



15th IAAE European Conference 2017

'HEADING TOWARDS SUSTAINABLE ENERGY SYSTEMS: EVOLUTION OR REVOLUTION?'



3rd to 6th September 2017, Hofburg Congress Center, Vienna, Austria



E-CONTROL



Uniting against Poverty



Abstracts, Papers & Presentations available [here!](#)

The 15th IAAE European Conference takes place in Vienna, Austria, at the Hofburg Congress Center, 3rd to 6th September 2017. The main topic will be: "HEADING TOWARDS SUSTAINABLE ENERGY SYSTEMS: EVOLUTION OR REVOLUTION?".

In recent years, energy systems as well as Energy markets underwent remarkable changes, world-wide. Developments in oil, natural gas as well as electricity markets brought challenges of



- Lesezeichen
- Suchen
- Lesezeichen-Symboleiste
- Lesezeichen-Menü
- https://www.bmw-connecteddrive.at/cdp/release/in...
- Kürzlich als Lesezeichen gesetzt
- Kürzlich verwendete Schlagwörter
- Lesezeichen-Add-ons herunterladen
- Importierte Lesezeichen
- Links
- Media
- Medium
- Microsoft-Websites
- Urlaub
- EEG - IEW
- Online Shipping
- Willkommen bei Google Kalender
- Google
- ÖAMTC
- AGB_TU Wien Veranstaltungen
- TU Wien
- Vortragsraum der UB TUW - Vergabe-Information
- Home - TUinsight
- Buchbestell-Formular-Unibibliothek
- Cisco Unified CM Console
- IAAE 2017 Vienna
- TISS - Startseite
- Bundesdienststellen für E-Rechnungen
- assystNET
- Aktive Anschlussdosen in der TUNET Datenbank
- Publikationsdatenbank-Anmeldung
- Projektdatenbank Anmeldung
- Portal Austria
- ESS
- IBAN-Rechner
- BusinessNet - Willkommen
- PayUnity Multi Access



Old vs new thinking in electricity systems and markets

Reinhard HAAS

Energy Economics Group, TU Wien

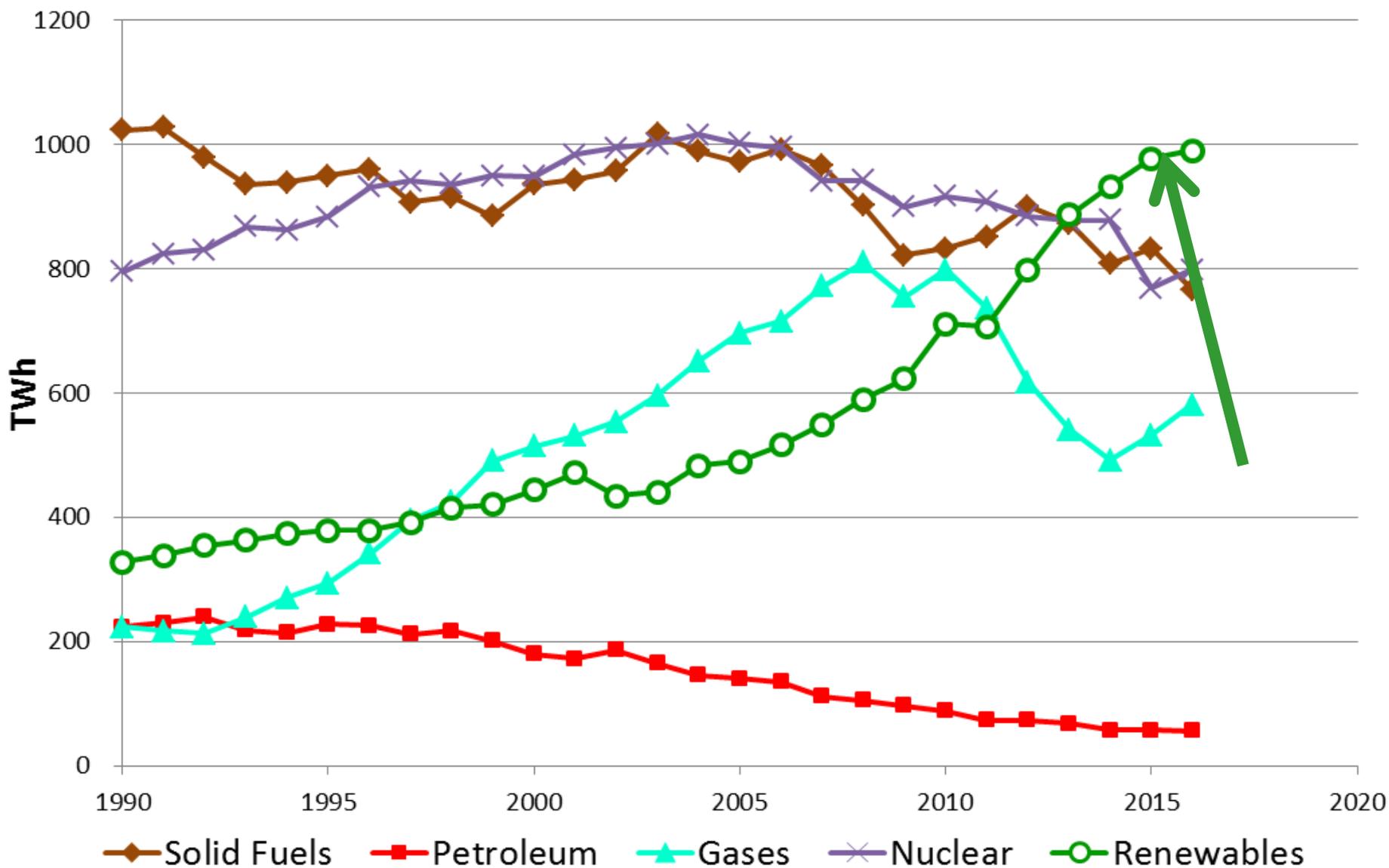
Vienna, 4 September 2017

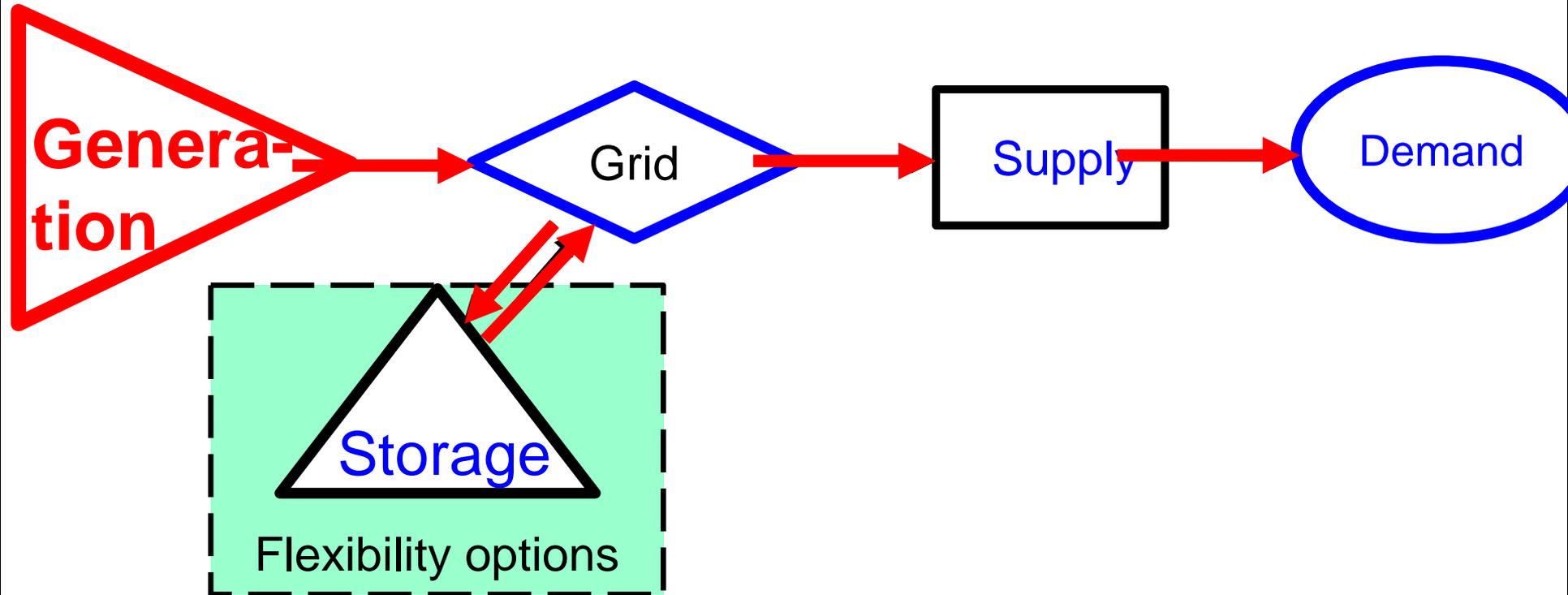
- 1. Introduction: Motivation**
- 2. Method of approach**
- 3. How variable renewables impact prices in electricity markets**
- 4. The core problem of capacity payments**
- 5. The role of flexibility and sector coupling**
- 6. Balancing groups: A future market design**
- 7. Subsidizing RES: How long?**
- 8. Conclusions**

Motivation:

- * **Climate change → Paris agreements**
- * **Targets for renewables**
- * **Competition & democracy**
- * **It is not possible to squeeze variable renewables into the system by violence**
system integration

Introduction: Electricity generation EU-28





... 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

- **Identification of hourly residual load over a year for various scenarios with large quantities of variable renewables;**
- **Applying a fundamental model to calculate (static) hourly residual loads and electricity spot market prices;**
- **Integration of flexibility in a dynamic framework for price calculation;**

