NEW CHALLENGES IN ELECTRICITY MARKETS

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Energy Economics Group,
TU Wien

CZ-AT summer school, May 2025

CONTENT:

1. Introduction: Motivation
2. The key term of the future: Residual load
3. Capacity payments vs Flexibility
4. Prospects for hydrogen
5. Electricity prices
6. Retail markets: Towards prosumagers and energy communities

1. INTRODUCTION

Motivation:

* Europe: The clean energy package → RE-Power → FIT for 55%

* It is not possible to force variable renewables into the system

* Strong desire of more and more customers to participate in electricity supply

* Highly volatile electricity prices

A revised **EU electricity market design** to:

Boost renewable energy investments

Better protect and empower EU consumers

Enhance the competitiveness of EU industry

European Commission

14. Dezember 2023

Commission welcomes deal on

https://ec.europa.eu/commission/presscorner/detail/en/ip_23_6602

European Commission

EN English

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Available languages: English

PRESS RELEASE | 14 December 2023 | Brussels

Commission welcomes deal on electricity market reform

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The Commission welcomes the provisional agreement reached today by the European Parliament and Council on the **reform of the EU's electricity market design.** This deal will help the EU build a **renewables-based energy system**, **lower energy bills** and **better protect consumers** from price spikes and empower them to benefit from the transition. It will ensure a **sustainable and independent energy supply** to the EU, in line with the European Green Deal and the REPowerEU Plan. This reform, which was proposed by the Commission as part of the Green Deal Industrial Plan, will also make the **European industry cleaner and more competitive** thanks to better access to affordable renewable, non-fossil energy.

The reform provisionally agreed today by the EU co-legislators features revisions to several pieces of EU legislation– notably the Electricity Regulation, the Electricity Directive, and the REMIT Regulation. Building on the lessons of the energy crisis spurred by Russia's invasion of Ukraine, the agreed reform will bring **more price stability** to both consumers and suppliers thanks to a broader use of **long-term contracts for clean power production** and will bring more **non-fossil flexible solutions** into the system such as demand response and storage.

Better protected and empowered consumers

Suchen

Adresse

Desktop

Links

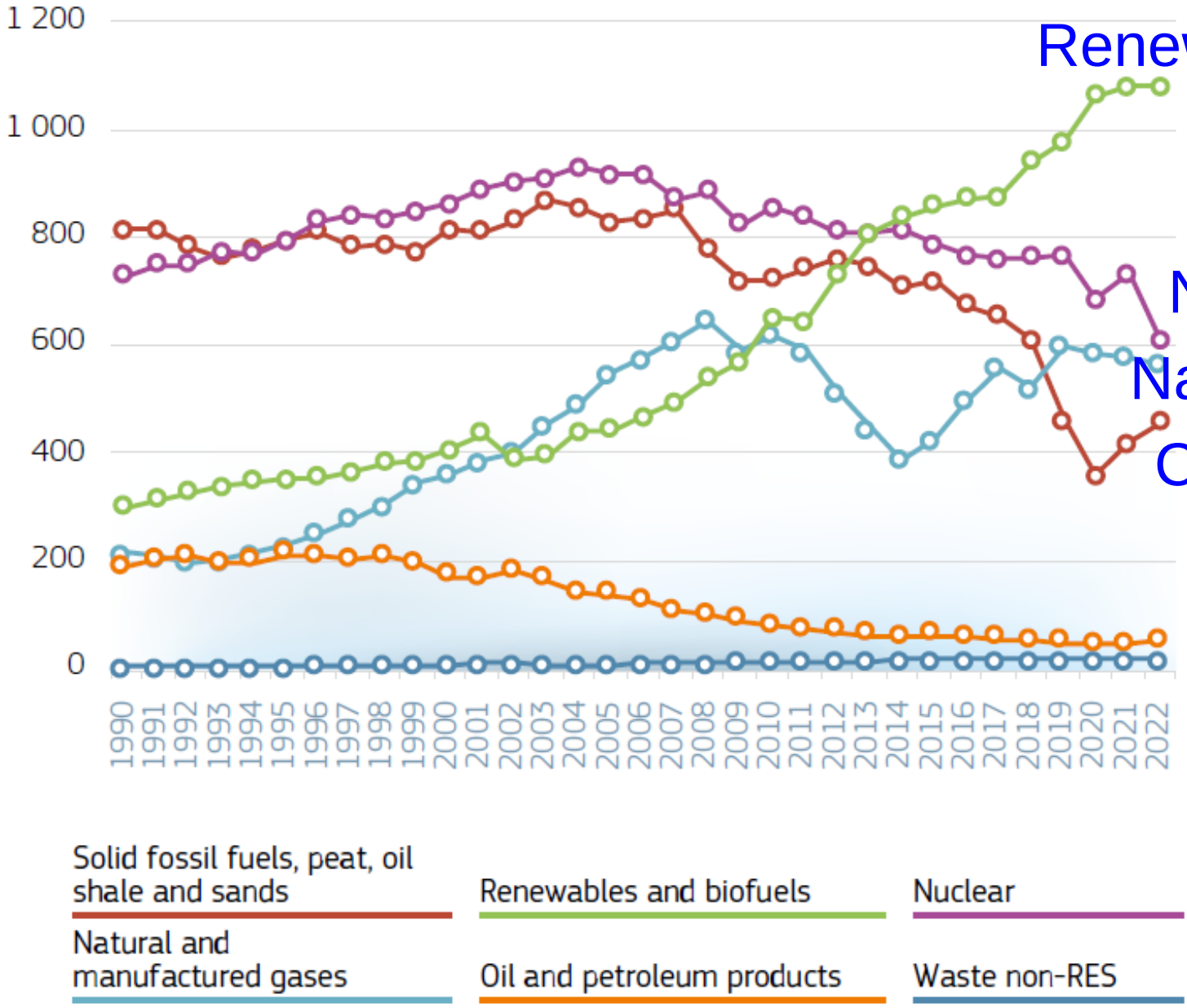
Son...

17:14
14.02.2024

MAJOR ISSUES:

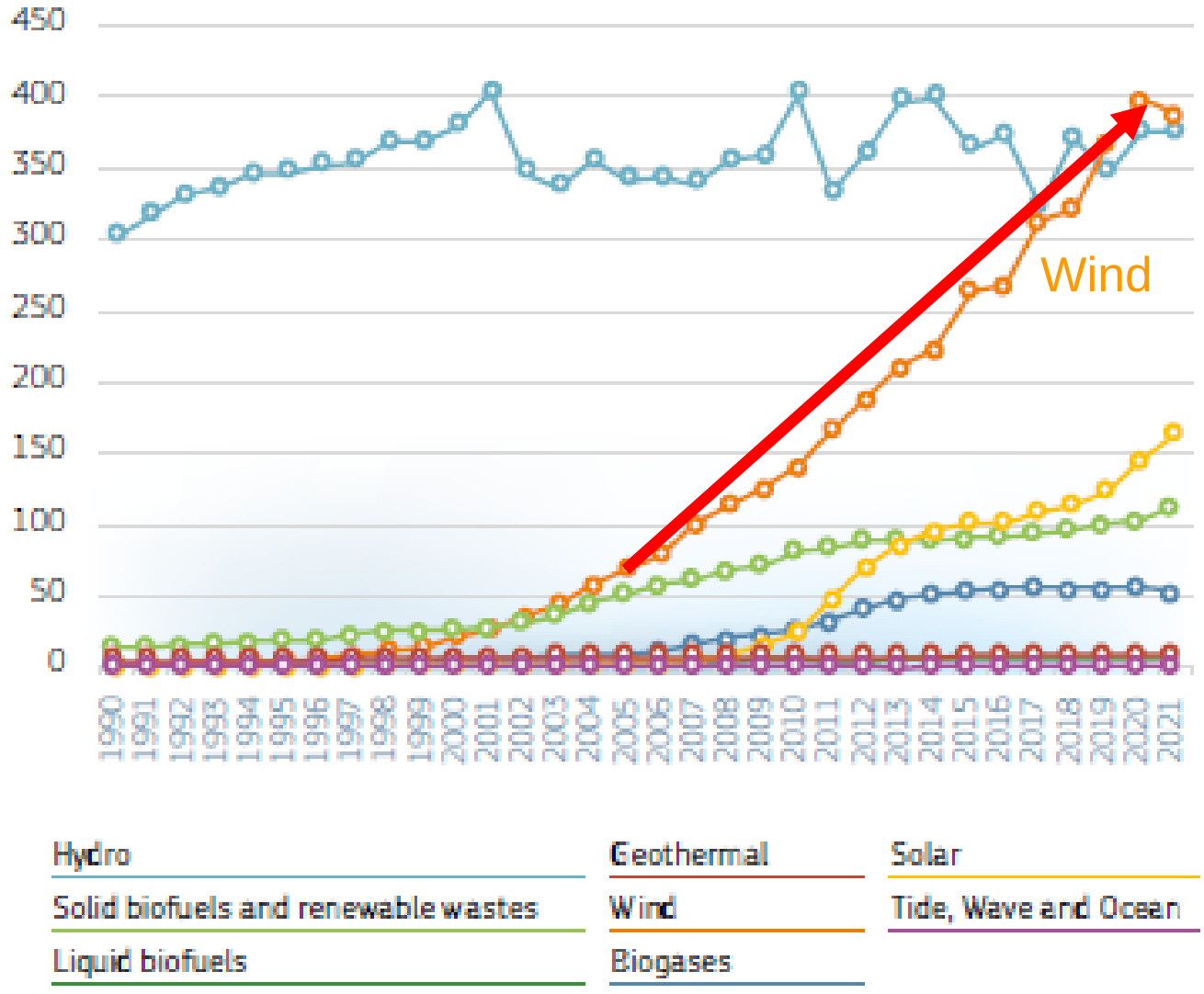
* Better protected and empowered consumers;
* energy market integrity and transparency (ACER) ;
* A competitive European industry with predictable energy costs
* Long-term contracts: PPAs and CfD
* integration of renewables

Electricity generation EU-27

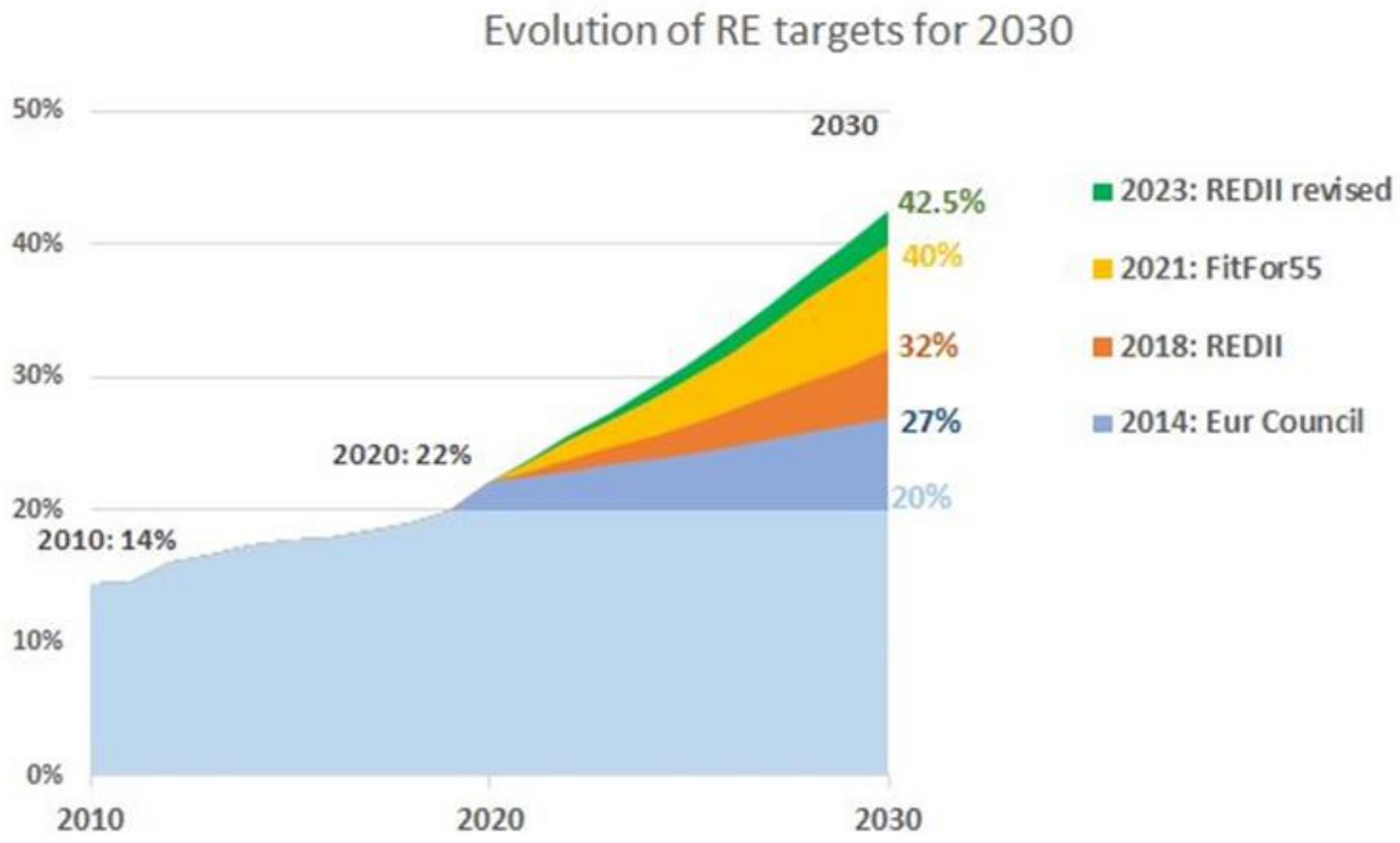


Electricity generation EU-27

EU27_2020 – BY FUEL – GROSS ELECTRICITY GENERATION, BY FUEL: RENEWABLES – 1990-2021 (TWh)

