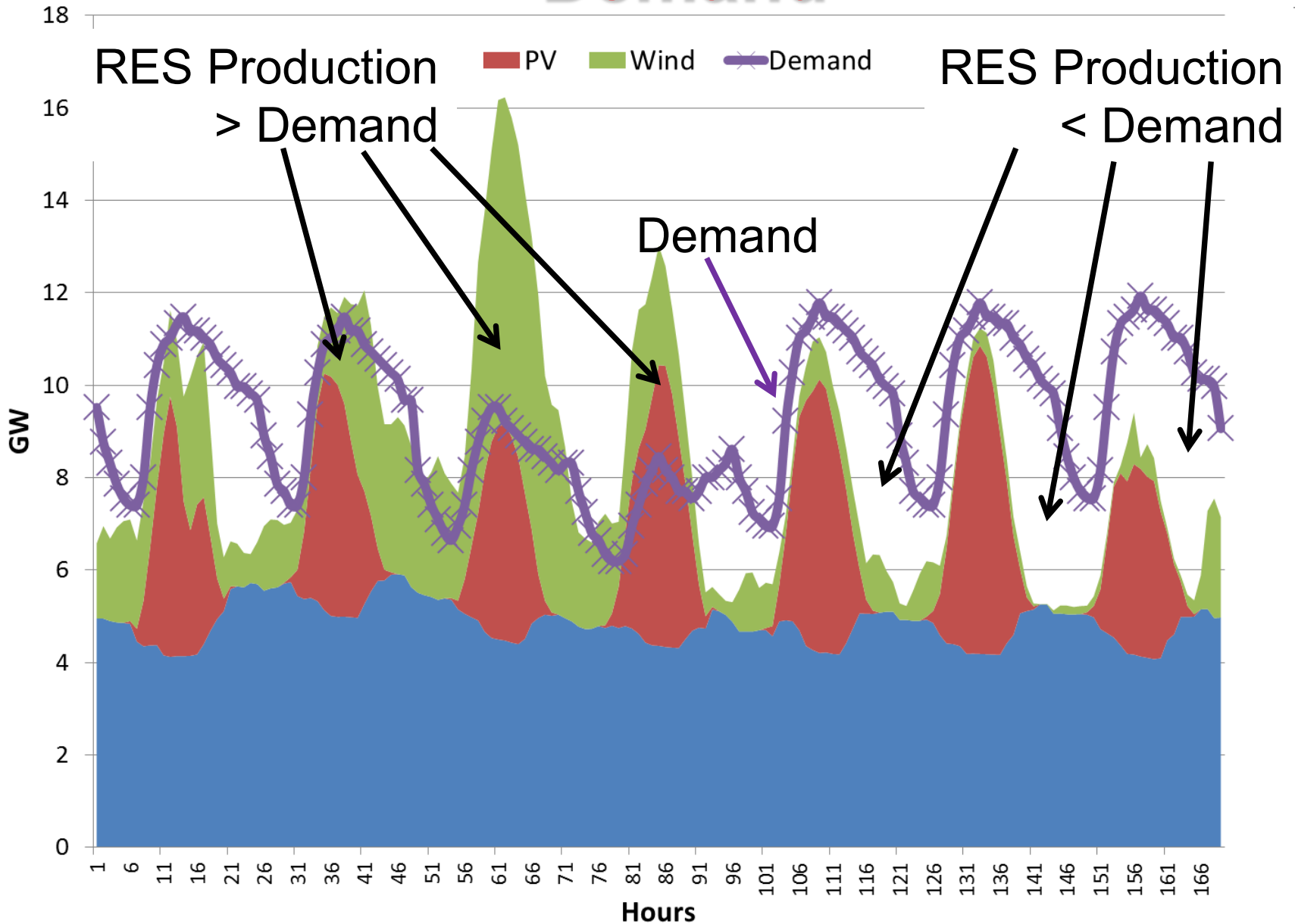
PROBLEM: EINFLUSS TEMPORÄR GROSSER MENGEN EET (?) AUF SPOTMARKTPREISE





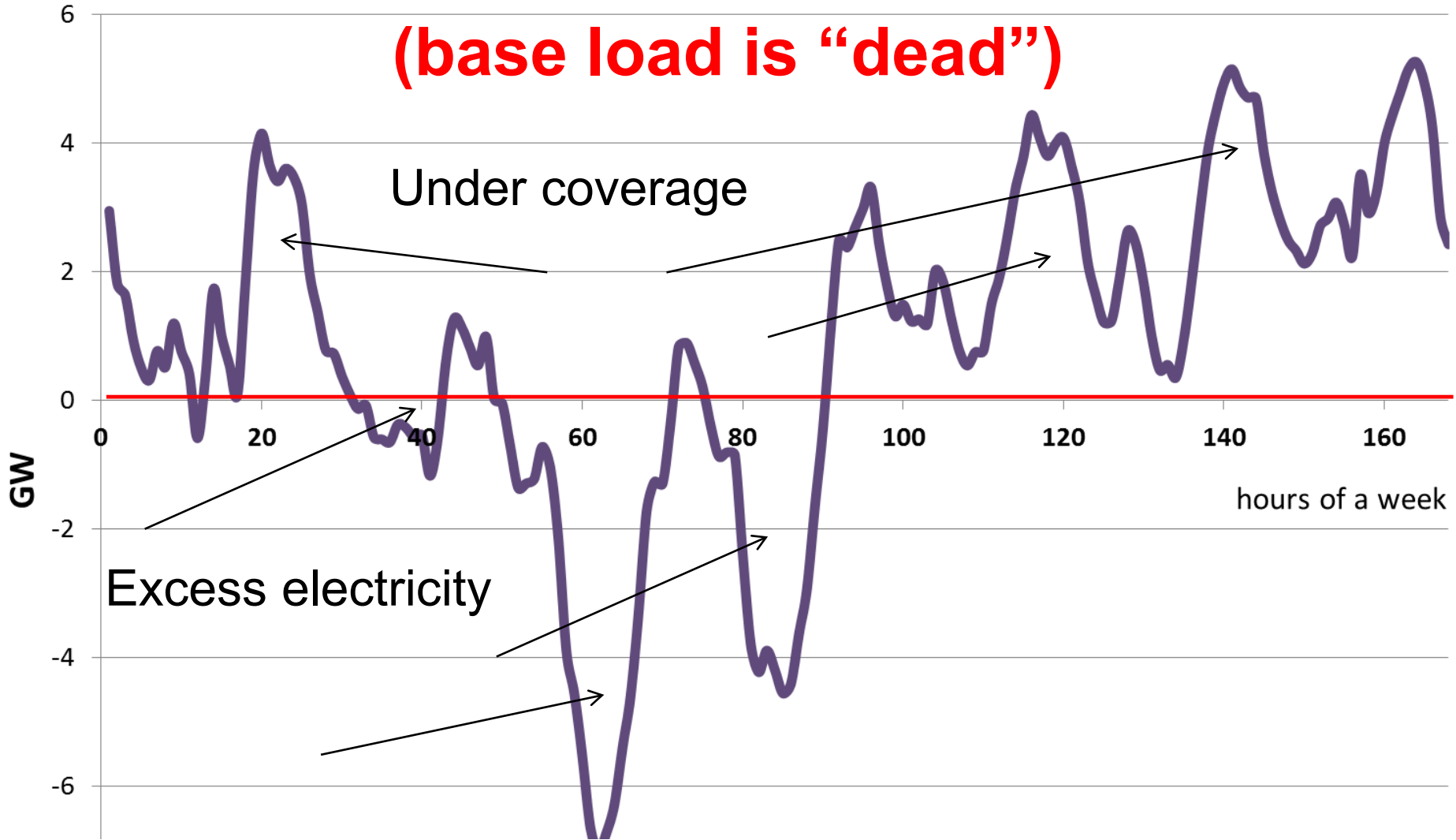
