

New challenges in electricity markets

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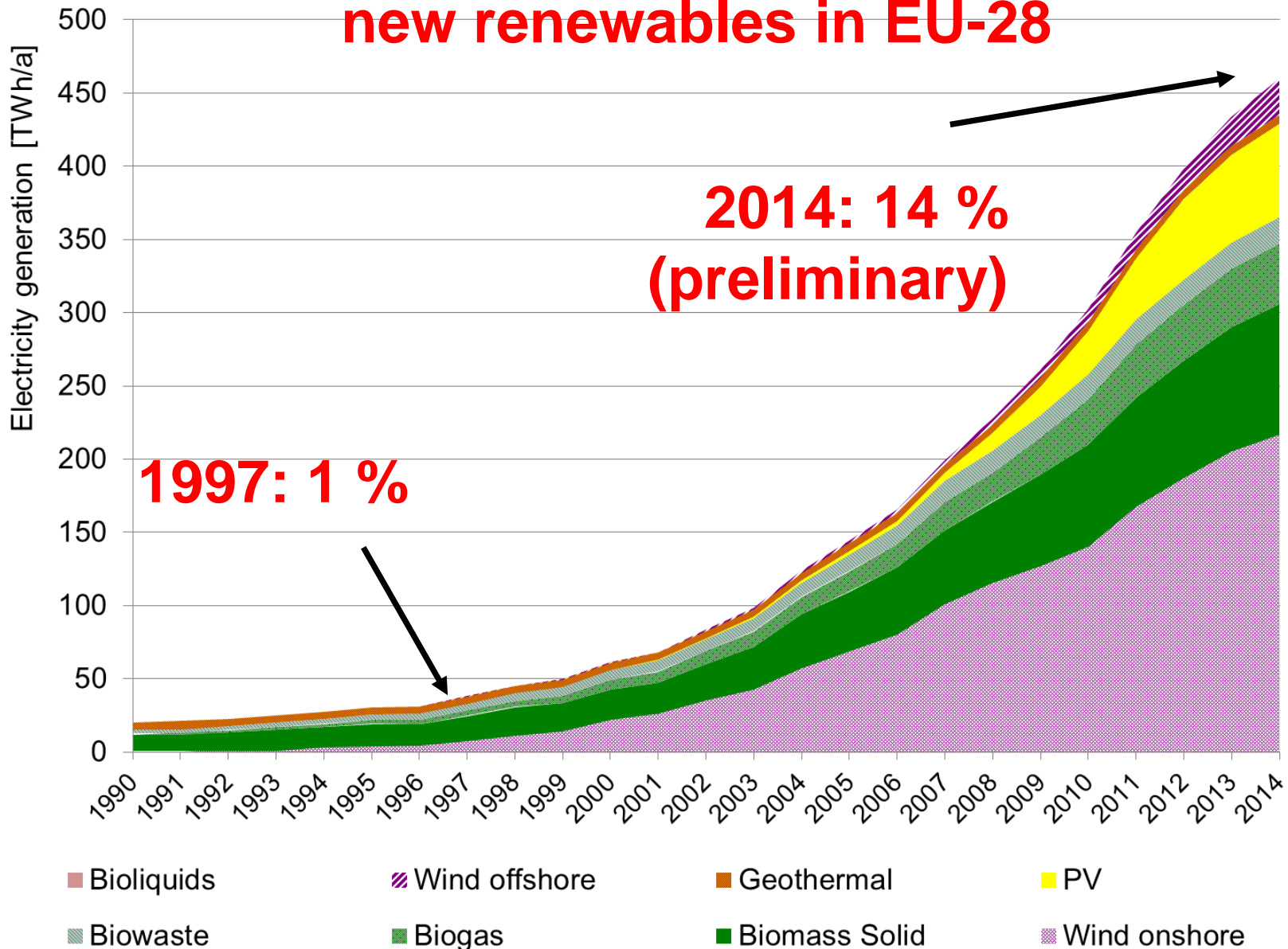
Energy Economics Group, TU Wien

Summerschool, May 2016

- 1. Introduction: Recent developments**
- 2. How prices come about in electricity markets**
- 3. Impact of variable renewables on prices**
- 4. Supply security and dimensions of electricity markets**
- 5. Economic incentives**
- 6. Conclusions**

1. INTRODUCTION

Development of electricity from new renewables in EU-28



2. HOW PRICES IN ELECTRICITY MARKETS COME ABOUT

(SOME THEORY)

before liberalisation

after liberalisation

Price, costs (EUR/MWh)

