Managing large amounts of variable renewables in the electricity system to mitigate global warming

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Prag, 8th November 2016

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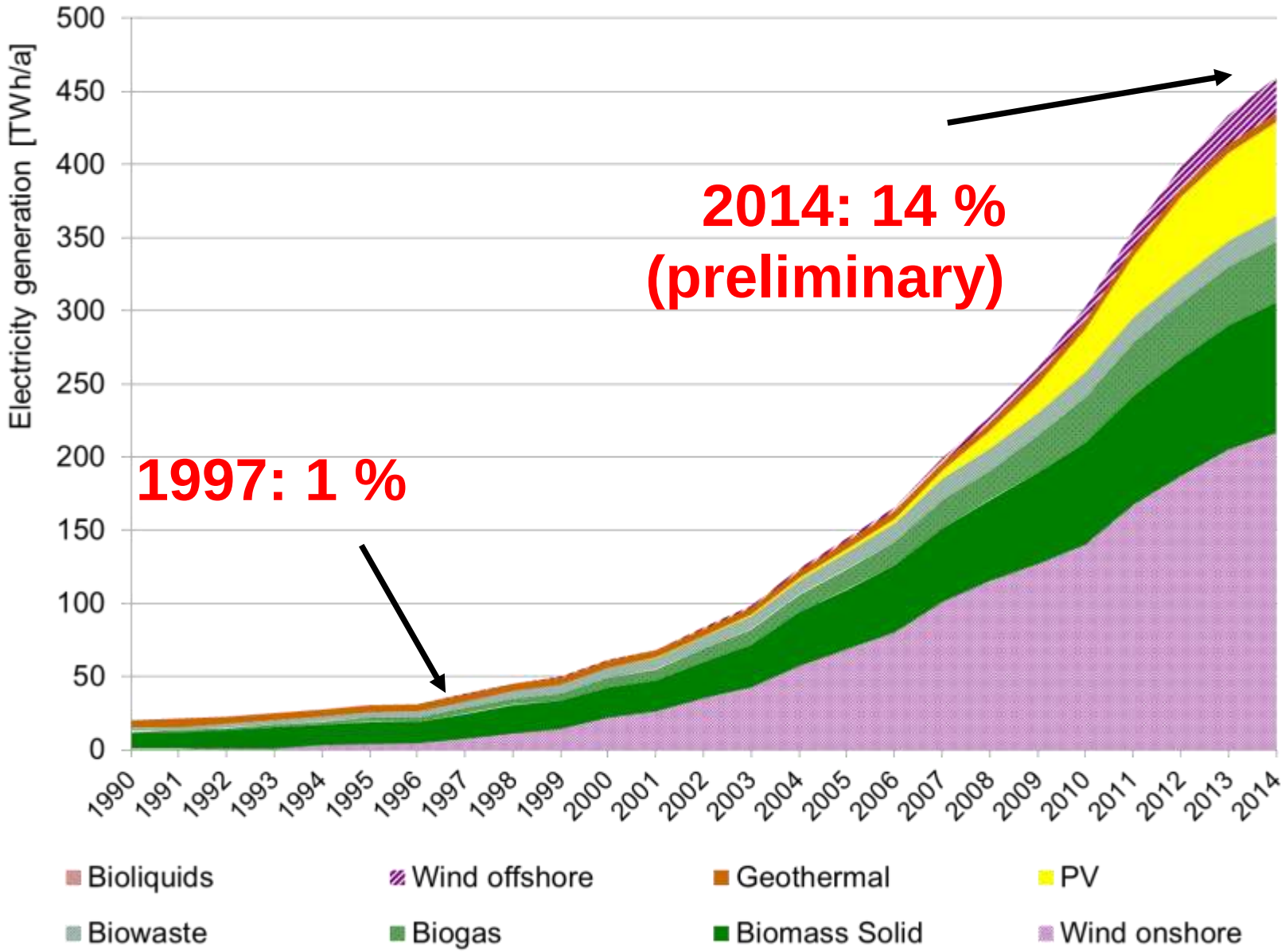
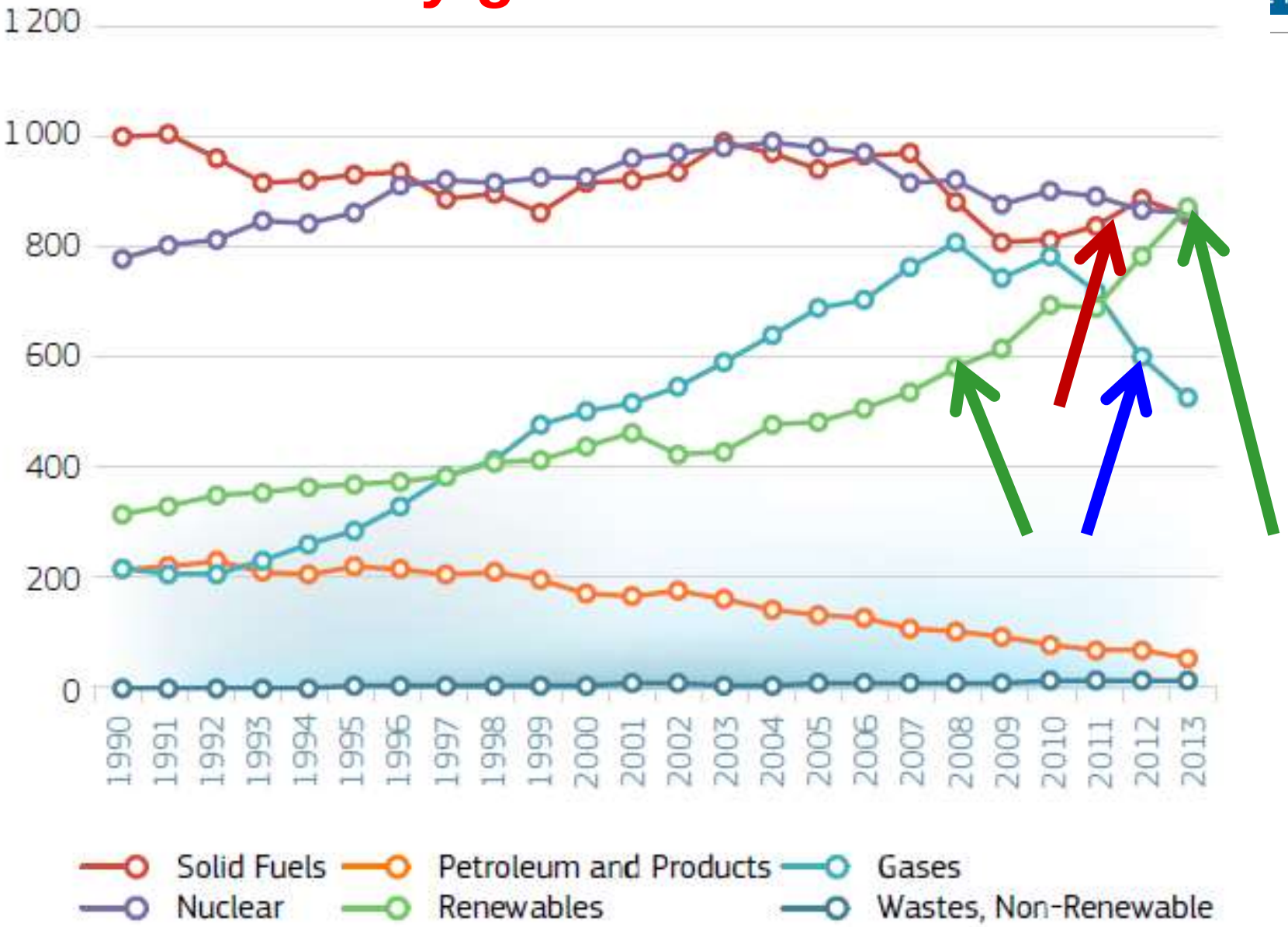
2. Method of approach
3. How variable renewables impact prices in electricity markets
4. A market design
5. Conclusions