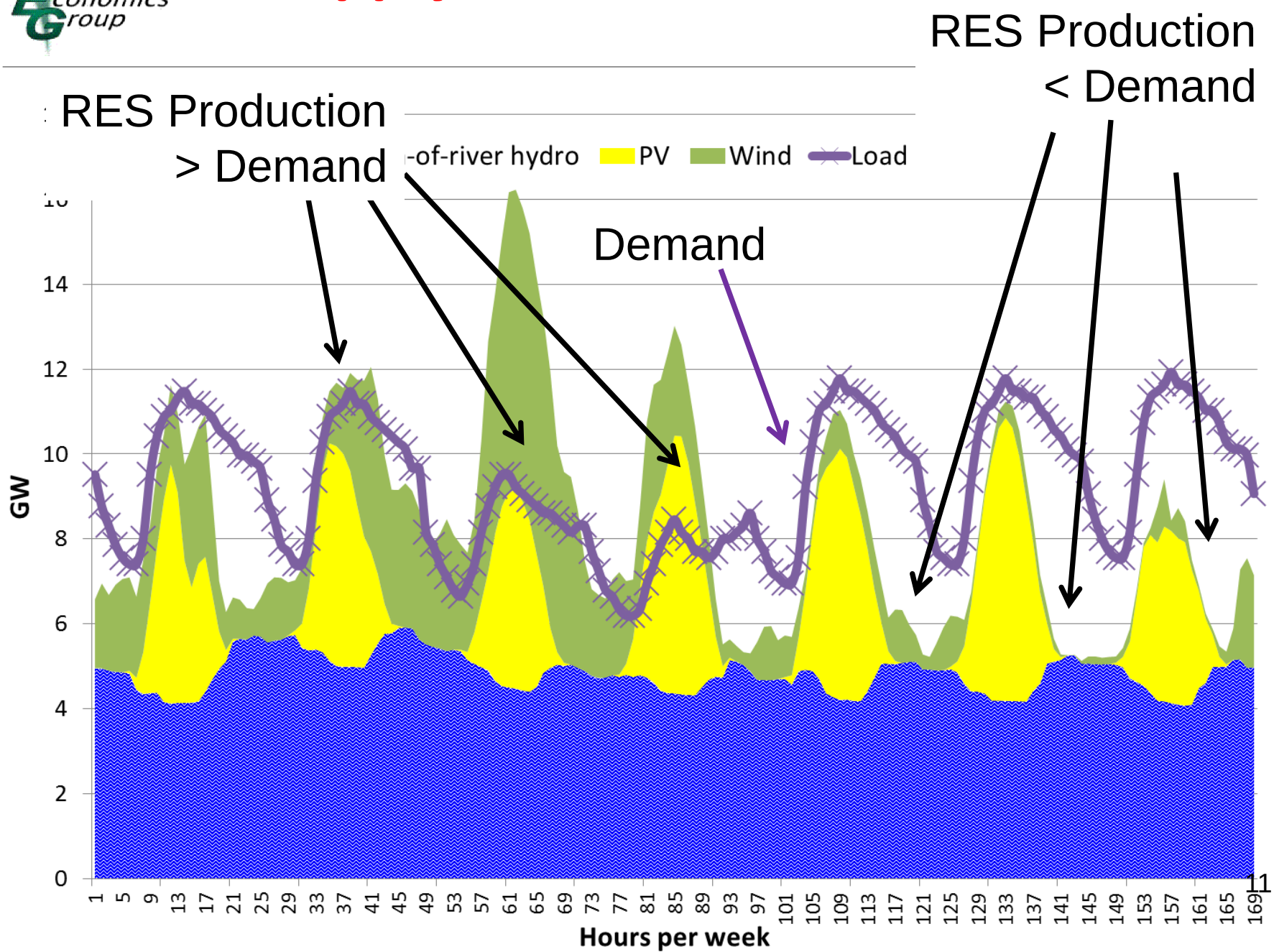


Renewable energy targets EU-28

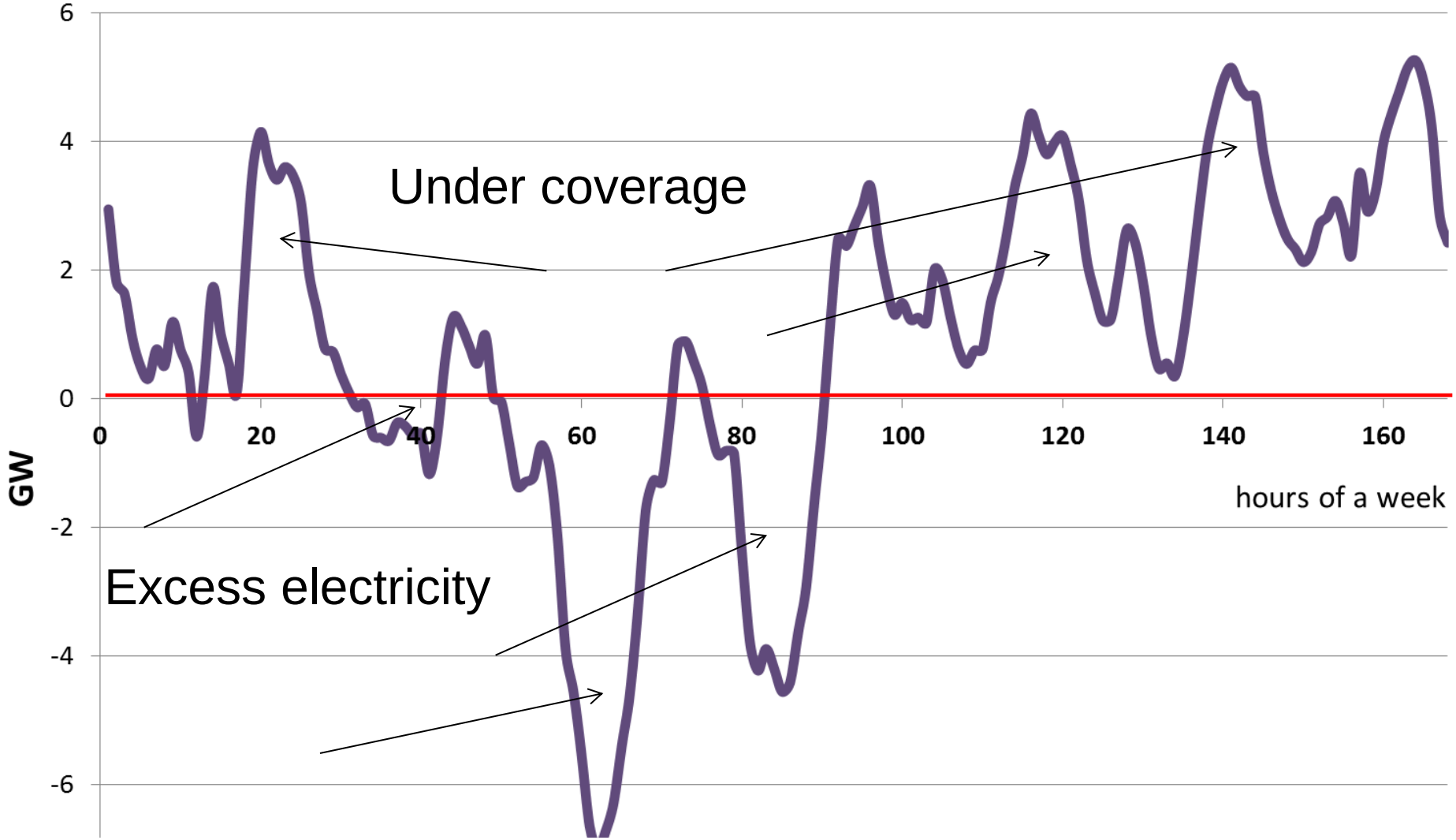


2 Key term of the future: Residual load

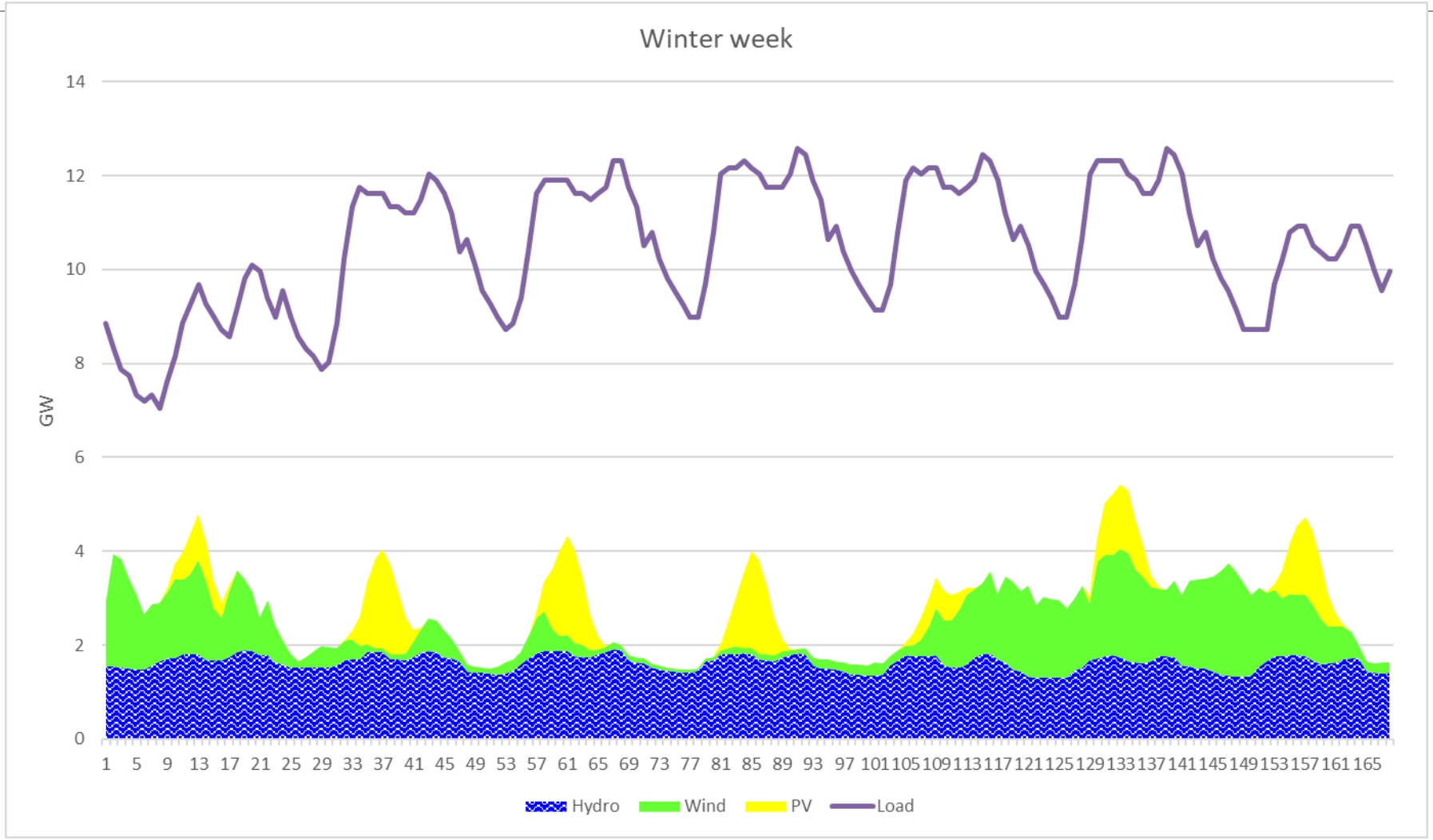
Supply and Demand 2030



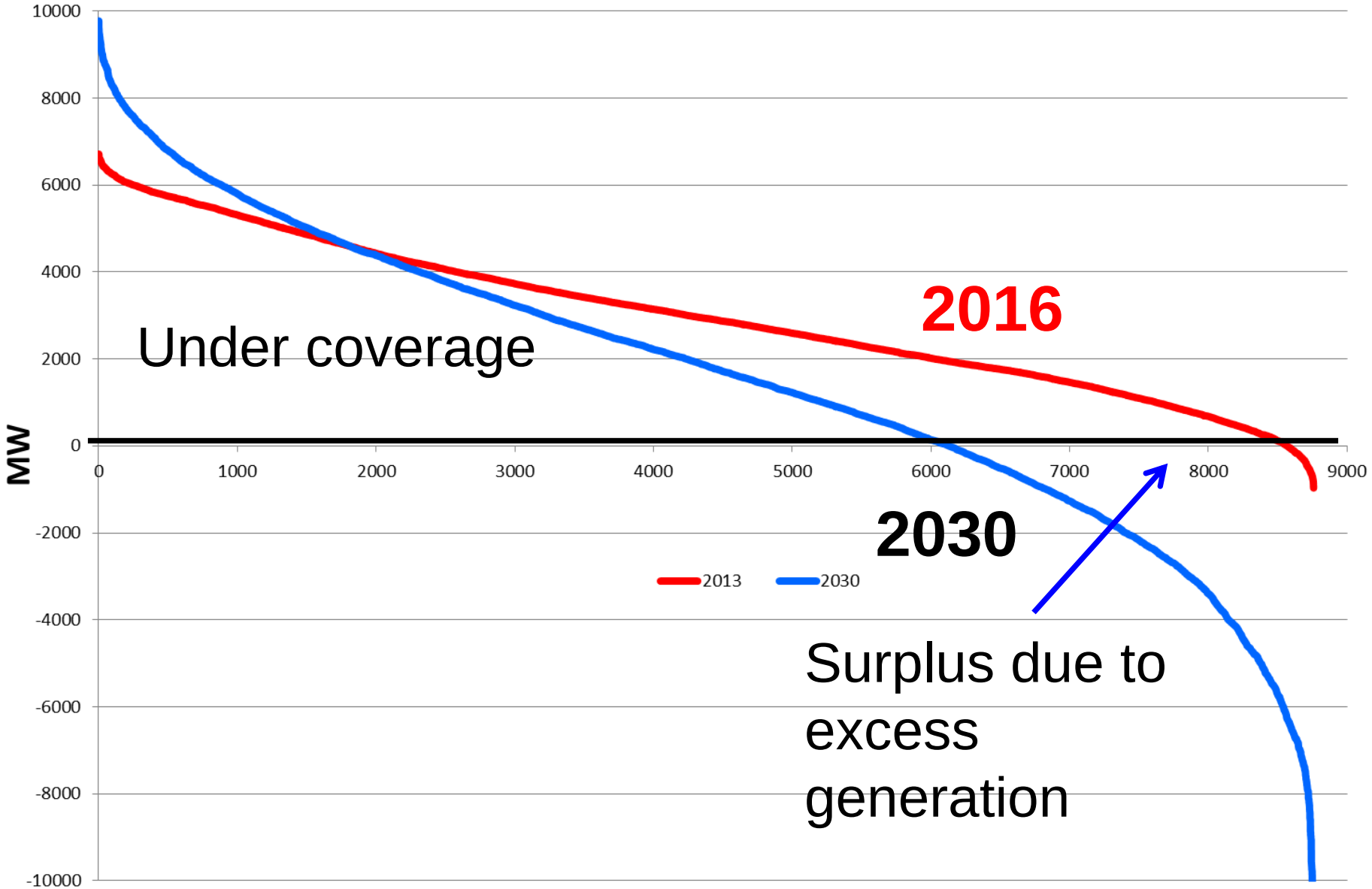
3. Key term of the future: Residual load

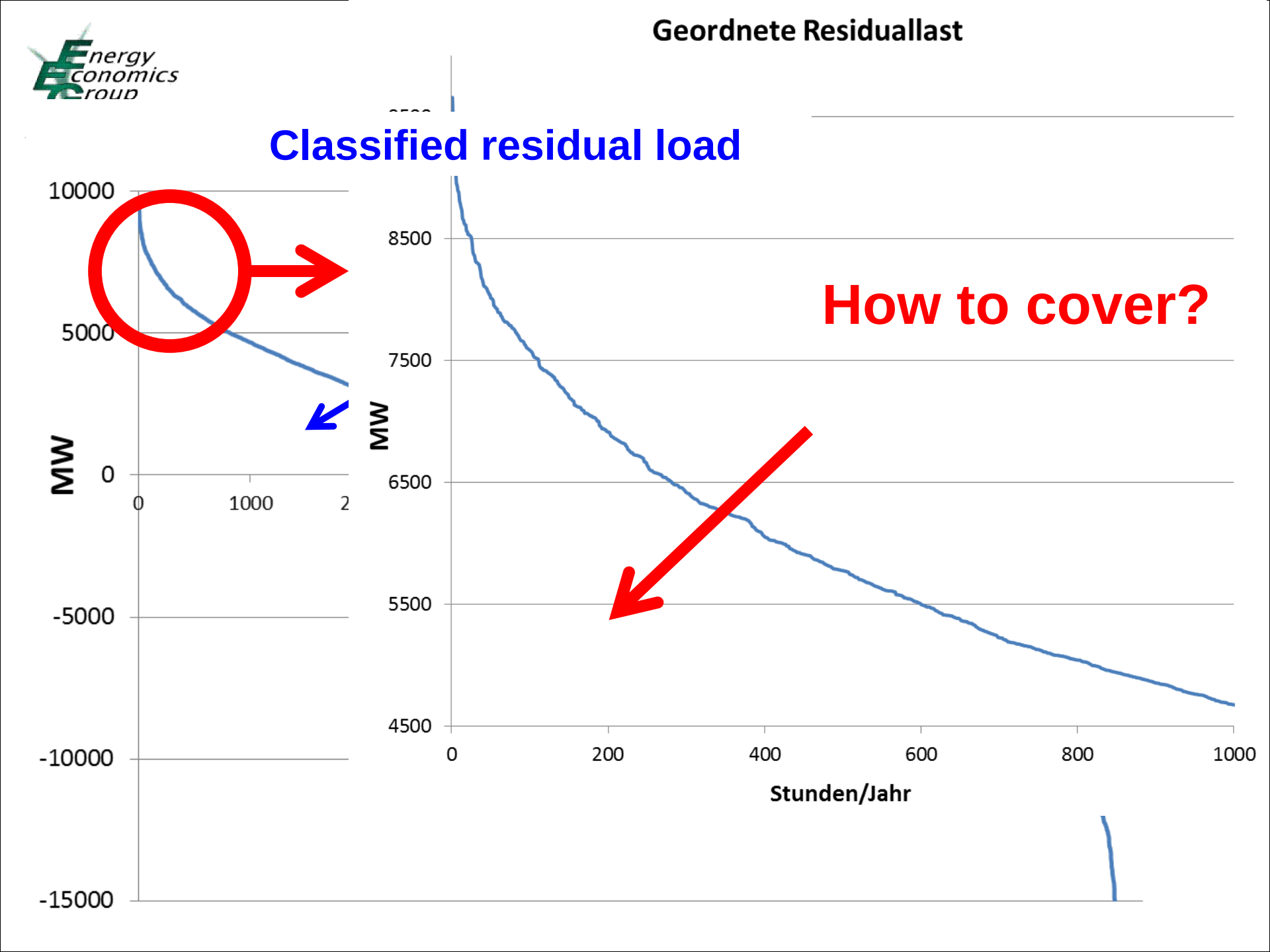


Residual load = Load – non-flexible generation


Winter week
GW
14
12
10
8
6
4
2
0
1 5 9 13 17 21 25 29 33 37 41 45 49 53 57 61 65 69 73 77 81 85 89 93 97 101 105 109 113 117 121 125 129 133 137 141 145 149 153 157 161 165
Hydro
Wind
PV
Load

Classified residual load




Geordnete Residuallast
Classified residual load
How to cover?
MW
10000
5000
0
-5000
-10000
-15000
0
1000
8500
7500
6500
5500
4500
200
400
600
800
Stunden/Jahr

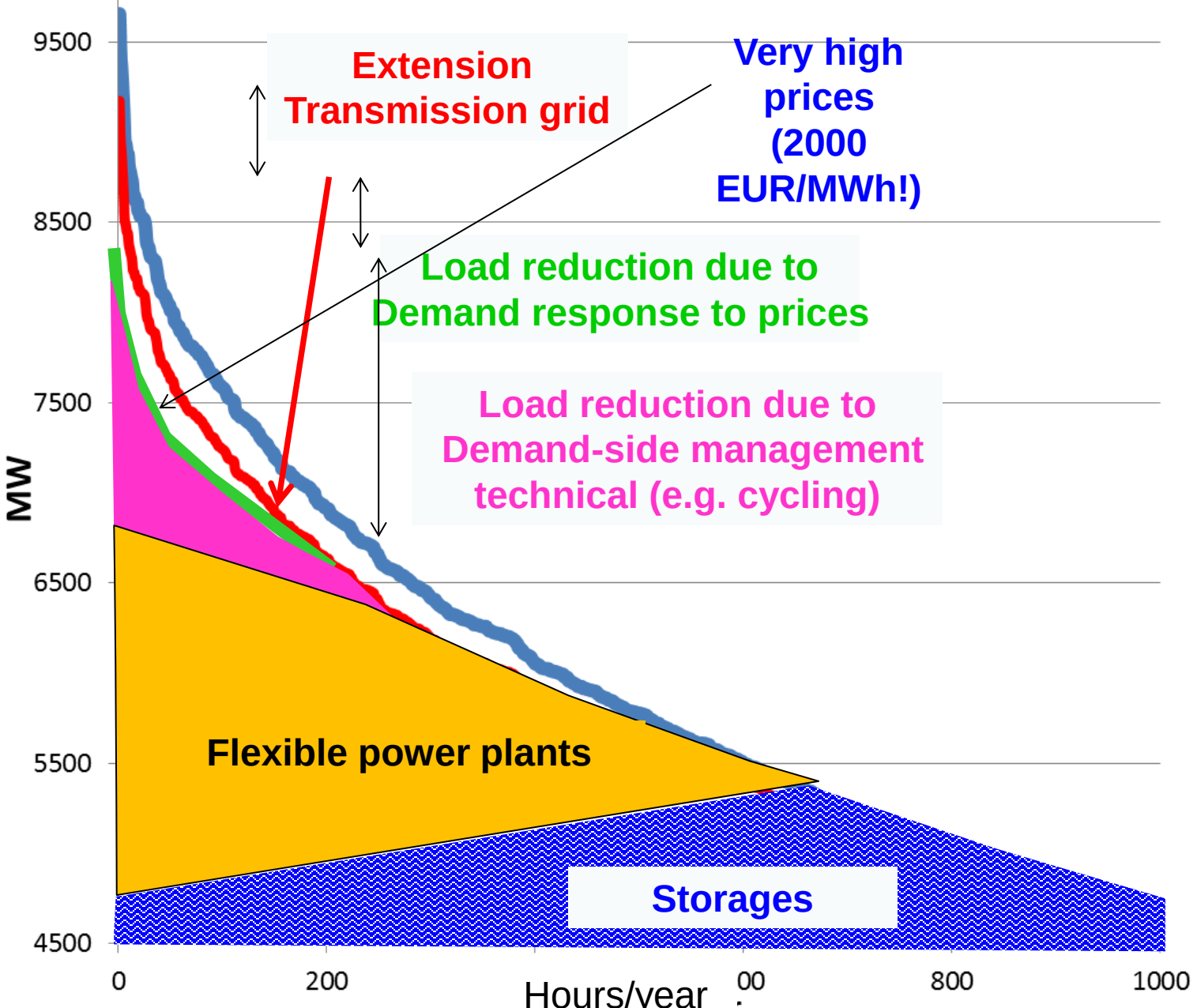
3. Capacity payments vs Flexibility

By a regulated capacity „market“ ?