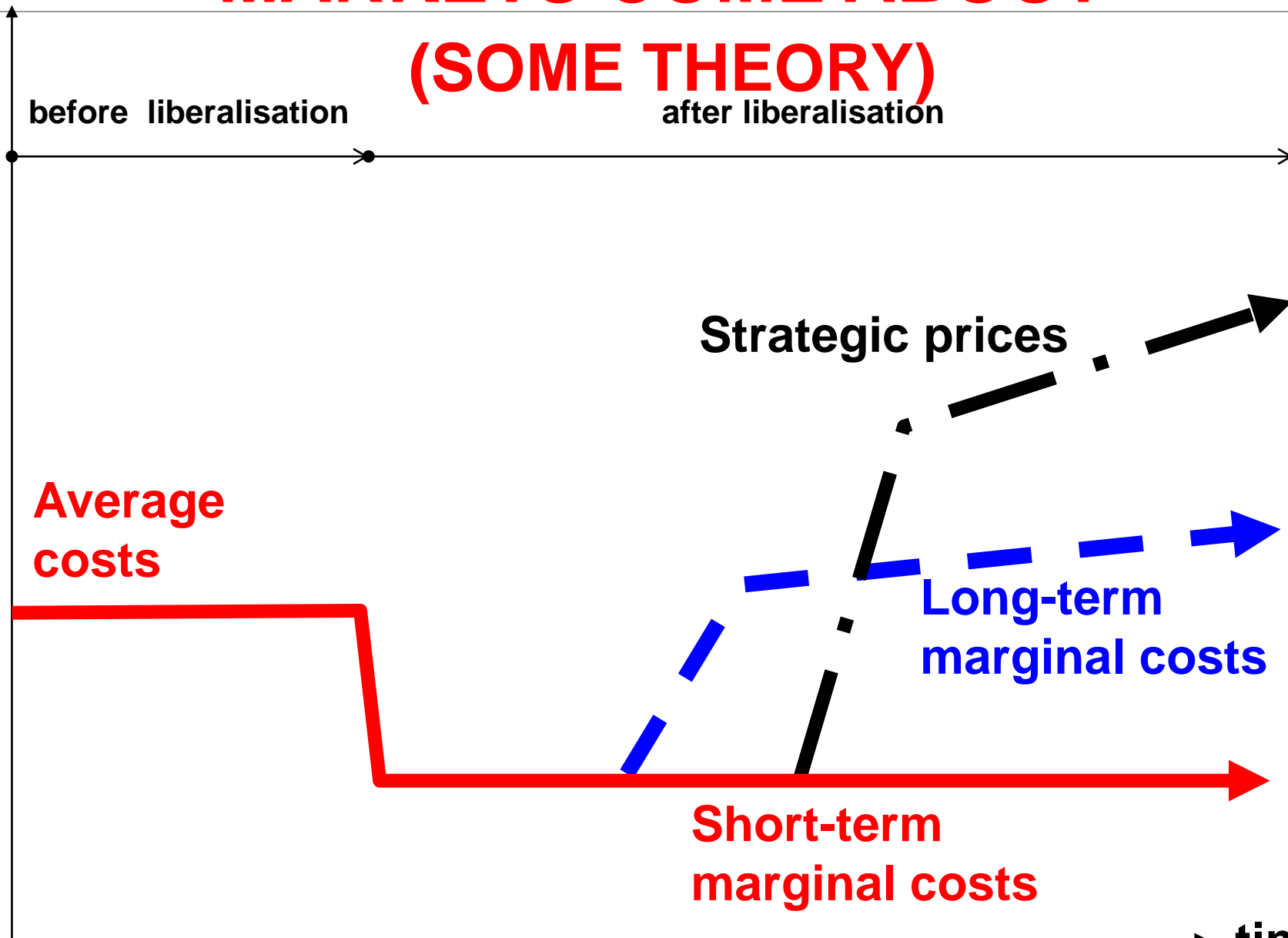
Average
costs

Strategic prices

Long-term
marginal costs

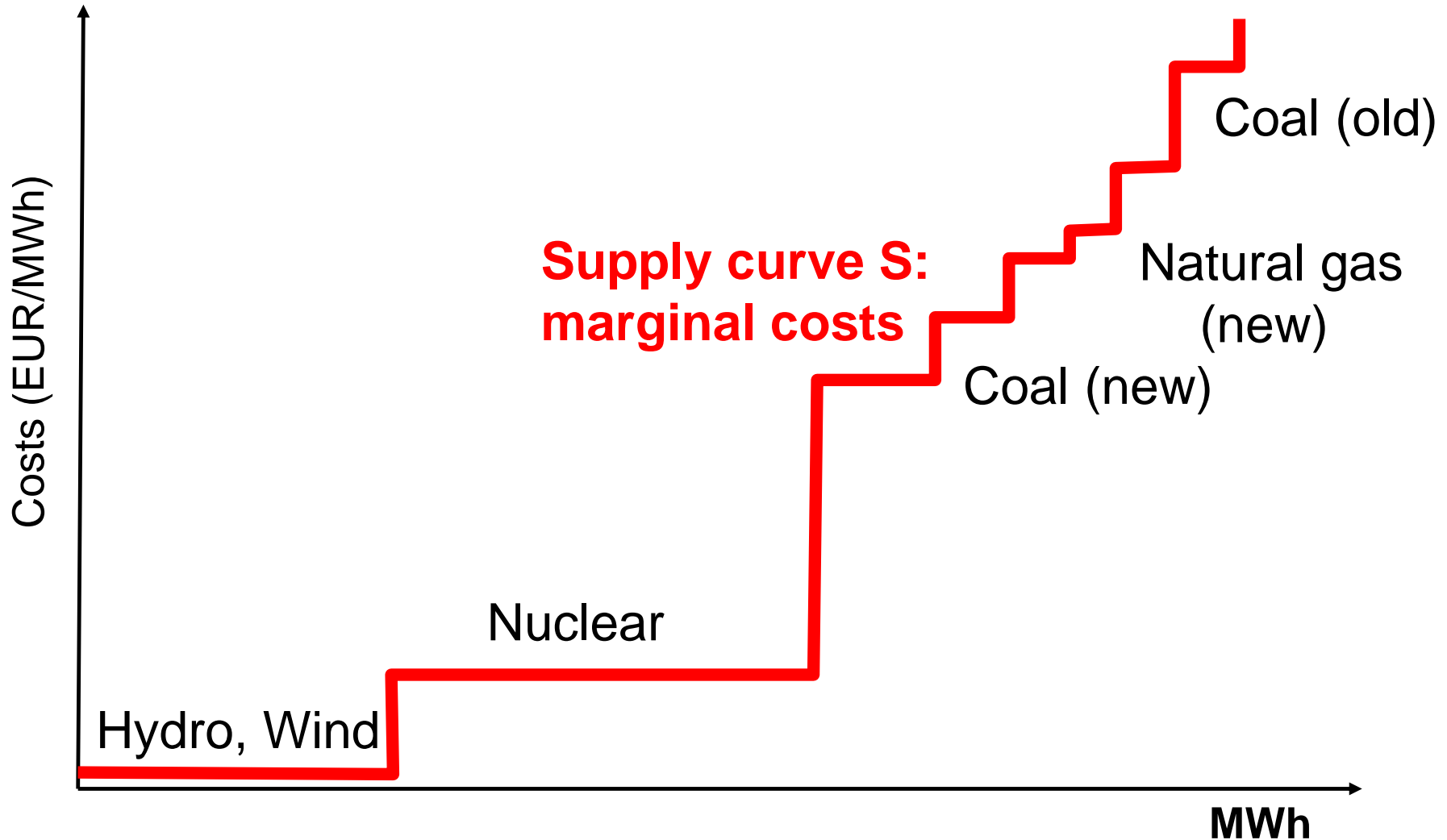
Short-term
marginal costs

time

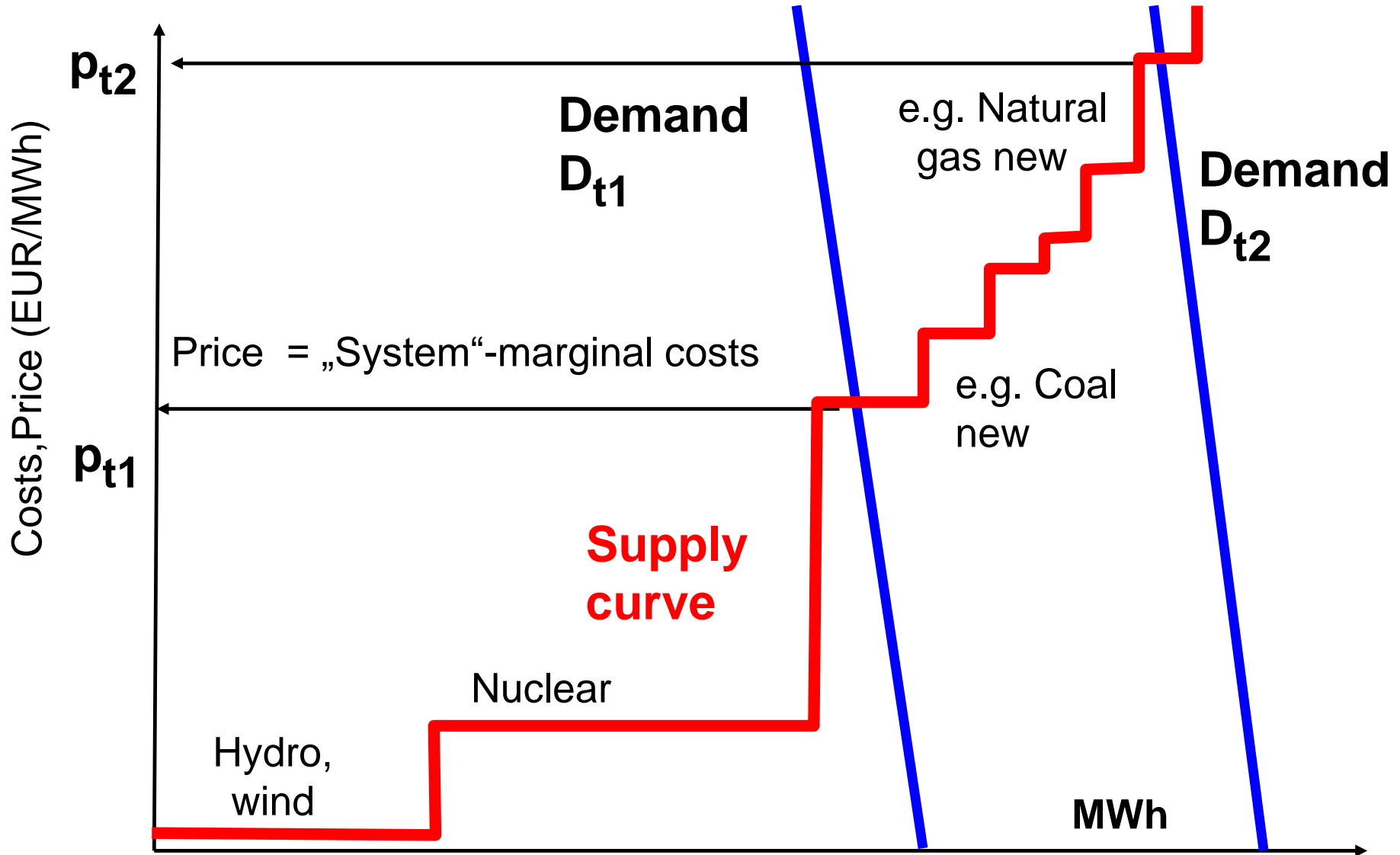


The *MERIT-ORDER* curve of supply

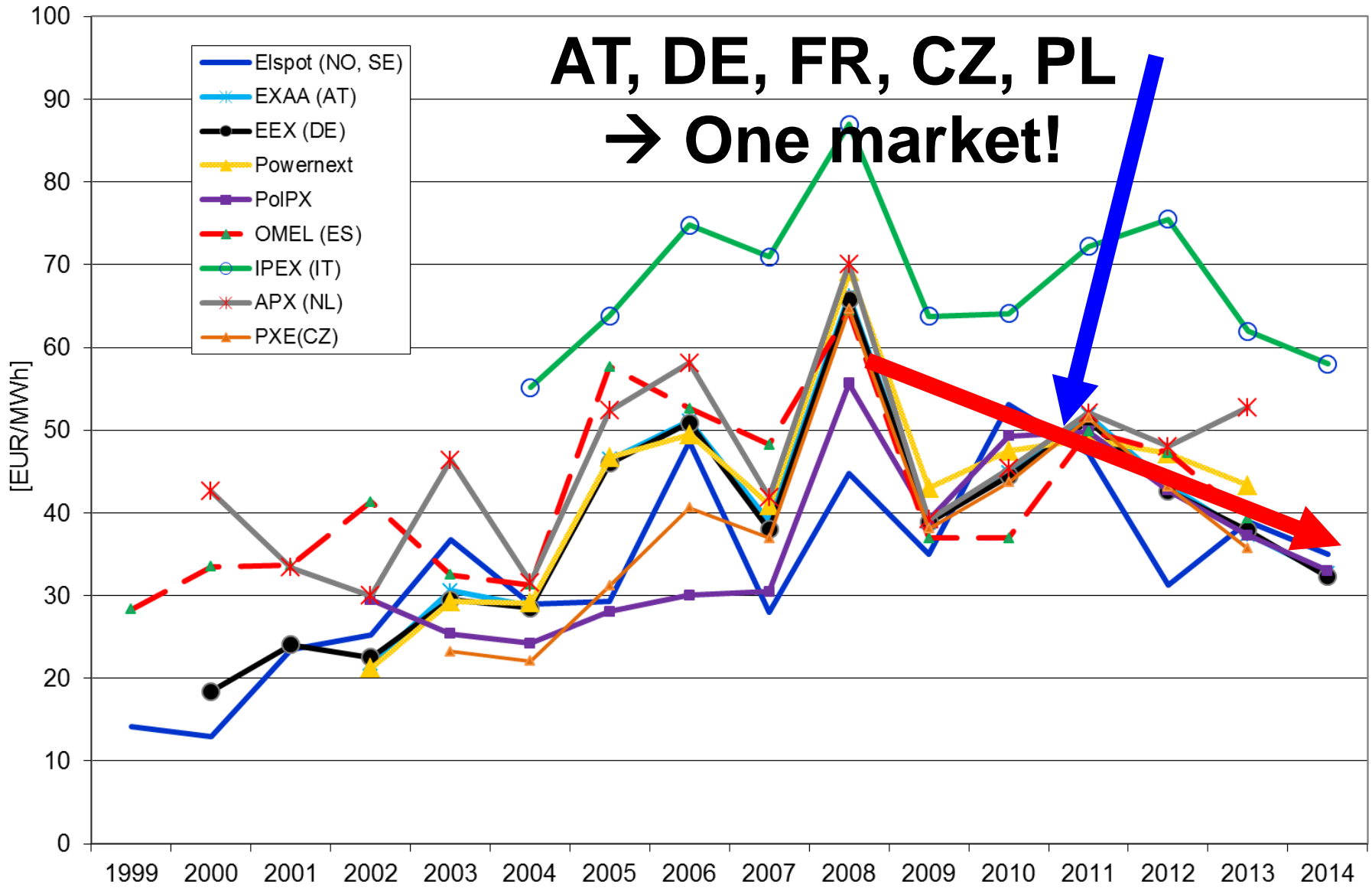
based on short-term marginal costs (MC)



BASIC PRINCIPLE OF COMPETITION: PRICE = MARGINAL COSTS



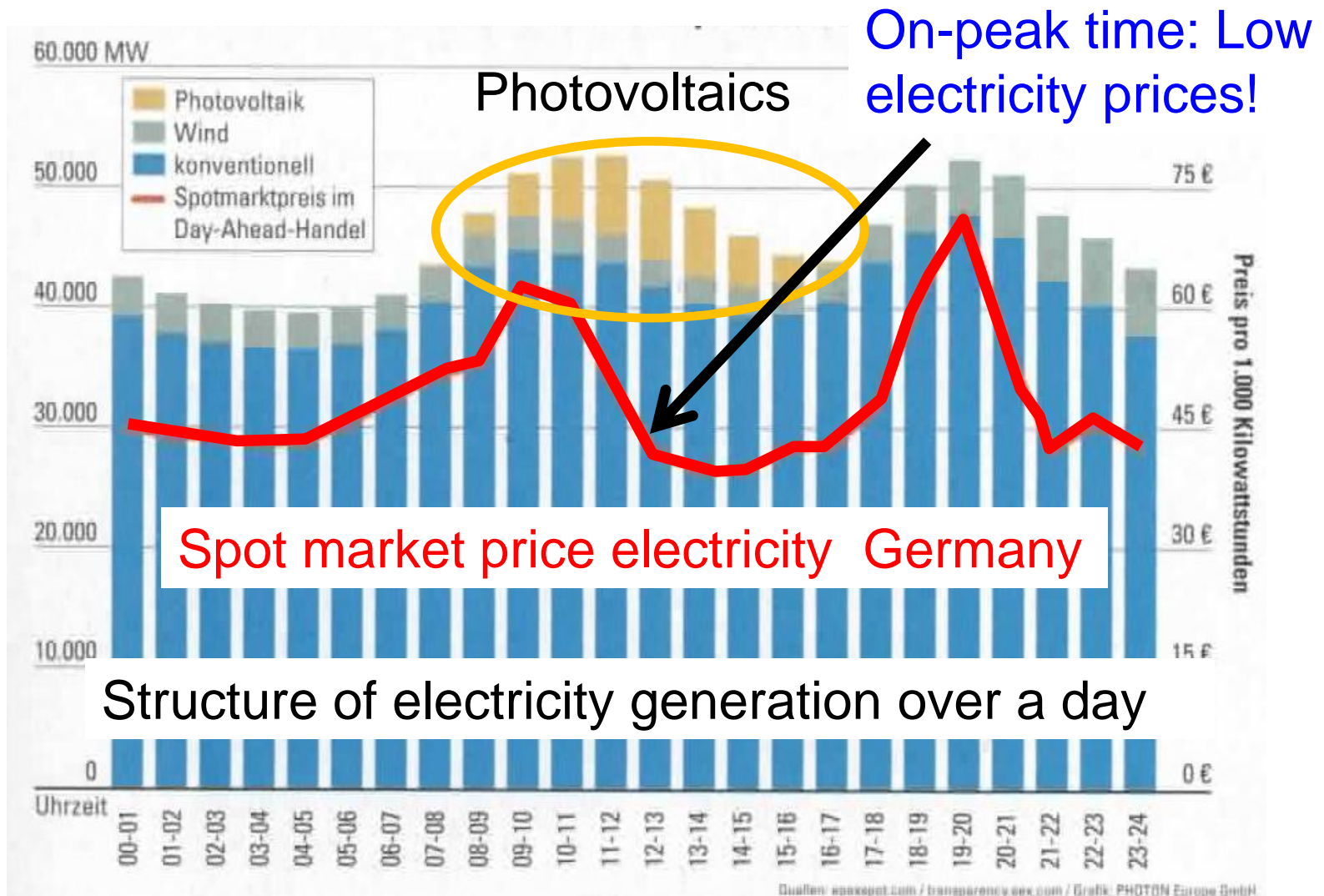
Development of day-ahead electricity prices in Europe per year



WHY?

STMC = 0!