Development of electricity from new renewables in EU-28



Electricity generation EU-28



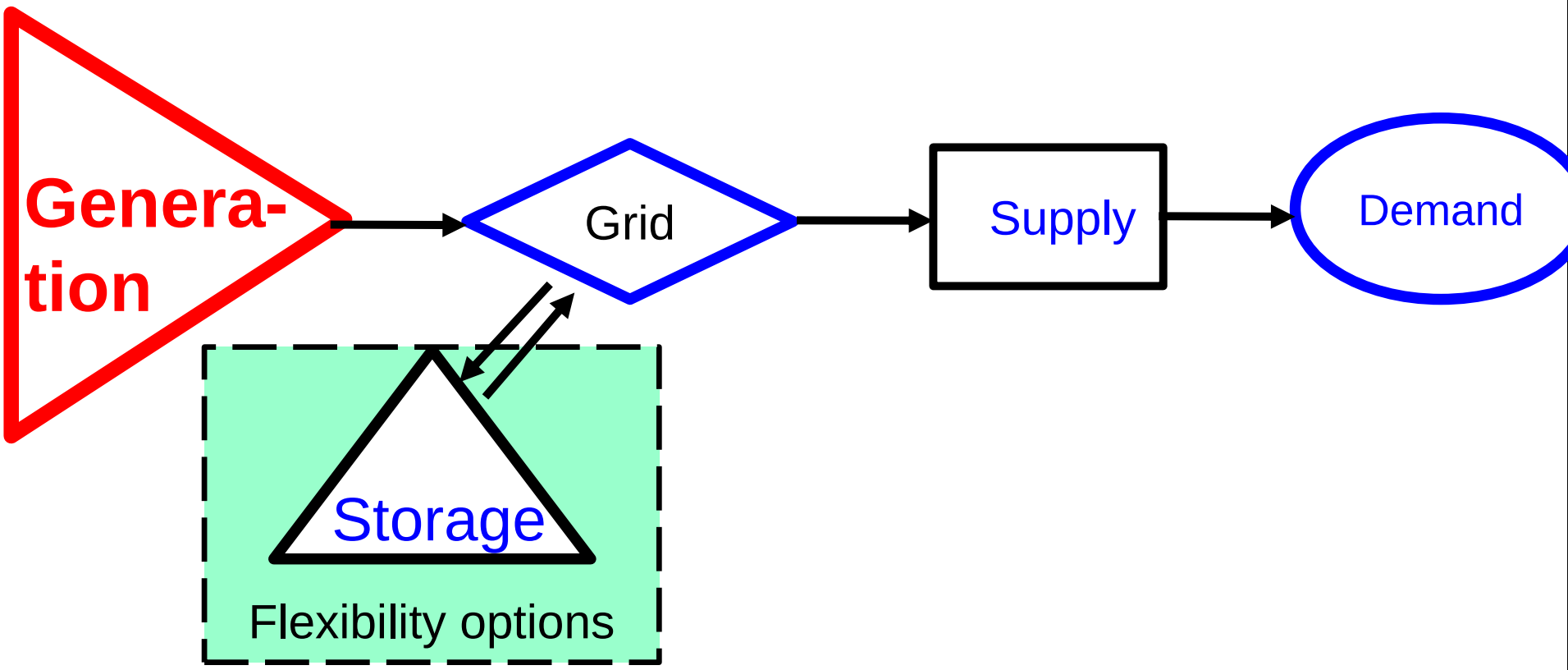
Core objective/ our contribution:

… to identify major boundary conditions for sustainability and competition in the Austrian electricity system

Very important:

Our reflections apply in principle to every electricity system world-wide, regardless of the quantity of variable sources!