Expectation of

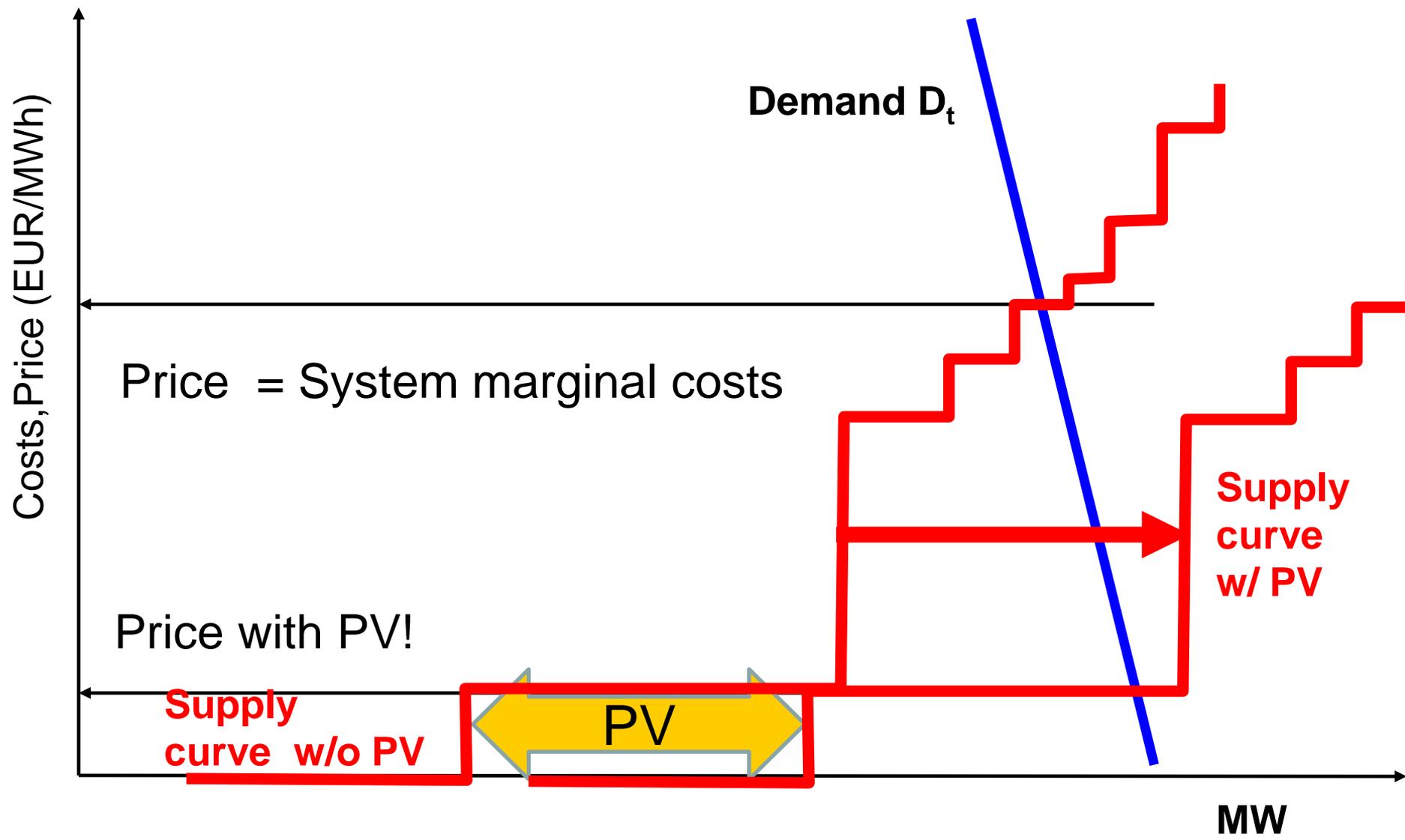
prices = Short-term marginal costs

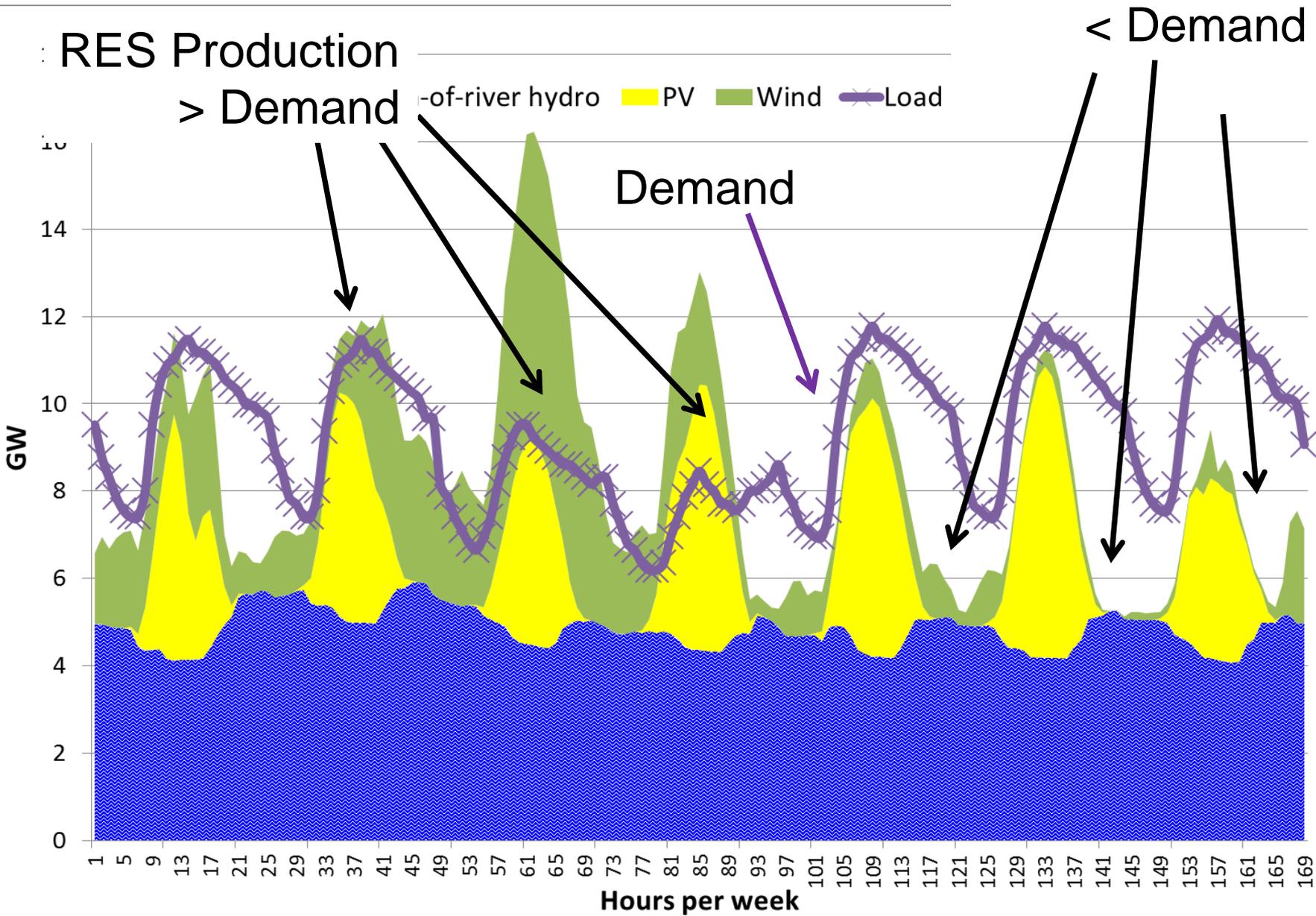
(Short-term marginal costs = fuel costs)

due to huge **depreciated** excess
capacities at the beginning of
liberalisation!

3 HOW VARIABLE RENEWABLES IMPACT THE ELECTRICITY SYSTEM AND PRICES IN ELECTRICITY MARKETS

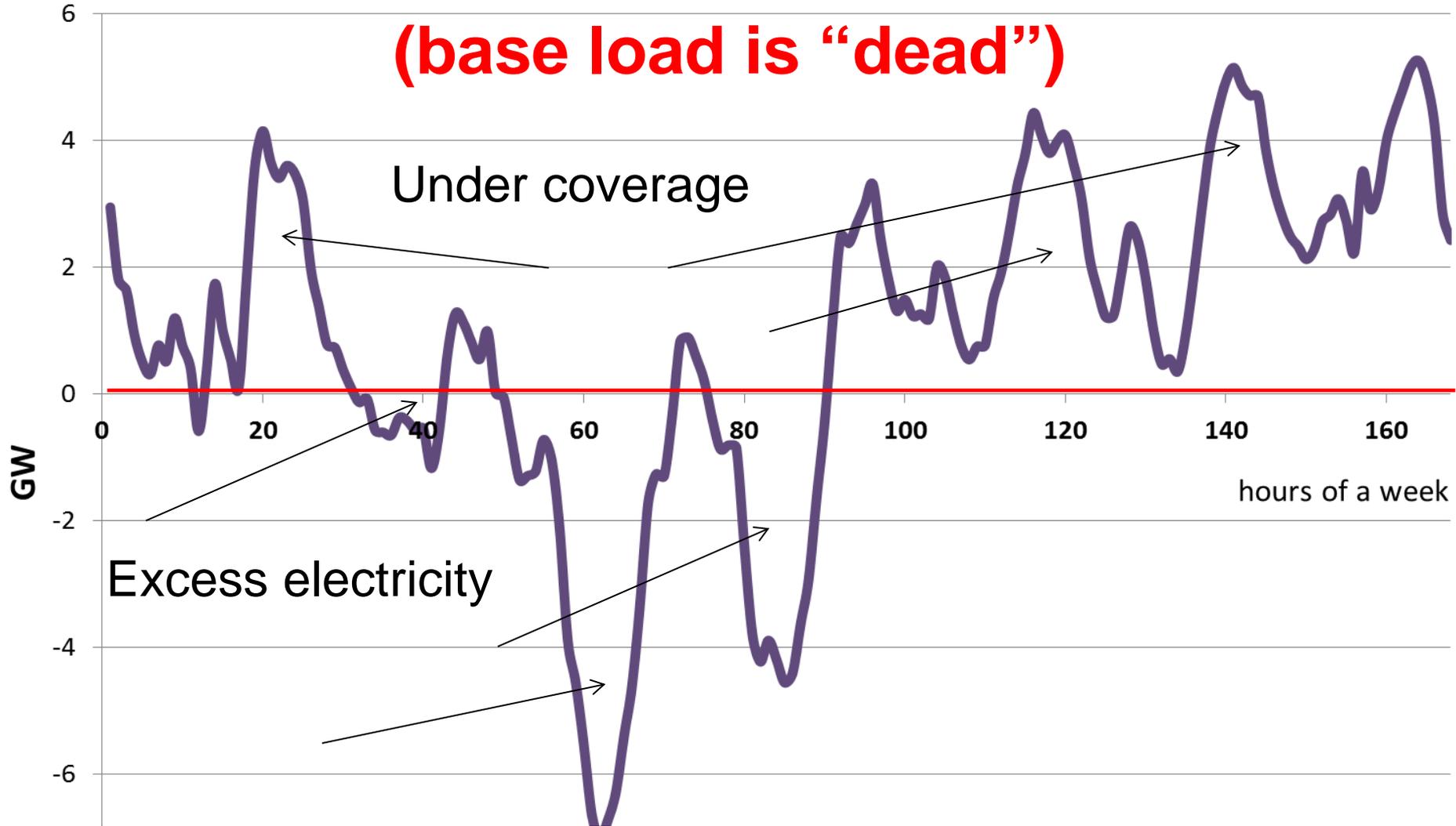
Example: prices without and with PV





Key term of the future: Residual load

(base load is “dead”)