How PV affects the electricity market price in (Example of Germany)



LONG-TERM VS SHORT-TERM MARGINAL COSTS

$$MC = C'(X) = dC(x)/dX$$

Marginal costs are the increment of costs due to a generation of one additional unit of kWh

$$P = MC$$

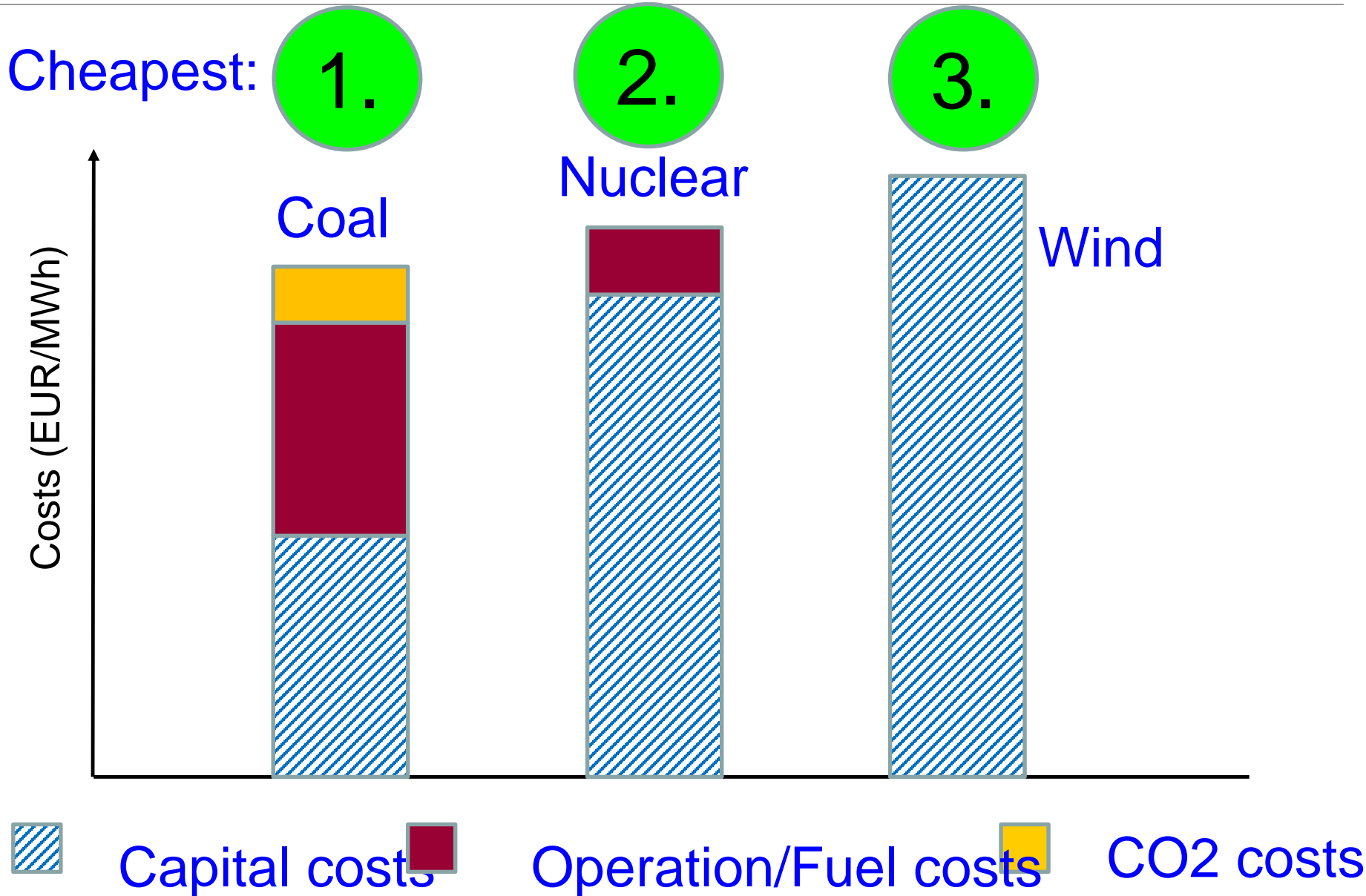
Short-term marginal costs (STMC):

$$STMC = \text{Fuel costs} + \text{CO}_2 \text{ costs}$$

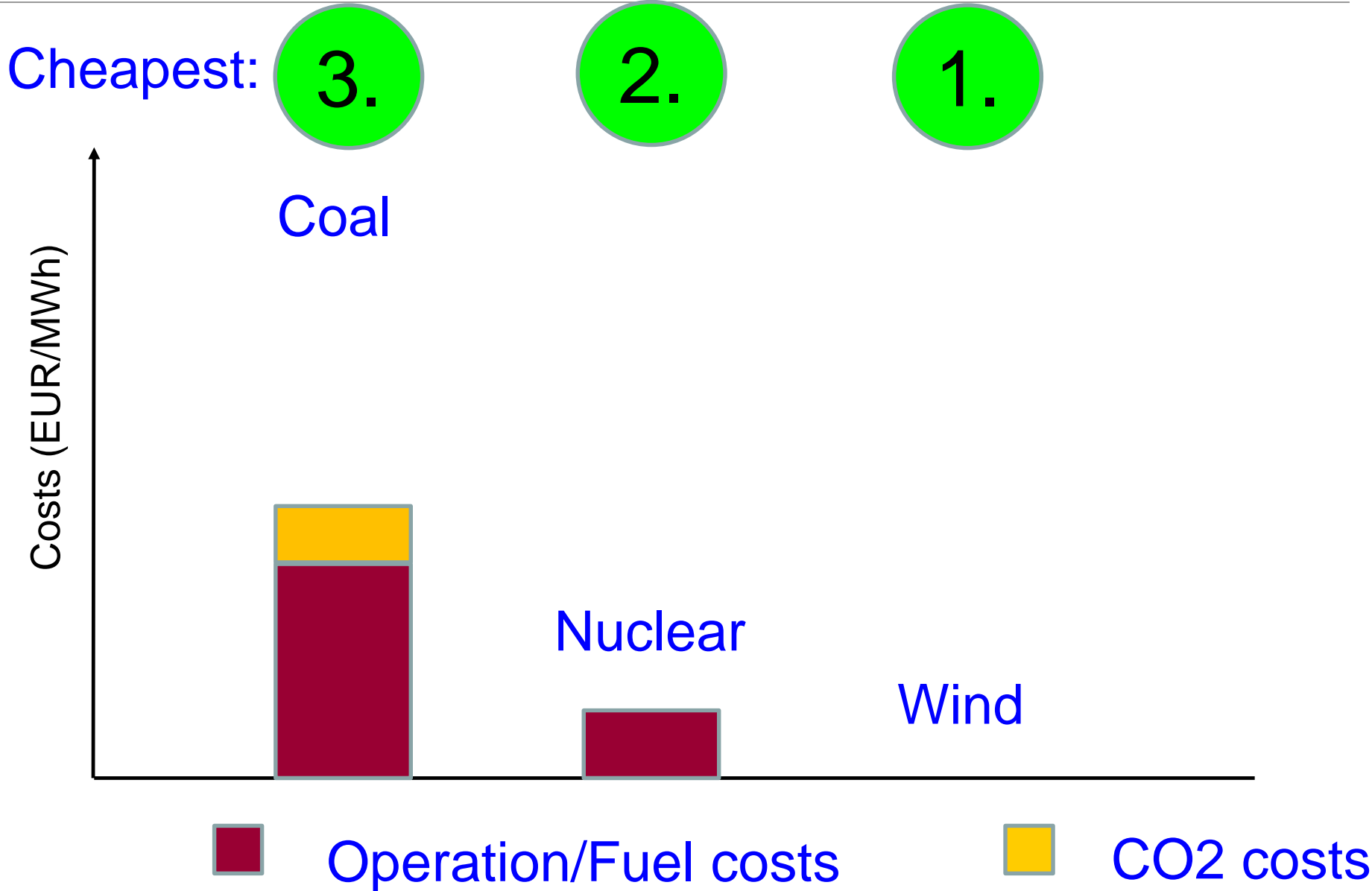
Long-term marginal costs (LTMC):

$$LTMC = STMC + \text{Capital costs} + \text{O\&M costs}$$

Long-term marginal costs



Short-term marginal costs



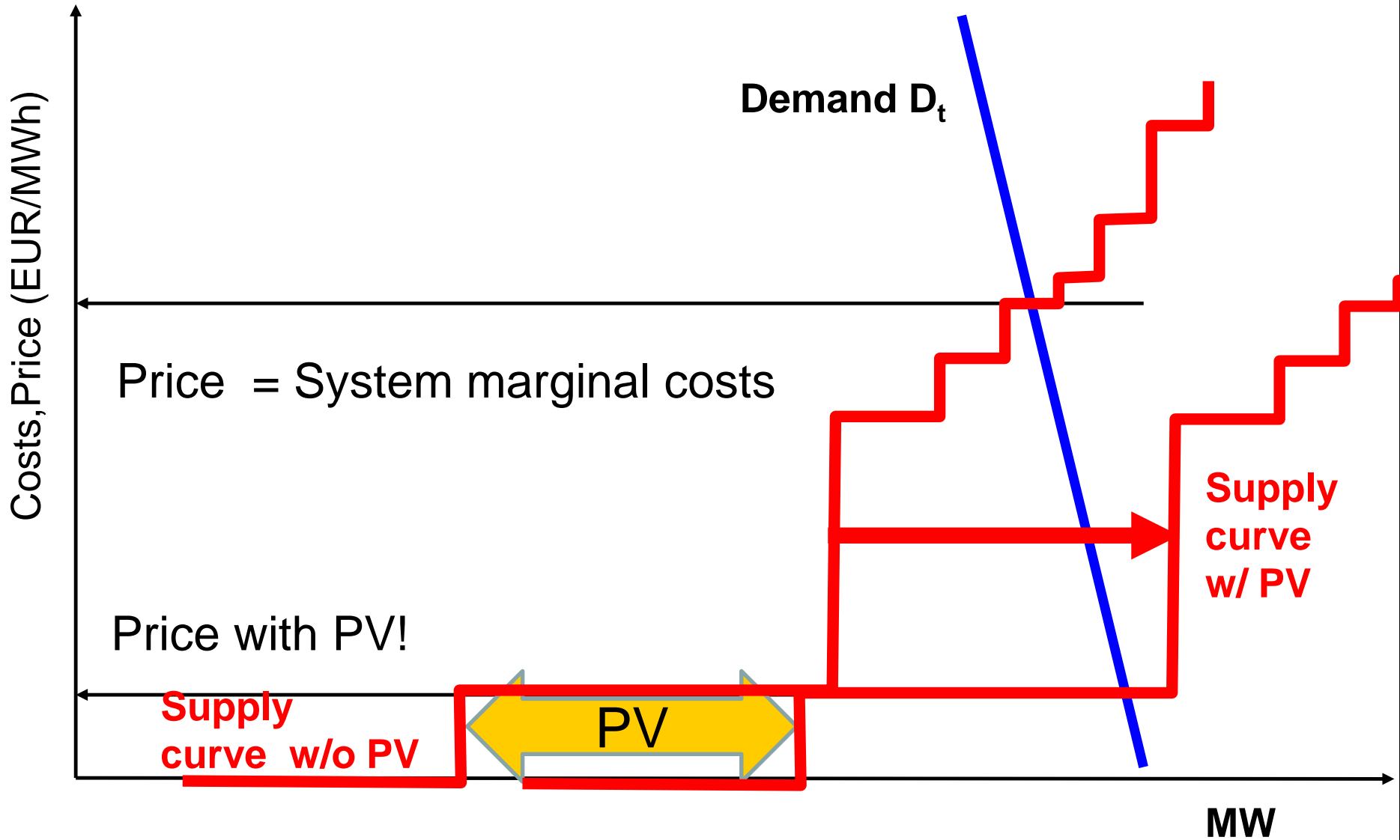
Expectation of:

prices = Short-term marginal costs:

(Short-term marginal costs = fuel costs)

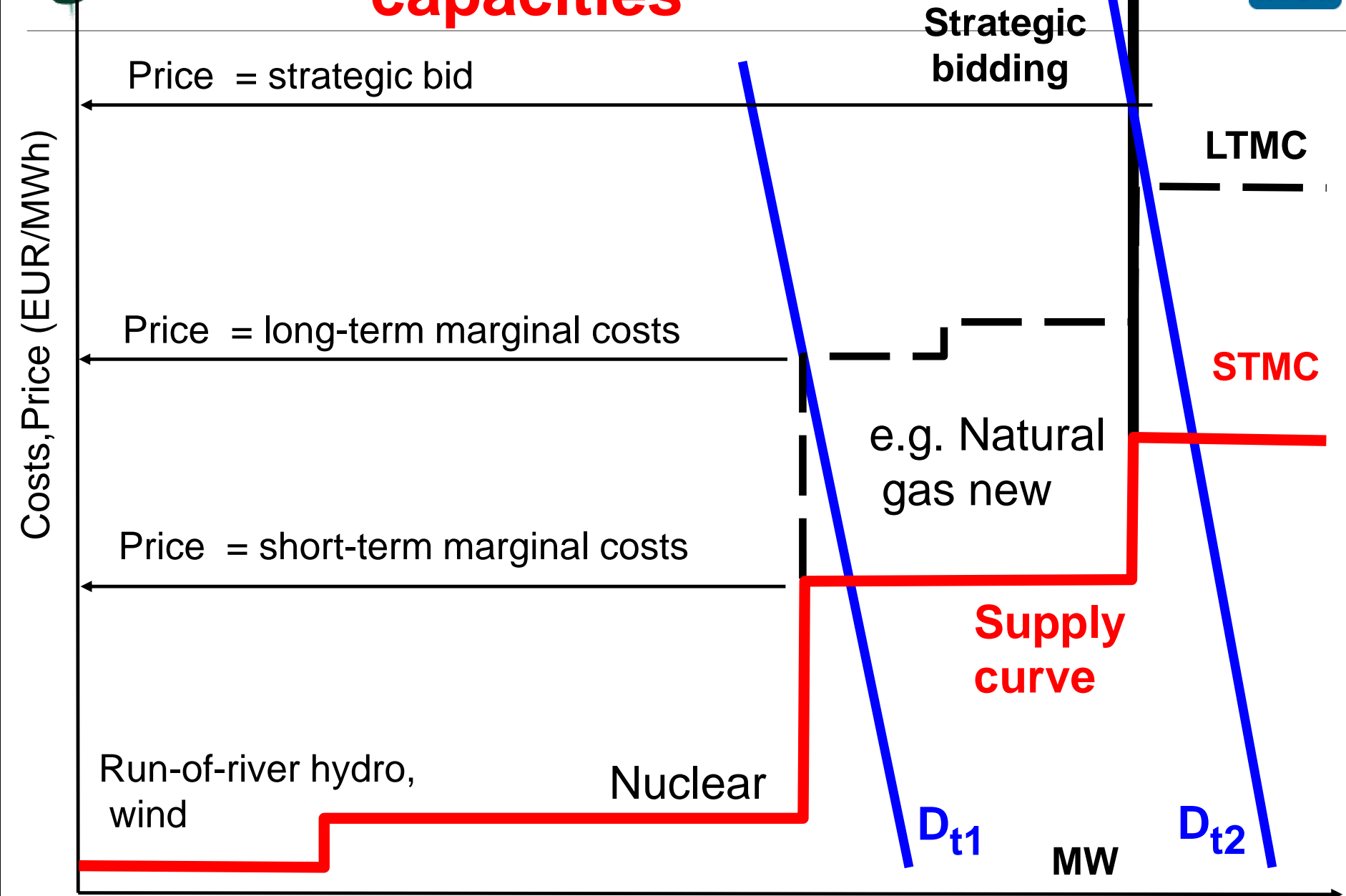
**due to huge depreciated excess
capacities at the beginning of
liberalisation!**