**Spotmarktpreisveränderung durch
Abregelung von Windkraftanlagen**

Example: Supply and Demand



Key term of the future: Residual load

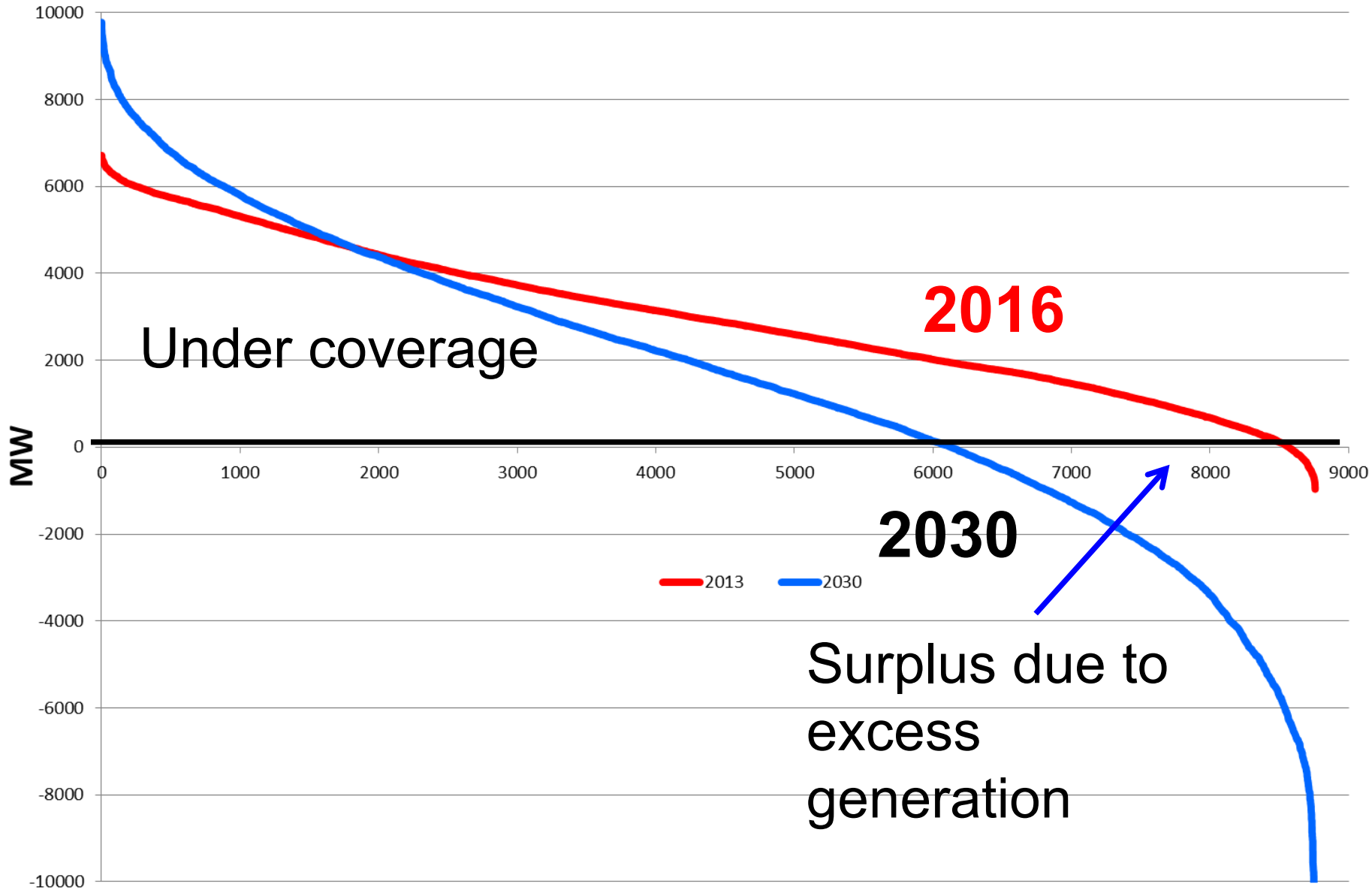
(base load is “dead”)