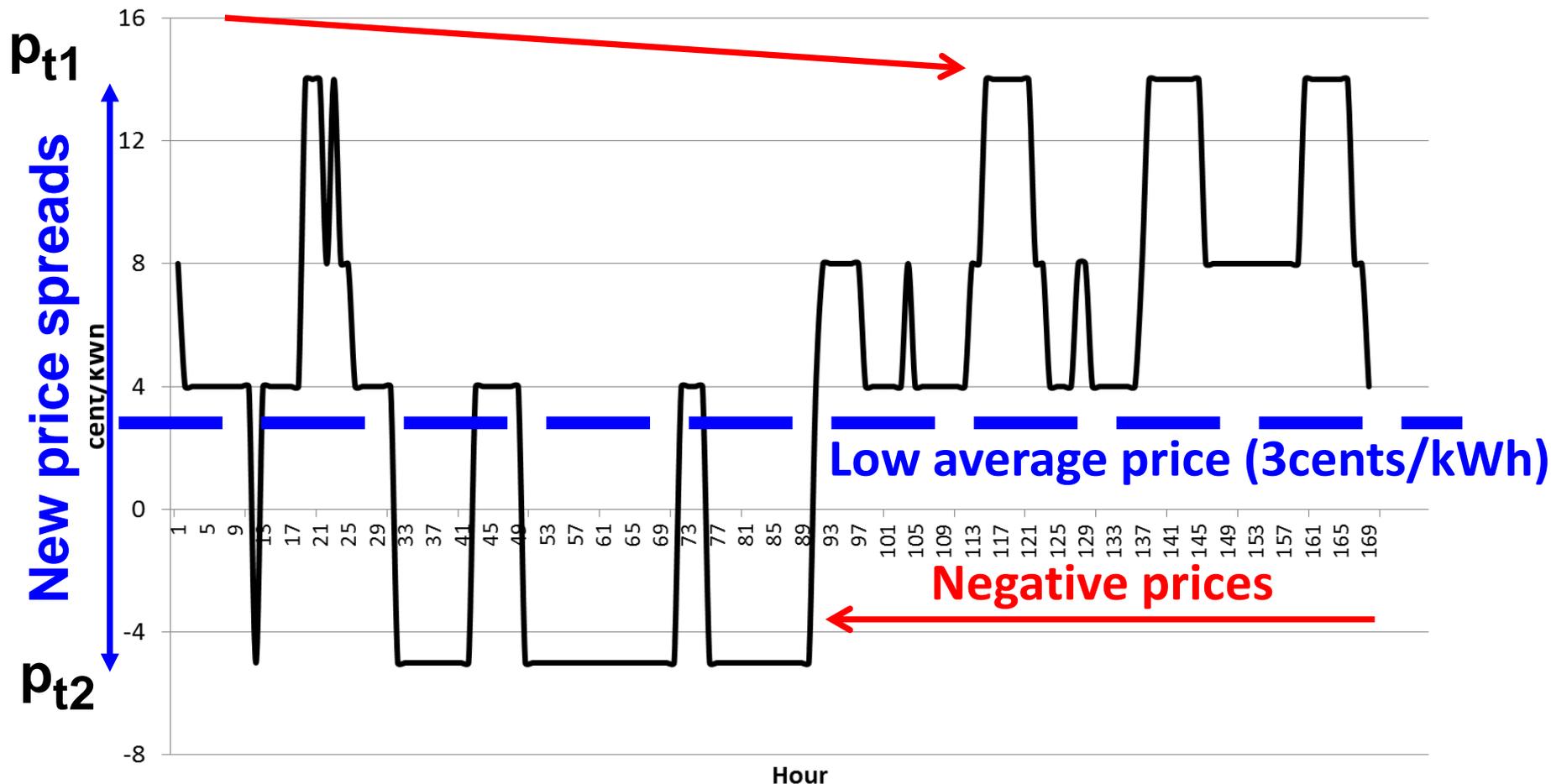


Residual load = Load – non-flexible generation

Deviation from STMC-pricing in spot markets

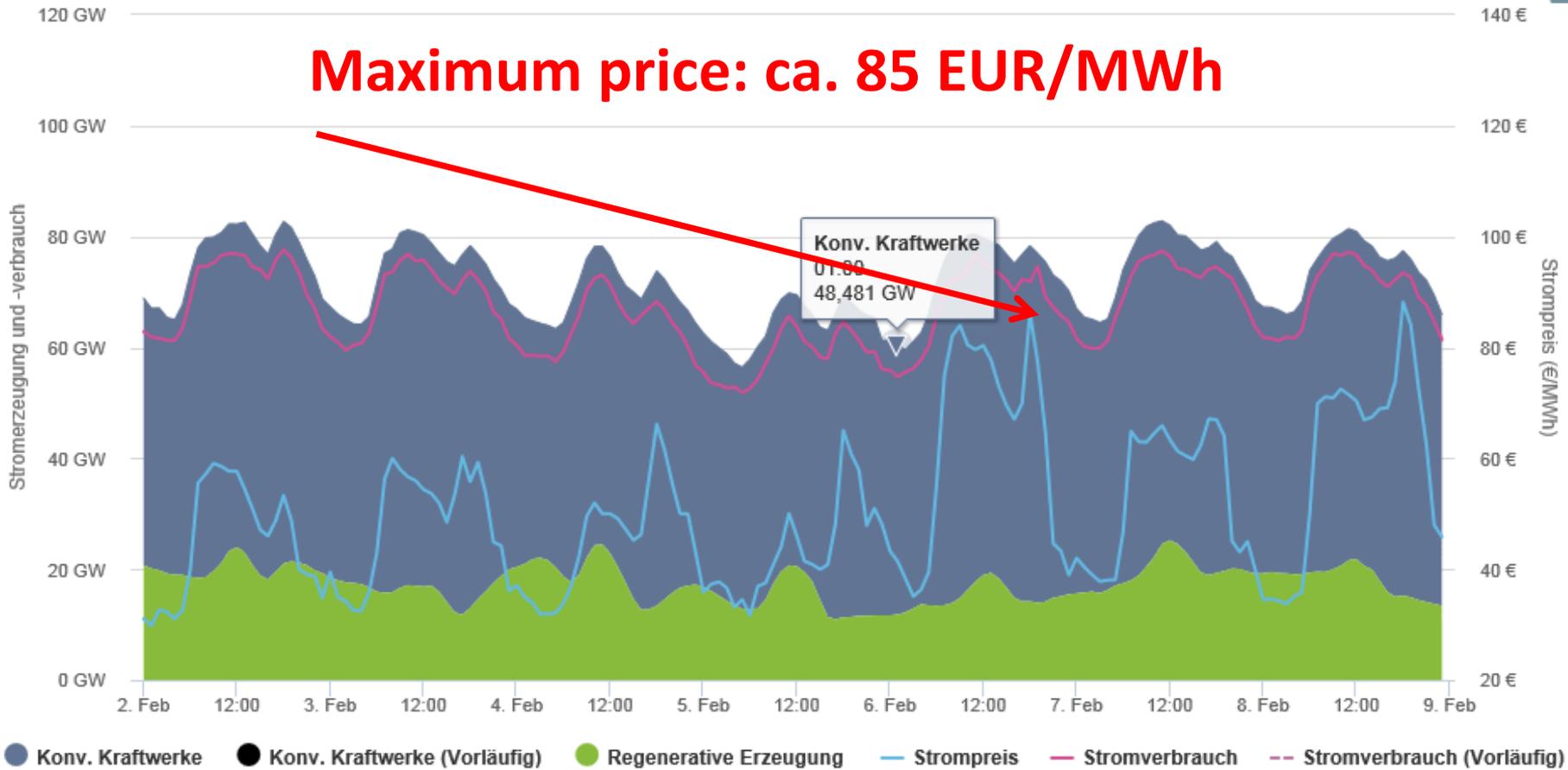
Scarcity prices

Electricity price spot market

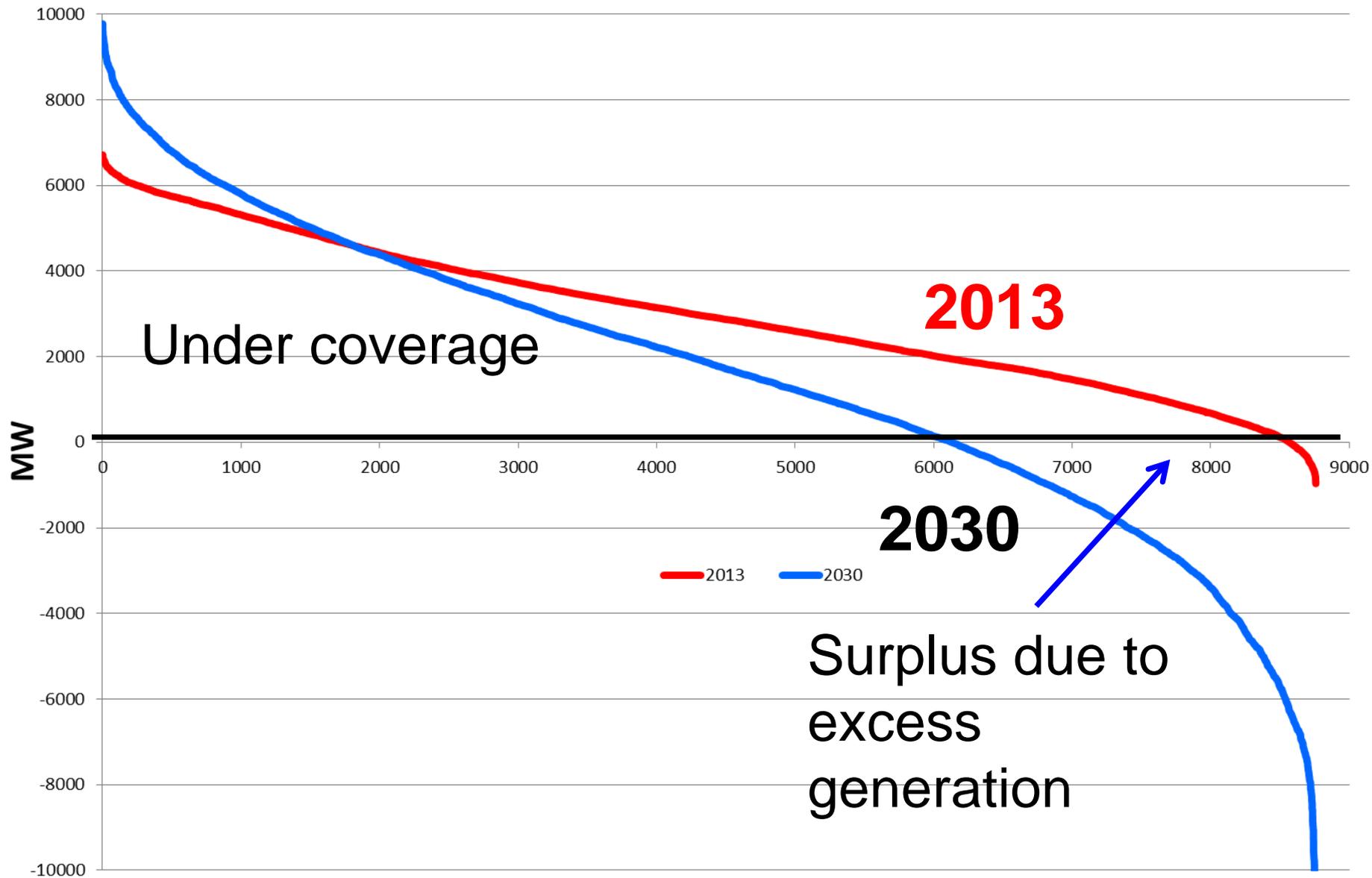


→ These price spreads provide incentives for new flexible solutions!!!!