3 HOW VARIABLE RENEWABLES IMPACT PRICES IN ELECTRICITY MARKETS

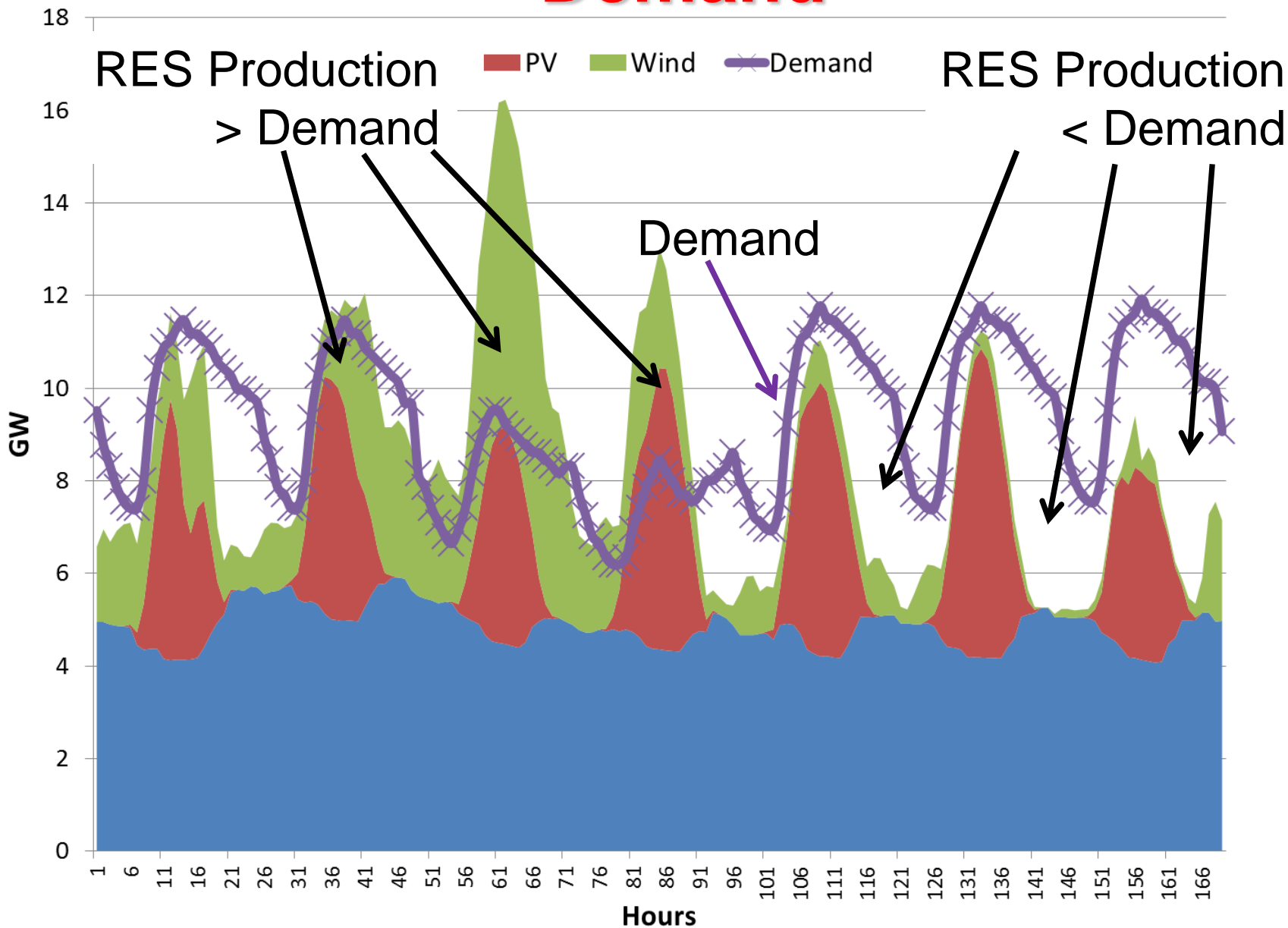


- 1. Prices decrease to Zero (or below) at a number of days;**
- 2. Lacking contribution margin to fixed costs**
- 3. On how many days will we face high and on how many days low prices?**

Prices under scarce capacities

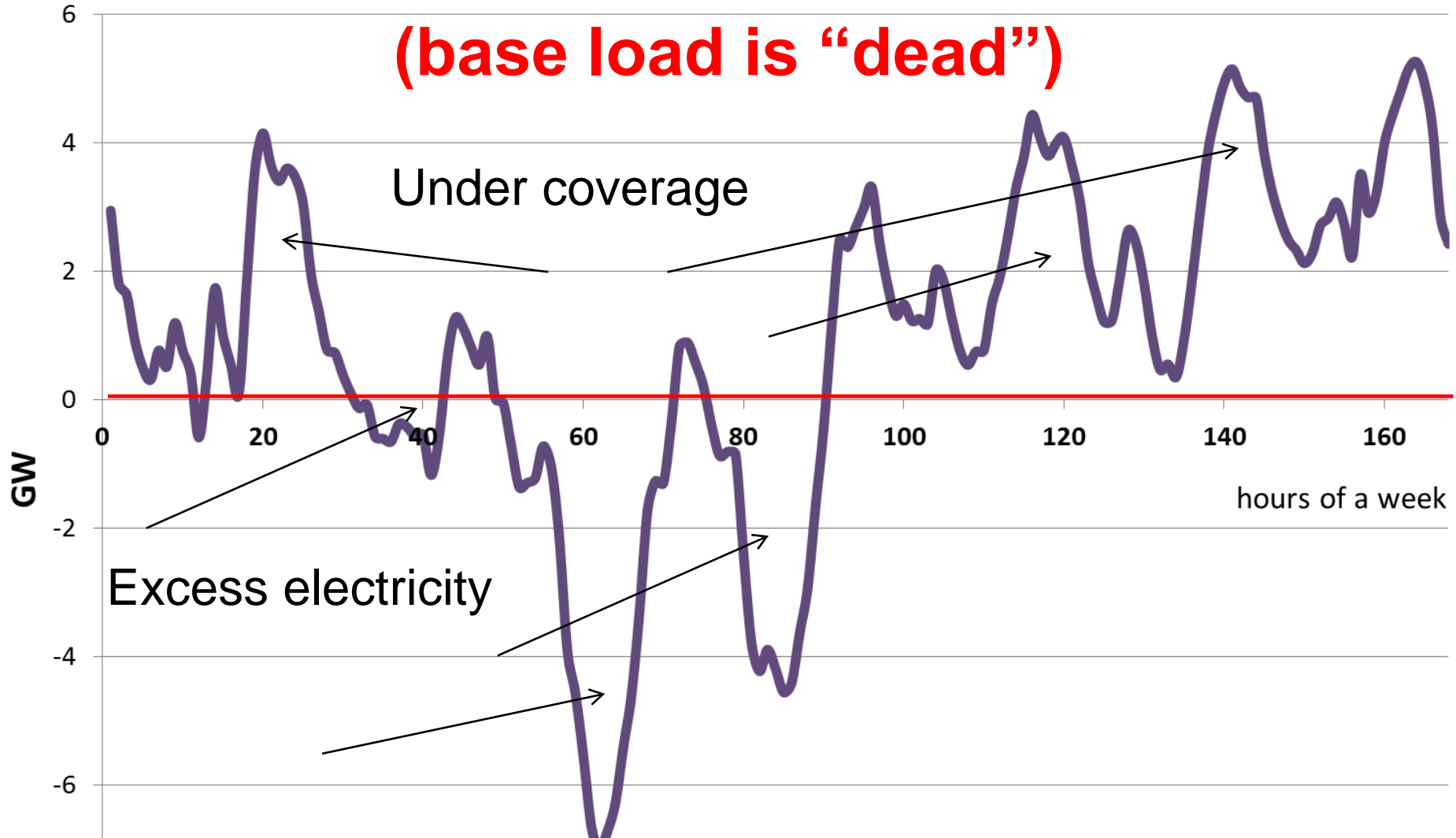


Example: Supply and Demand



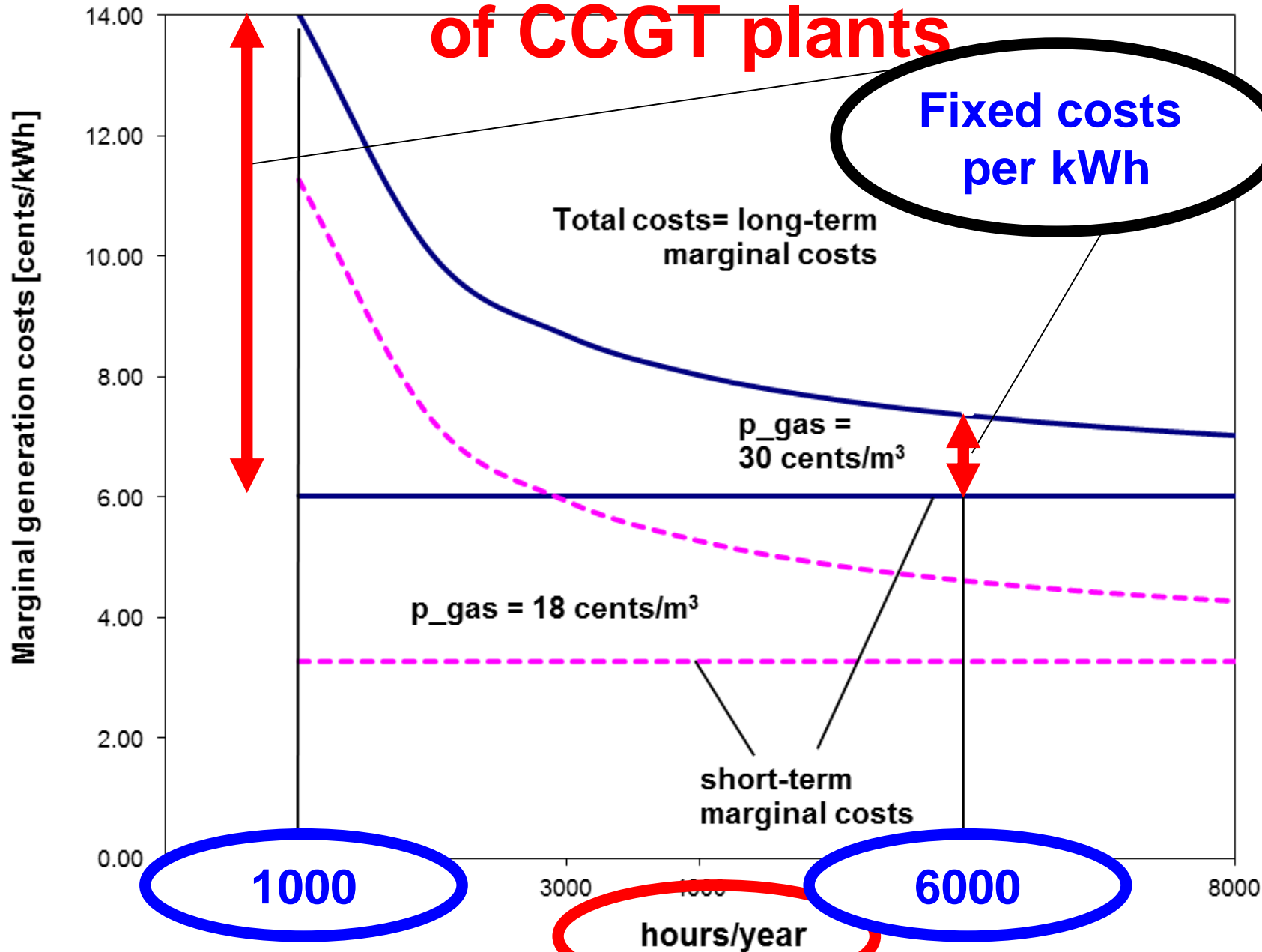
Key term of the future: Residual load

(base load is “dead”)