Old thinking: a one-way system

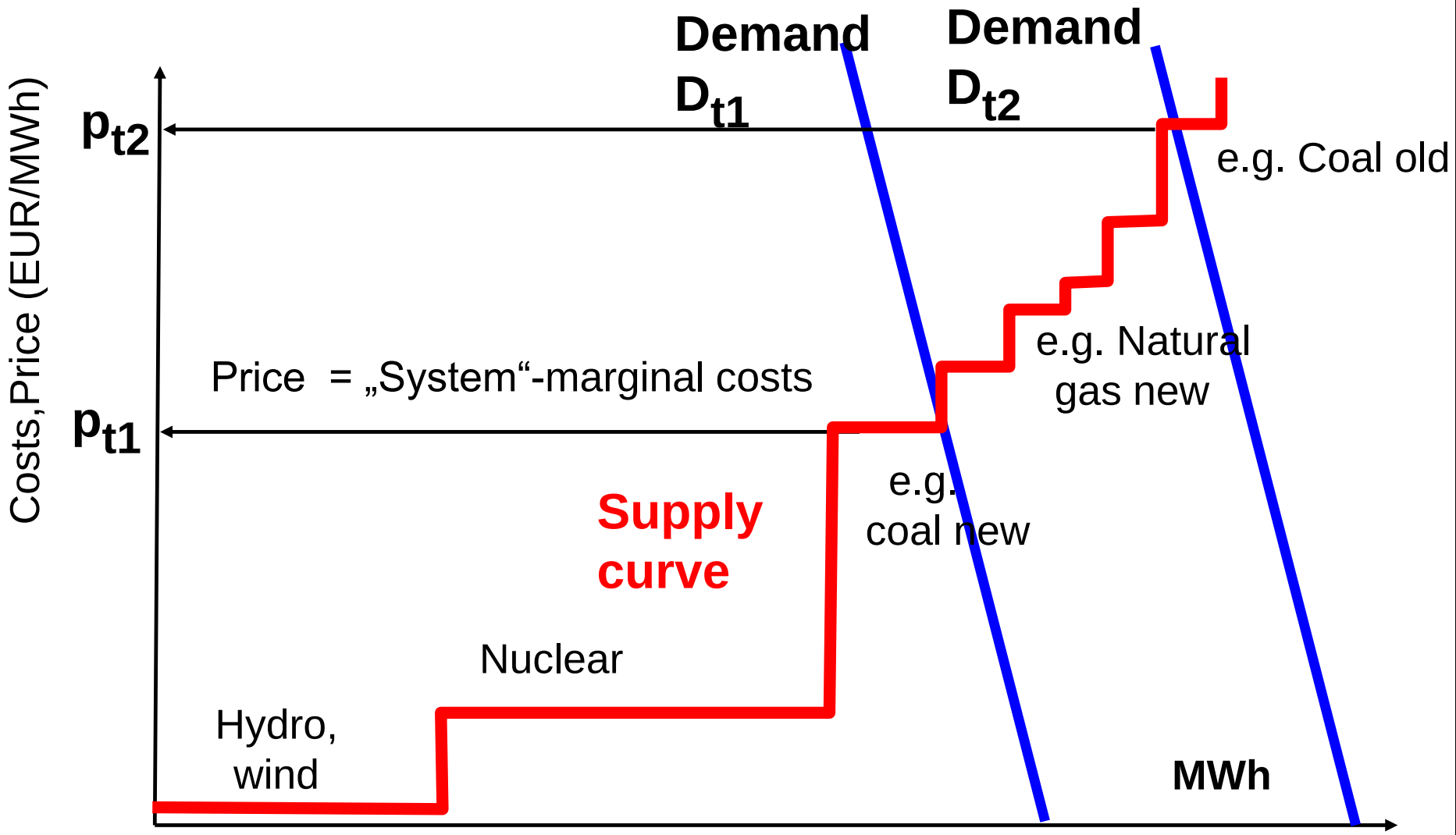


2 METHOD OF APPROACH

- **Identification of hourly residual load over a year for various scenarios;**
- **Applying a fundamental model to calculate (static) hourly electricity spot market prices;**
- **Integration of storage, flexibility and demand- response in a dynamic framework for price calculation;**

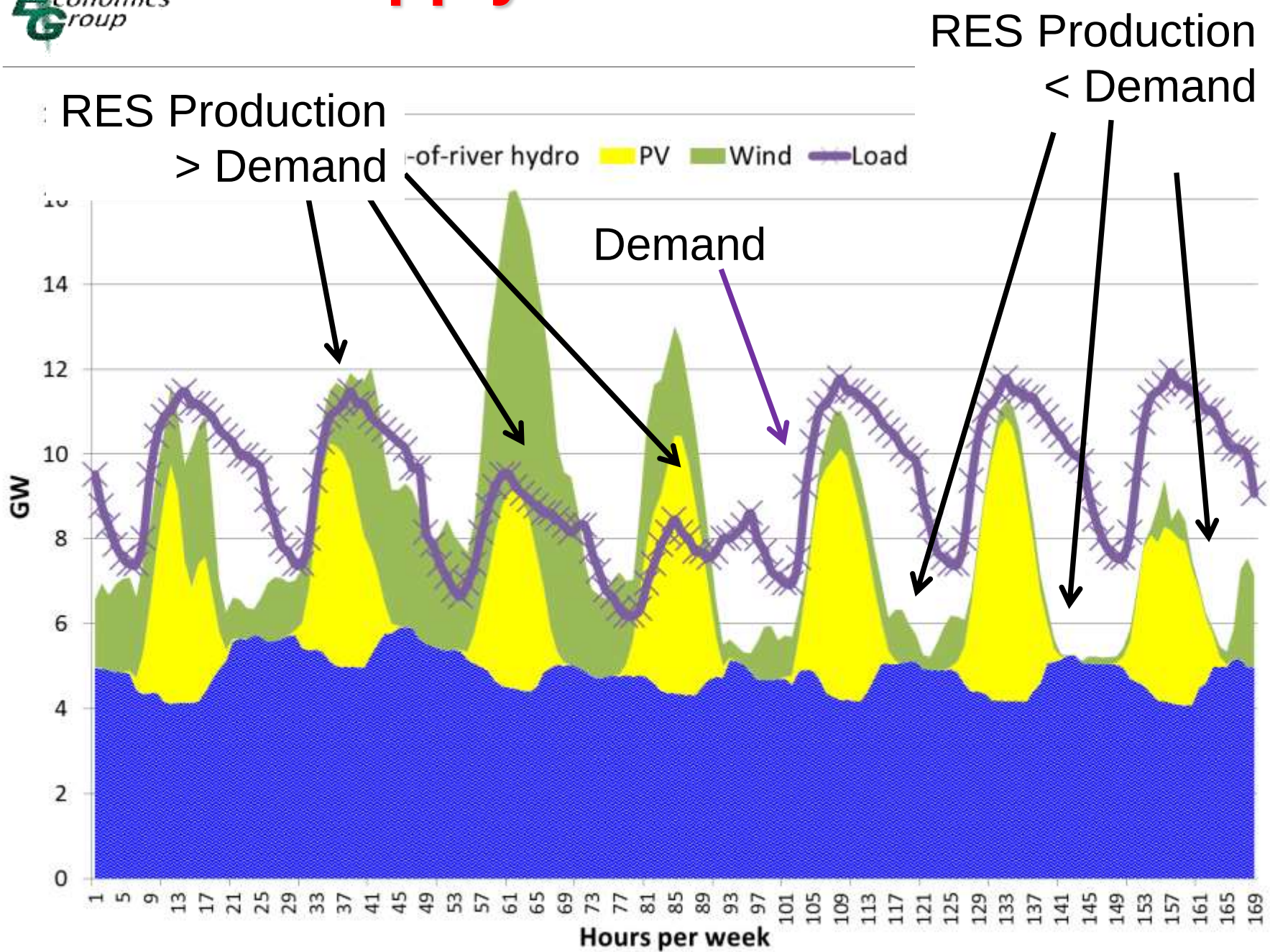
How prices come about in electricity markets:

Competition: Prices = Marginal Costs at every hour

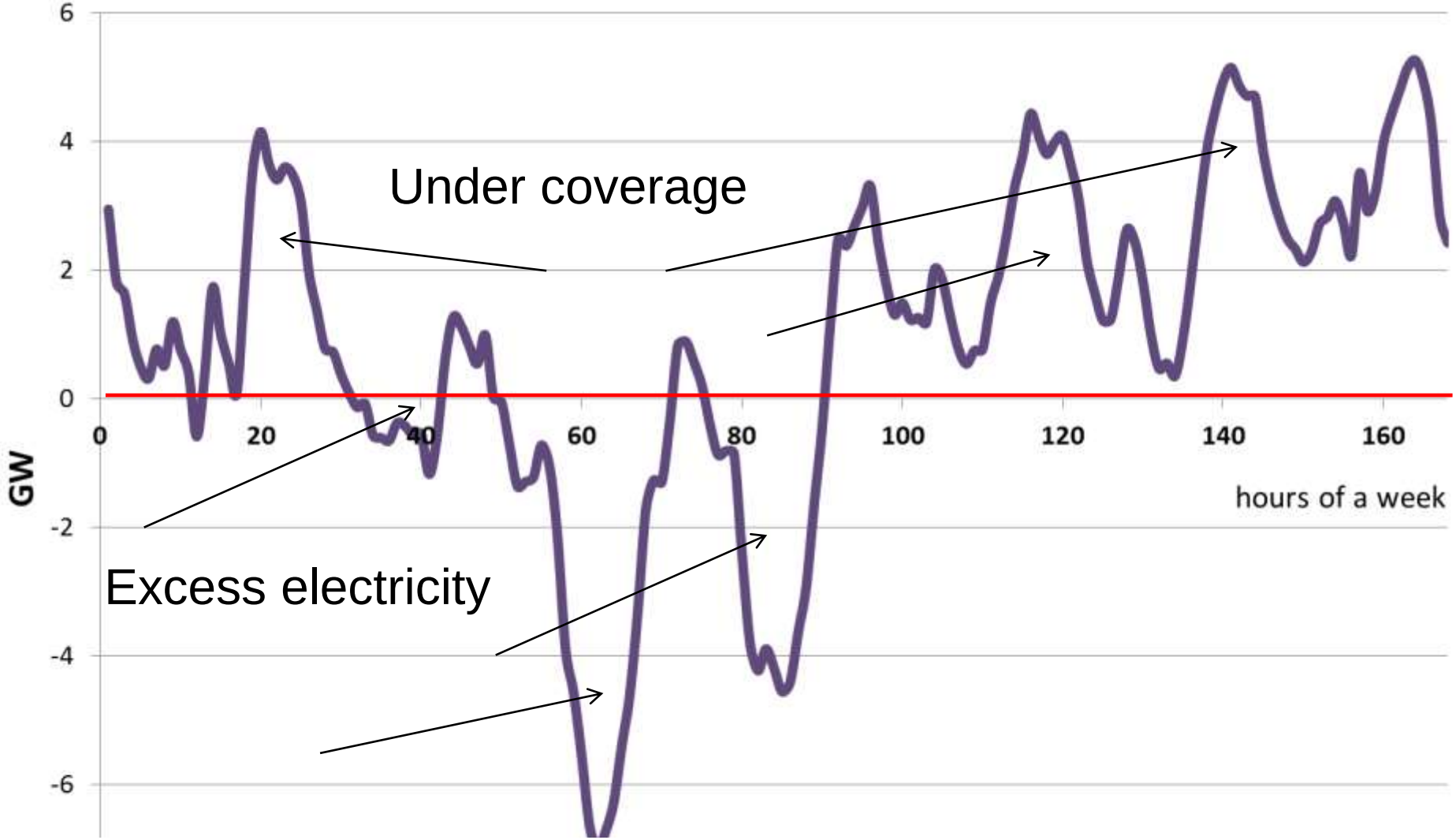


3 HOW VARIABLE RENEWABLES IMPACT PRICES IN ELECTRICITY MARKETS

Supply and Demand



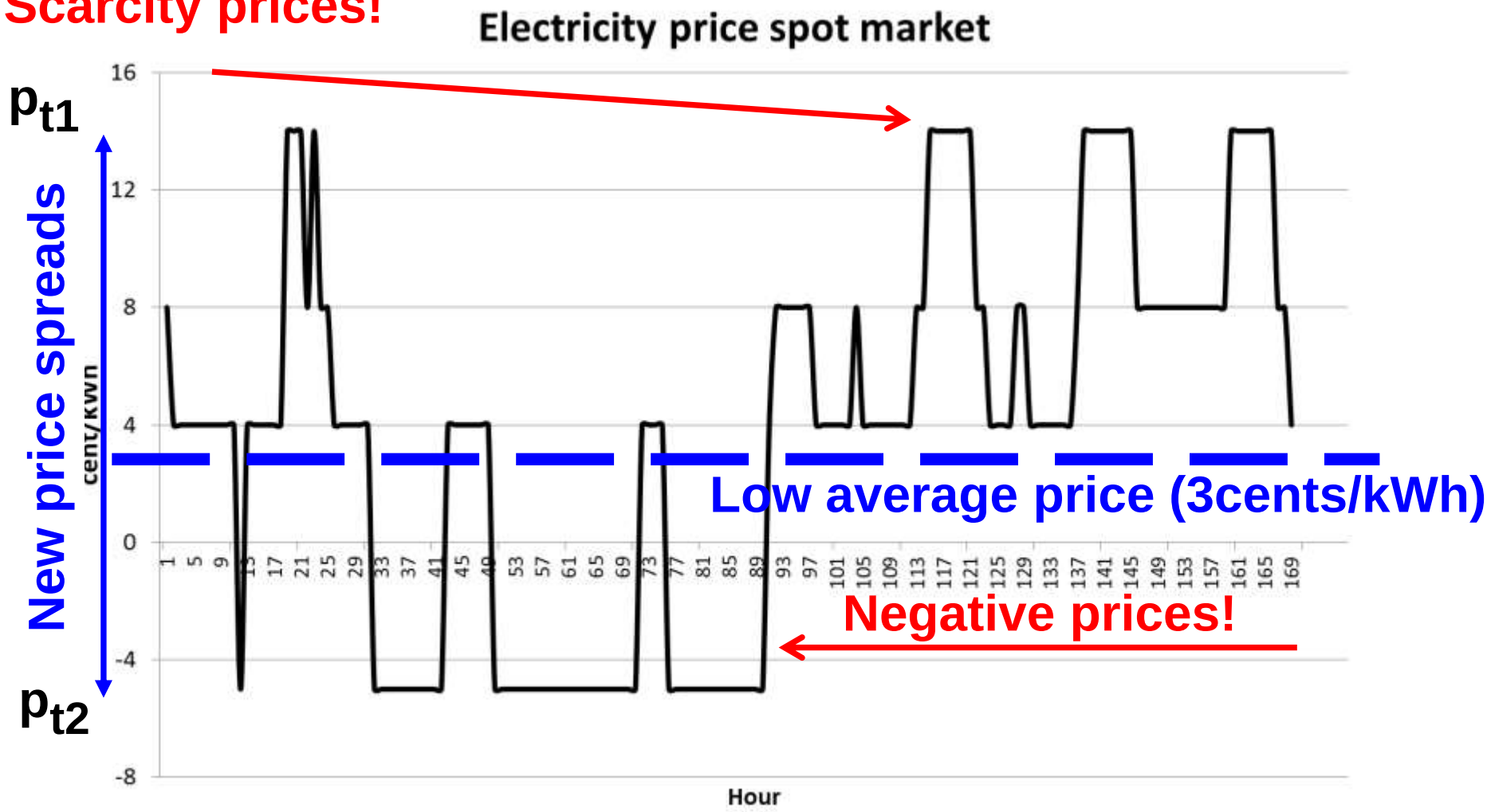