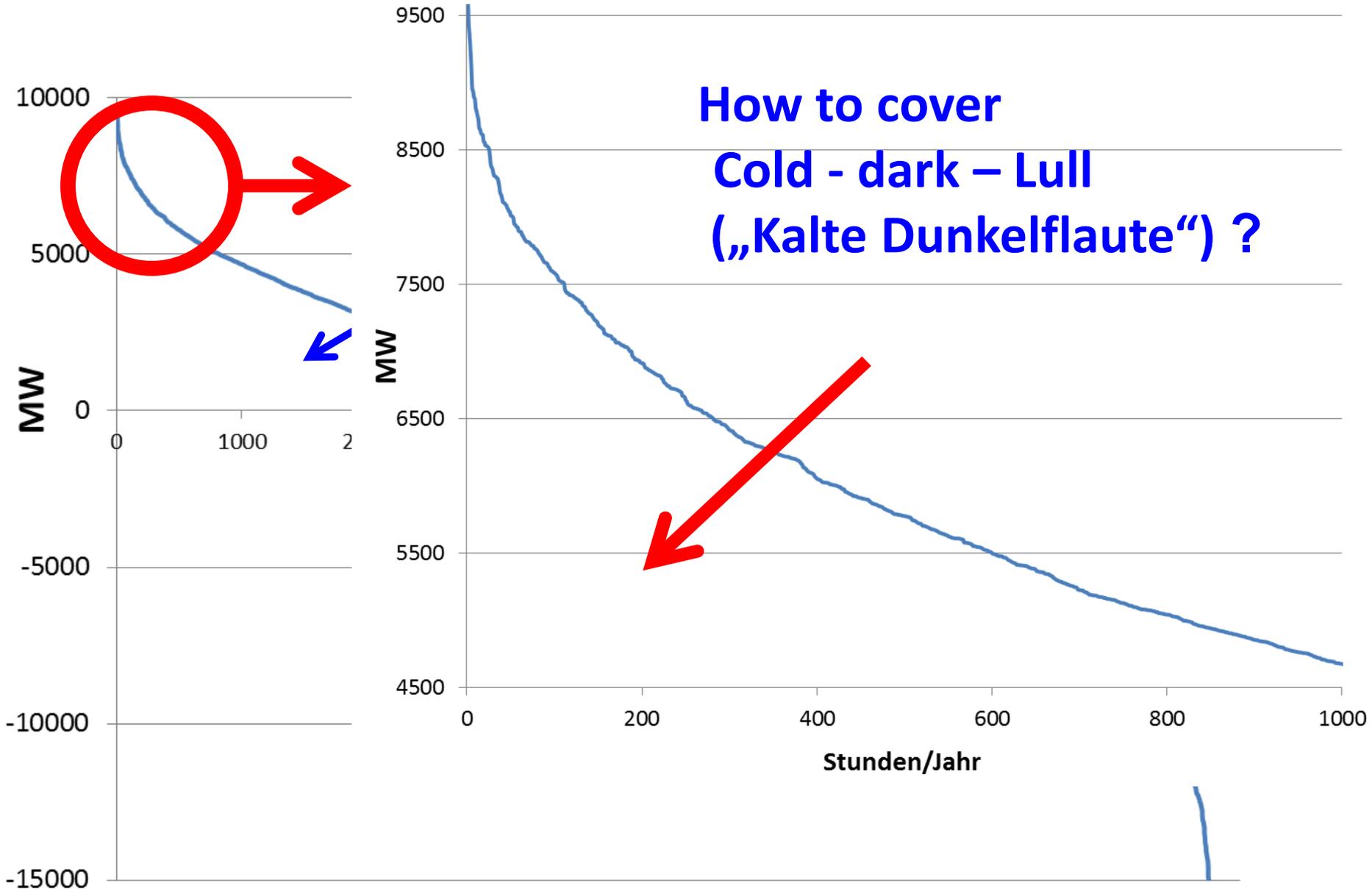
Remark: Cold - dark – Lull („Kalte Dunkelflaute“)



Classified residual load over a year



Classified residual load



By a regulated capacity „market“ with STMC pricing?

or

By competition between supply-side and demand-side technologies and behaviour (incl. Storages, grid and other flexibility options) with correct scarcity pricing signals?

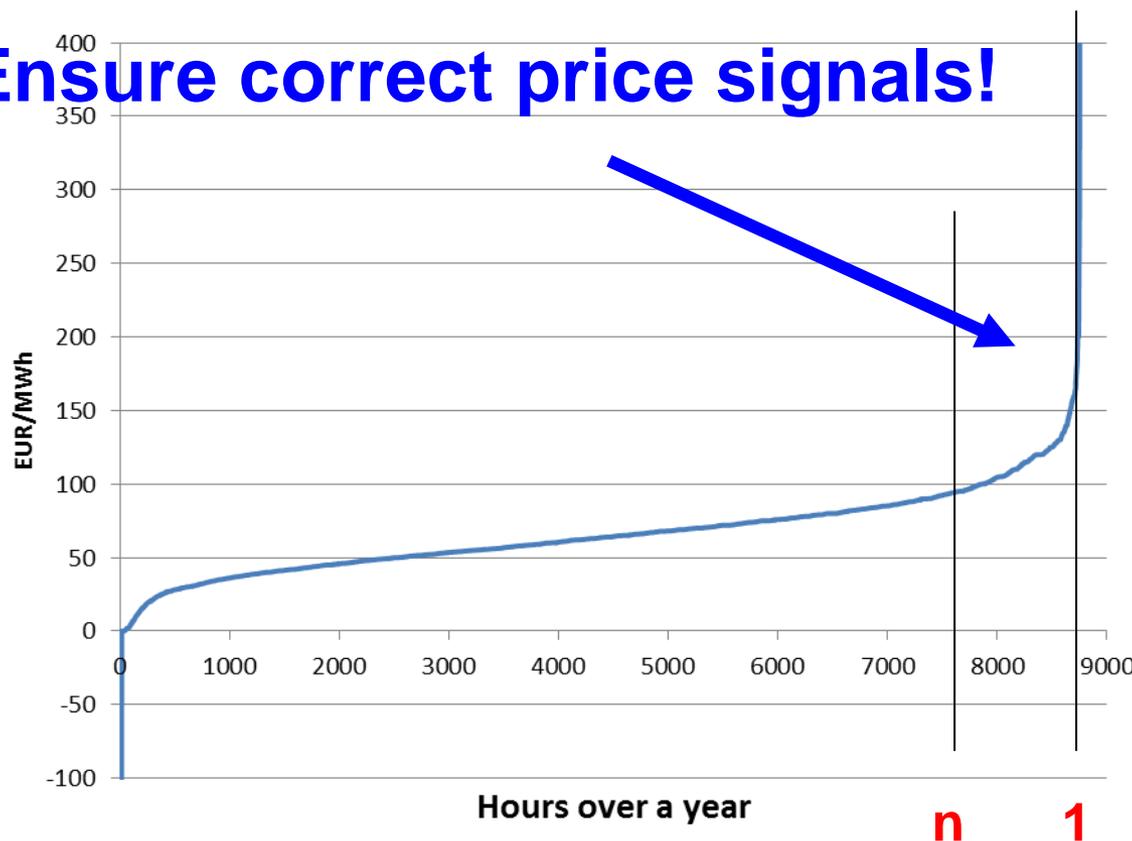
4 THE CORE PROBLEMS OF CAPACITY PAYMENTS

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

We should strive to retain system resource adequacy by ensuring correct price signals and without capacity payments

Ensure correct price signals!



Generators stay in the market if:

$$\sum_{t=1}^n (p_{elet_t} \cdot q_{elet_t} - c_{ft}) > (c_{cy} + c_{O\&M_y})$$

Given a price pattern, showing **excess and scarcity prices** it would be attractive for a sufficient number of flexible power plant operators to stay in the market!