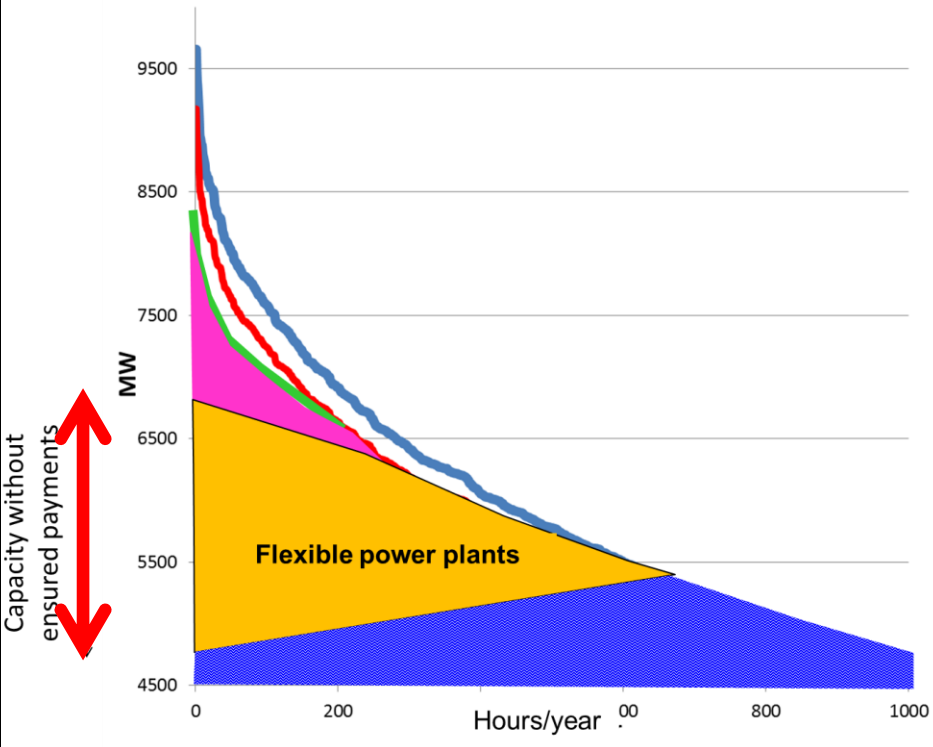
or

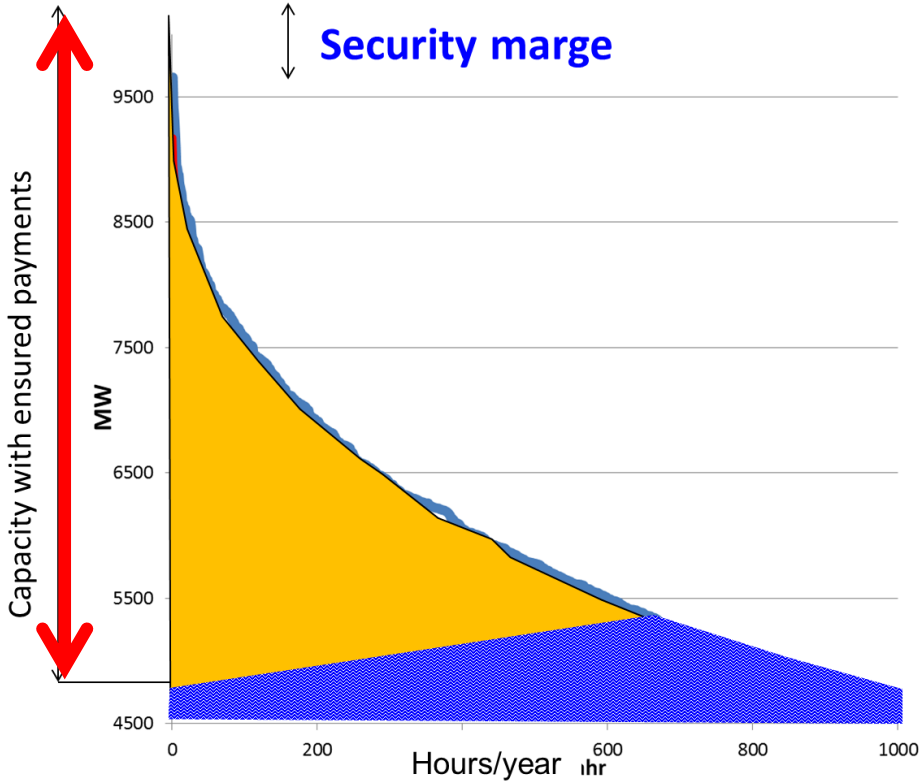
By competition between supply-side and demand-side technologies (incl. storages and grid)?

Flexible coverage of residual load



Comparison


9500
8500
7500
6500
5500
4500
MW
0
200
800
1000
Hours/year
Capacity without ensured payments
Flexible power plants


Security marge
Capacity with ensured payments
9500
8500
7500
6500
5500
4500
MW
0
200
600
800
1000
Hours/year

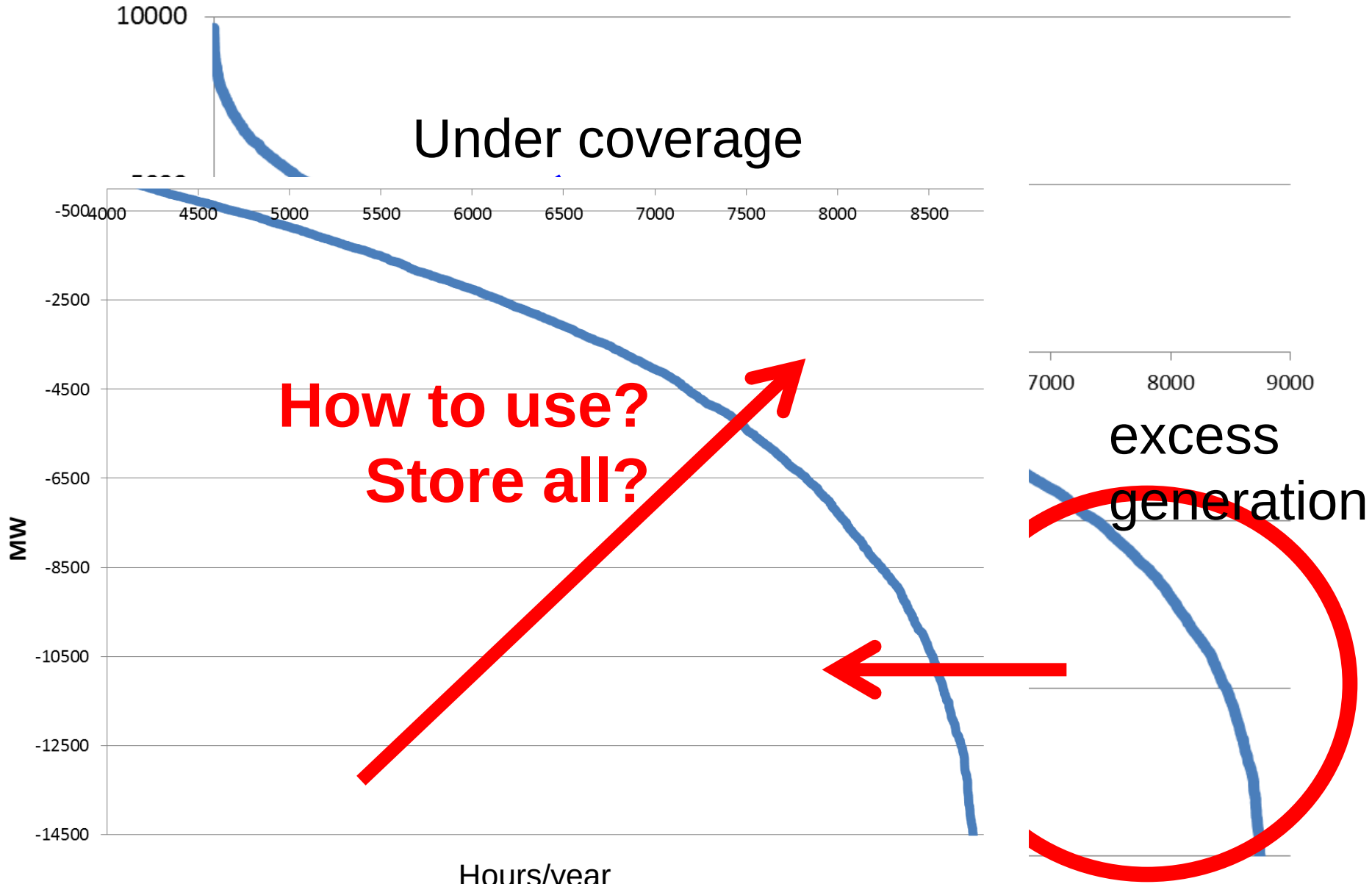
THE CORE PROBLEMS OF CAPACITY PAYMENTS

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

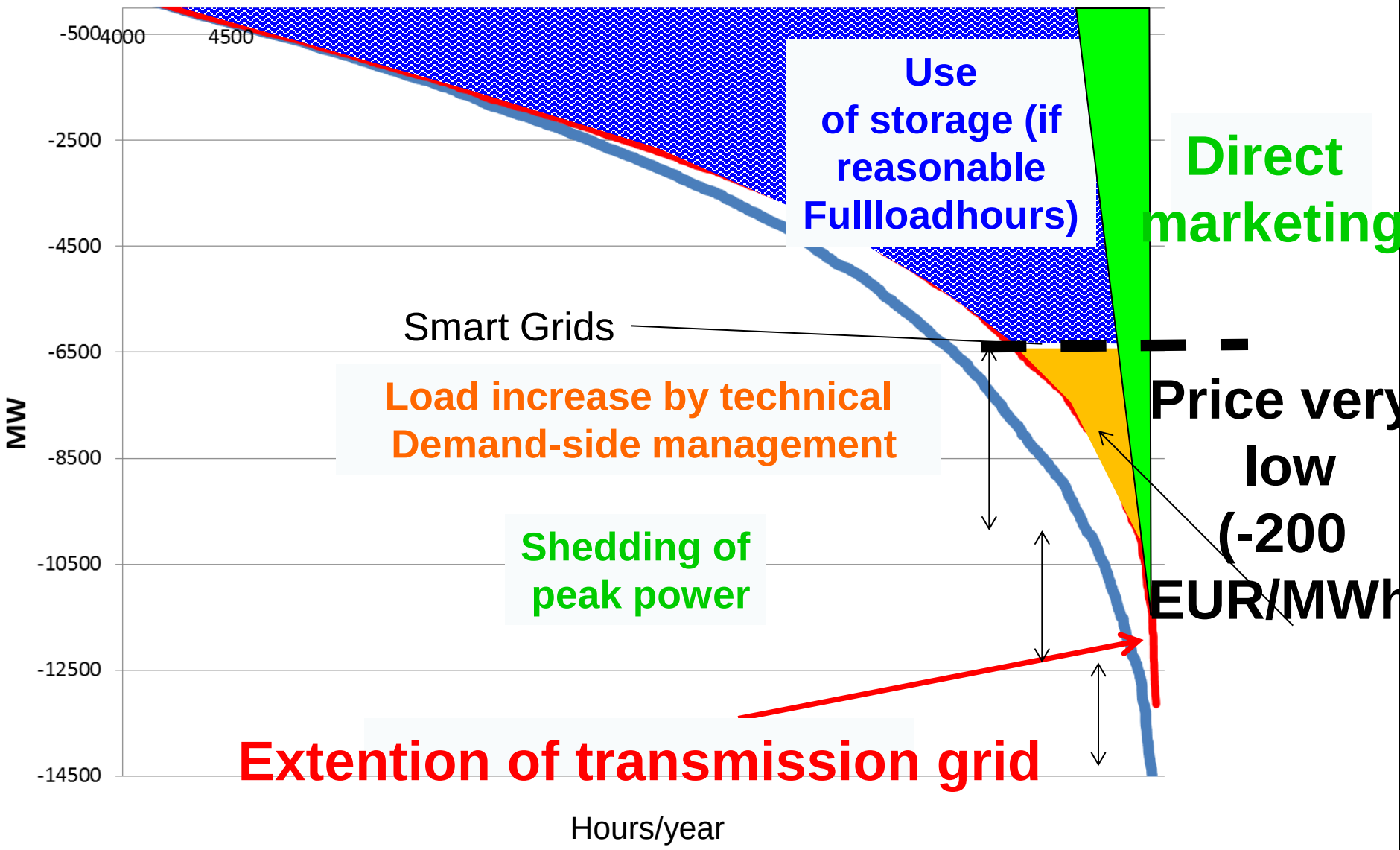
Price peaks at times of scarce resource should revive the markets and lead to effective competition

strive to retain system resource adequacy by correct price signals

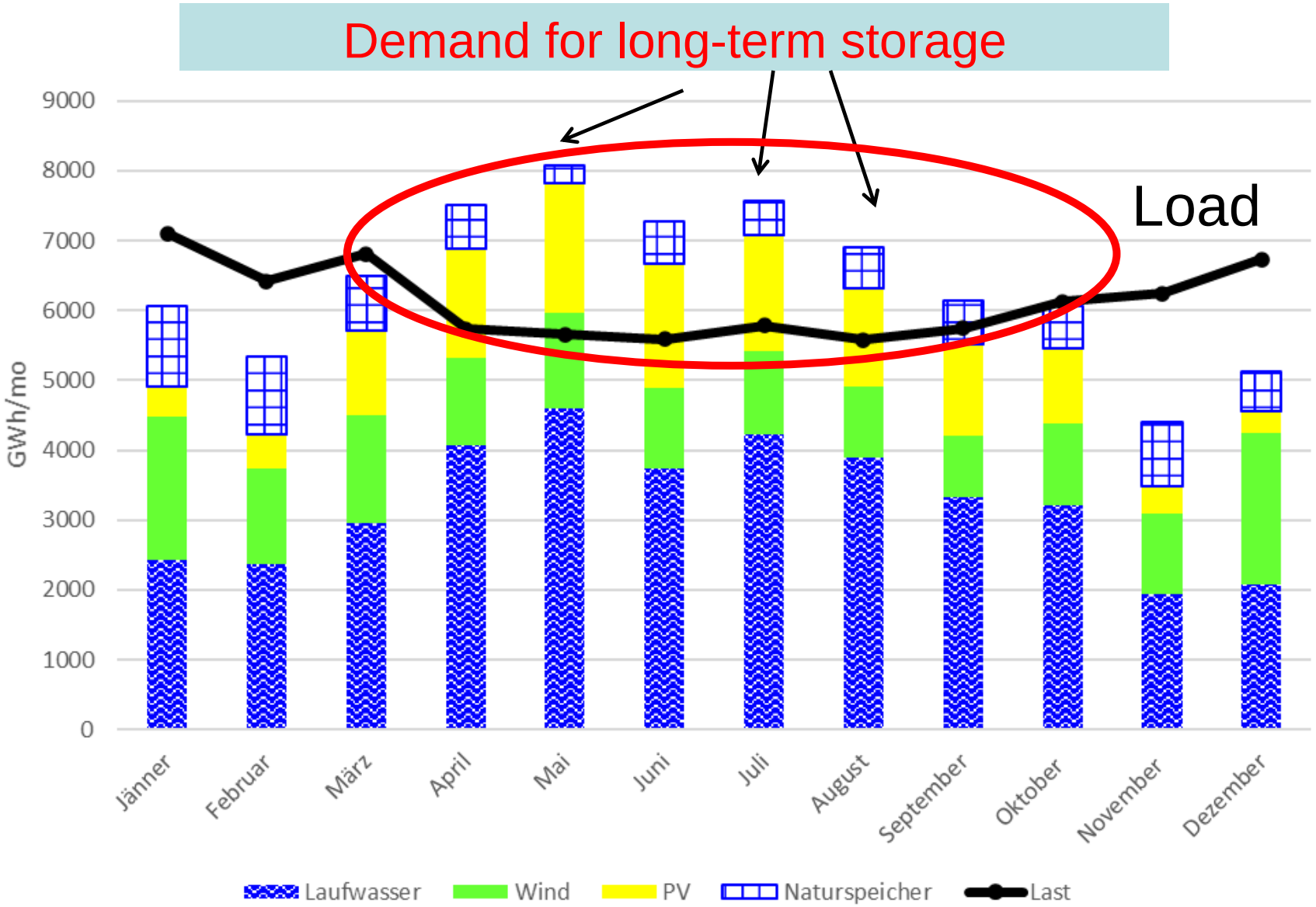
STORING EVERY PEAK?