Key term of the future: Residual load



Residual load = Load – non-flexible generation

Deviation from STMC-pricing in spot markets

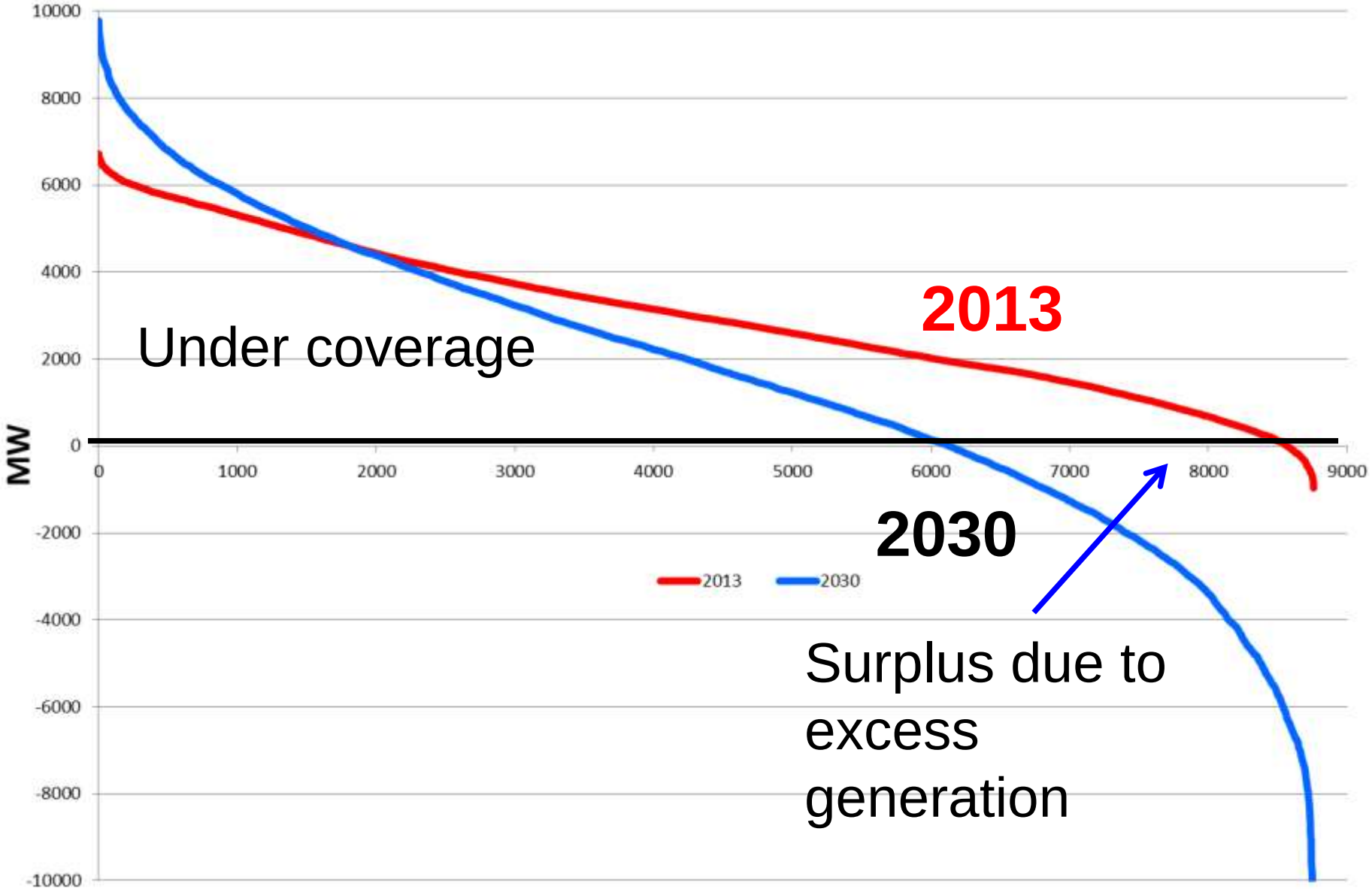
Scarcity prices!