REVISED ENERGY-ONLY MARKET

5 THE ROLE OF FLEXIBILITY AND SECTOR COUPLING

FLEXIBLE GENERATION

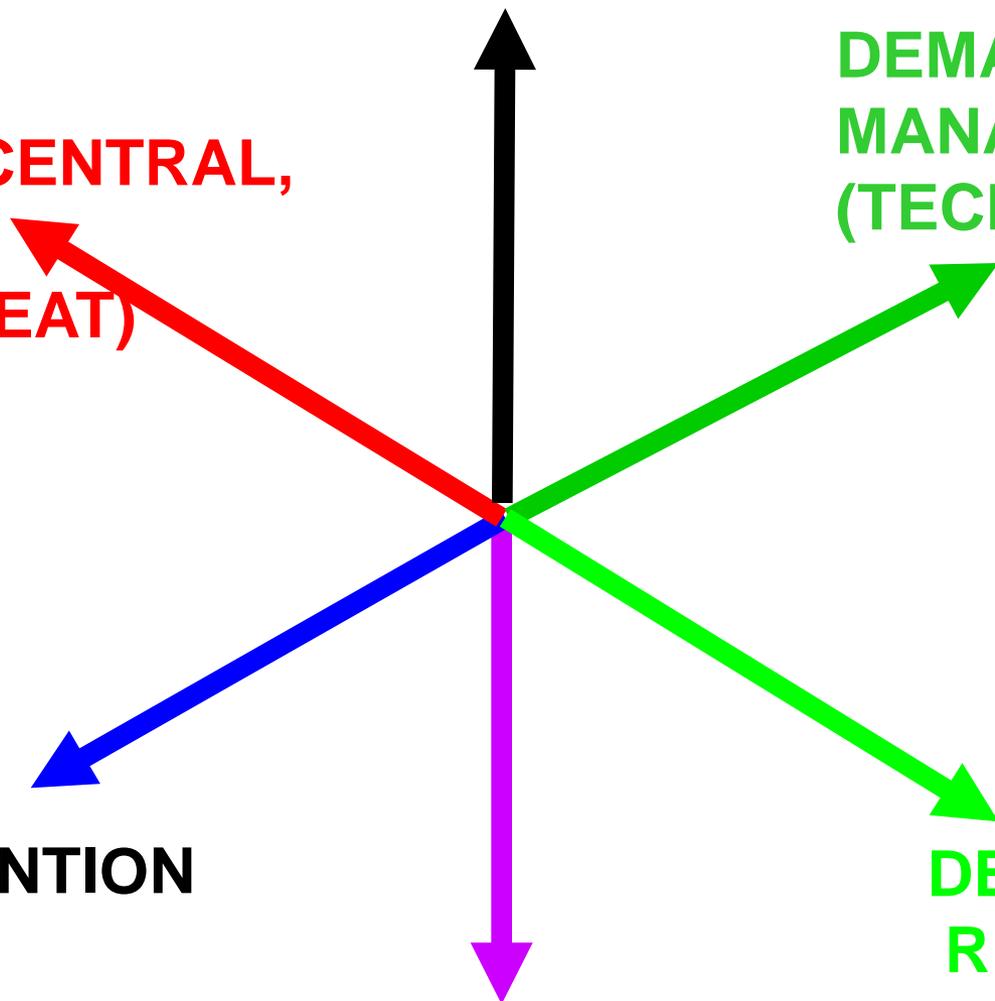
**STORAGES (CENTRAL,
DECENTRAL,
POWER-TO-HEAT)**