FLEXIBLE USE OF EXCESS ELECTRICITY



Scenario Austria monthly 2030



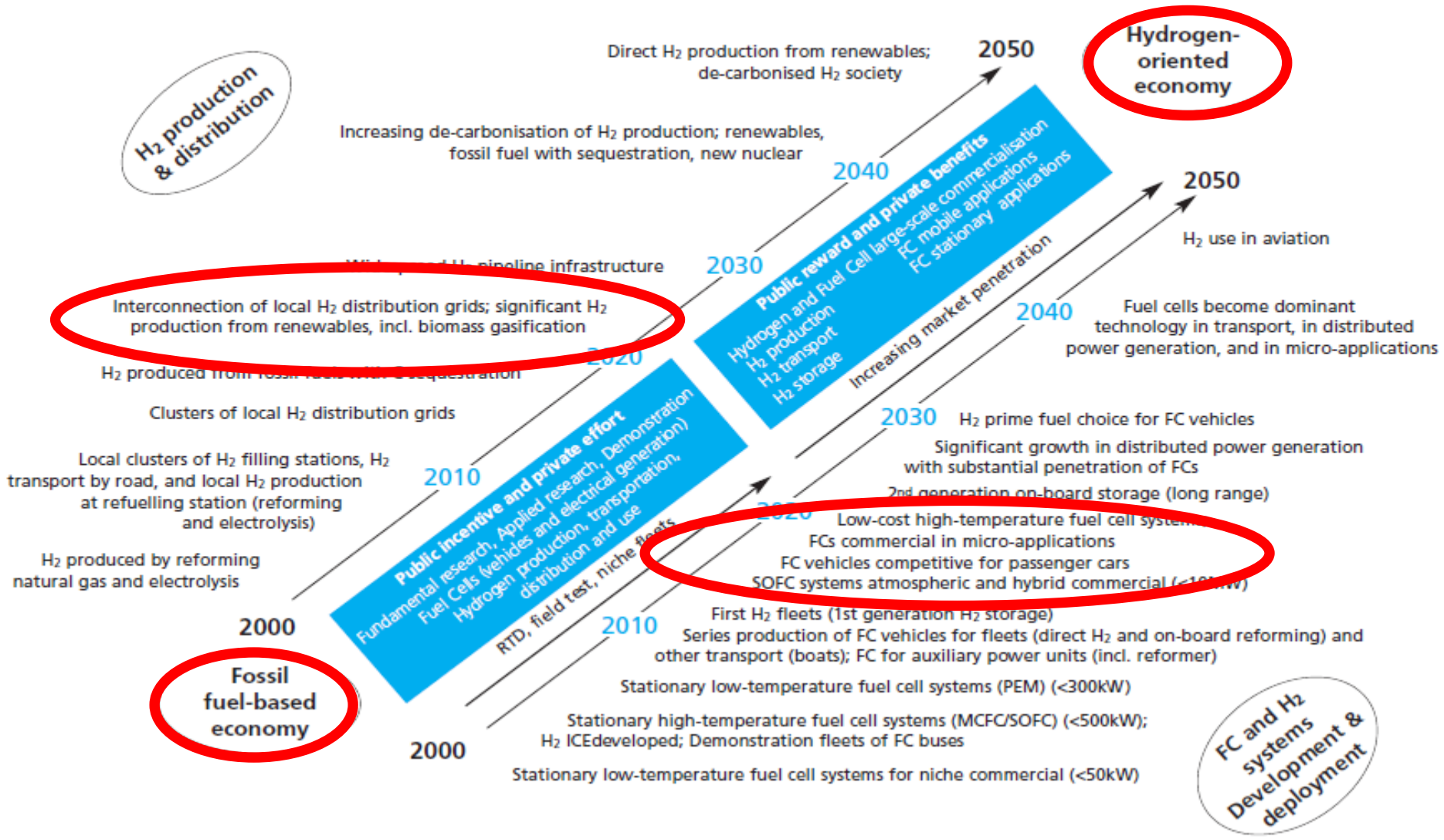
4. PROSPECTS FOR HYDROGEN

* Urgent needs for clean energy carriers

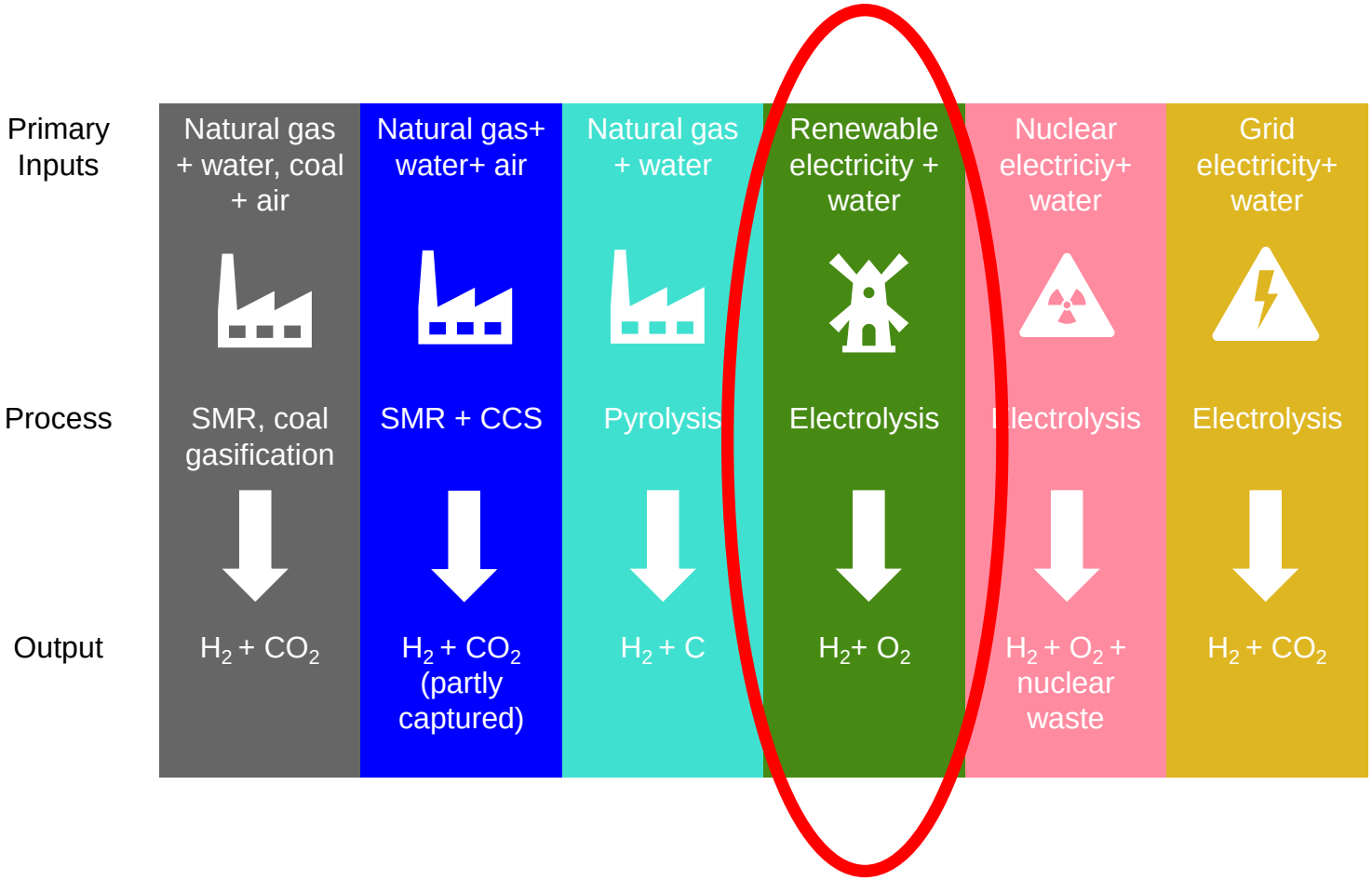
* Hydrogen is seen as such a clean energy carrier since decades

* Yet so far it has not delivered

EU-Roadmap H2 (2003)

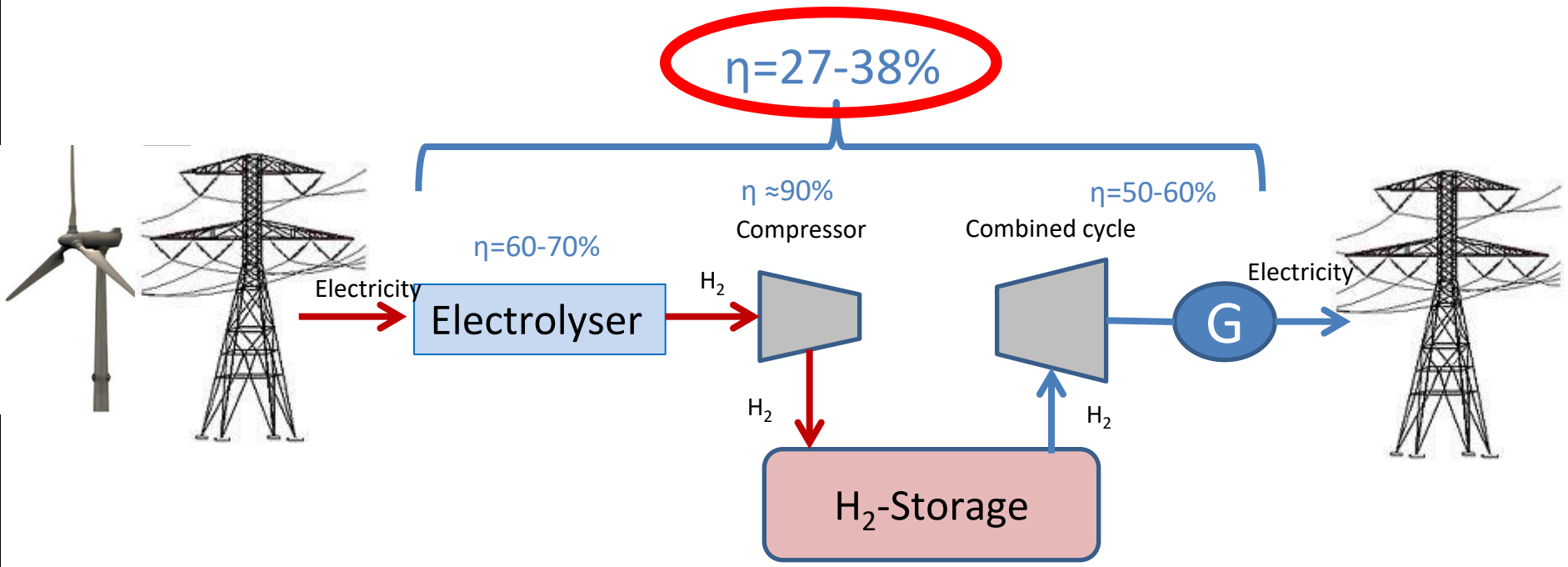


Main colors of hydrogen

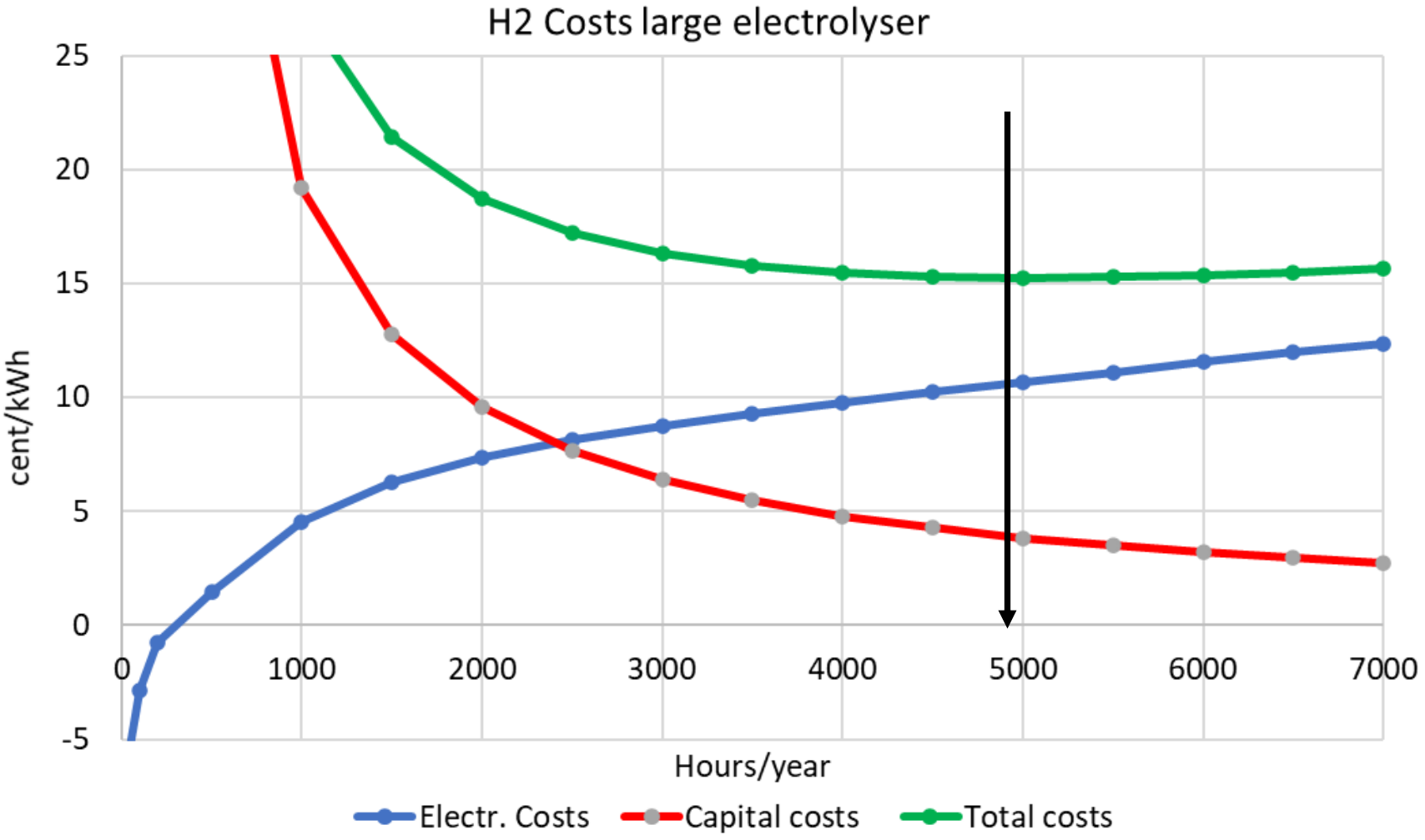


Hydrogen as storage for re-electrification

Very low roundtrip efficiency for electricity!