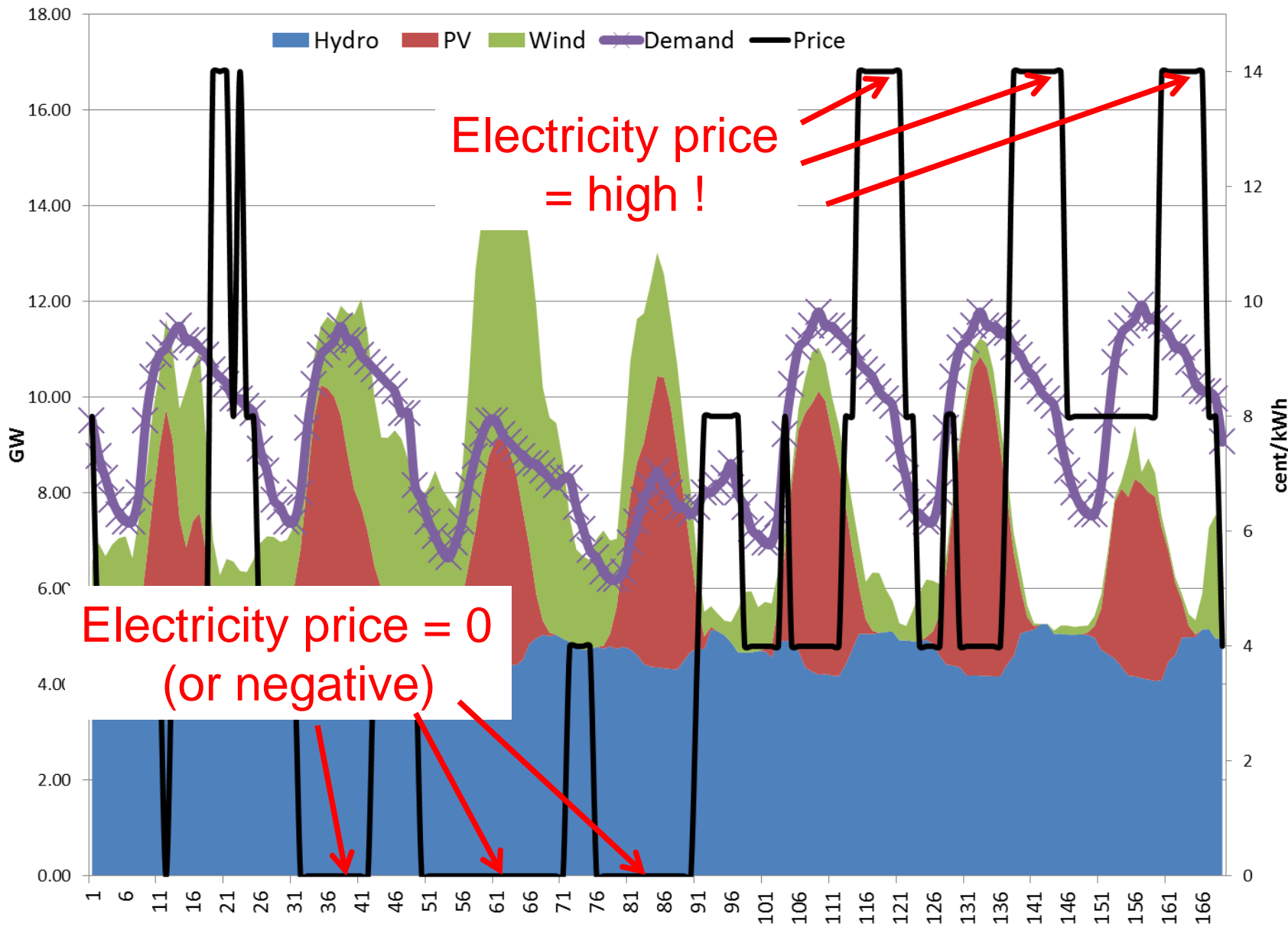


Residual load = Load – non-flexible generation

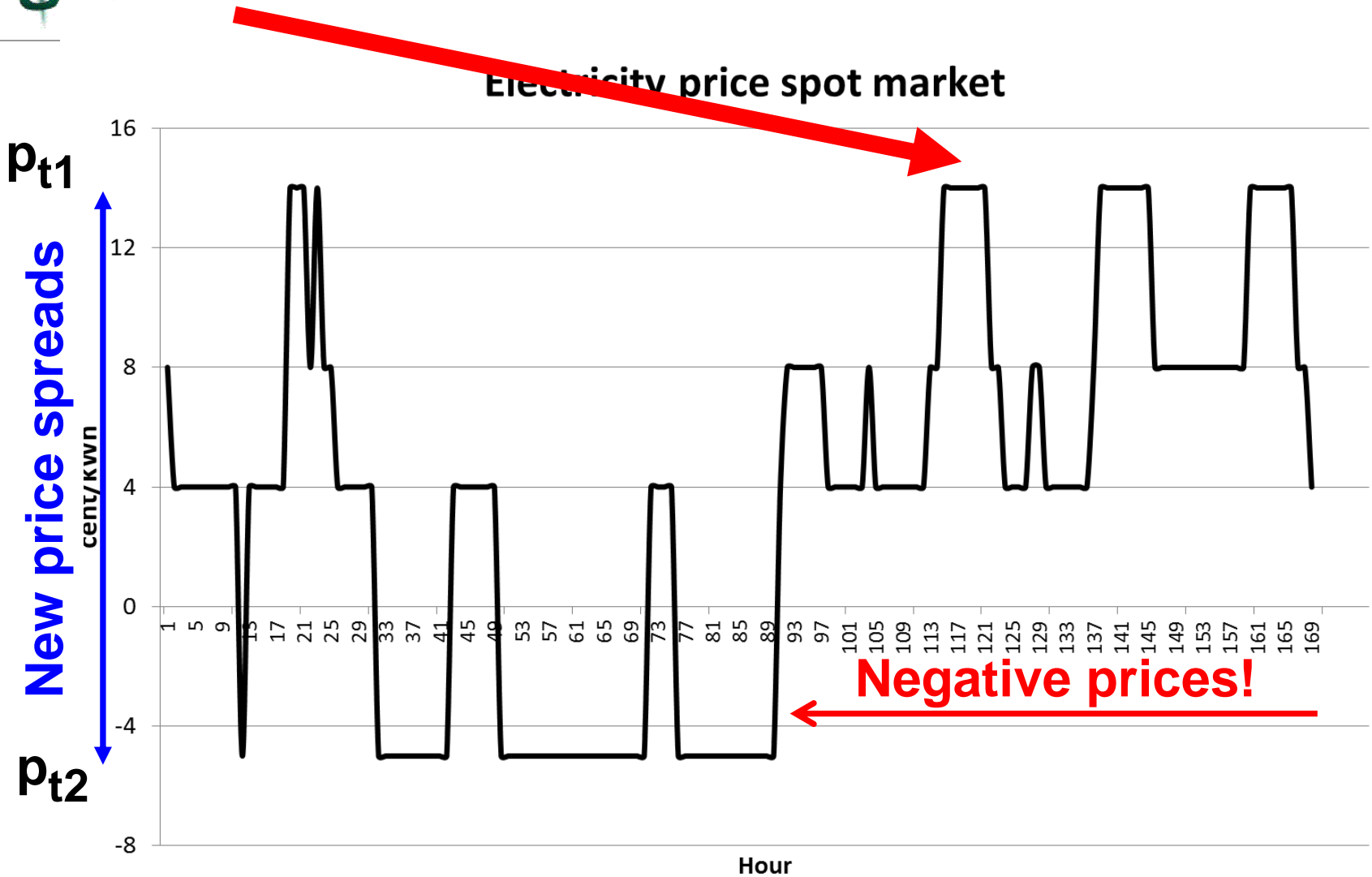
Effects on cost-effectiveness of CCGT plants



Temporarily high prices



Are these prices TOO HIGH?



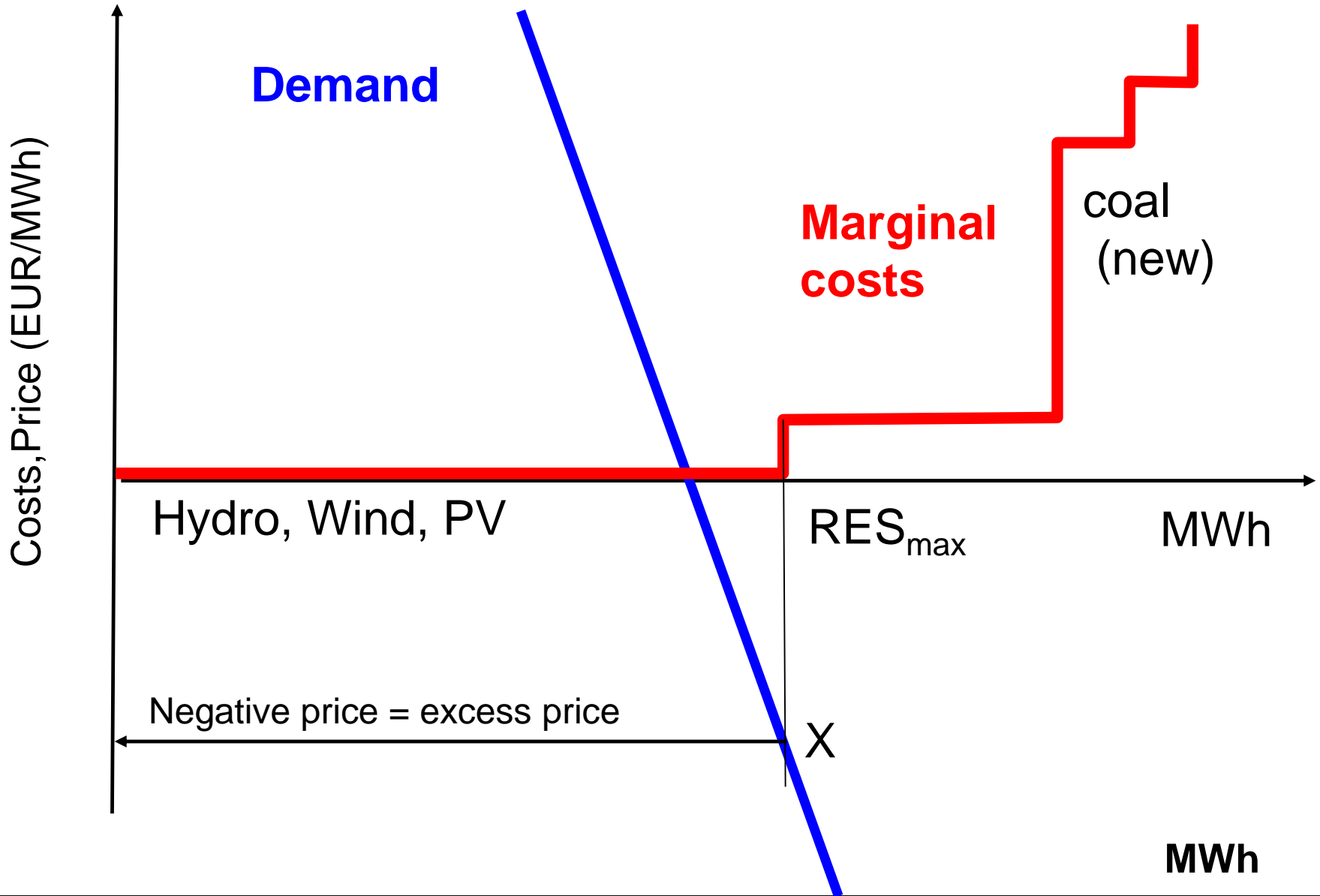
→ These price spreads provide incentives for new flexible solutions!!!!