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

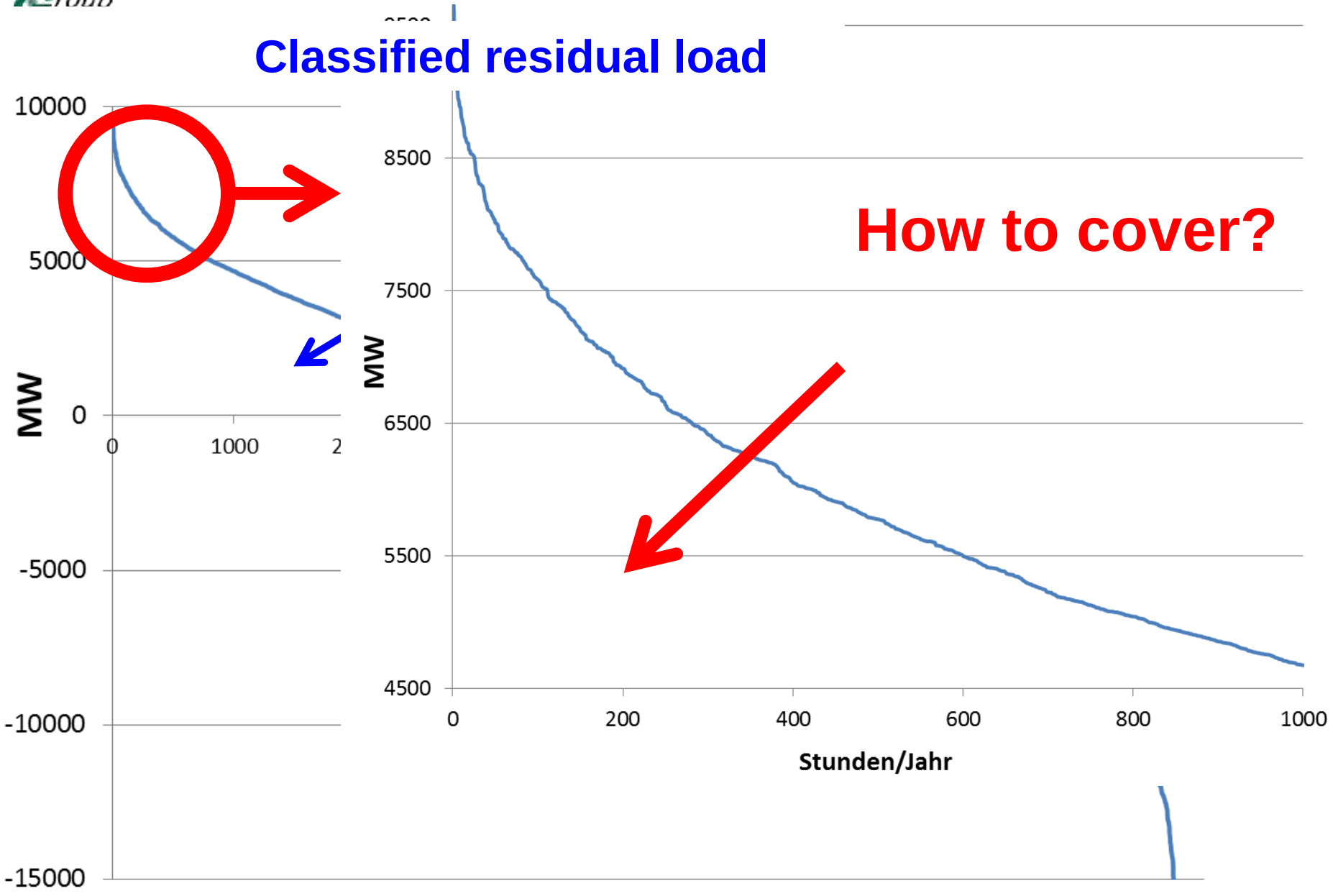
4 A MARKET DESIGN

Classified residual load