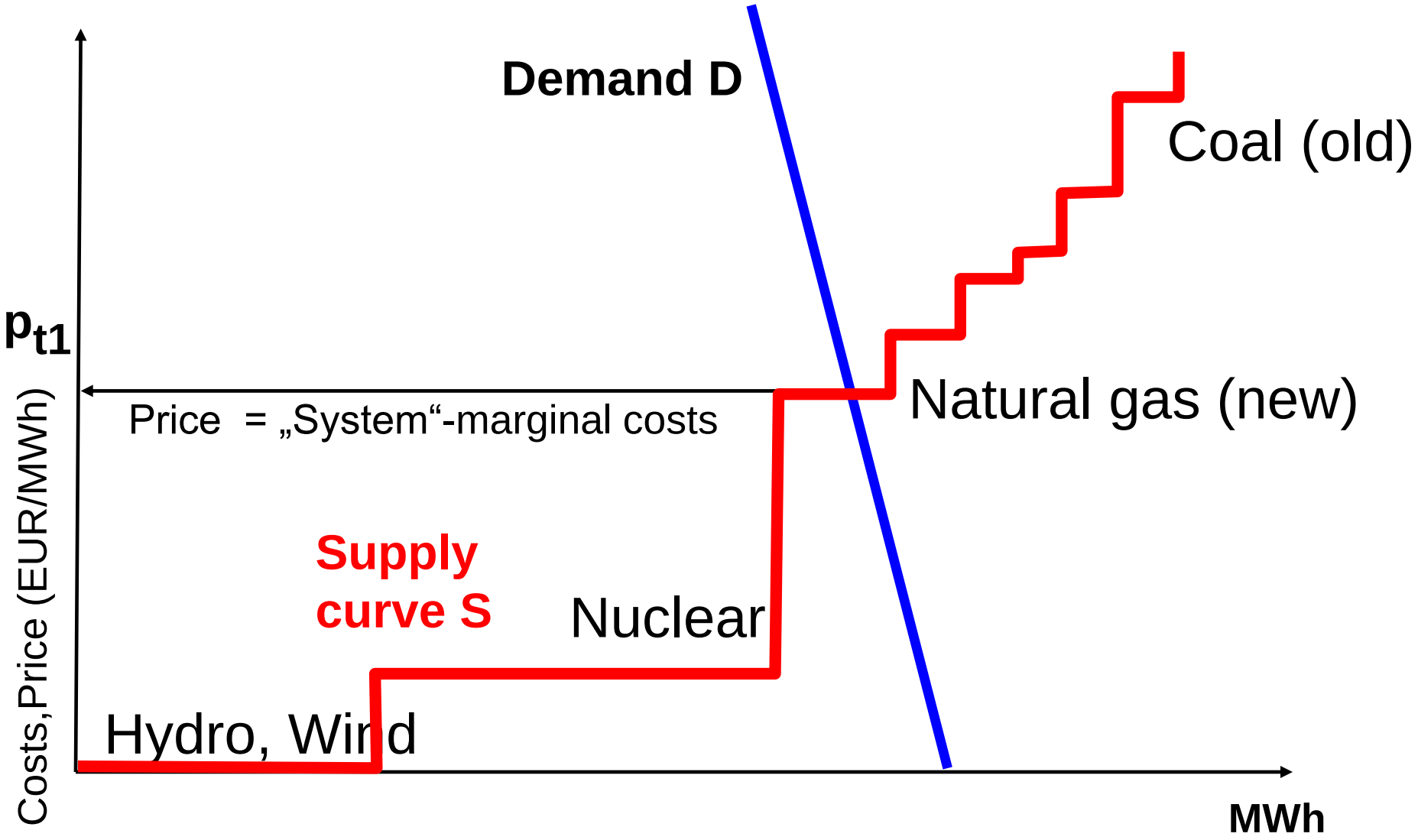


Hydrogen costs and fulloadhours

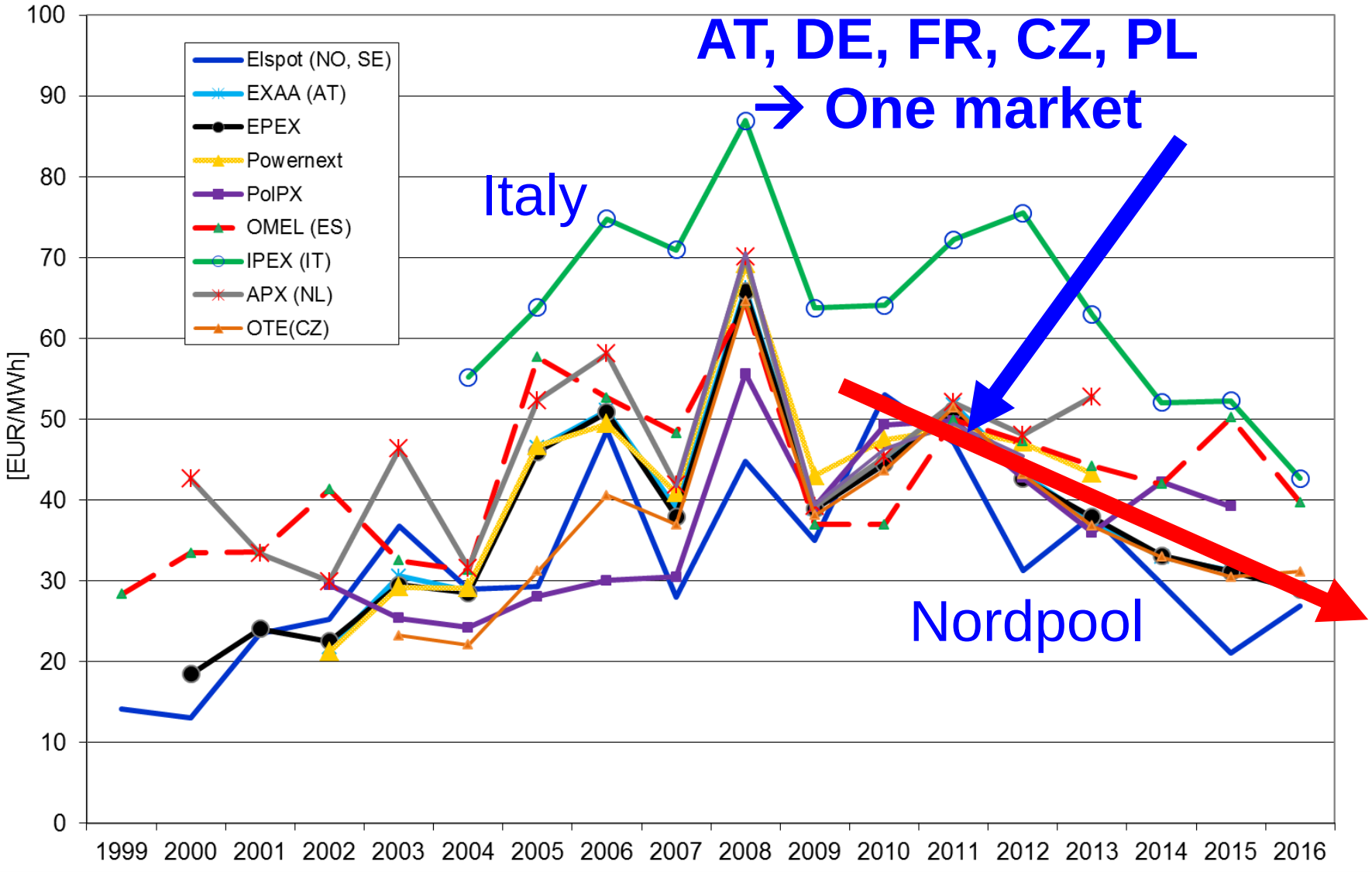


5 DEVELOPMENT OF ELECTRICITY MARKET PRICES

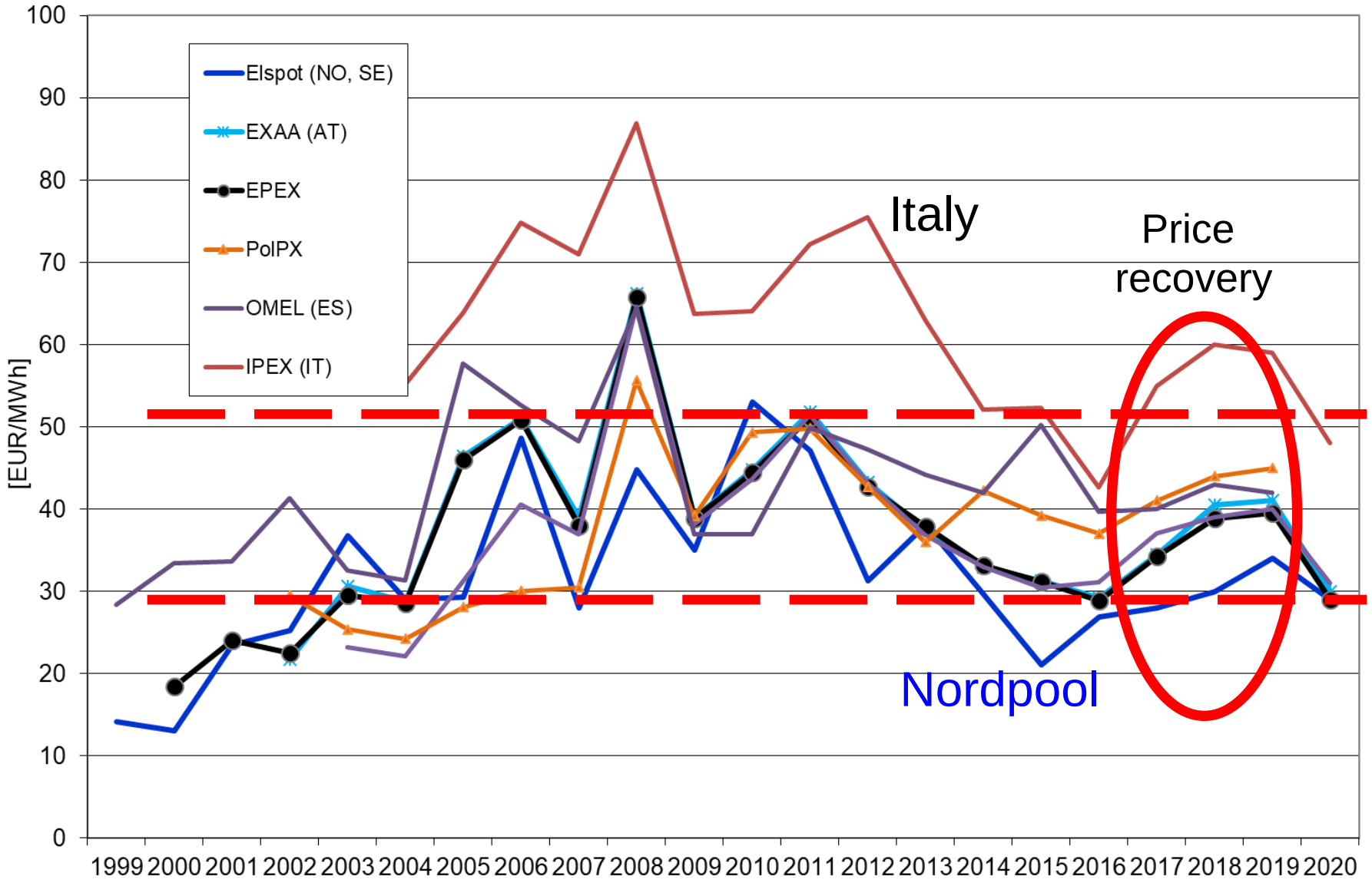
BASIC PRINCIPLE OF COMPETITION: PRICE = MARGINAL COSTS

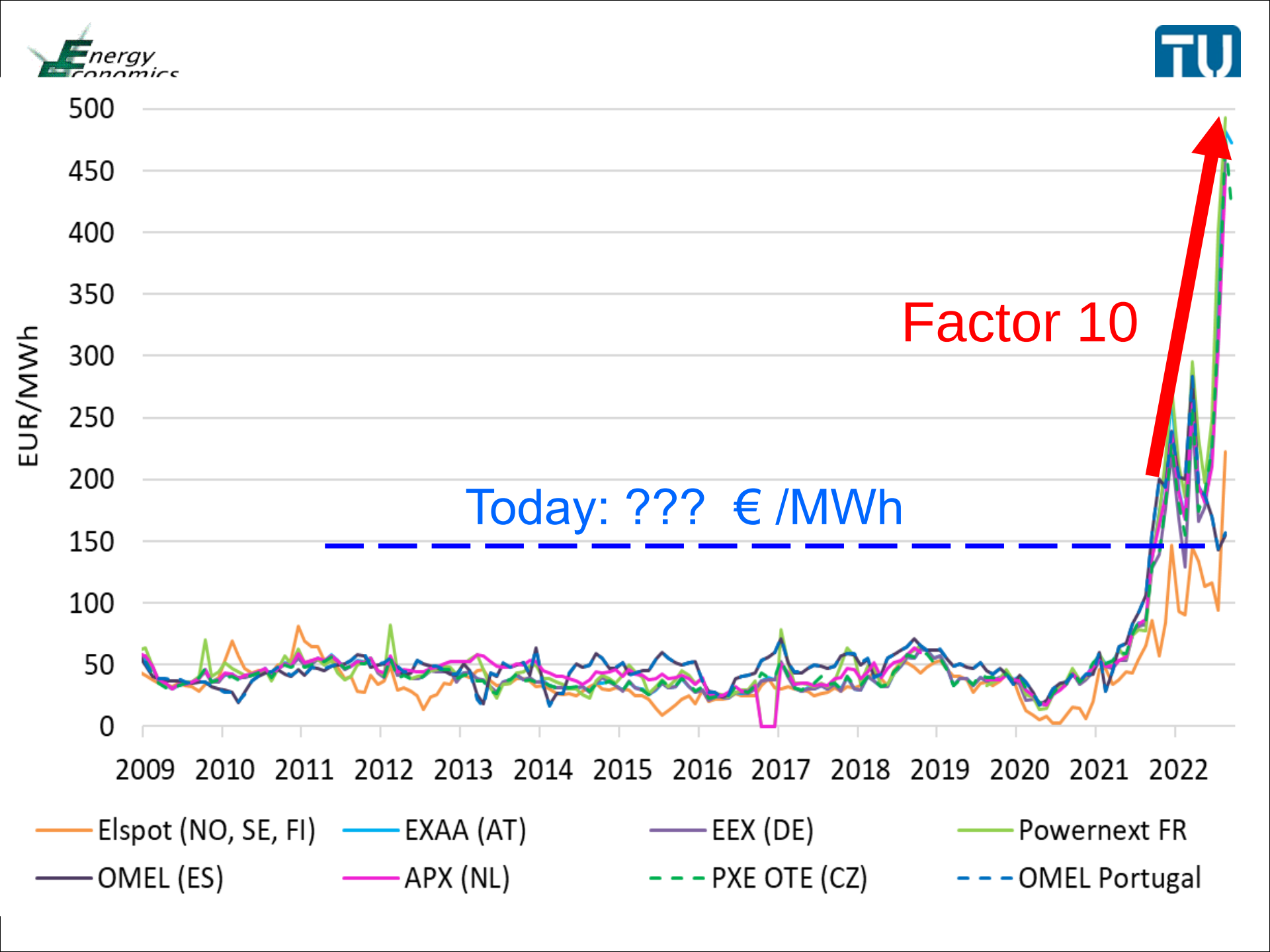


Development of electricity prices in Europe up to 2016 (1)

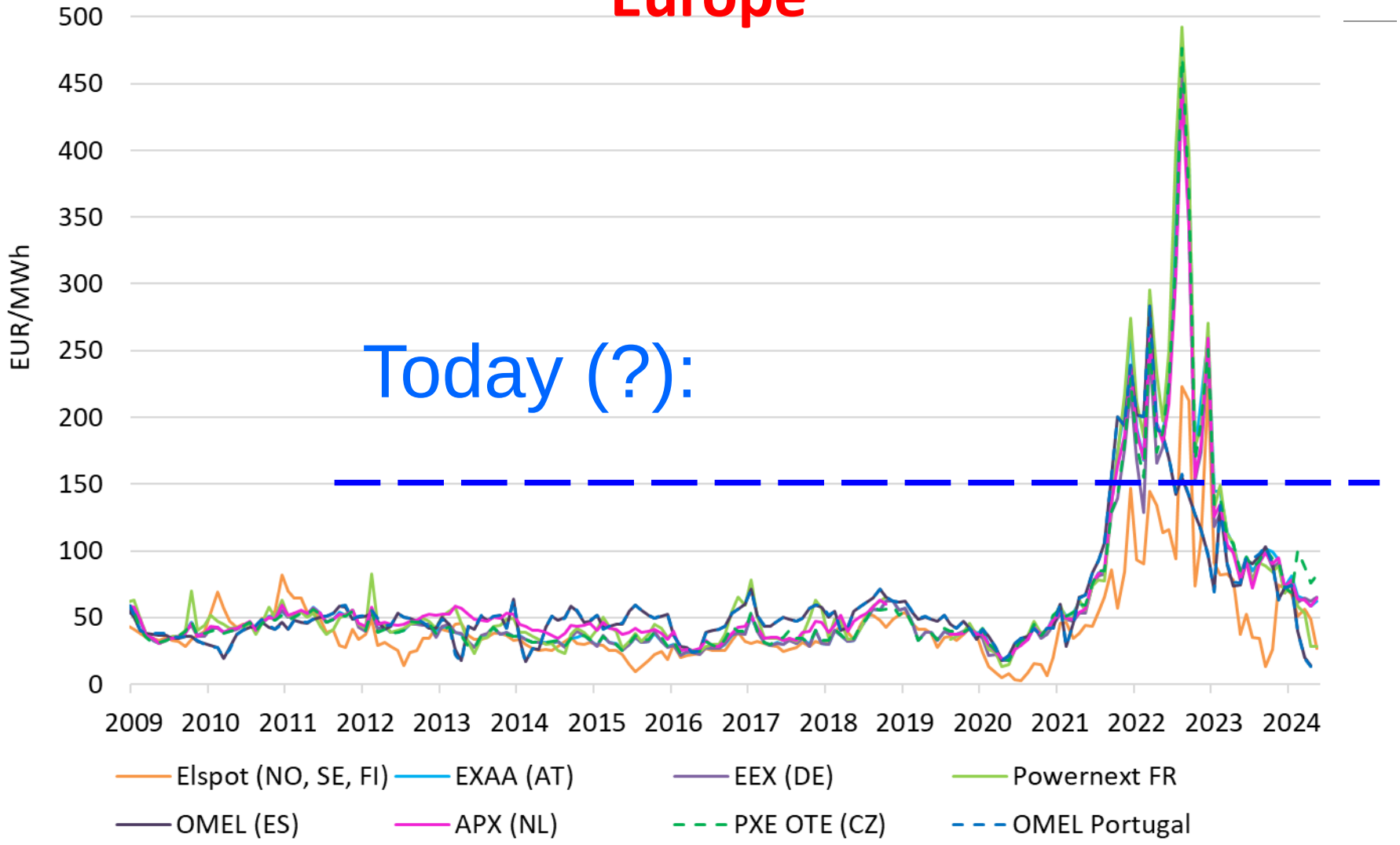


Development of day-ahead electricity prices in Europe per year (2)

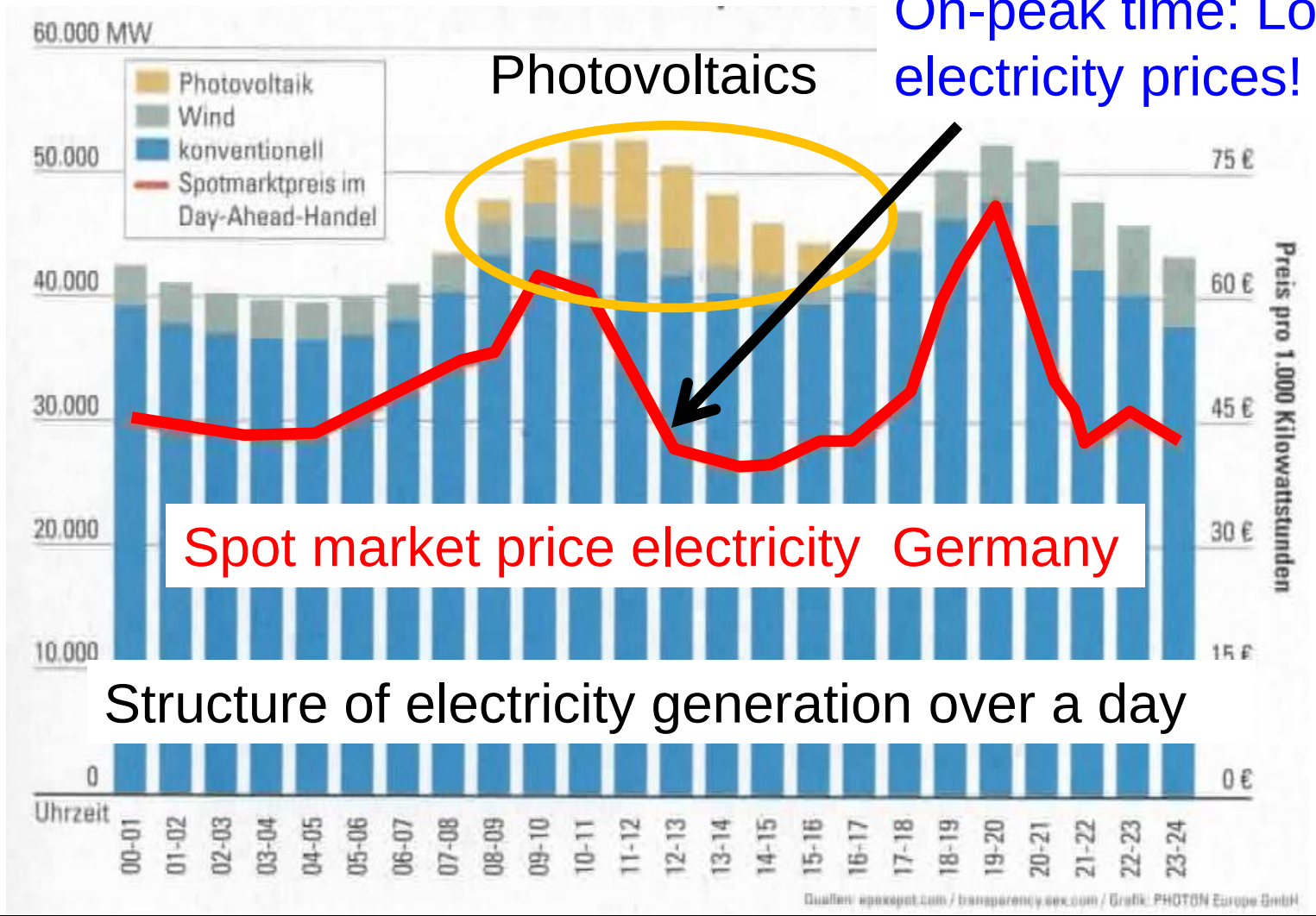



Energy Economics
EUR/MWh
500
450
400
350
300
250
200
150
100
50
0
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Factor 10
Today: ??? € /MWh
Elspot (NO, SE, FI)
EXAA (AT)
EEX (DE)
Powernext FR
OMEL (ES)
APX (NL)
PXE OTE (CZ)
OMEL Portugal