**DEMAND-SIDE
MANAGEMENT
(TECHNICAL)**

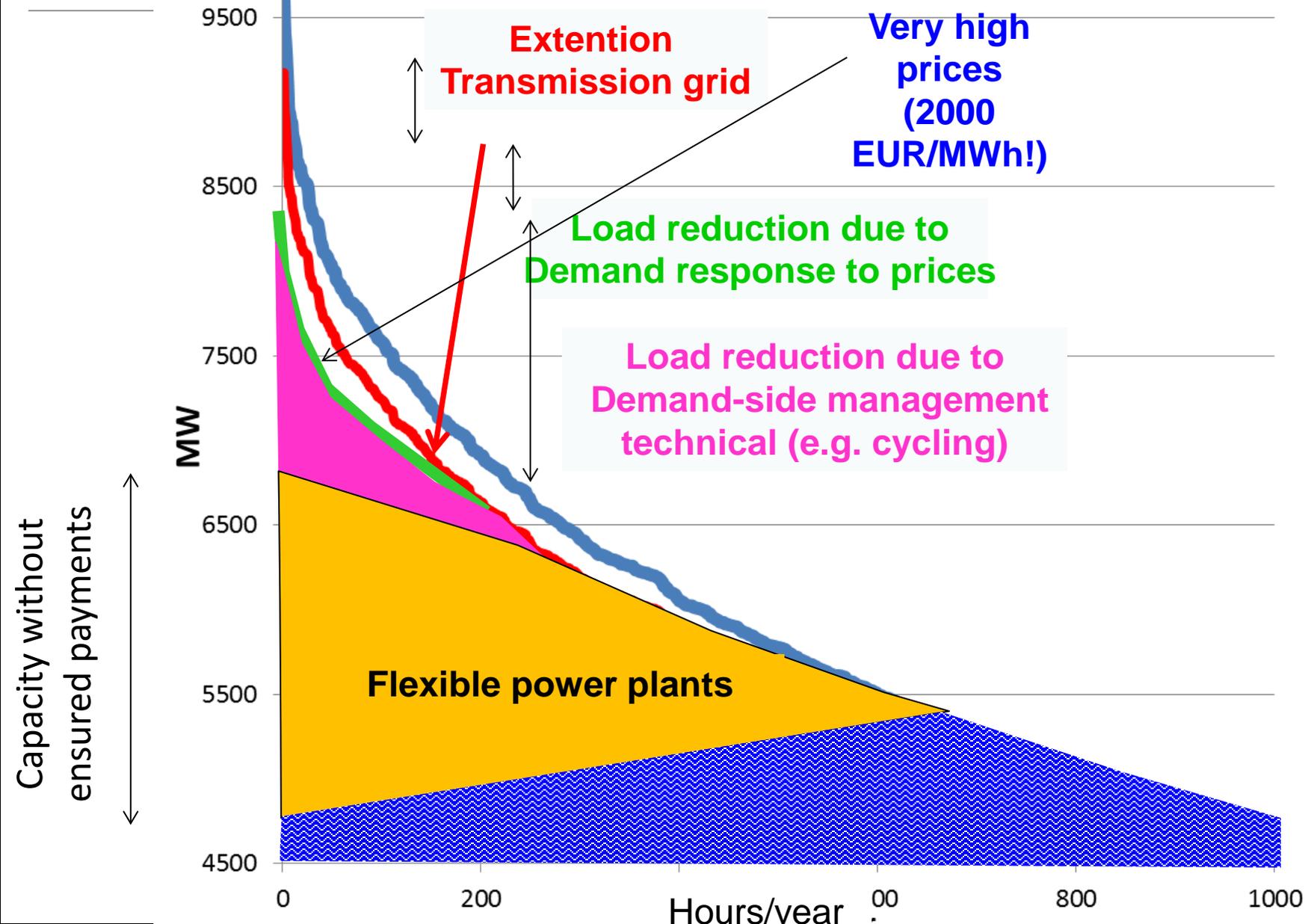
GRID EXTENTION

**DEMAND
RESPONSE
(PRICE SIGNALS)**

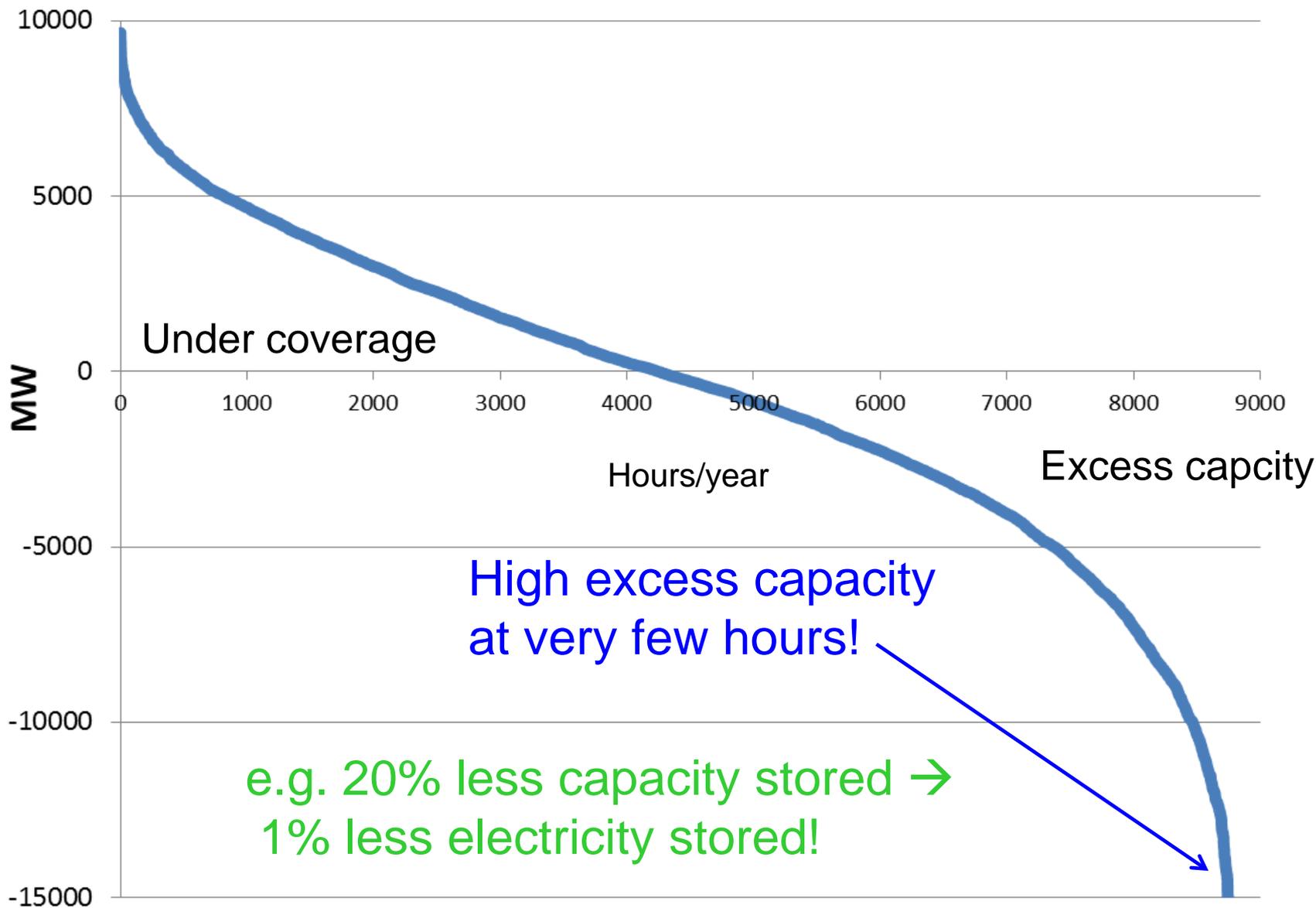
SMART GRIDS

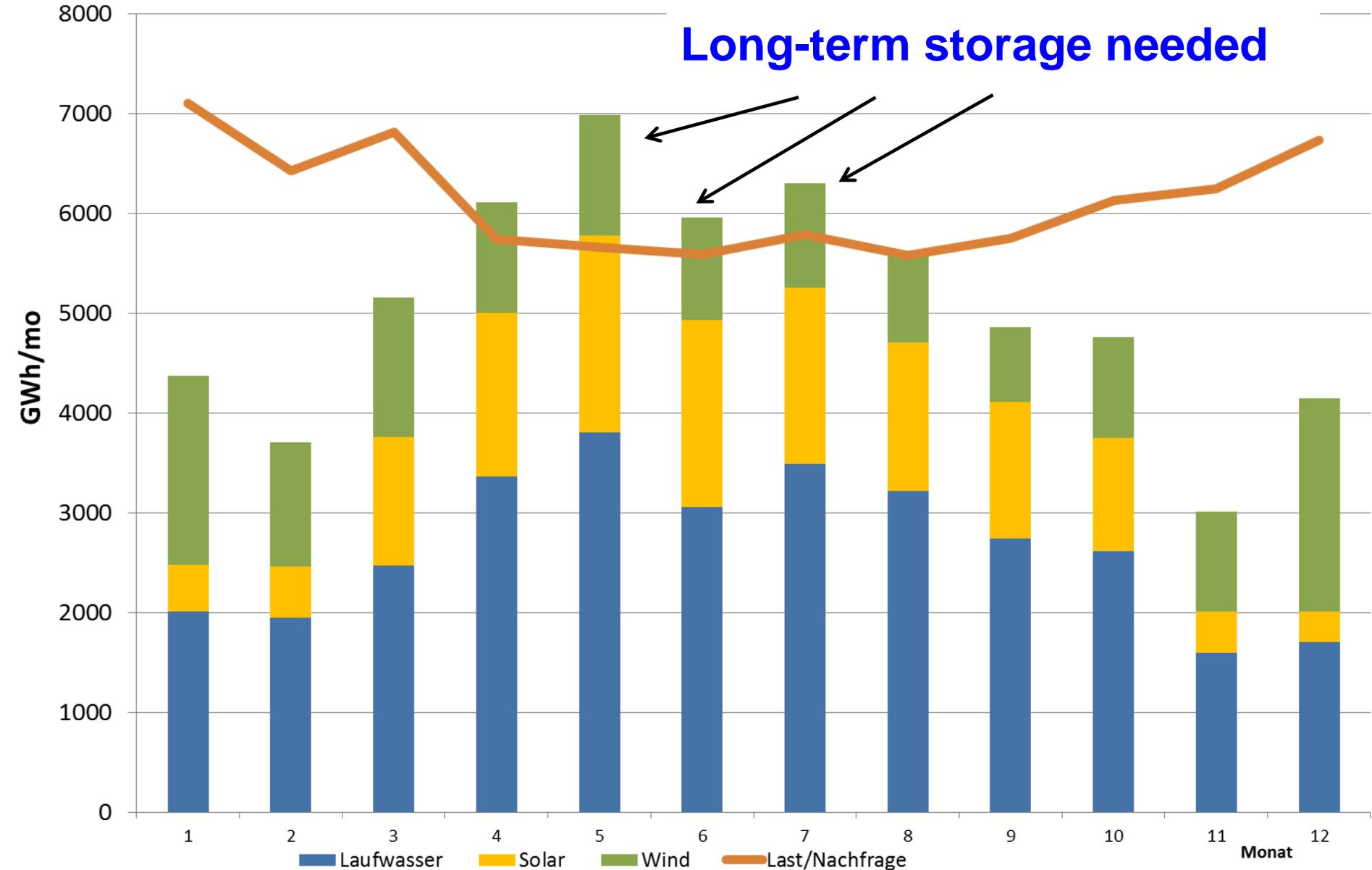


Flexible coverage of residual load



Storing every peak?





Sector coupling / Sector integration

- * In times of surplus generation: How to **use excess electricity** in meaningful way?