Given this price pattern it would be attractive for (some) power plant operators to stay in the market

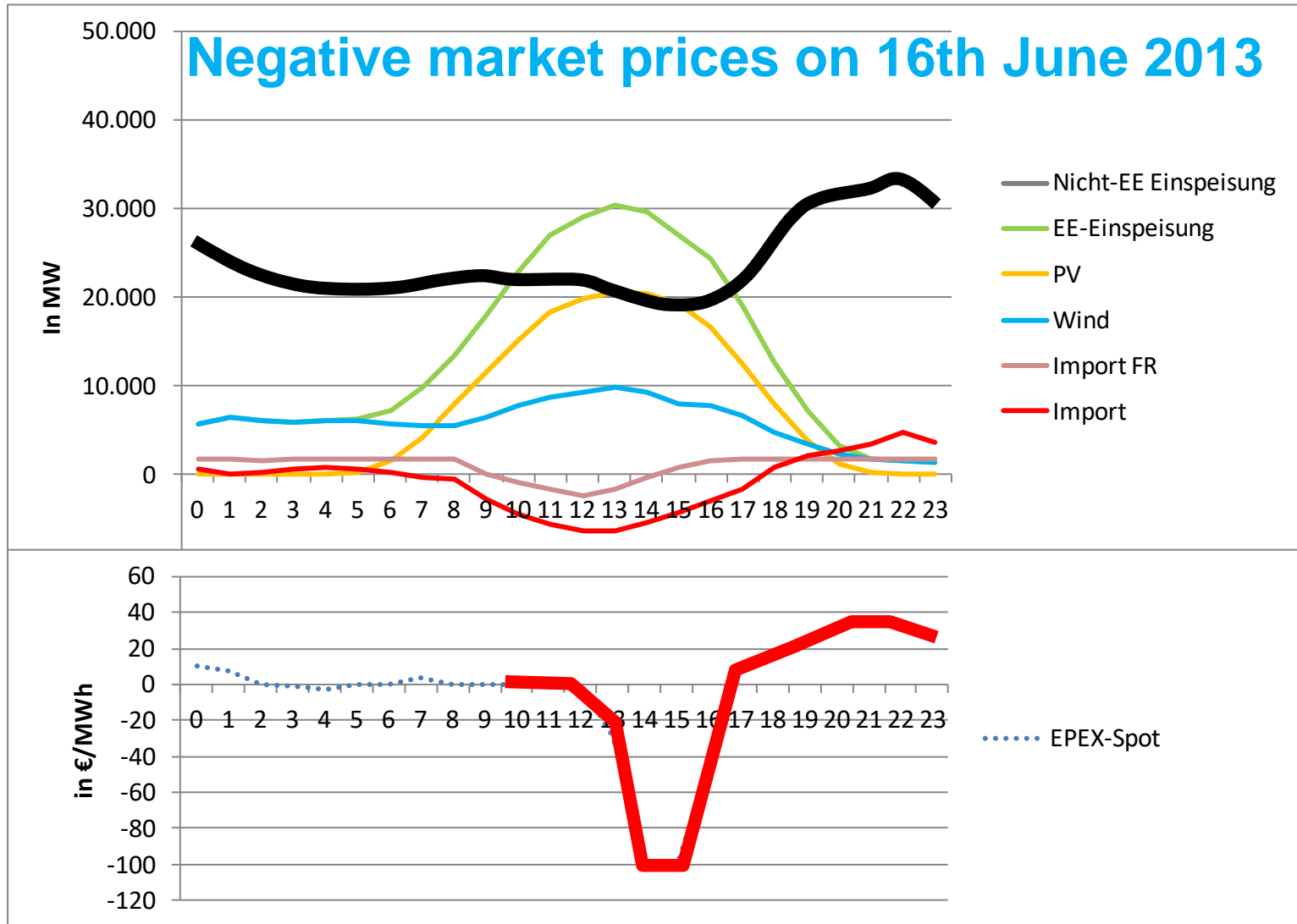


REVISED ENERGY-ONLY MARKET

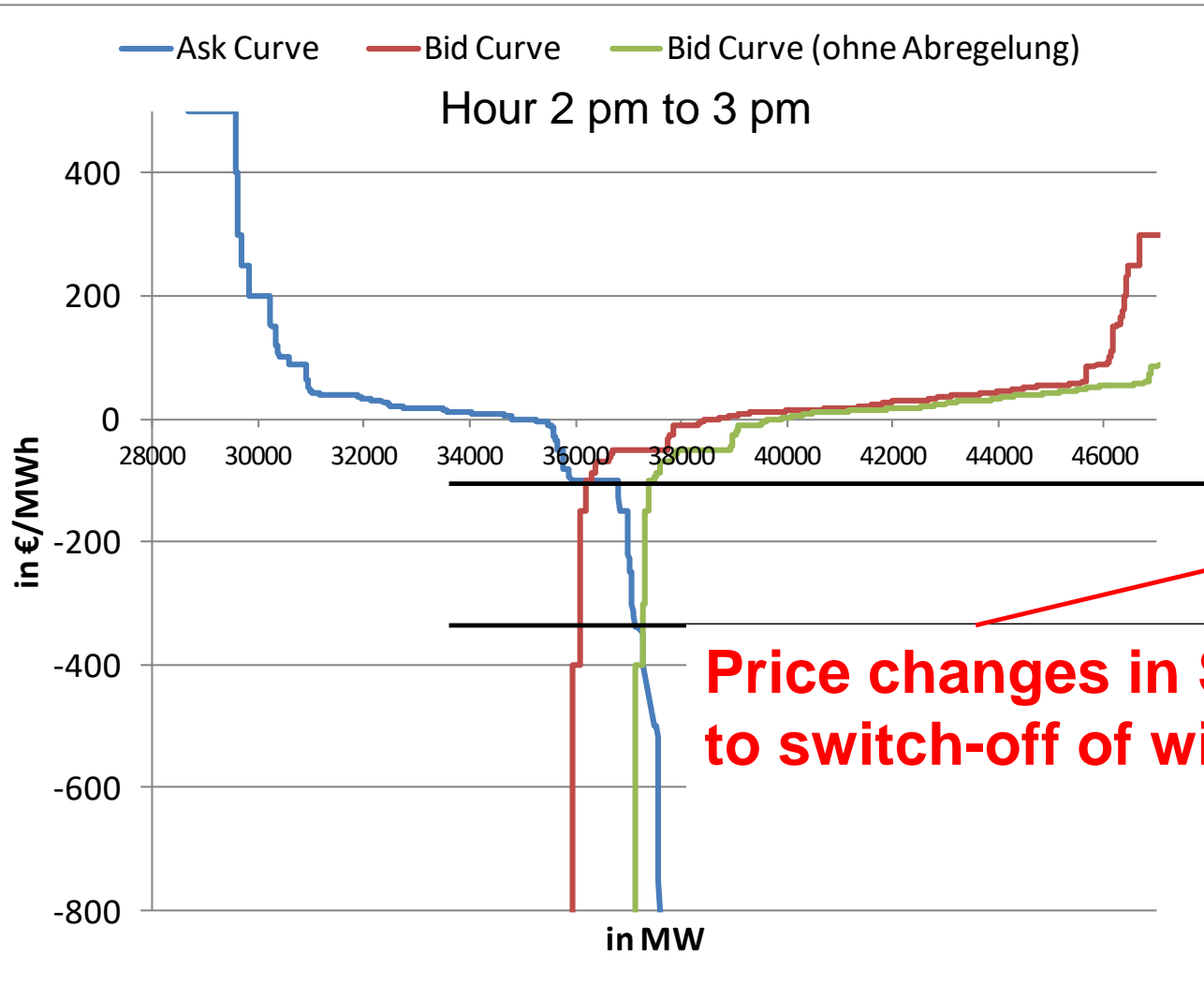
PRICE SETTING UNDER EXCESS CAPACITY



Problem: high impact of temporarily large quantities of variable RES (?) on electricity market prices