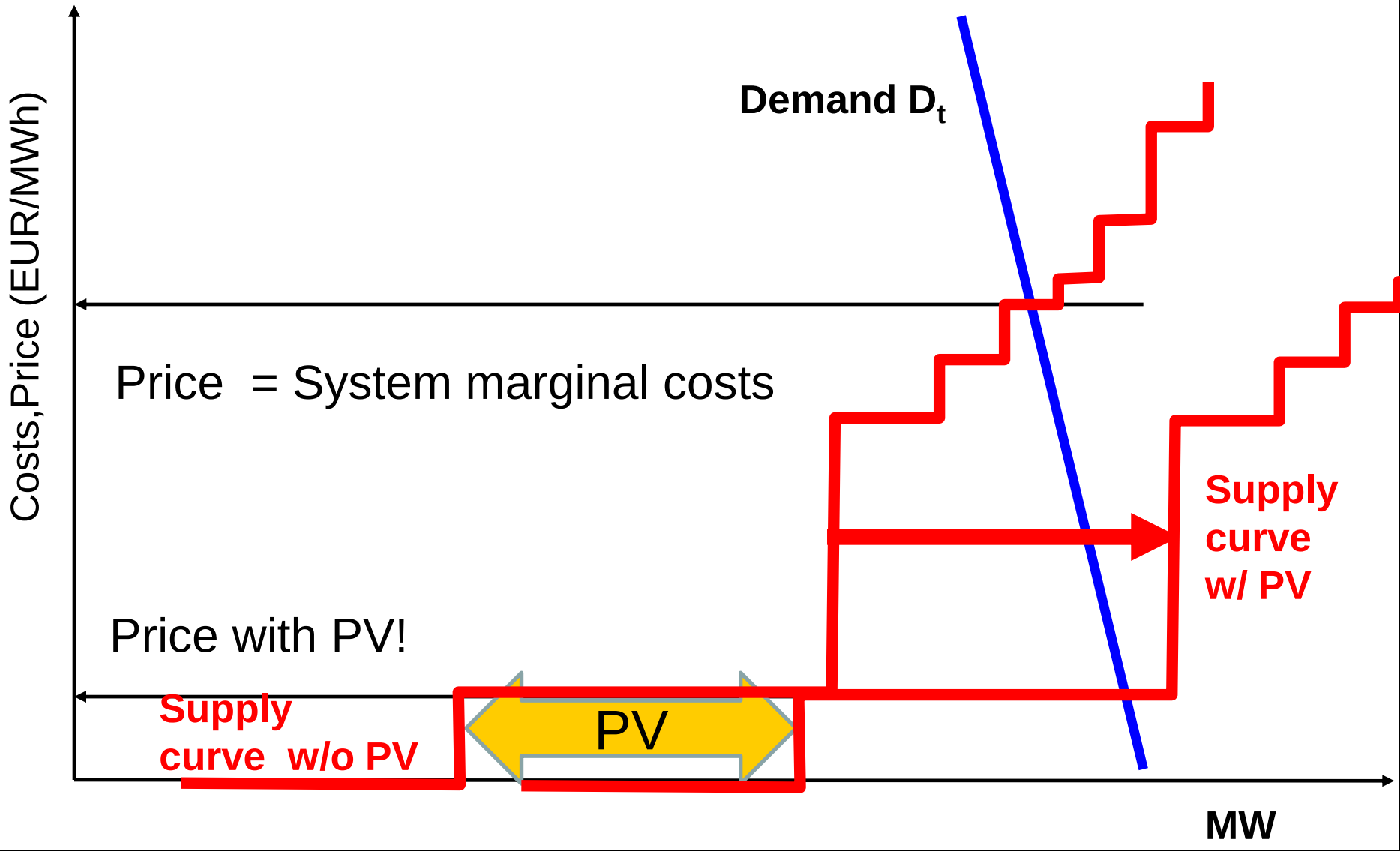
Day-ahead electricity prices in Europe



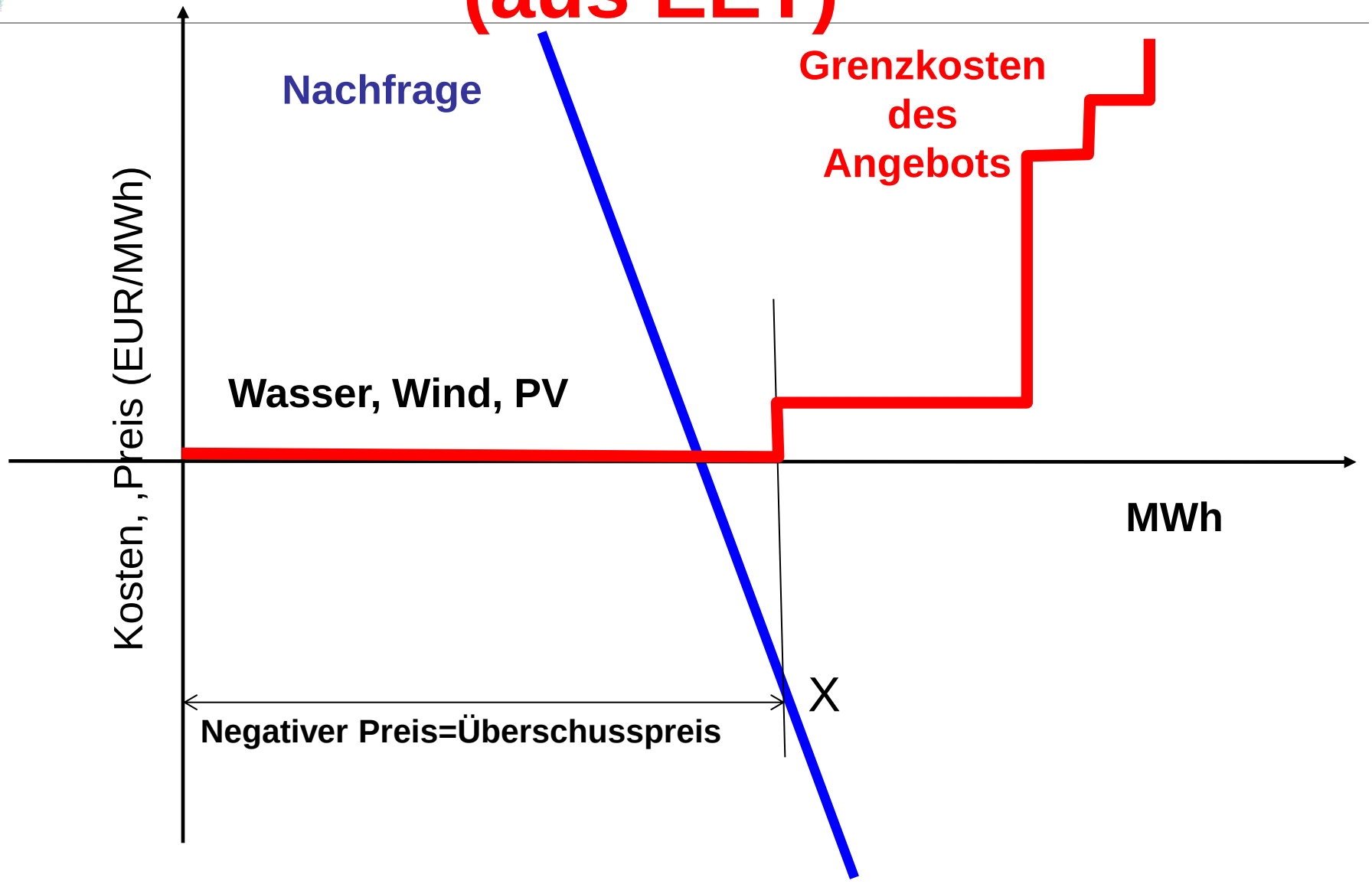
PV AFFECTS THE ELECTRICITY MARKET PRICE IN GERMANY



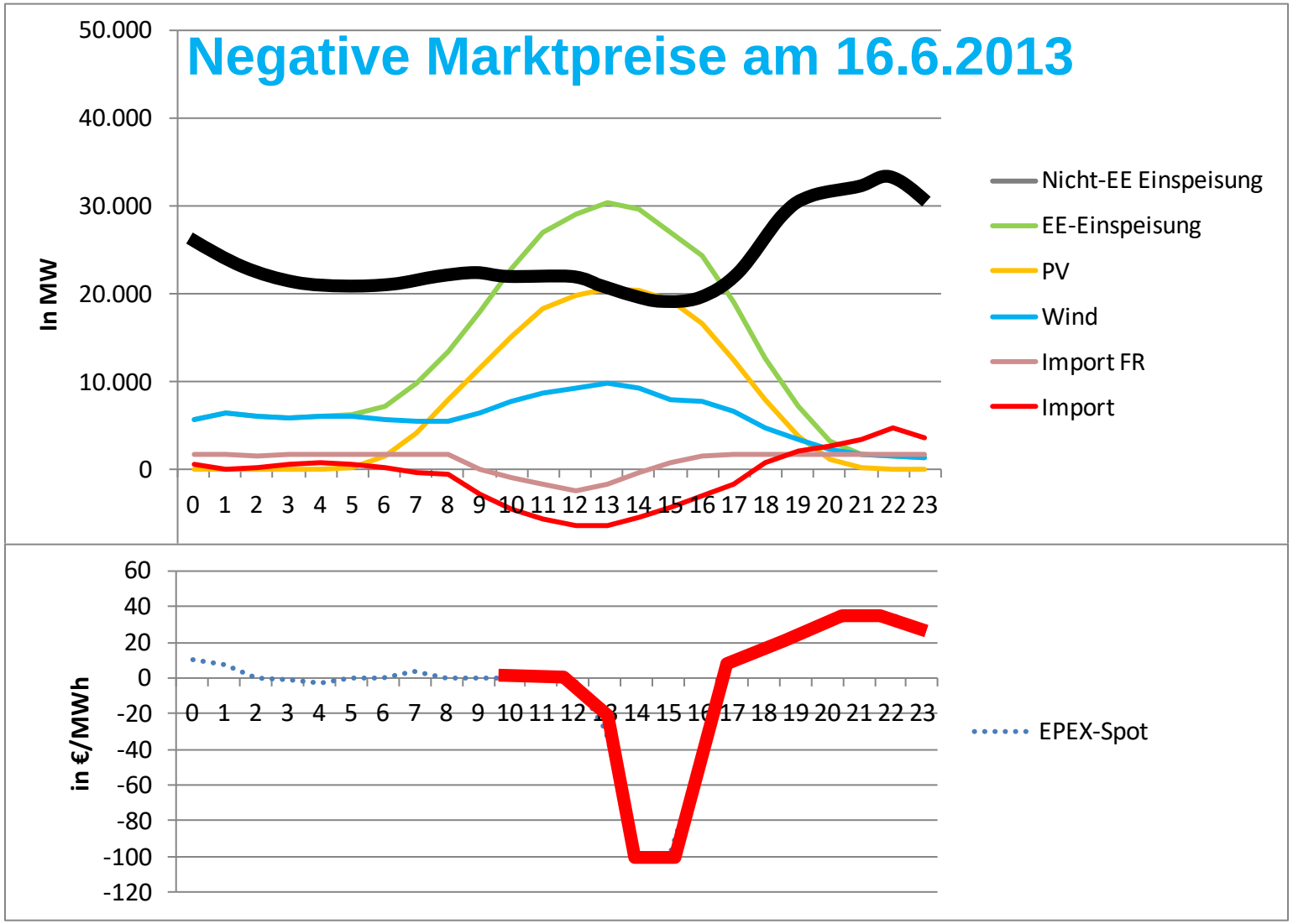
PRICES WITHOUT AND WITH PV

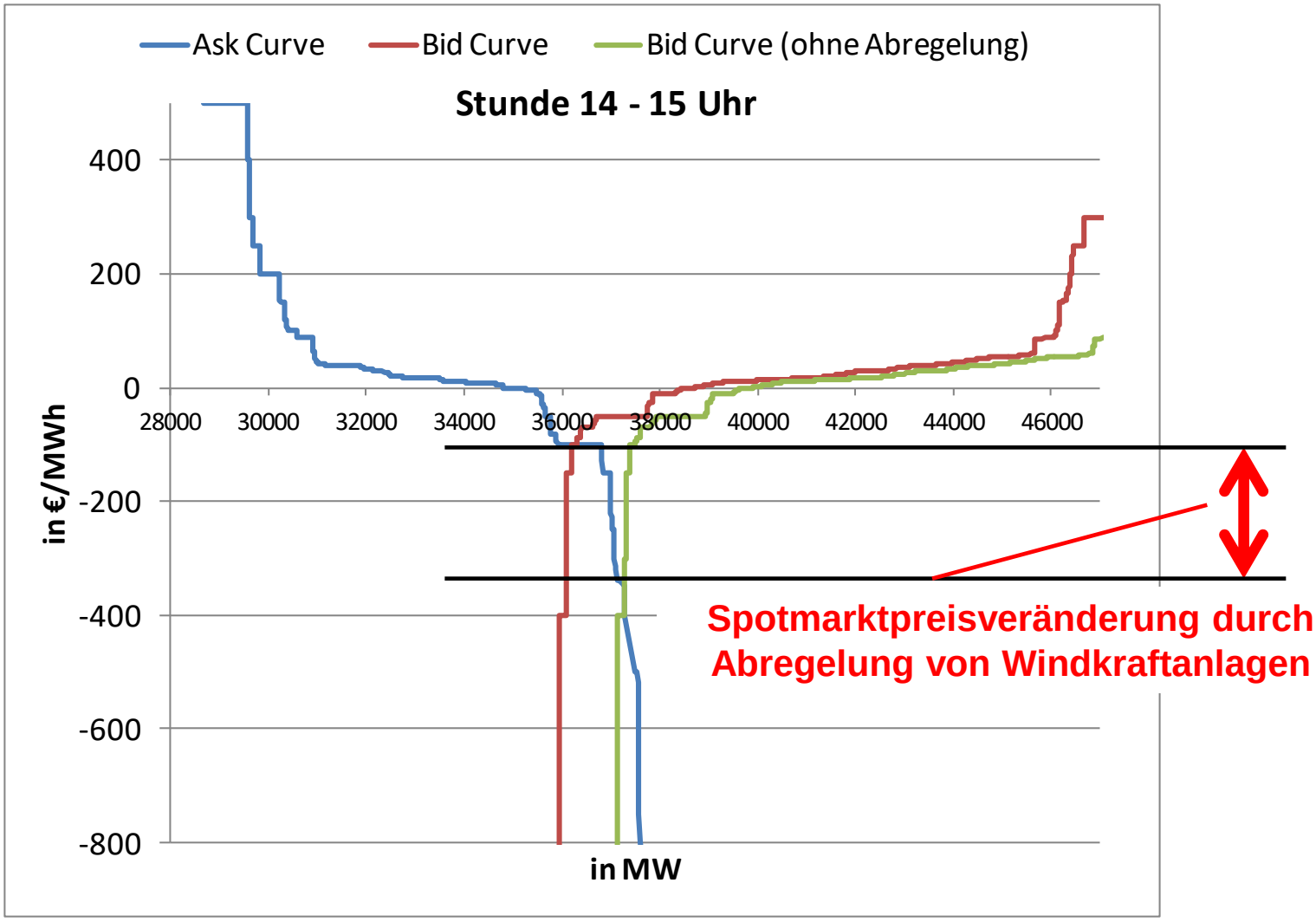


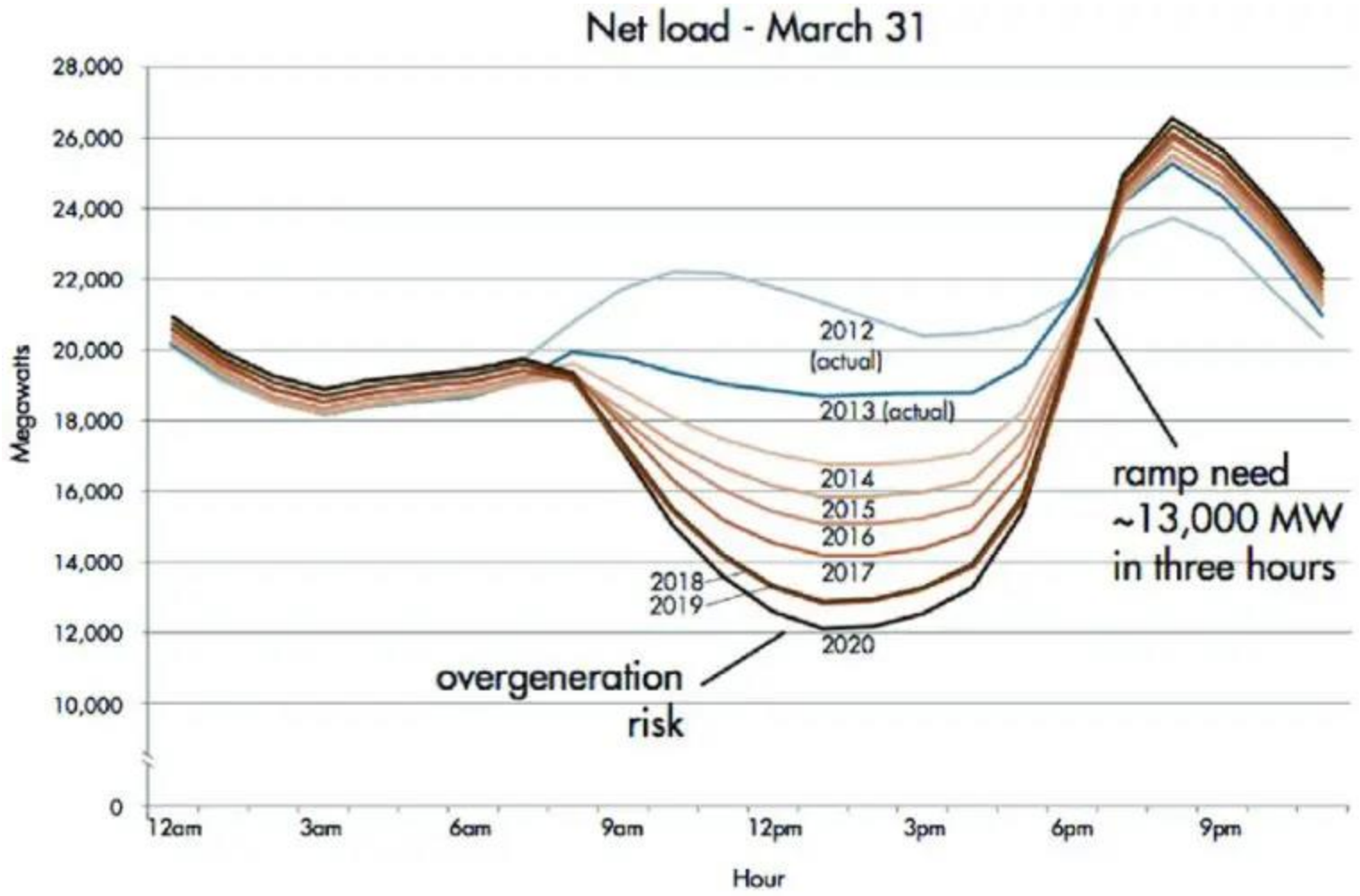
Preisbildung bei Überschuss (aus EET)