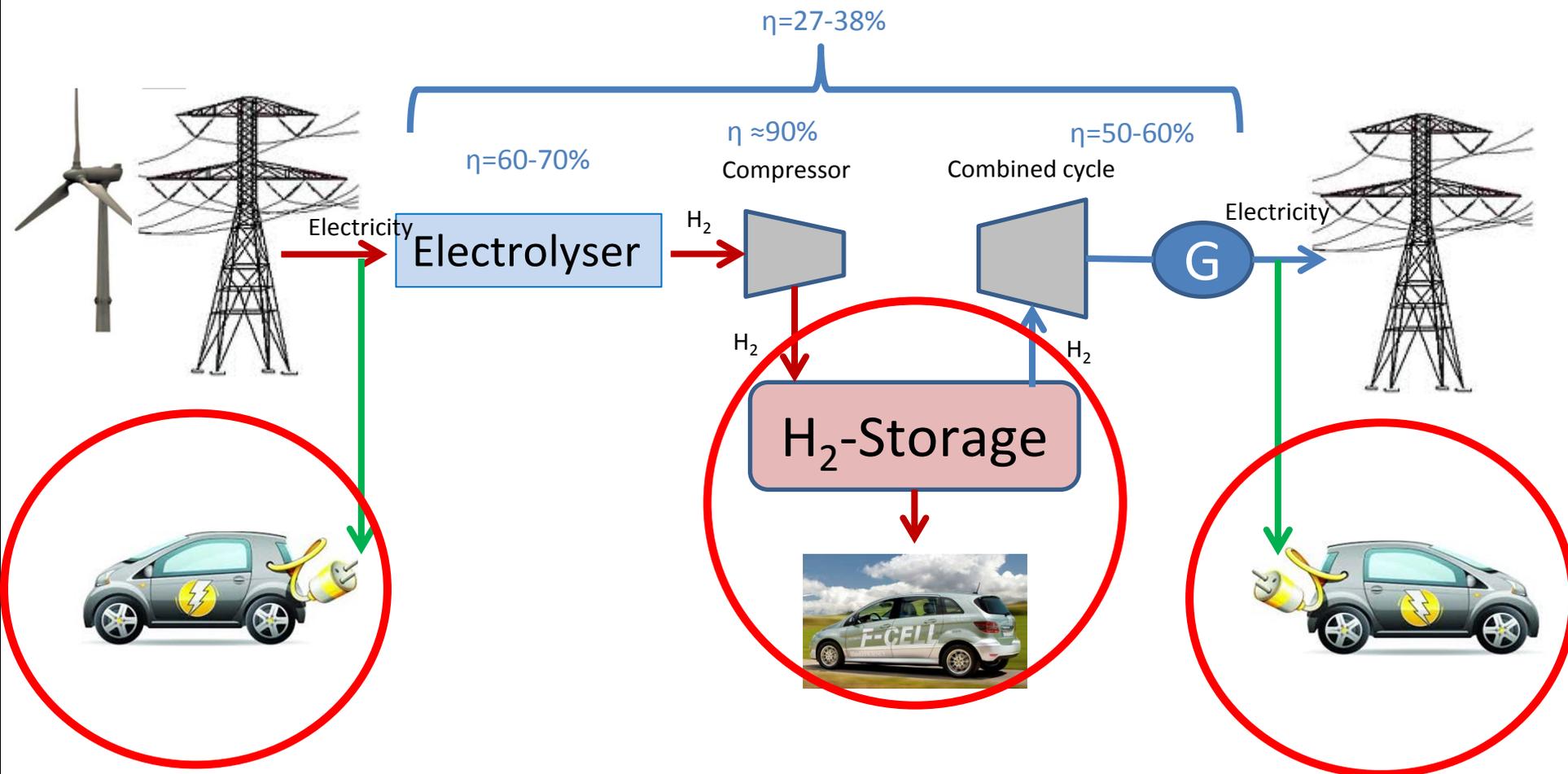
Heating/Cooling

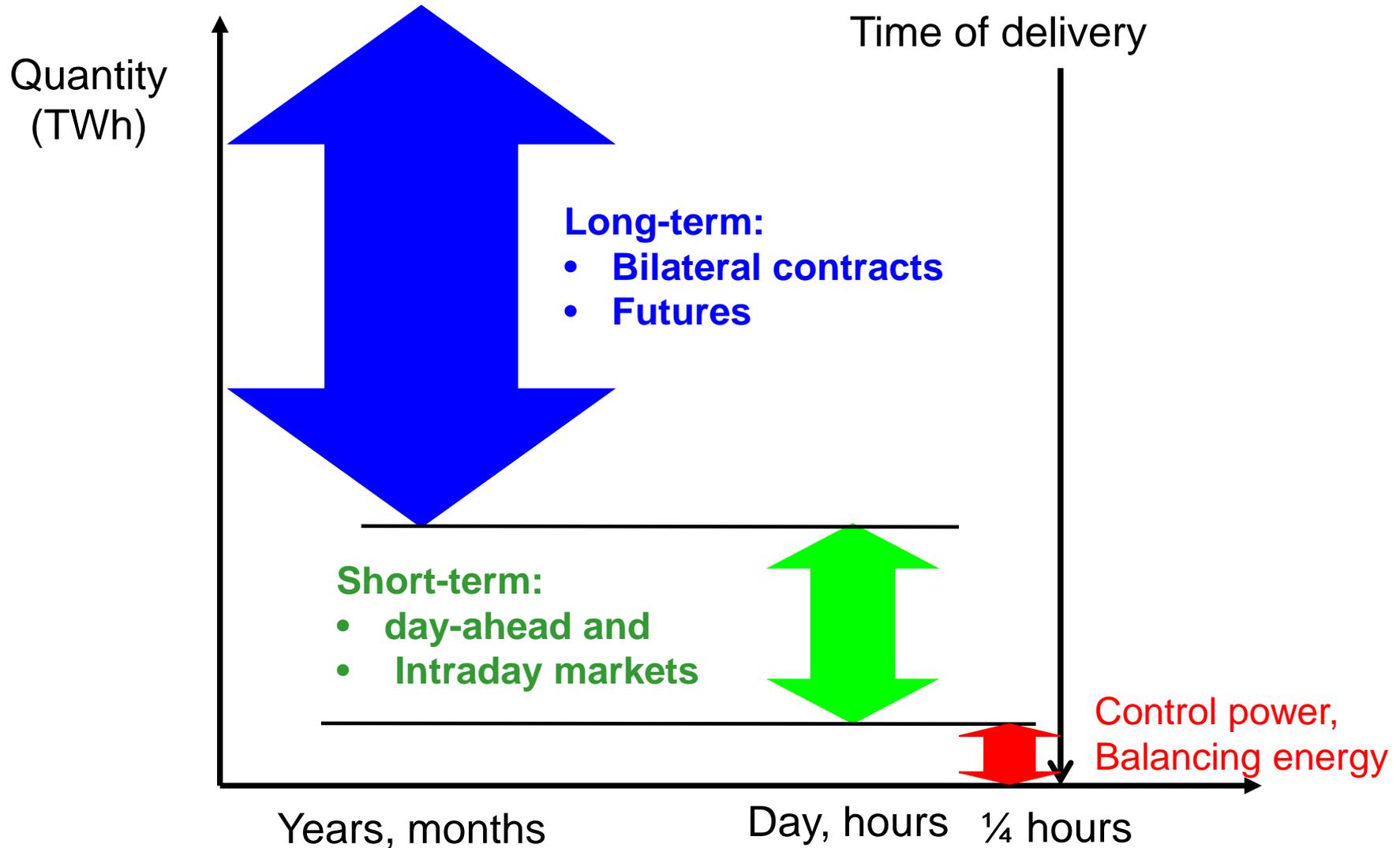


Transport

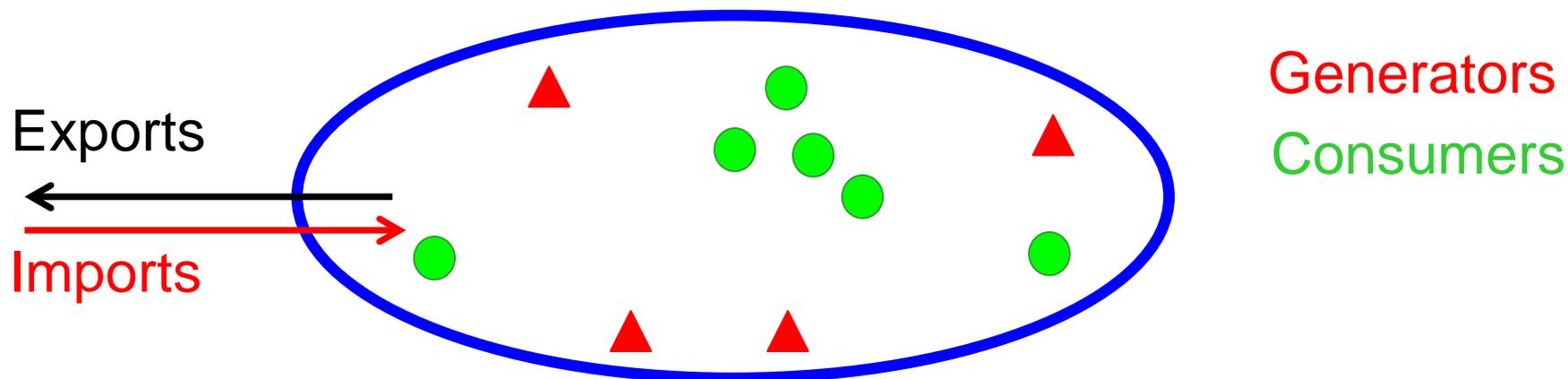
- * Vague simplified suggestions, no convincing long-term solutions
- * **Central** (Ptx approaches, e.g. H₂) vs **decentral** (end user level, E.g. Evs, heat pumps for heating) applications
- * How to **fit use with time of surplus**, e.g. of PV for heating ?

Sector coupling hydrogen: Storage and fuel in transport?





8. THE CORE ROLE AND RESPONSIBILITY OF BALANCING GROUPS



Balancing group: entity in a control area of an electricity system; it has to ensure that at every moment demand and supply is balanced

E.g. municipal utility of Vienna, Dresden, Helsinki

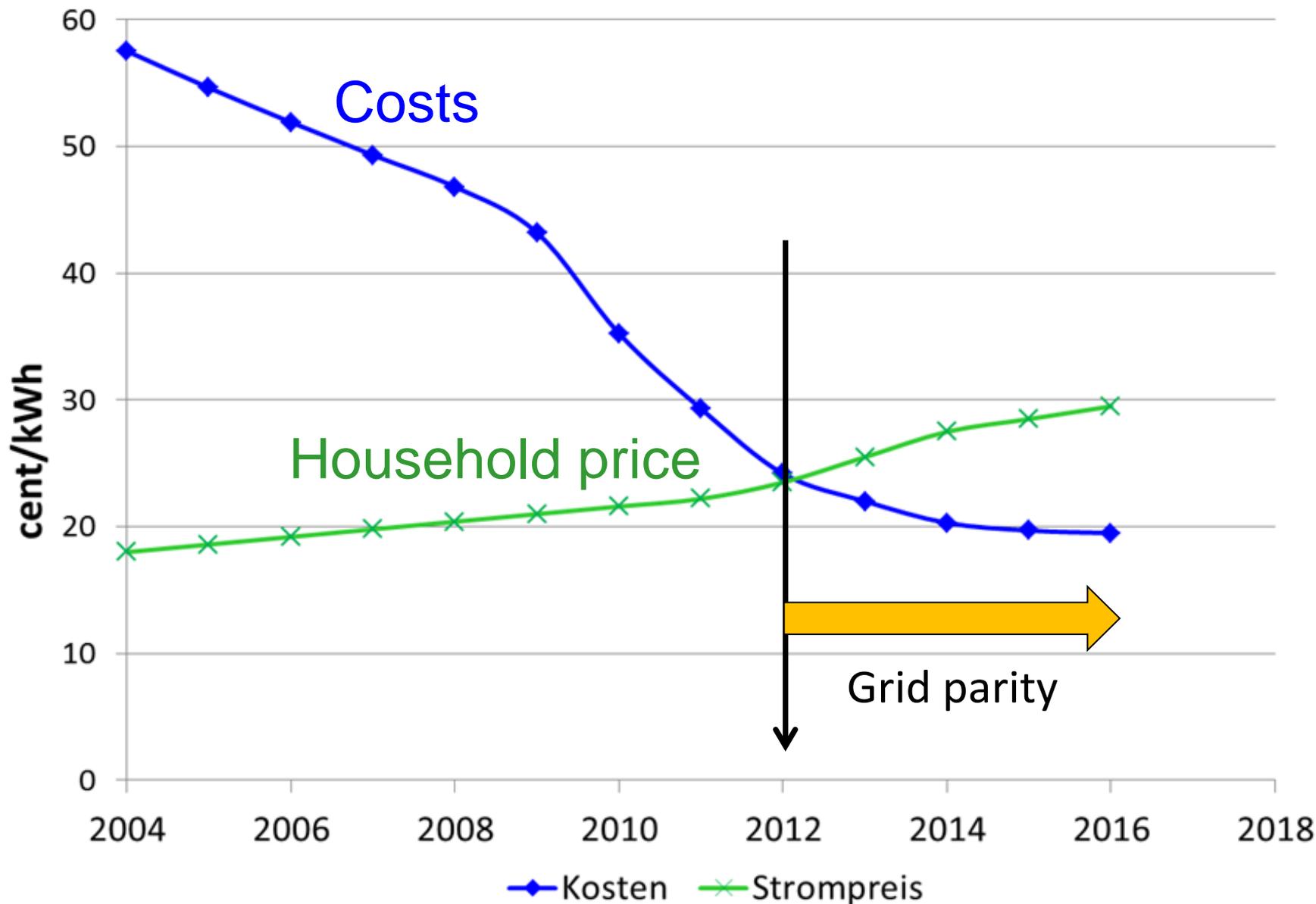
**To meet this target: own generation , storage, flexibility,
Trading in long-term, day-ahead and intraday market**

Every difference → high costs!

7. IS THE TIME FOR SUBSIDIZING RENEWABLES OVER ?

As long there is no price on CO₂

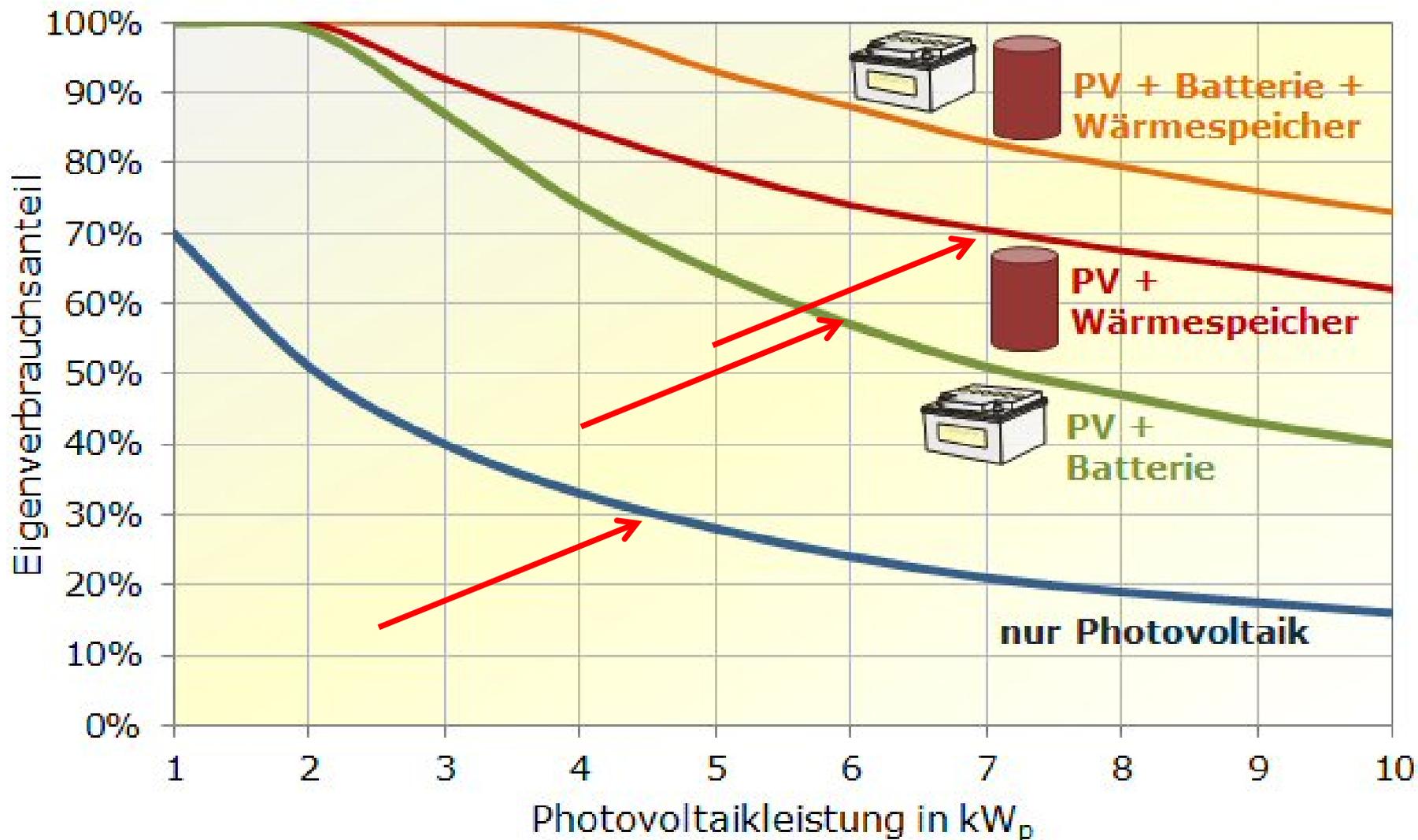
Grid parity: PV-costs and household electricity prices