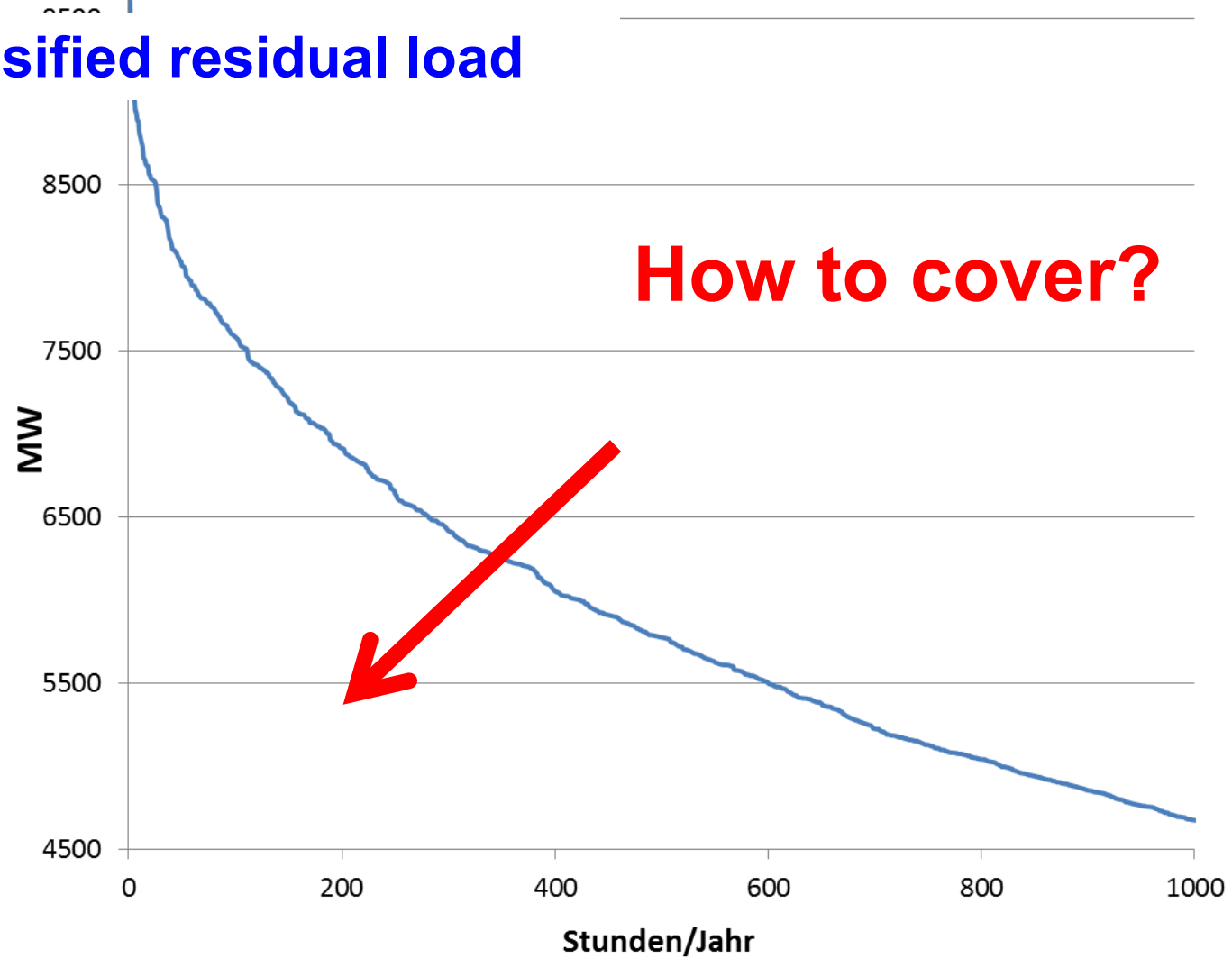
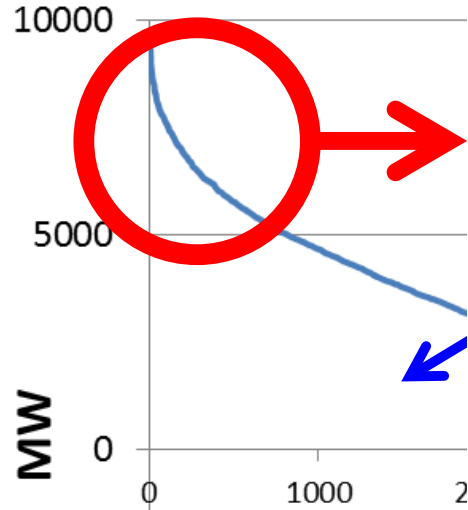
Residual load = Load – non-flexible generation