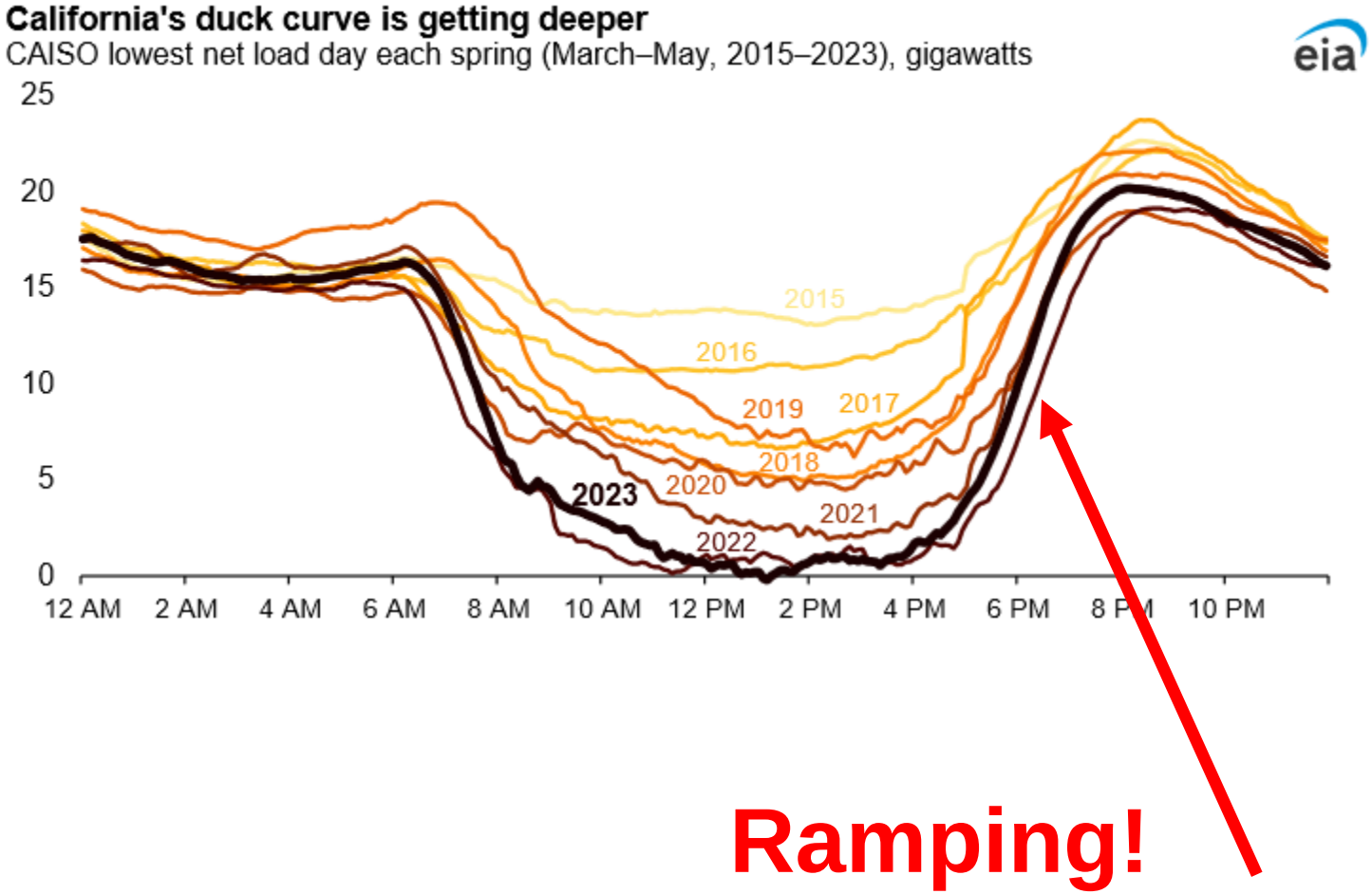


PROBLEM: EINFLUSS TEMPORÄR GROSSER MENGEN EET (?) AUF SPOTMARKTPREISE




Ask Curve
Bid Curve
Bid Curve (ohne Abregelung)
Stunde 14 - 15 Uhr
400
200
0
-200
-400
-600
-800
28000
30000
32000
34000
36000
38000
40000
42000
44000
46000
in €/MWh
in MW
Spotmarktpreisveränderung durch
Abregelung von Windkraftanlagen


Net load - March 31
28,000
26,000
24,000
22,000
20,000
18,000
16,000
14,000
12,000
10,000
0
Megawatts
12am
3am
6am
9am
12pm
3pm
6pm
9pm
Hour
2012
(actual)
2013 (actual)
2014
2015
2016
2017
2018
2019
2020
ramp need
~13,000 MW
in three hours
overgeneration
risk


California's duck curve is getting deeper
CAISO lowest net load day each spring (March–May, 2015–2023), gigawatts
eia
25
20
15
10
5
0
12 AM
2 AM
4 AM
6 AM
8 AM
10 AM
12 PM
2 PM
4 PM
6 PM
8 PM
10 PM
2015
2016
2019
2017
2018
2020
2023
2021
2022
Ramping!

https://www.exaa.at

On time

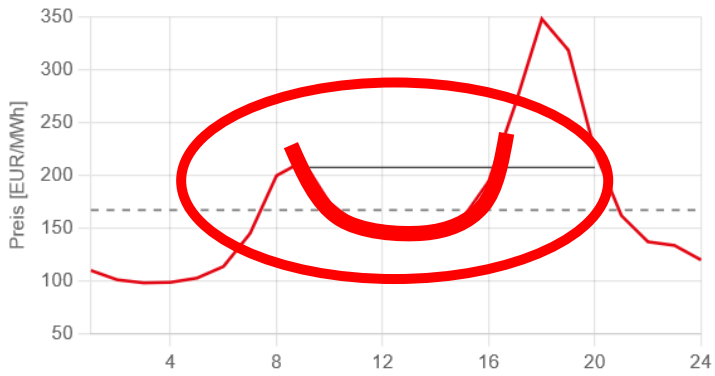
Day Ahead Auktionen Strom

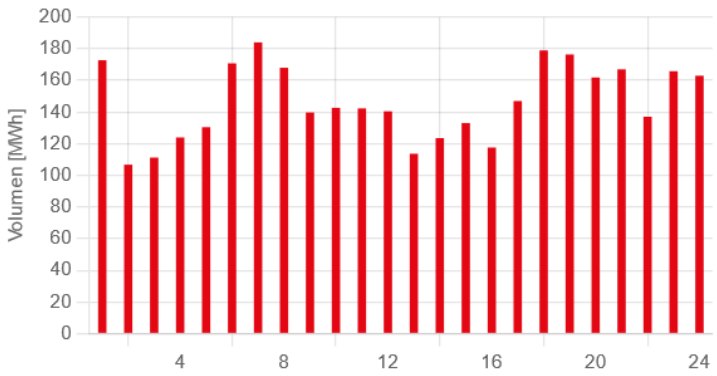
EXAA Austria

Liefertag: 12.11.2024

Auktion: 10:15 | 12:00 MC

Markt: AT





MCP	Base	Peak
	167,11 €/MWh	207,51 €/MWh

Aktuelle Handelsergebnisse

Suchen

Adresse

Desktop

Links

Nac...

7.5.2025

Datei Bearbeiten Ansicht Chronik Lesezeichen Extras Hilfe

Aktuelle Meditationskurse in Wien – | Modelling energy demand und | european electricity sub market | Electricity markets in the EU - Fl | CONTINUOUS INTRADAY MARI | EXAA - Die Strombörse mit fünf

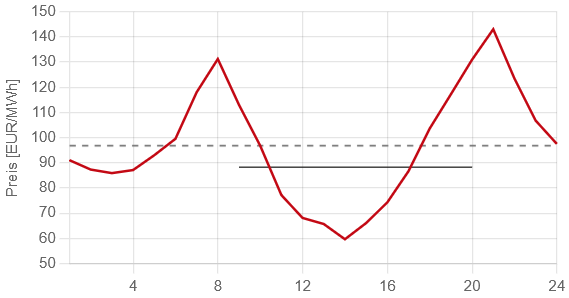
https://www.exaa.at

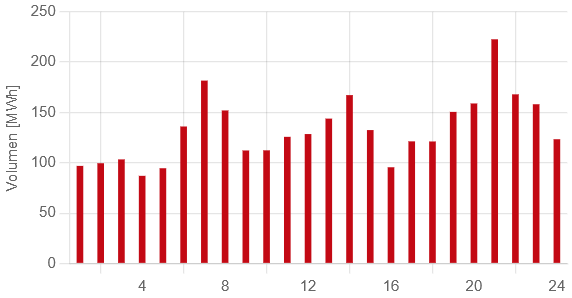
Day Ahead Auktionen Strom

Liefertag: 7.5.2025

Auktion: 10:15 | 12:00 MC

Markt: AT





MCP	Base	Peak
	96,79 €/MWh	88,26 €/MWh

Aktuelle Handelsergebnisse

Im Überblick

EXAA Dienstleistungen & Produkte

Suchen | Adresse | Desktop | Links | 12°C | 10:36 07.05.2025

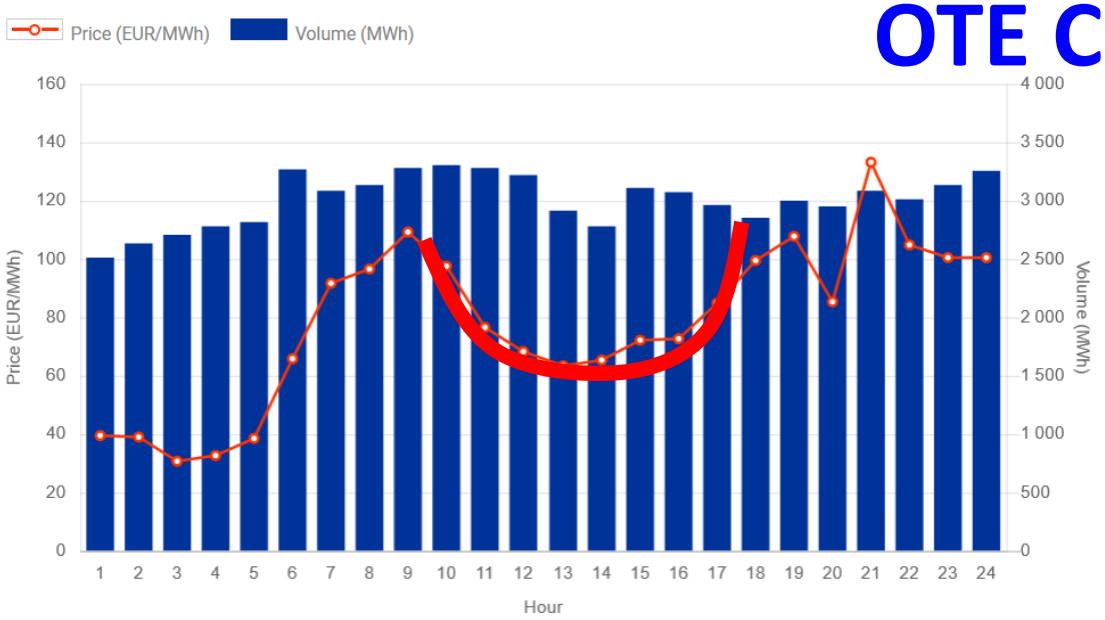
https://www.ote-cr.cz/en/short-term-markets/electricity/day-ahead-market?date=2024-09-11

Day-Ahead Market – DAM

11. September 2024

Day-Ahead Market CZ Results - 11.09.2024

OTE CZ



Index	EUR/MWh	Change (%)	Total volume CZ (MWh)
BASE LOAD	78,16	1,92	72 142,7
PEAK LOAD	83,53	16,14	36 713,7

Electricity

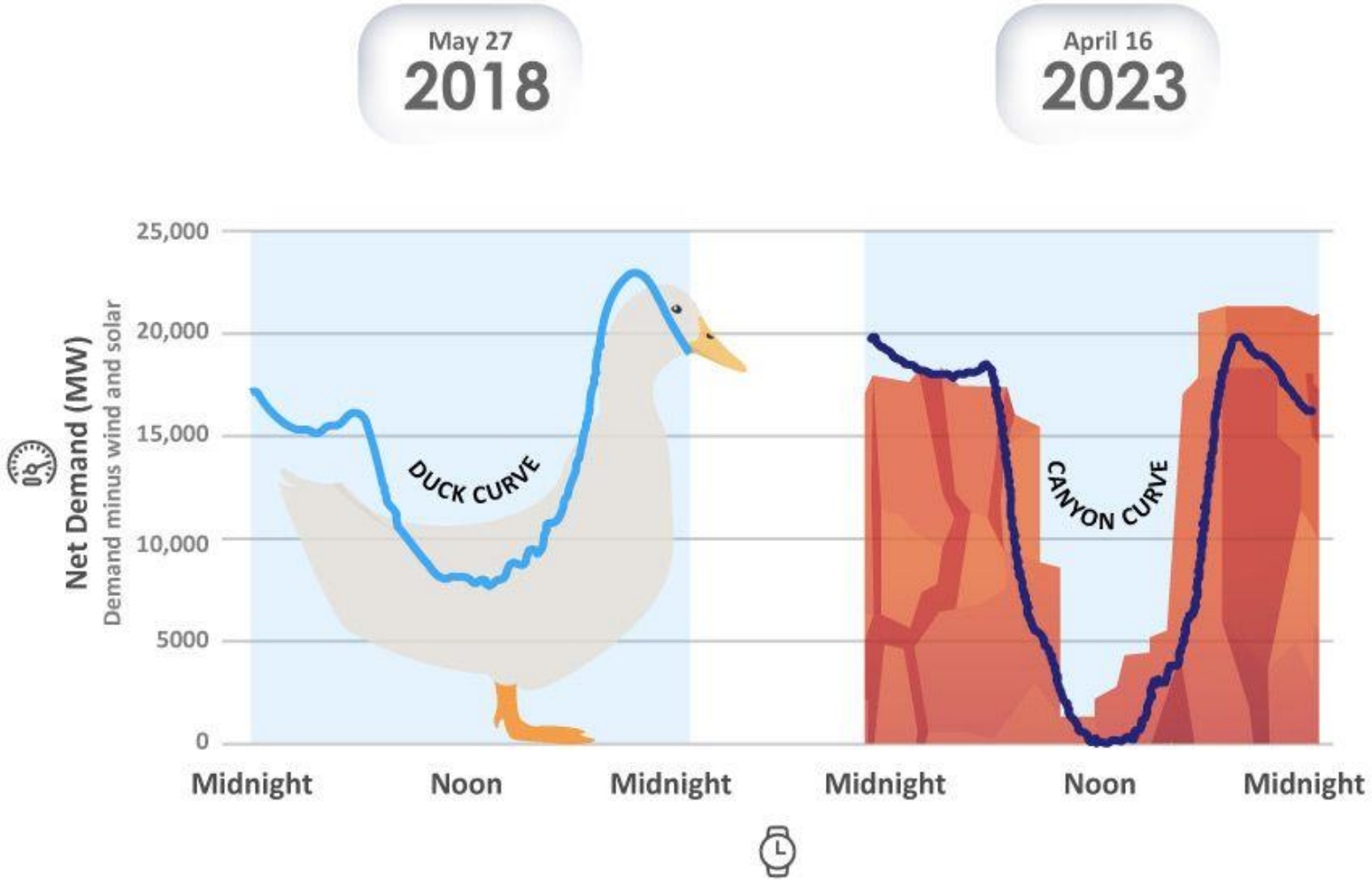
- Parameters of short-term markets
- » **Day-Ahead Market – DAM**
- DAM profile data
- DAM CORE - PTDF and RAM
- DAM Matching Curves
- DAM Spot Market Index
- Intraday Market - Continuous IM
- Intraday Market - Auction IDA
- IDA profile data
- IDA Matching curves
- IDA Market Index
- Mobile application OTE IM Power