Impact of switch-off of wind power plants on electricity market prices



Price changes in Spot markets due to switch-off of wind power plants

4. DIMENSIONS OF ELECTRICITY MARKETS

SUPPLY

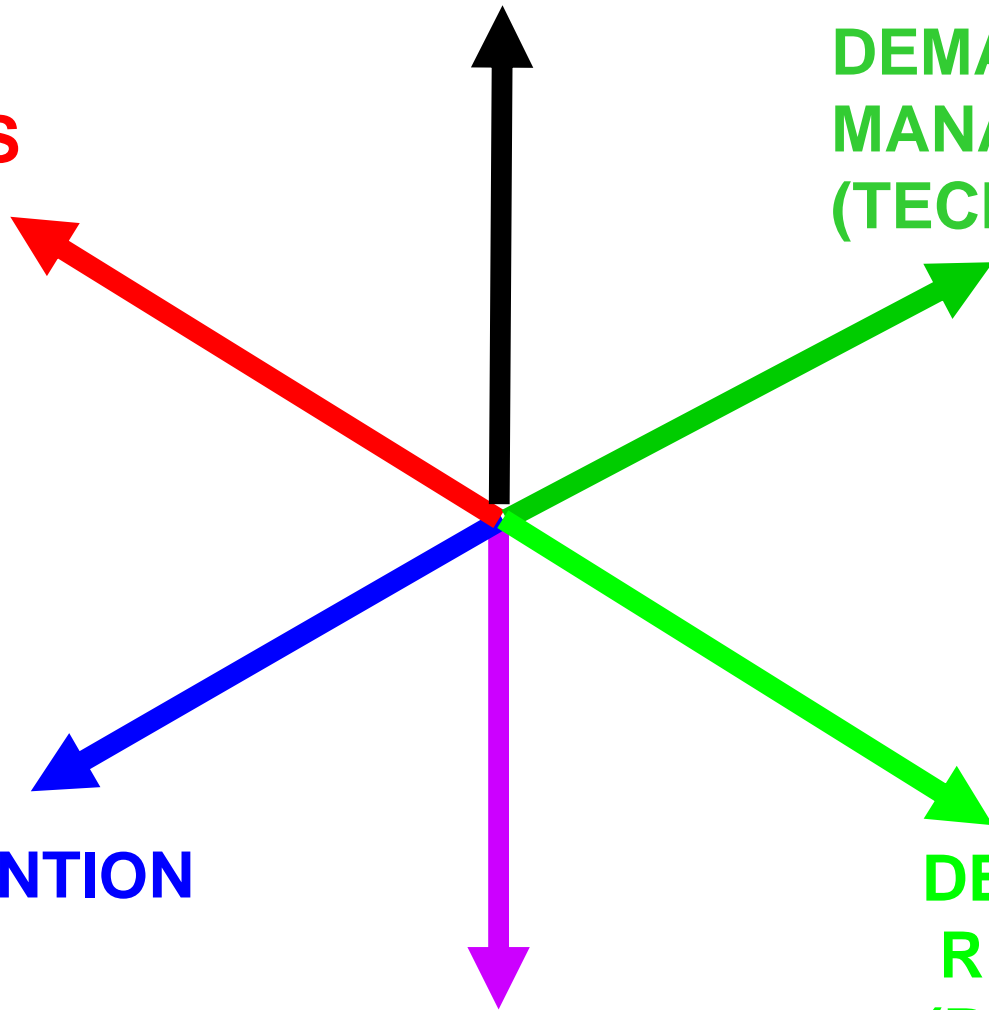
STORAGES

**DEMAND-SIDE
MANAGEMENT
(TECHNICAL)**

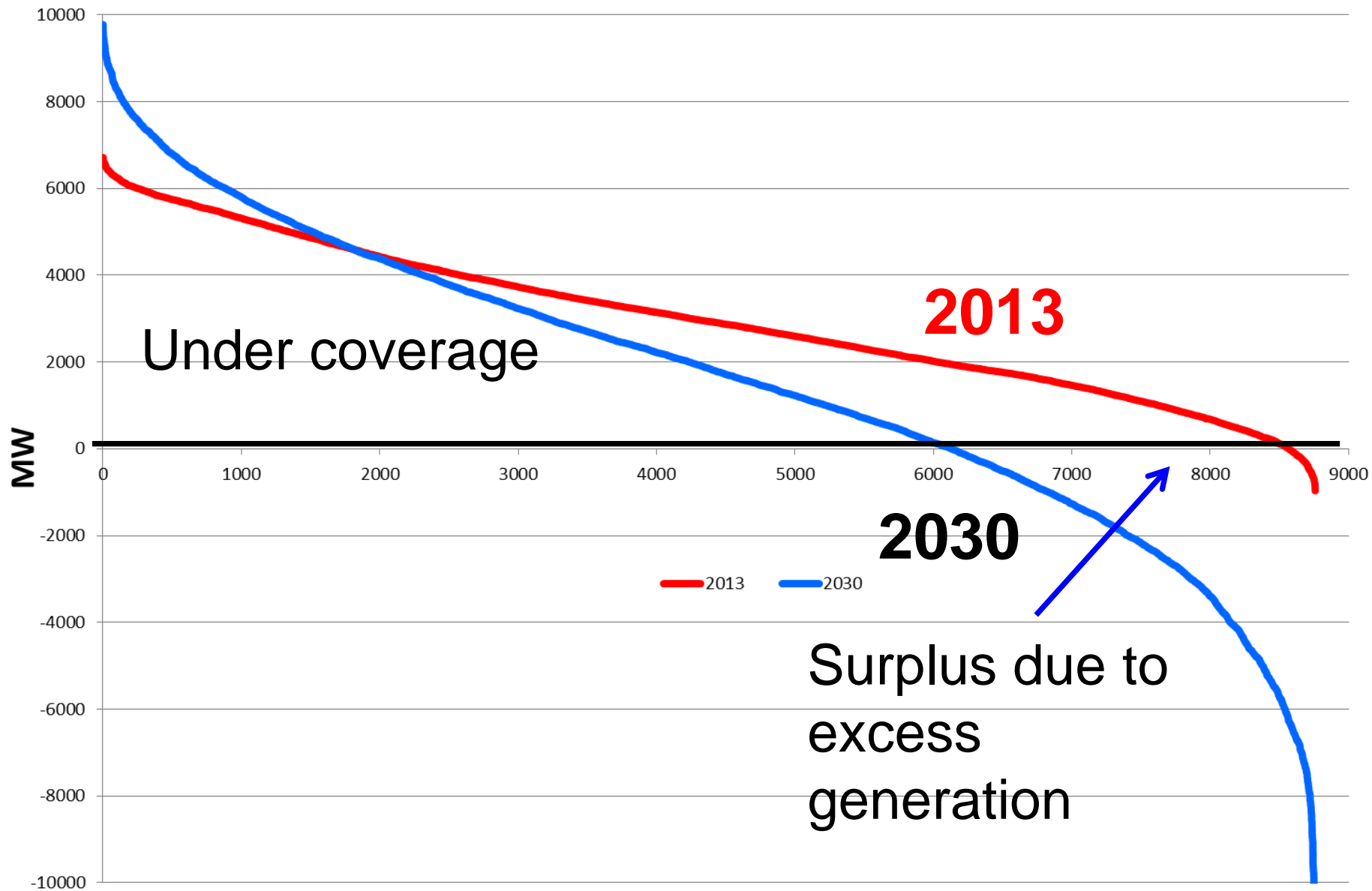
GRID EXTENTION

**DEMAND
RESPONSE
(PRICE SIGNALS)**

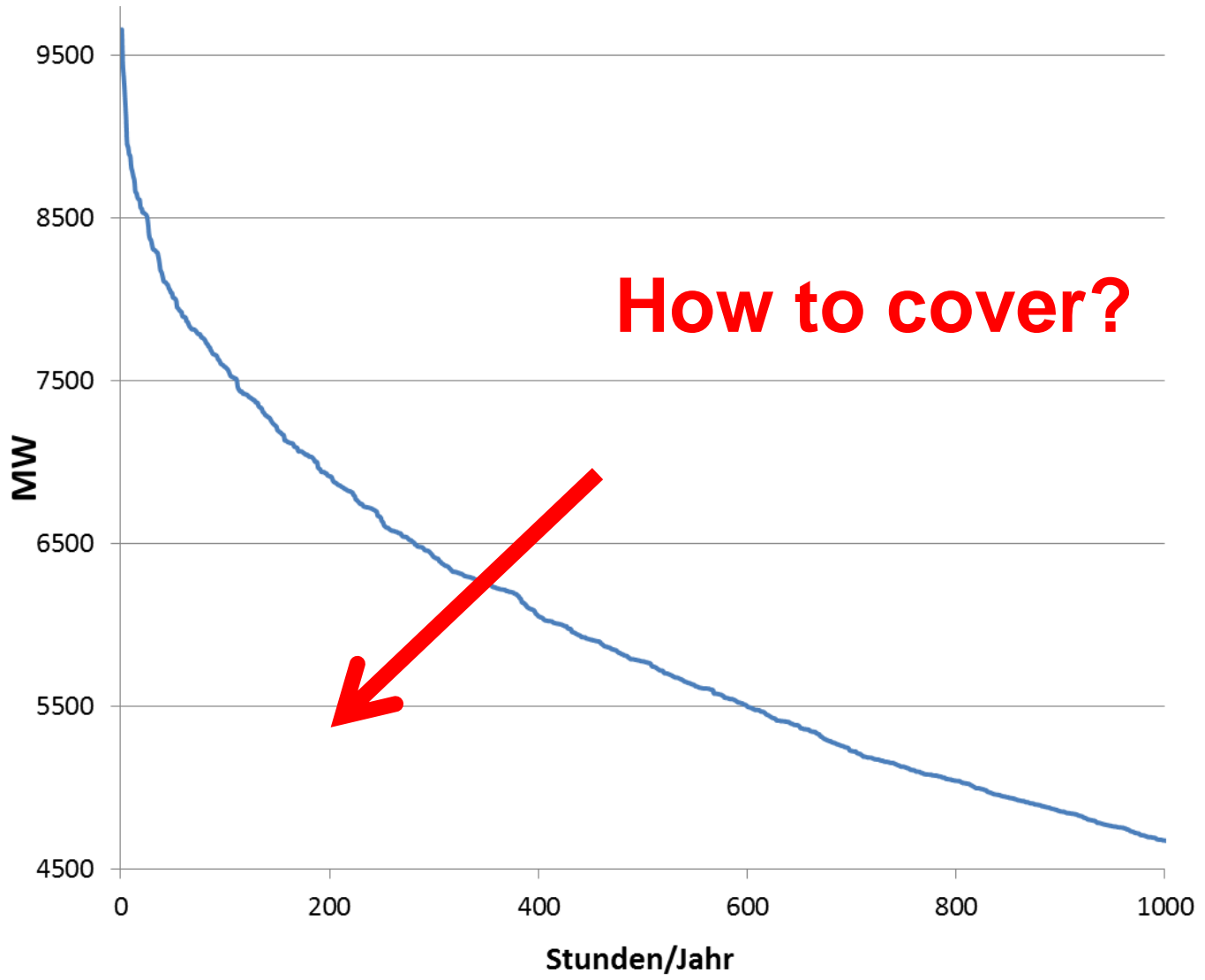
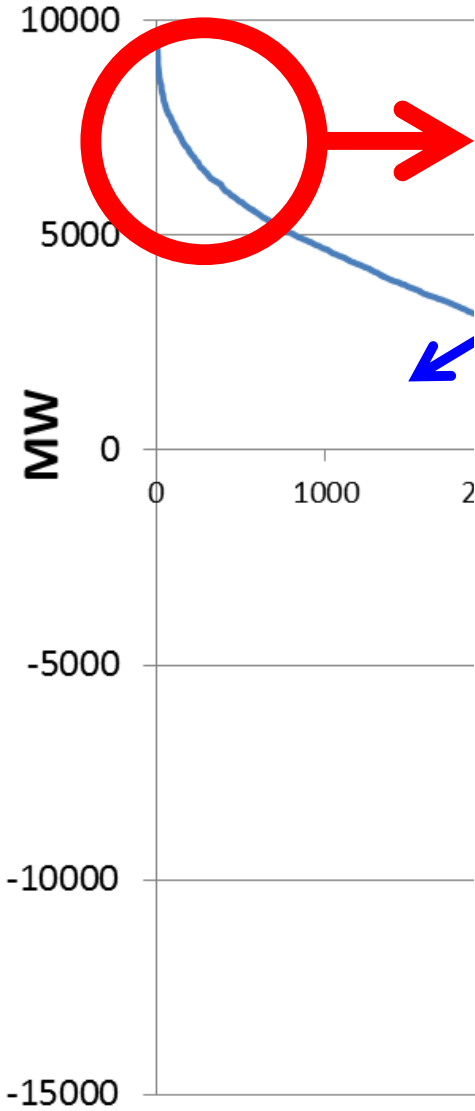
SMART GRIDS



Classified residual load



Classified residual load

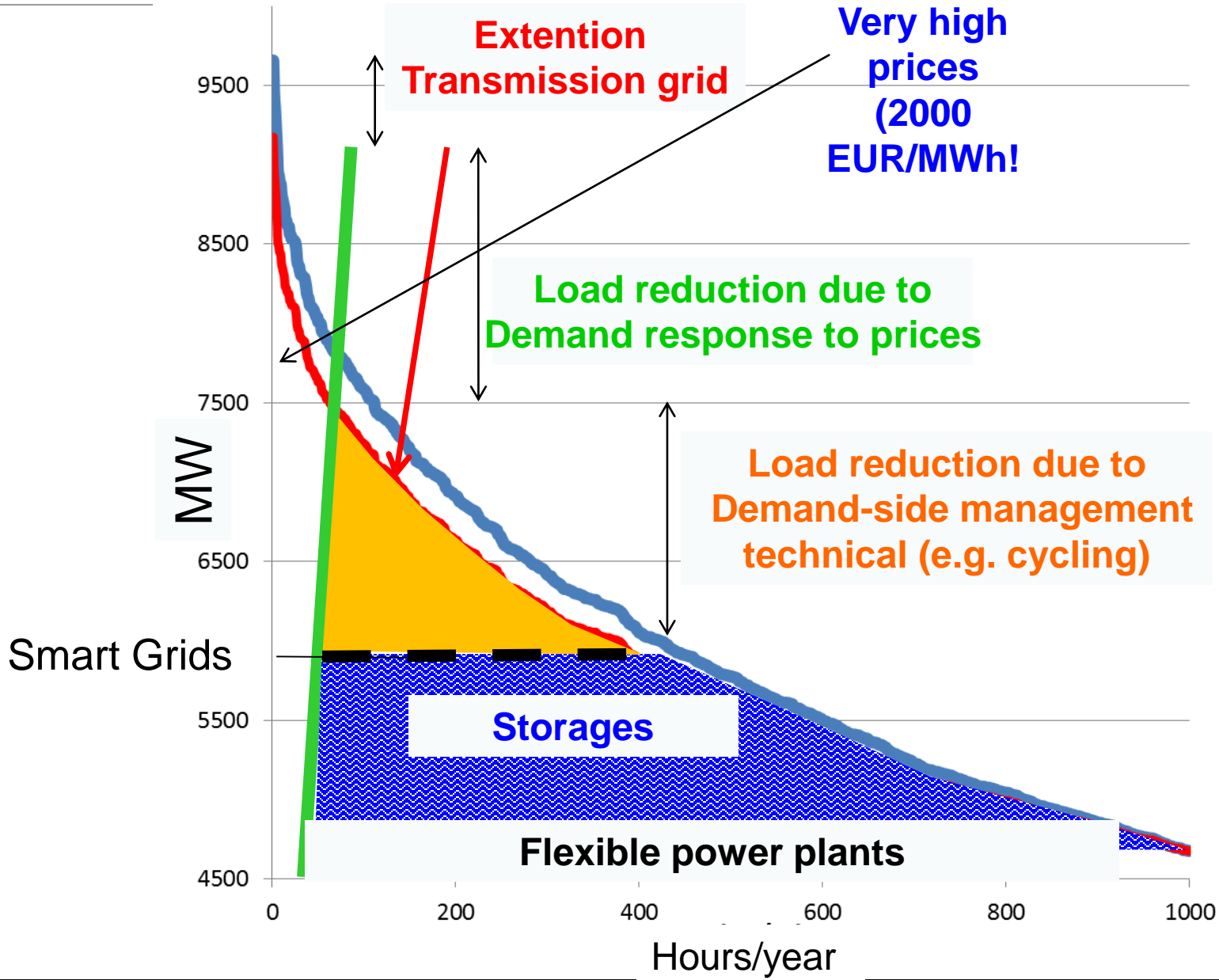


How to cover?