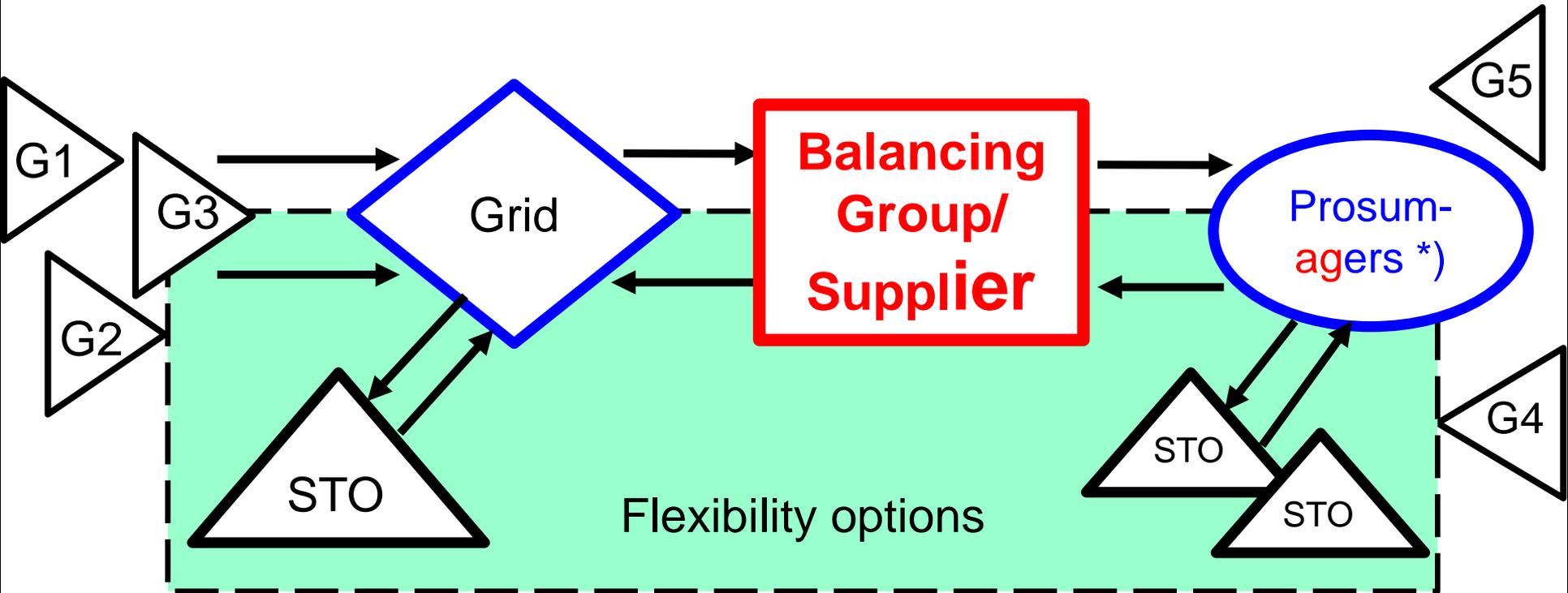
$$\begin{array}{c}
 \text{Savings/revenues} \qquad \qquad \qquad \text{Costs} \\
 \hline
 \text{E}_{\text{Own}} * \text{P}_{\text{HH}} + \text{E}_{\text{Feed-in}} * \text{P}_{\text{feed-in}} > \text{Annuity}
 \end{array}$$

Grid parity term

Subsidy still necessary?



New Thinking: Making the electricity system more democratic



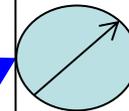
*) R. Green

Tenant electricity model and Blockchain

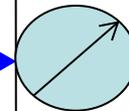
PV-System on the roof

Tenant electricity model:
Contracted PV-electricity

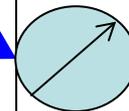
**Balancing
Group/
Supplier**



Customer 1



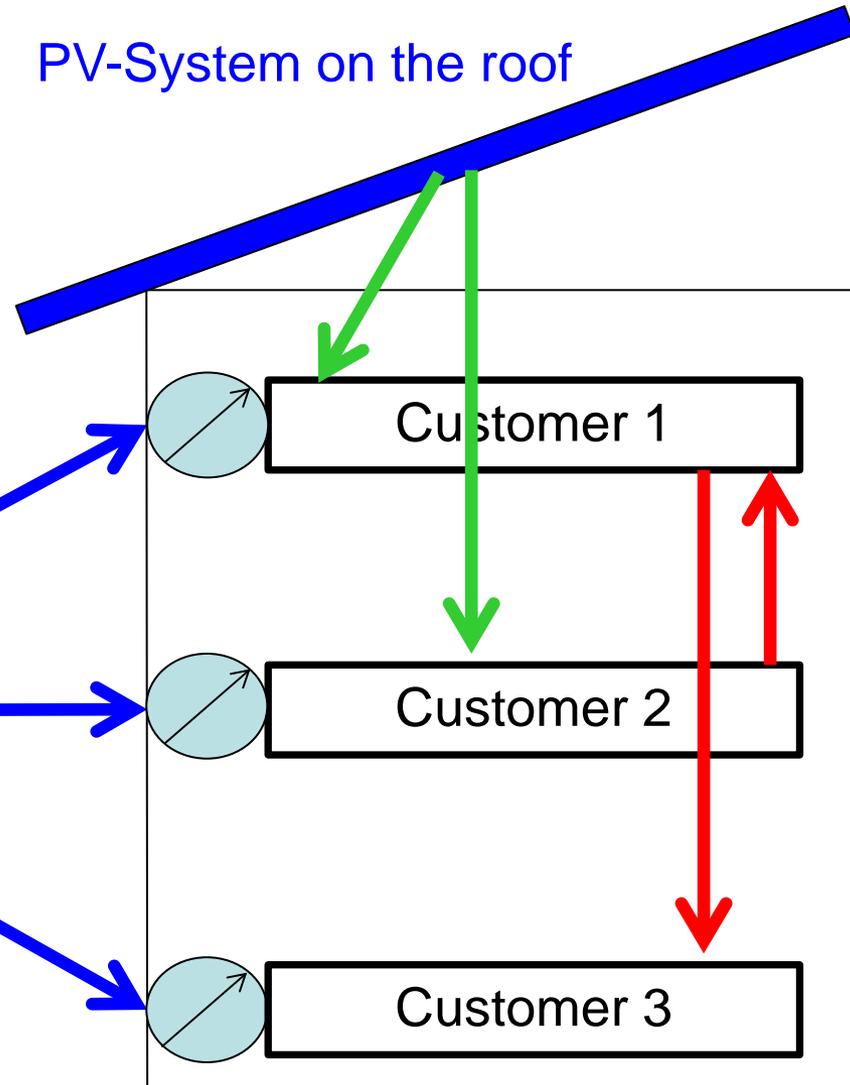
Customer 2

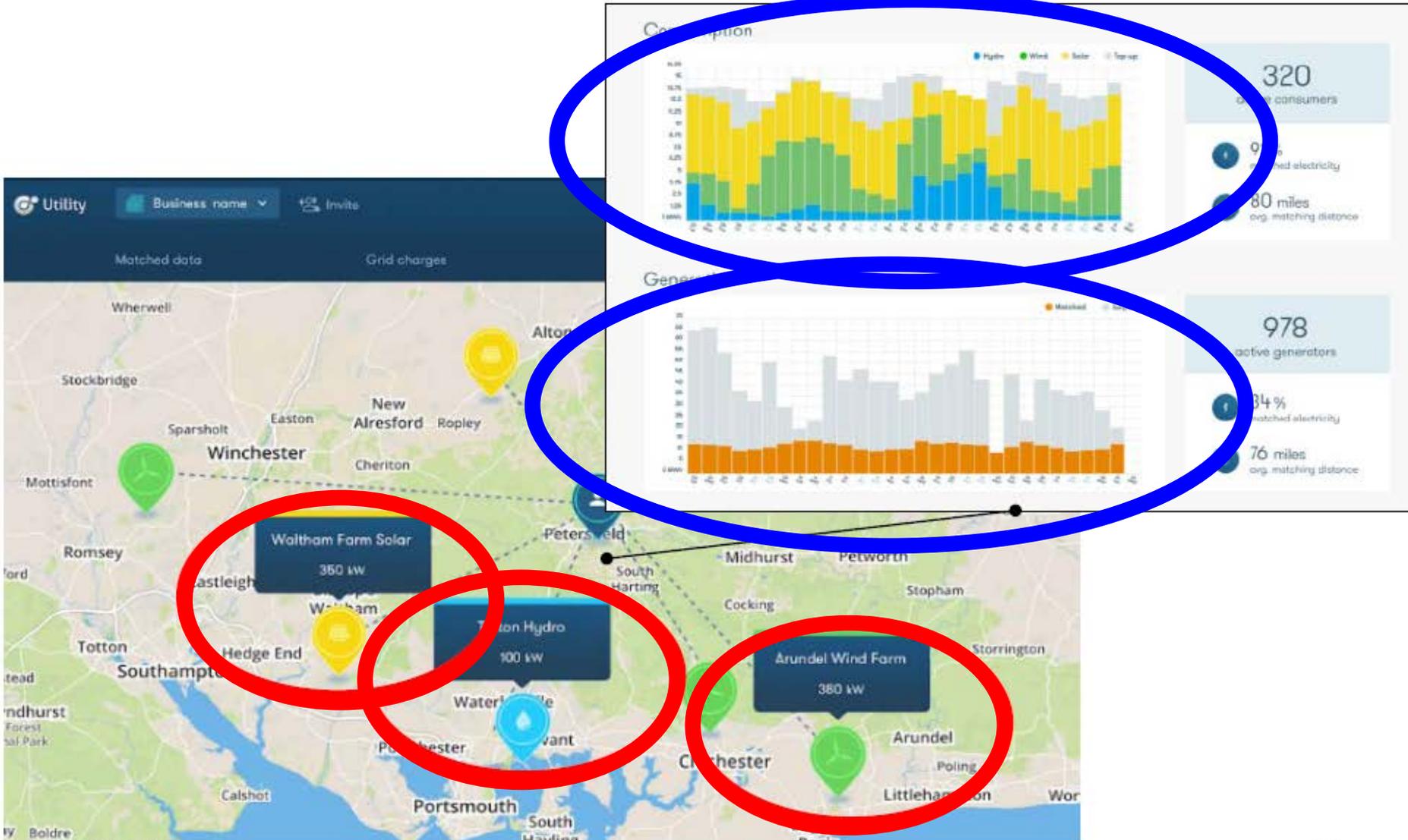


Customer 3

Meter

Blockchain





12/04/2017

Source: piclo.co.uk

- Sustainable electric. system → integration of a broad **technology** portfolio & **demand-side options**
- **Larger** market areas favourable
- Very important: **correct price signals** (incl. CO2)
- most urgent: exhaust **full creativity for flexibility** of all market participants incl. **decentralised PV systems**
- Capacity payments: **Any CP will distort the system** towards more conv. and less RES capacity
- **New key player: Balancing group (Supplier)**, no more the generator