5. NEED FOR NEW MARKET MODELS

Classified residual load



Classified residual load



How to cover?

By a regulated capacity „market“ ?
or

**By competition between supply-side
and demand-side technologies (incl.
storages and grid)?**

All regulatory capacity payments for power plants distort the EOM and lead to wrong price signals for all other options

Price peaks at times of scarce resource should revive the markets and lead to effective competition

The higher the excess capacities, the lower is the share of RES

strive to retain system resource adequacy by correct price signals

DIMENSIONS OF ELECTRICITY MARKETS

SUPPLY

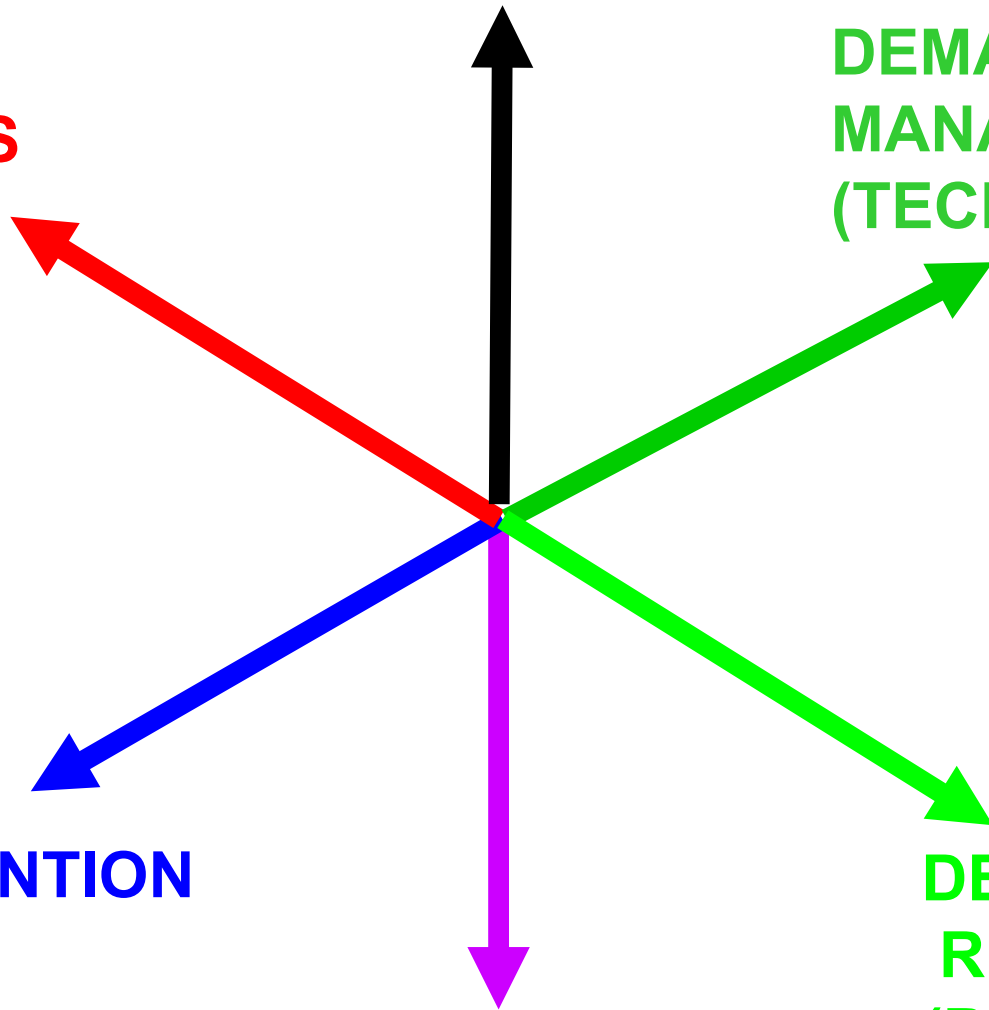
STORAGES

**DEMAND-SIDE
MANAGEMENT
(TECHNICAL)**

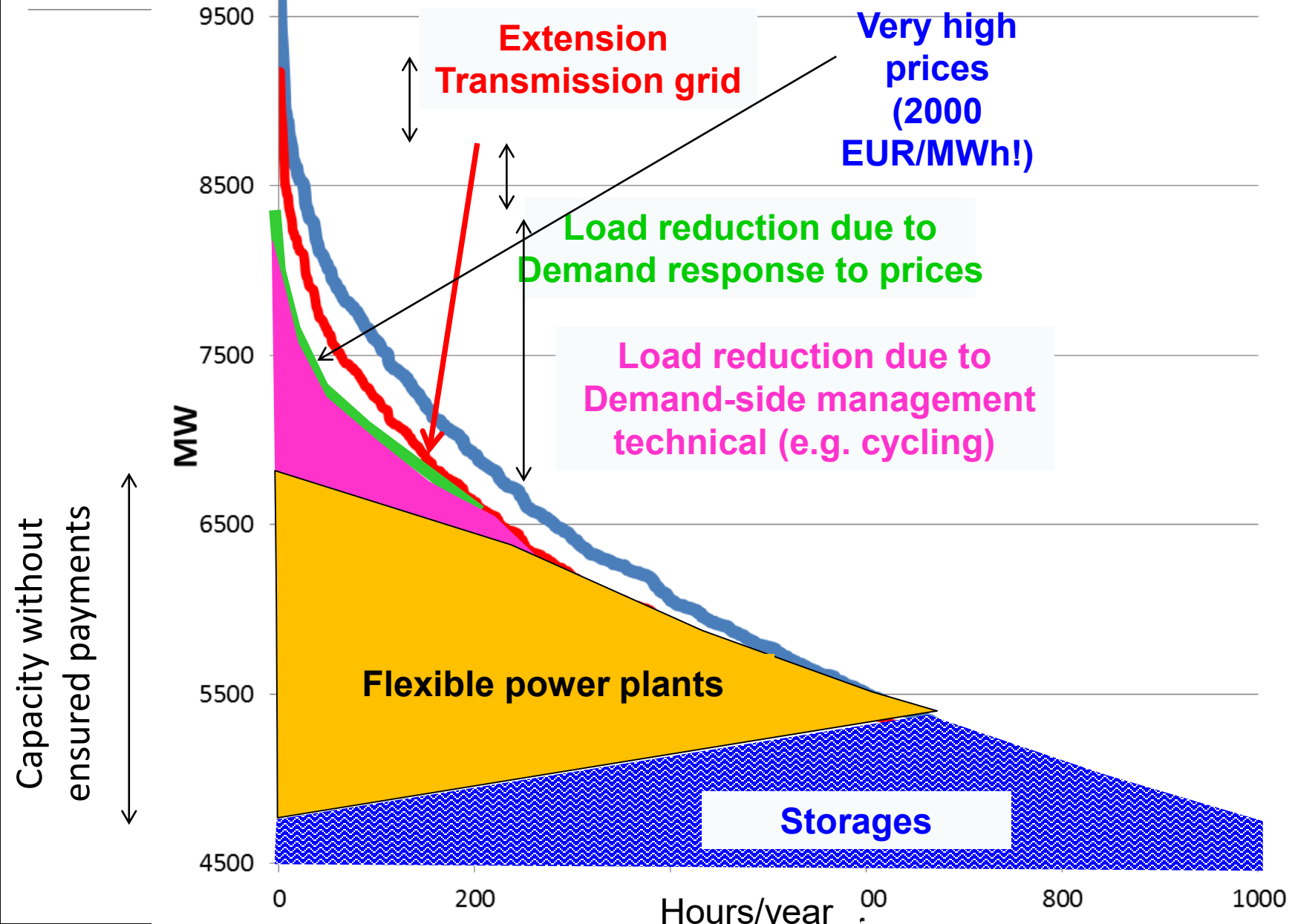
GRID EXTENTION

**DEMAND
RESPONSE
(PRICE SIGNALS)**

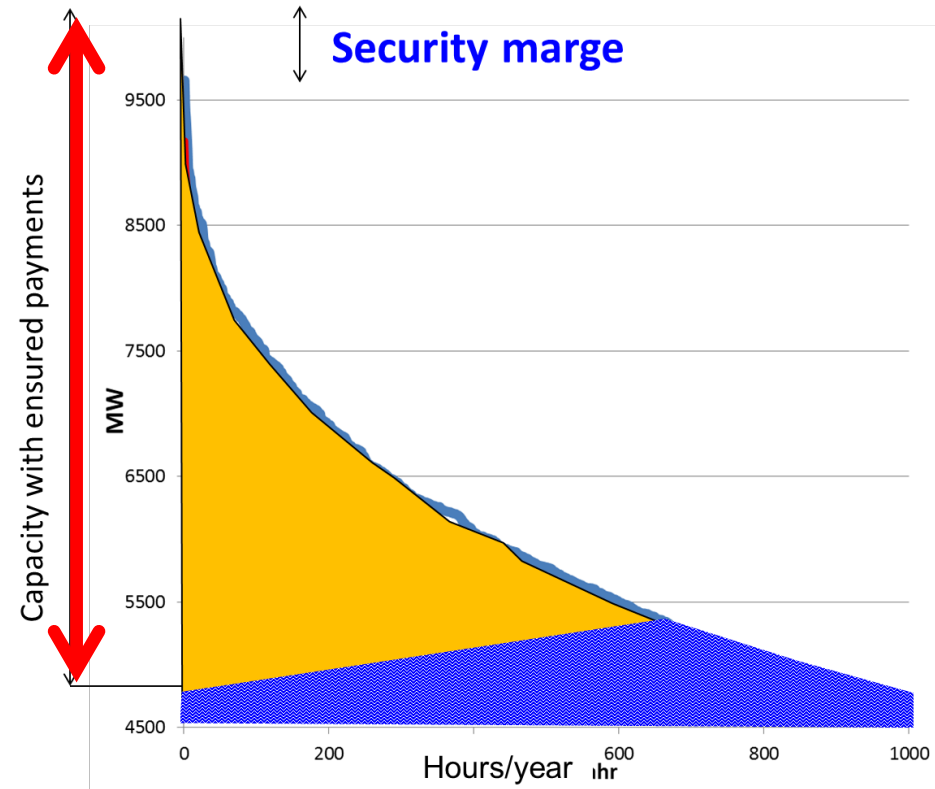
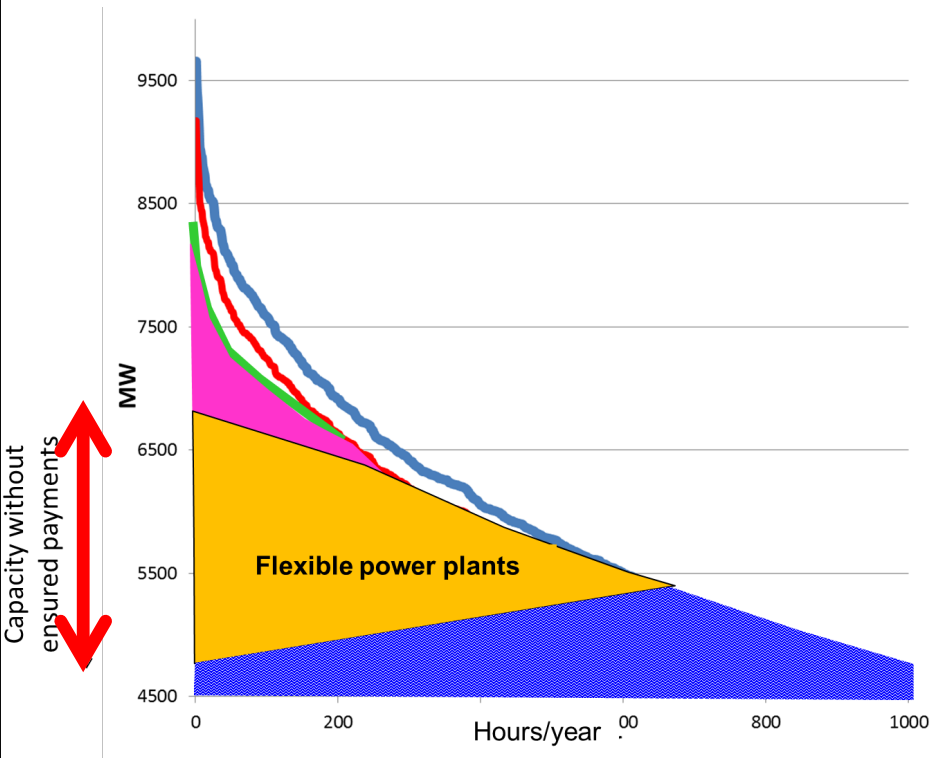
SMART GRIDS