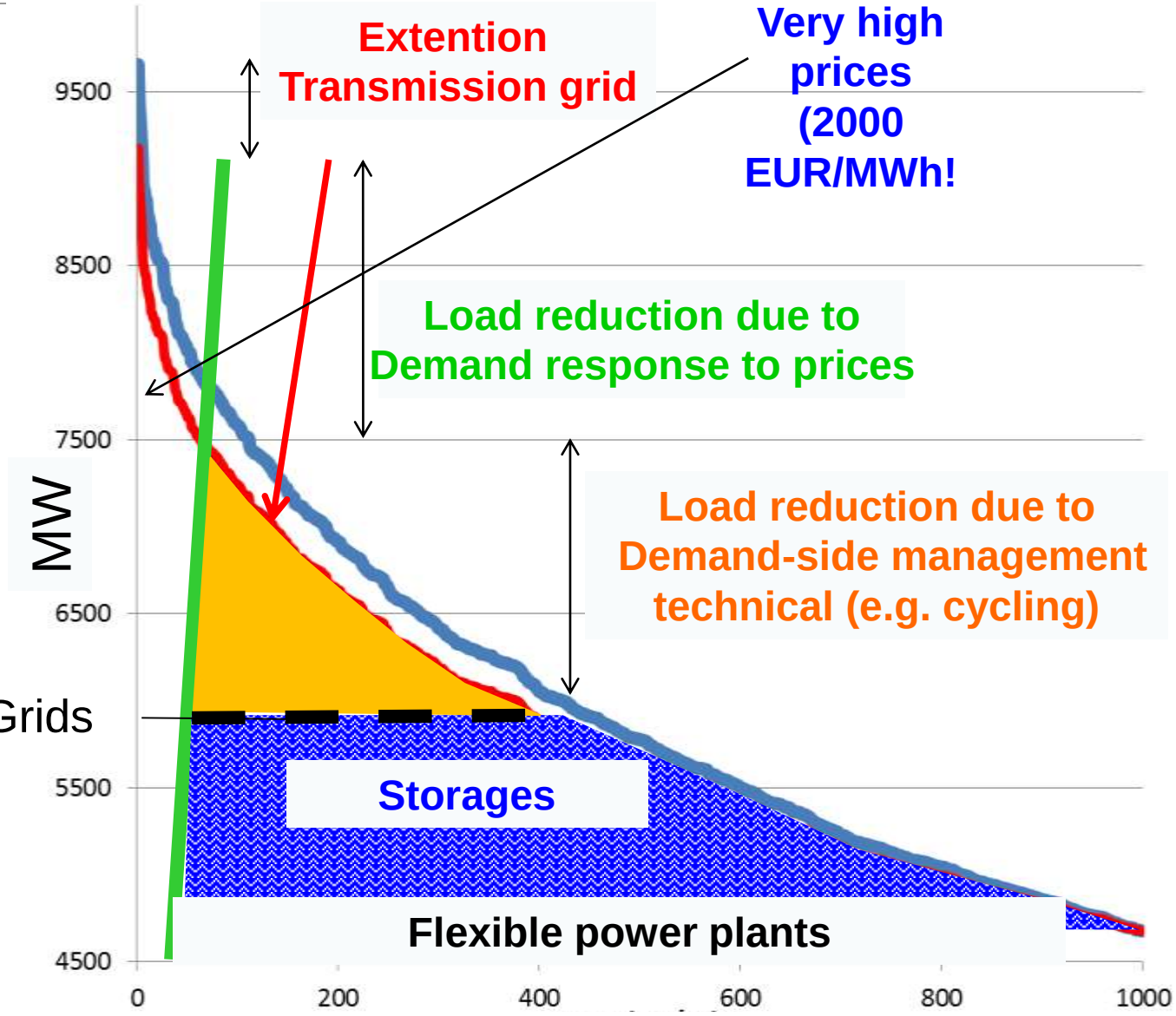
A MARKET DESIGN

Classified residual load



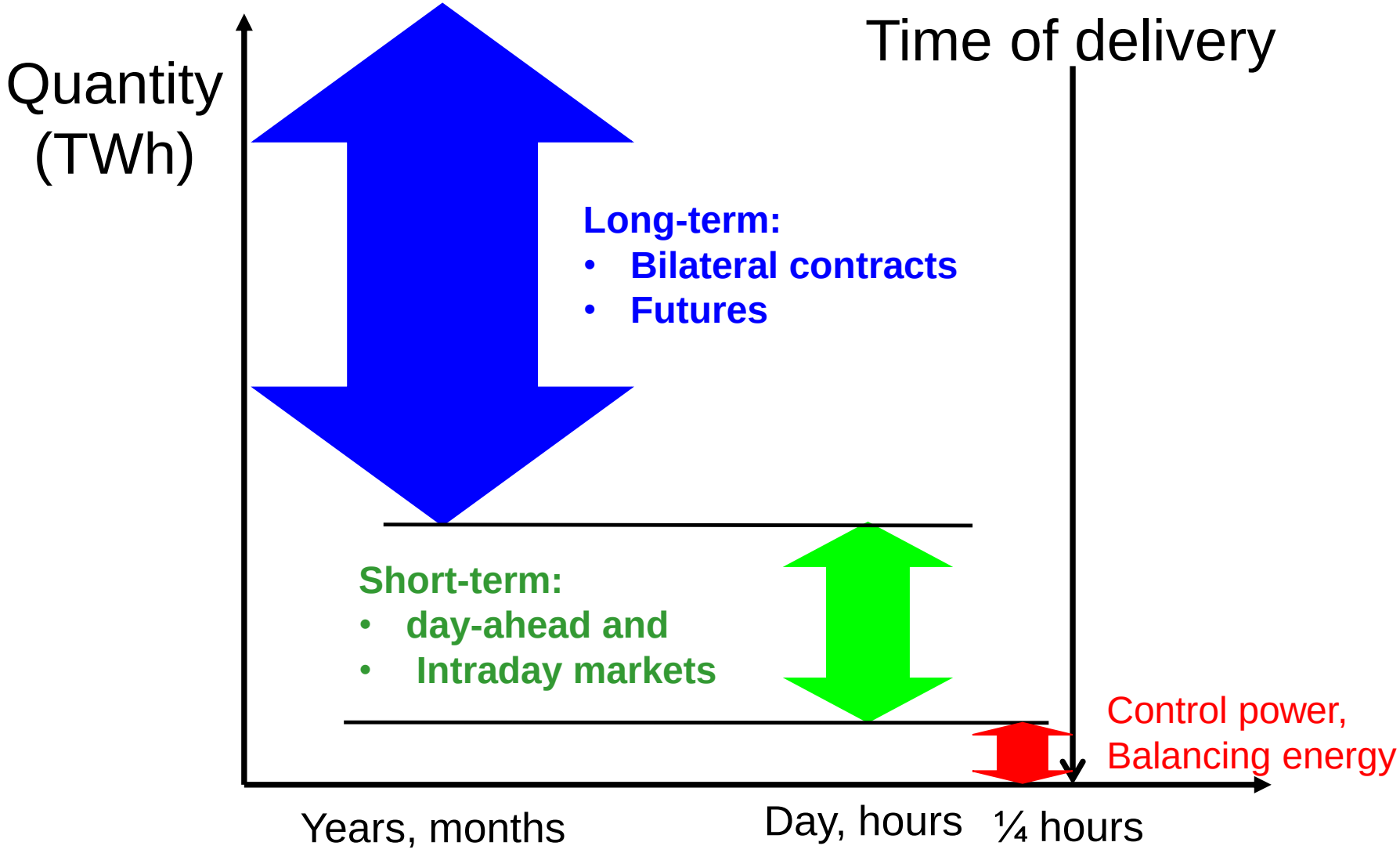
How to cover?