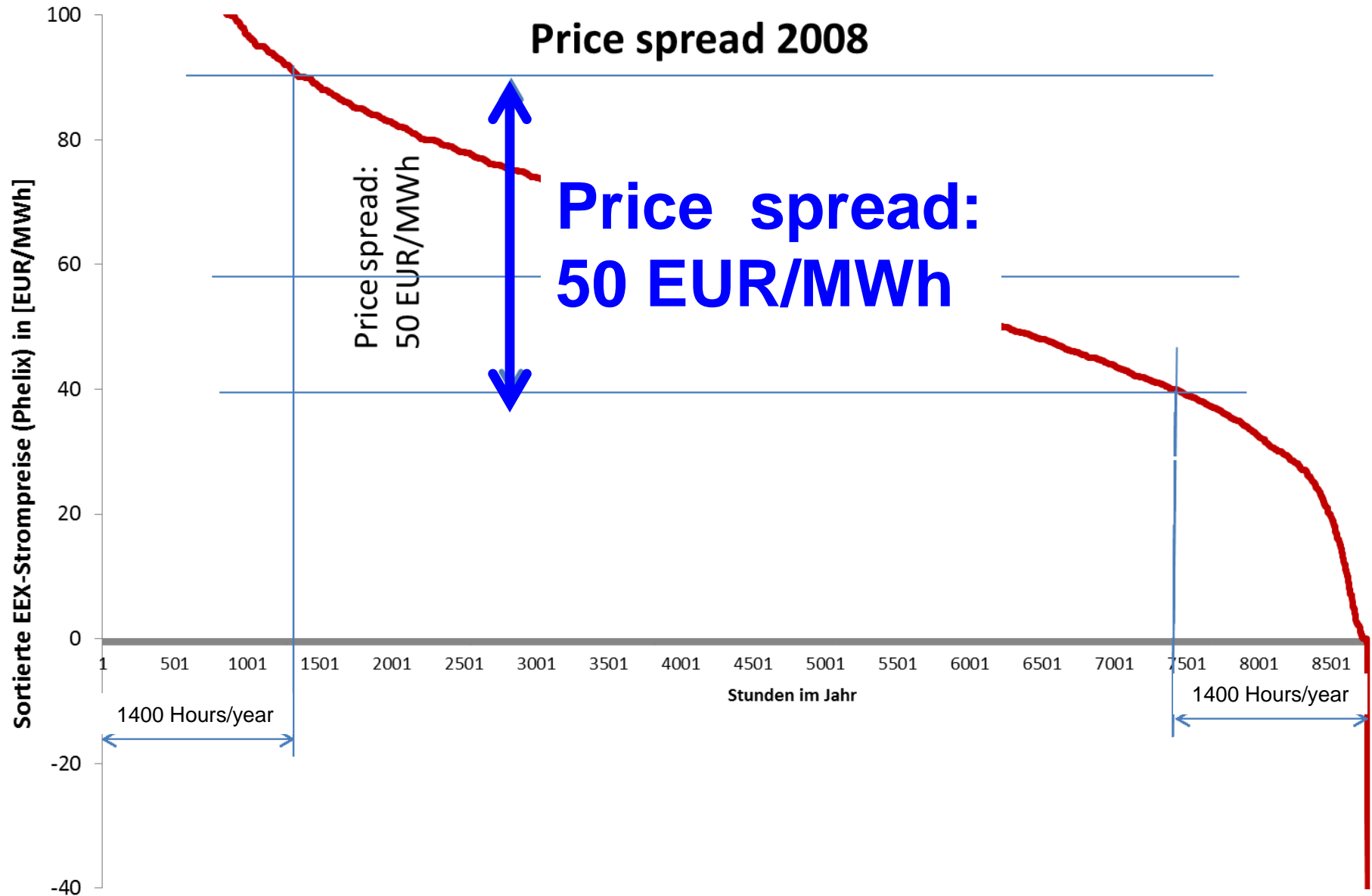
By a regulated capacity „market“ ?
or

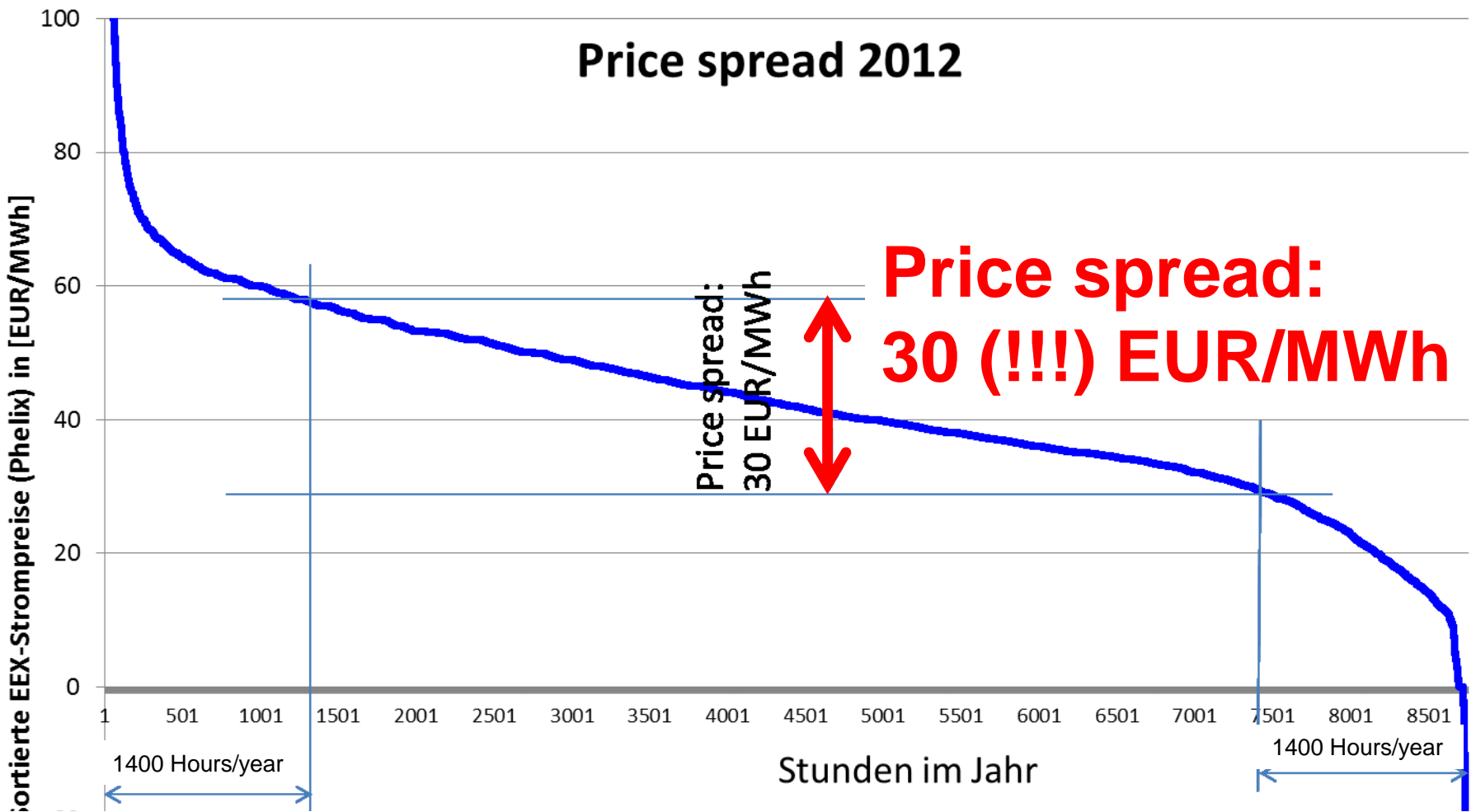
**By competition between supply-side
and demand-side technologies (incl.
storages and grid)?**

Flexible coverage of residual load



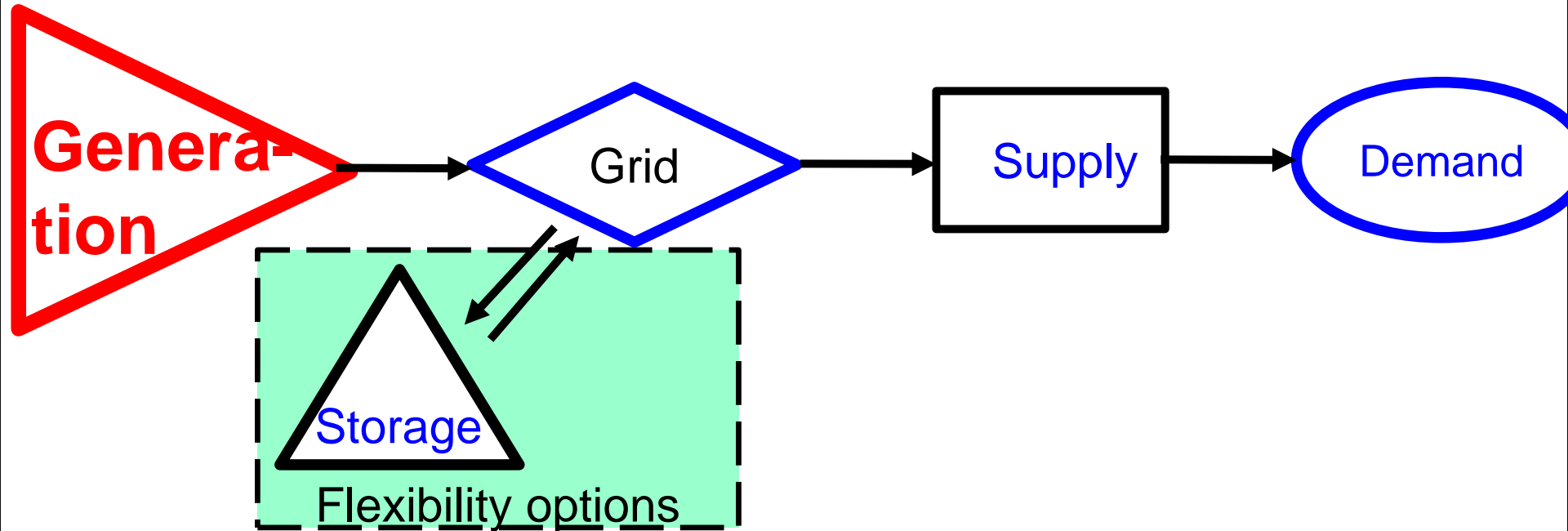
5. ECONOMIC INCENTIVES



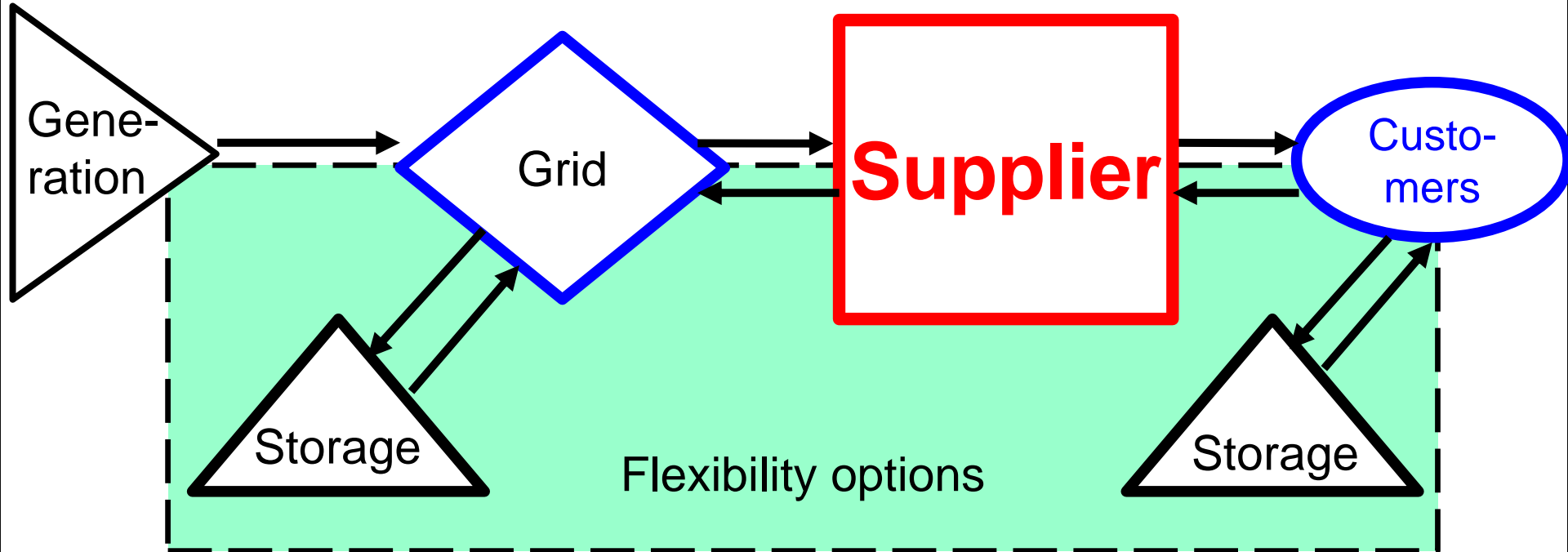


→ There is no incentive today to launch flexibility measures (except in the control power market)!

OLD THINKING



New Thinking:



6. CONCLUSIONS

- A sustainable electricity system is **not a technological winner-picking problem!**
- It is a question of **integrating a broad portfolio of technologies and demand response options!**
- most important now: **exhaust the full potential of the creativity of all market participants!**
- The key: **Flexibility!** Yet, currently no economic incentives but **activities started → very promising!**
- Very important: **correct price signals!!!**
- **calls for capacity markets: a last try of the old generation-focused system to survive**
- **New key player: Supplier, no more the generator!**