5 Flexible coverage of residual load

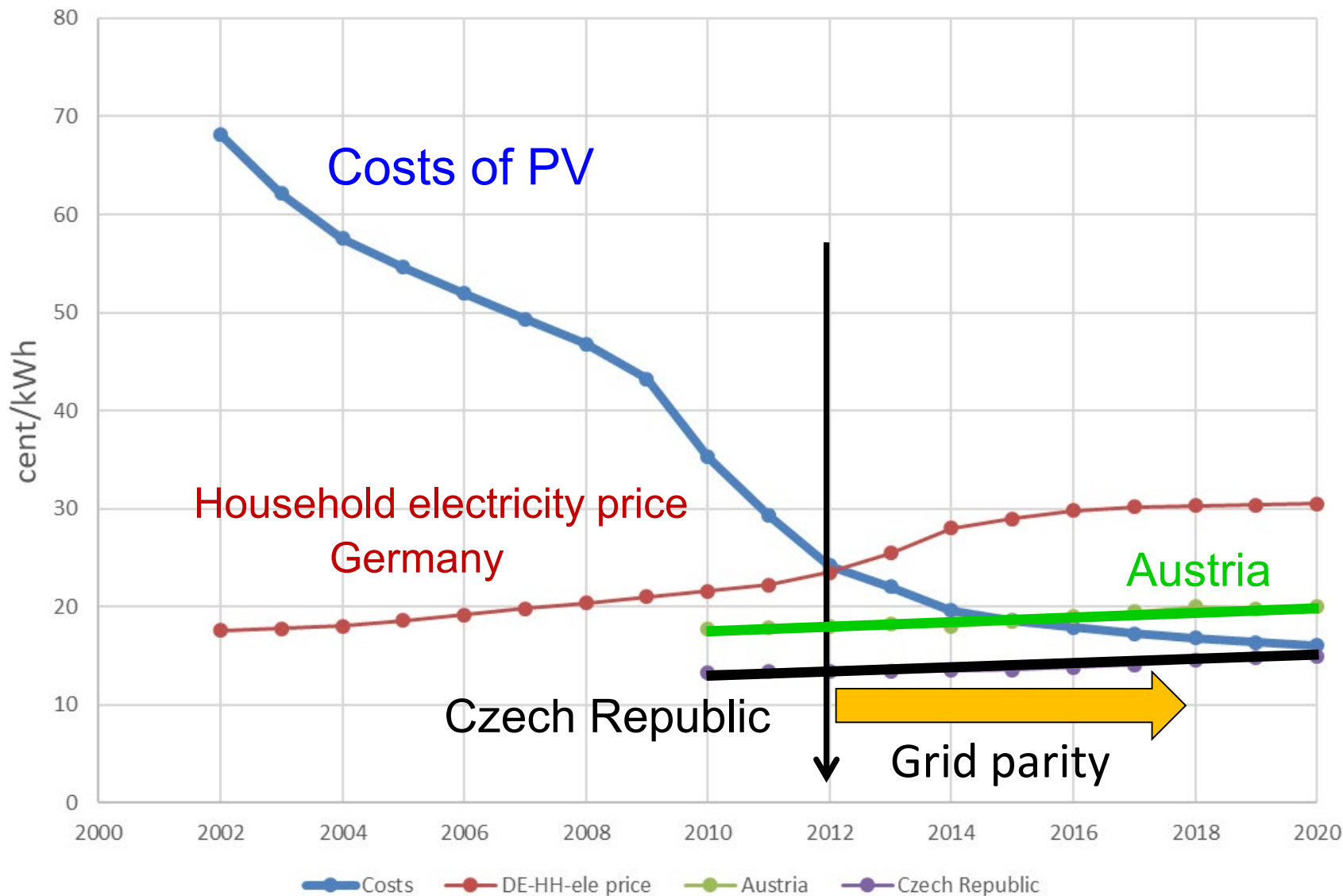


Comparison



6. TOWARDS PROSUMAGERS

Grid parity: PV-costs and household electricity prices

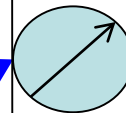


Tenant electricity model and Blockchain

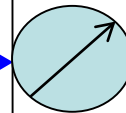
PV-System on the roof

Tenant electricity model:
Contracted PV-electricity

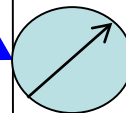
**Balancing
Group/
Supplier**



Customer 1



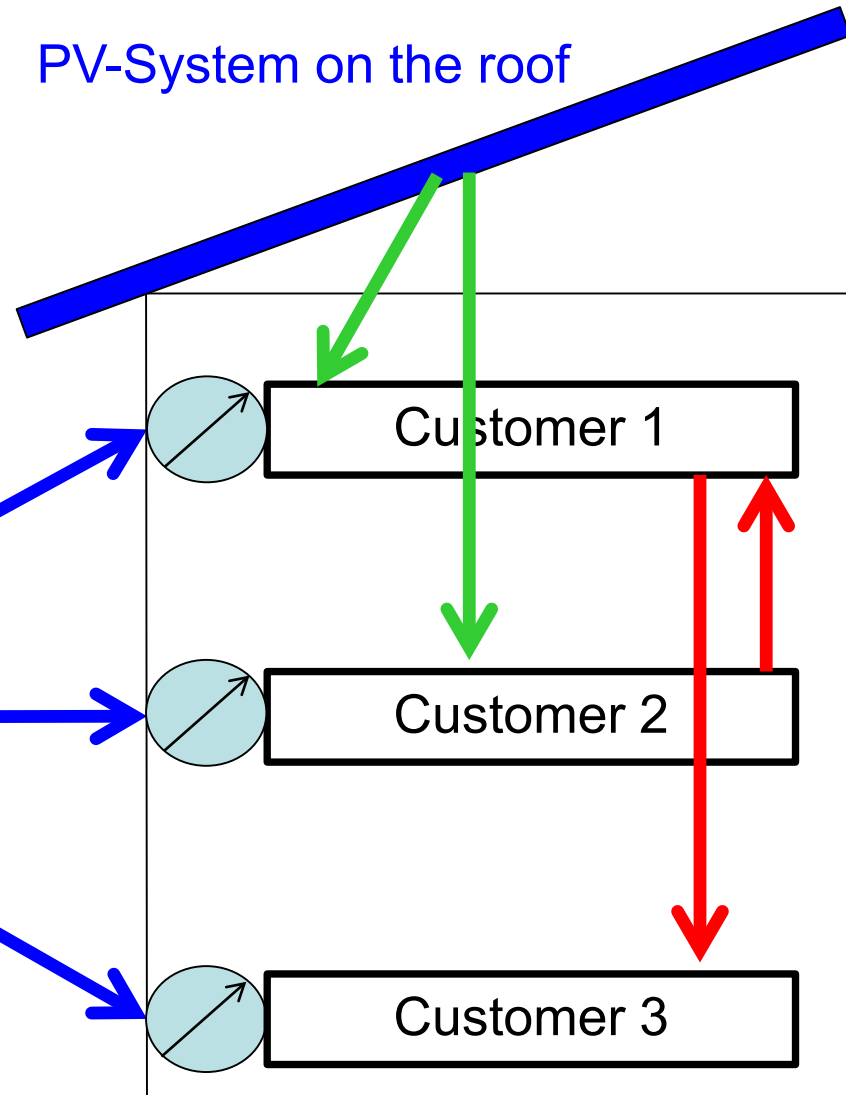
Customer 2



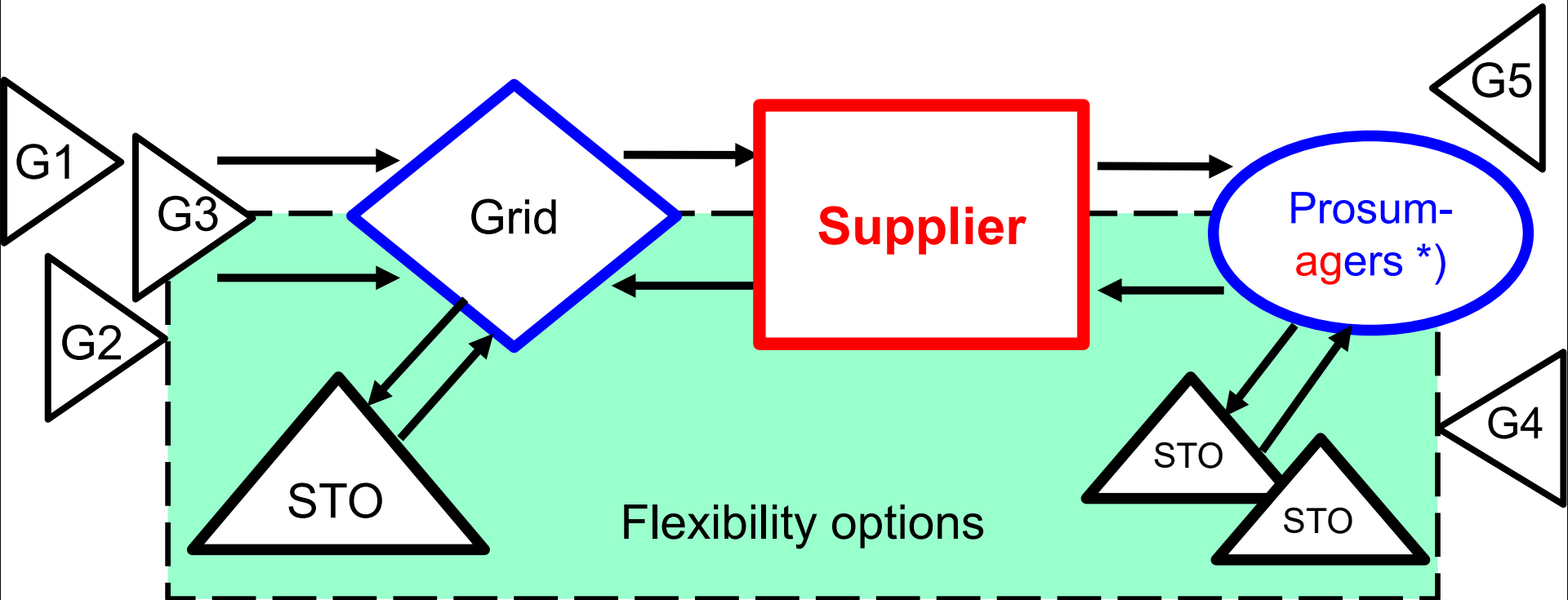
Customer 3

Meter

Blockchain



New Thinking: Making the electricity system more democratic



*) R. Green

- Sustainable electric. system → integration of a broad technology portfolio & demand-side options
- No quick fix, no one size fits all solutions
- Larger market areas favourable
- Important: correct price signals (incl. CO2)
- Urgent: exhaust full creativity for flexibility of all market participants (Erdmann)
- Prospects for storage: less bright than argued
- Core relevance: A contract coordinating entity
- New key players: Suppliers / balancing groups