Flexible coverage of residual load

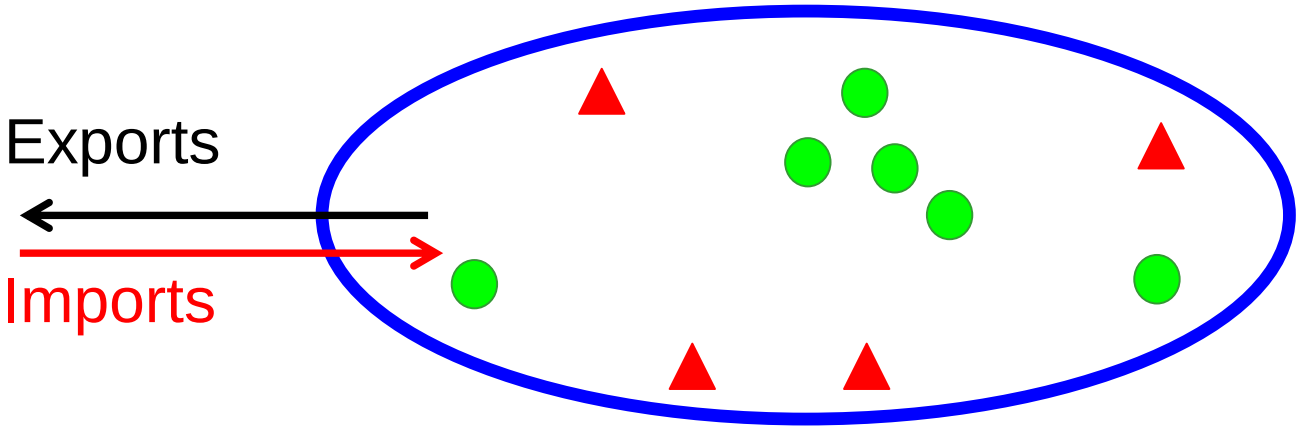


Smart Grids

Elements of electricity markets



The core role and responsibility of balancing groups



Generators

Consumers

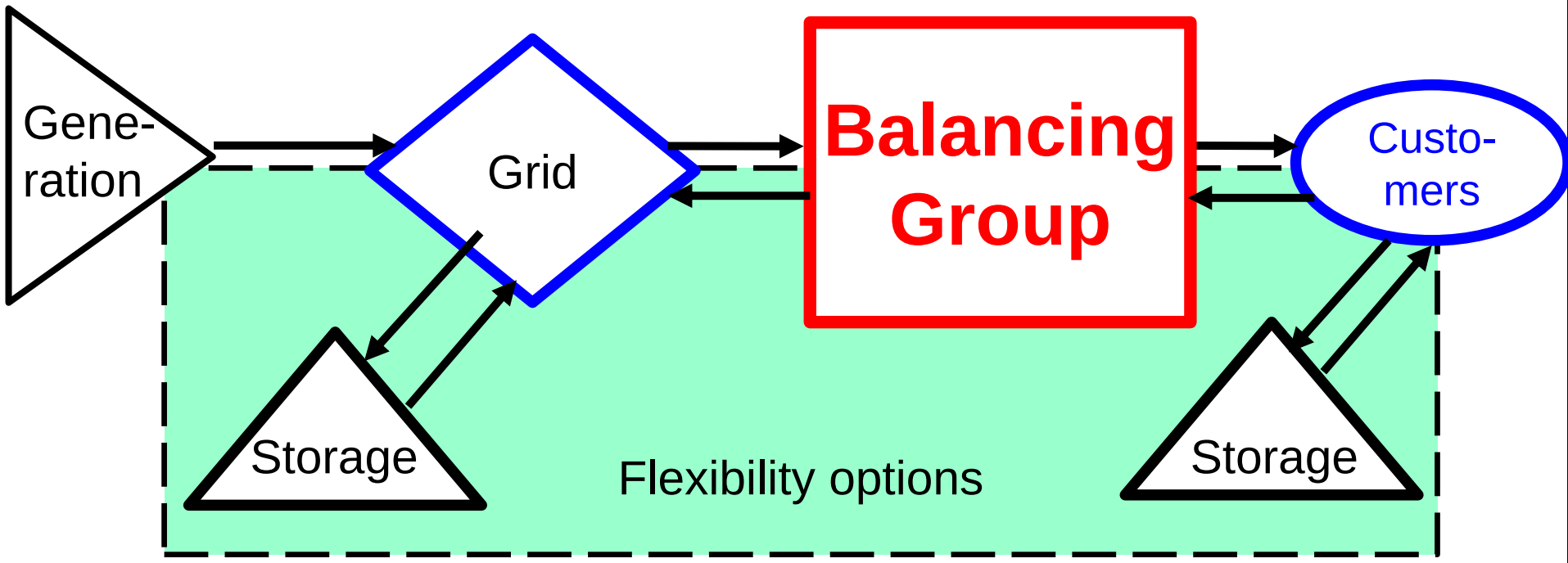
Balancing group: entity in a control area of an electricity system. has to ensure that at every moment demand and supply is balanced

E.g. municipal utility of Prag, Bratislava, Vienna

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

Every deviation → high costs!

New Thinking:



5. CONCLUSIONS

- A sustainable electricity system is a question of integrating a broad portfolio of technologies and demand response options!
- Very important: correct price signals!!!
- The key: Flexibility! Yet, currently no economic incentives but activities started → very promising!
- New key player: Balancing group or supplier, rather than the generator