Gas

REMIT

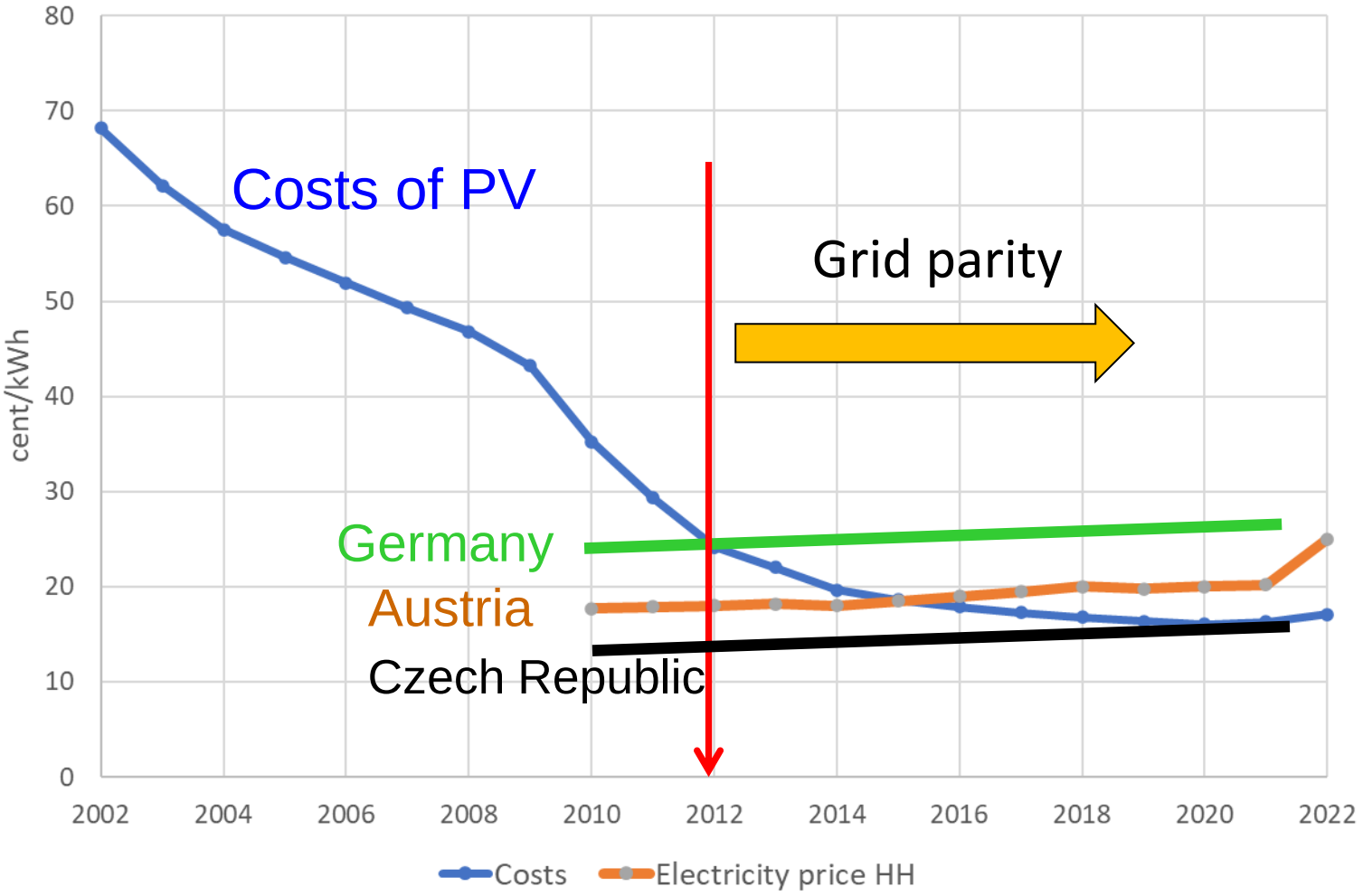
Market Coupling - Day-Ahead market

Market Coupling - Intraday Market

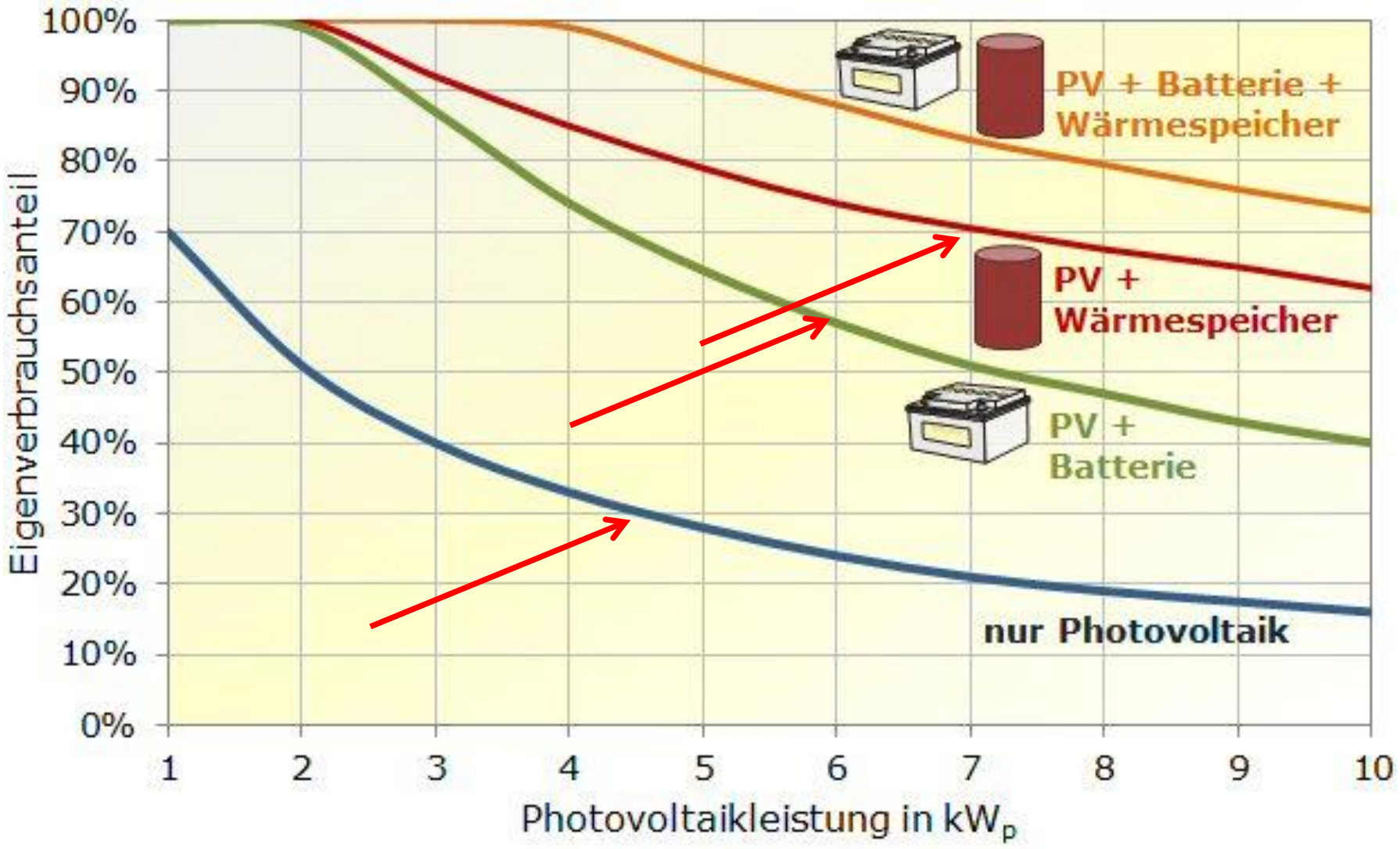

May 27
2018
April 16
2023
Net Demand (MW)
Demand minus wind and solar
25,000
20,000
15,000
10,000
5000
0
DUCK CURVE
CANYON CURVE
Midnight
Noon
Midnight
Midnight
Noon
Midnight

6. RETAIL MARKETS: TOWARDS PROSUMAGERS AND ENERGY COMMUNITIES

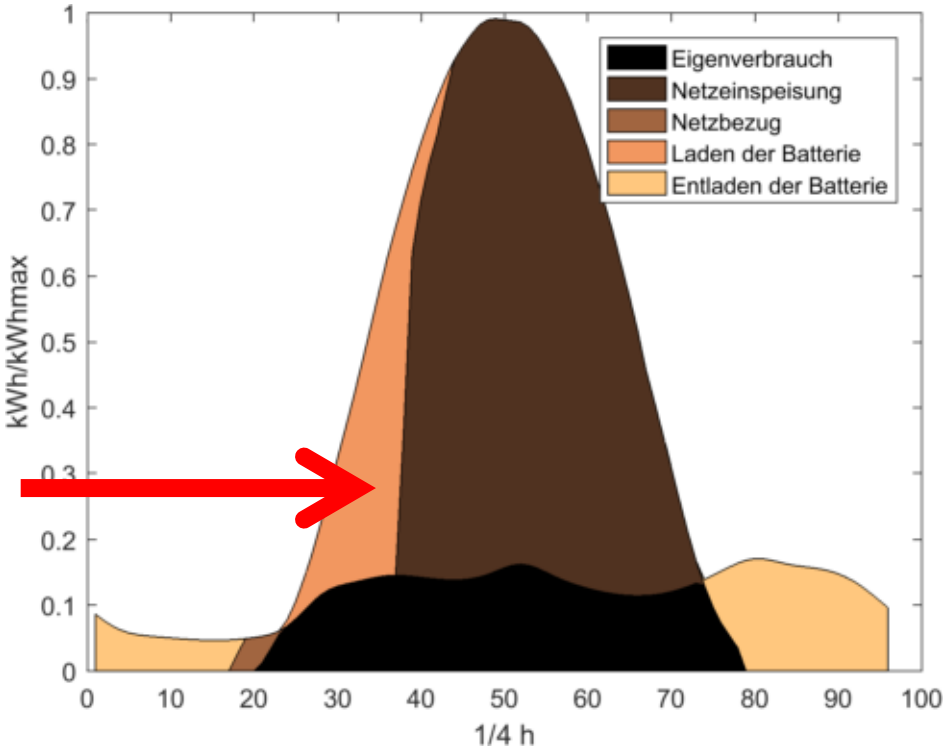
Grid parity: PV-costs and household electricity prices

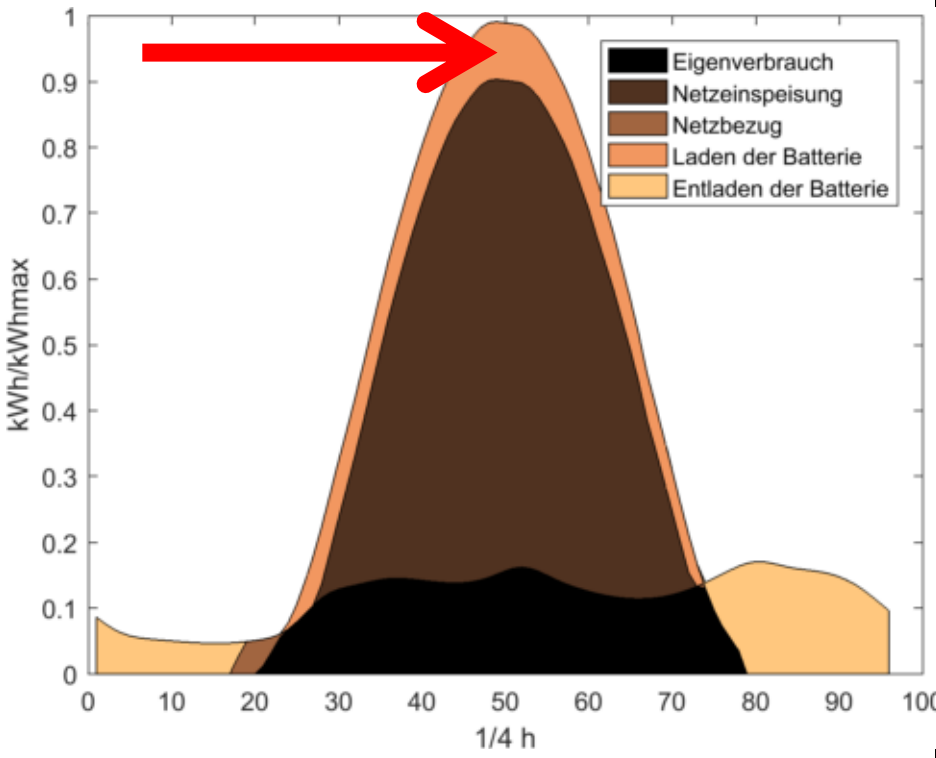


Eigenverbrauchsanteil:

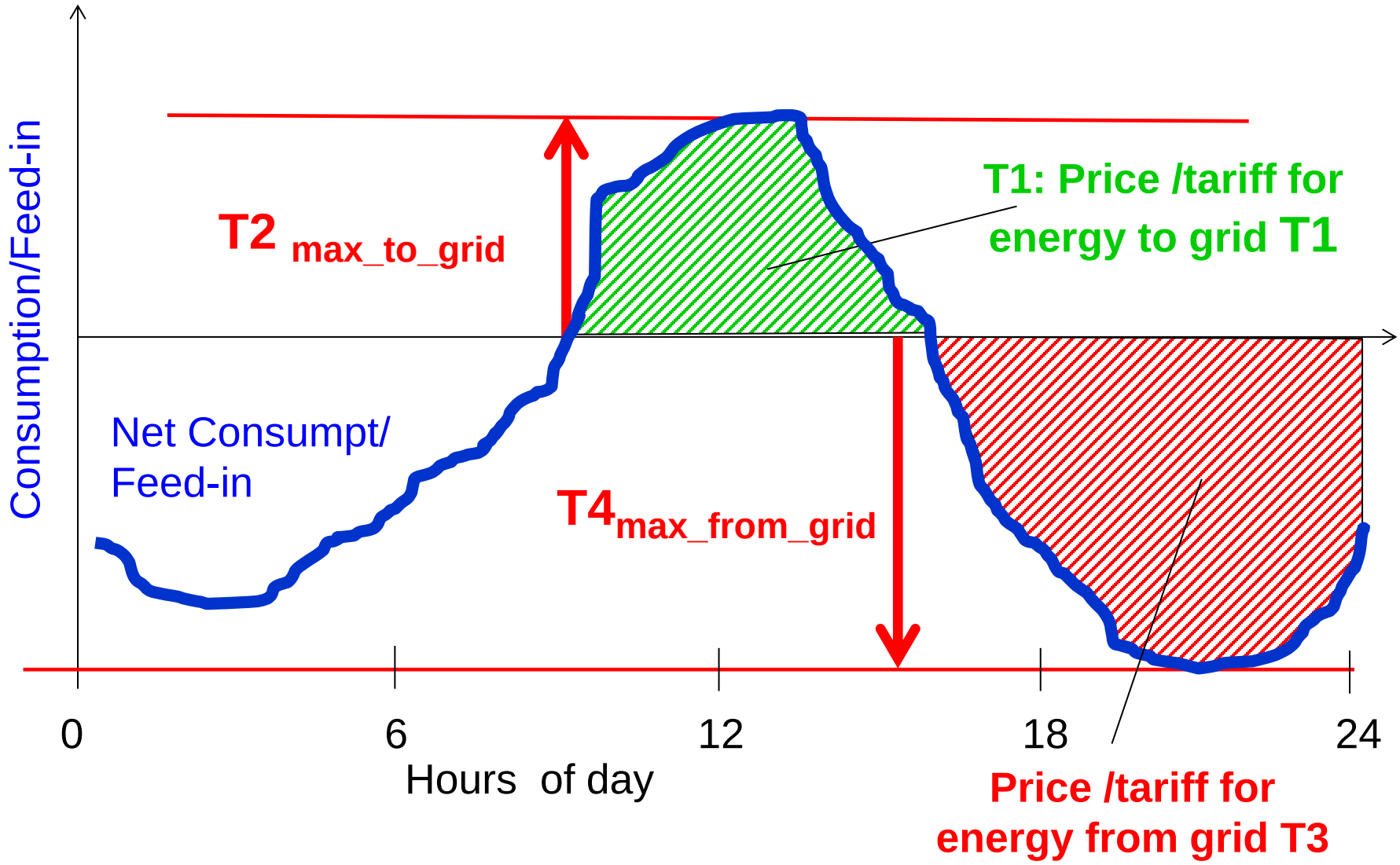


Koordinierte und nicht koordinierte Speichernutzung

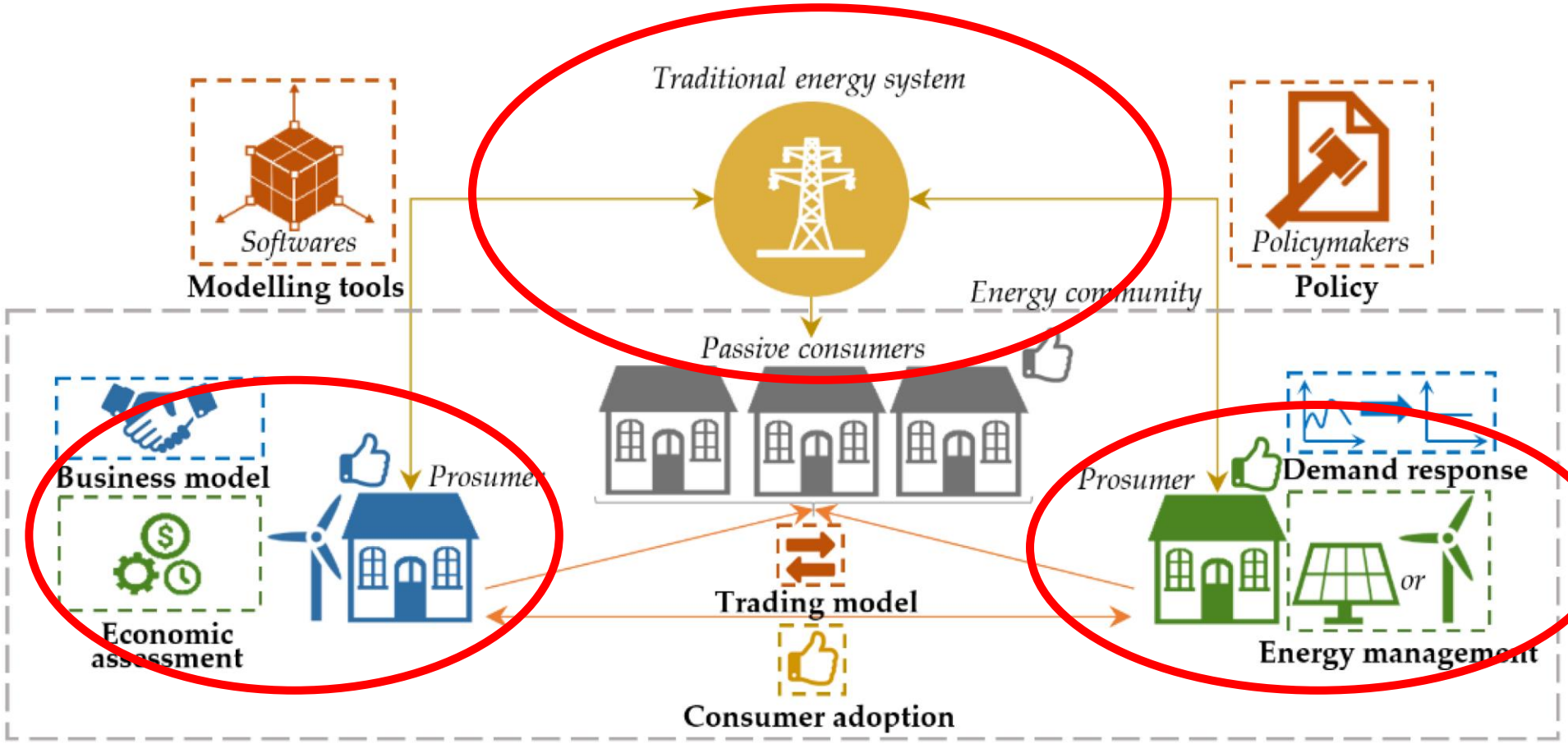




Bidirectional tariffs (and prices) for Power and energy



Energy Communities



New Thinking: Making the electricity system more democratic