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Winter outlook – lessons learned from the “Dunkelflaute”

Montel German Energy Day
April 3, 2025

Prof. Dr.-Ing. Christof Bauer
Technische Universität Darmstadt
Infraserv GmbH & Co. Höchst KG

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Dunkelflaute – when does it matter?

ute“
) as

- Low power generation from supply-dependent renewables
- Little/no wind
- No sun

- Night in summer
- Late afternoon/early evening in winter
- High Pressure Area

+

High power
consumption

- High load from
- Industry
 - Households

- Working day
- Noon & late afternoon/ early evening
- Cold outside temperatures

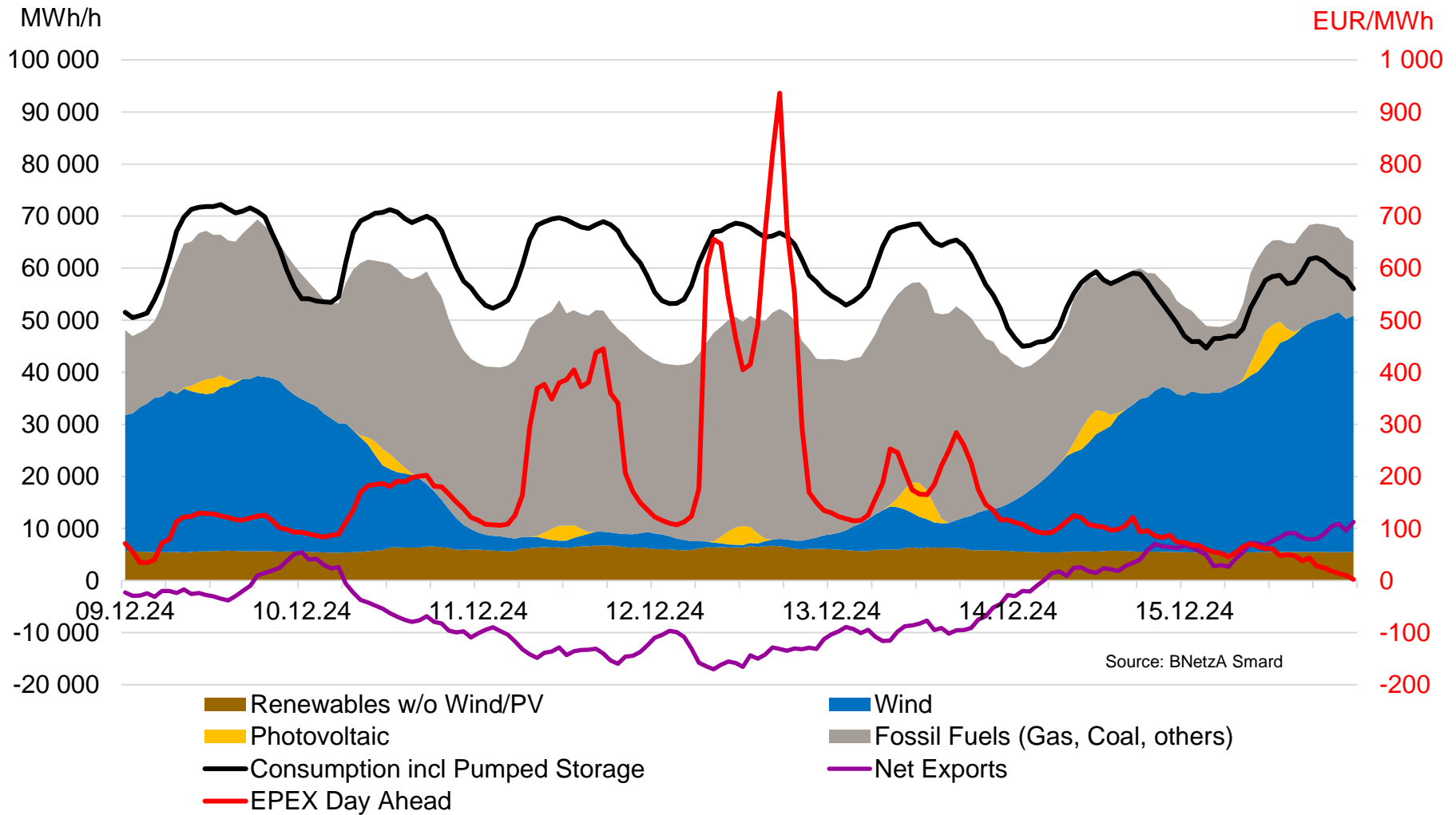
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„Kalte
Dunkelflaute“
(cold & dark
calm, CDC)

High demand for
power generation with
assured capacity (or
storage or DSM)
→ High power prices
& imports

- Working day
- Winter
- Late afternoon / early evening

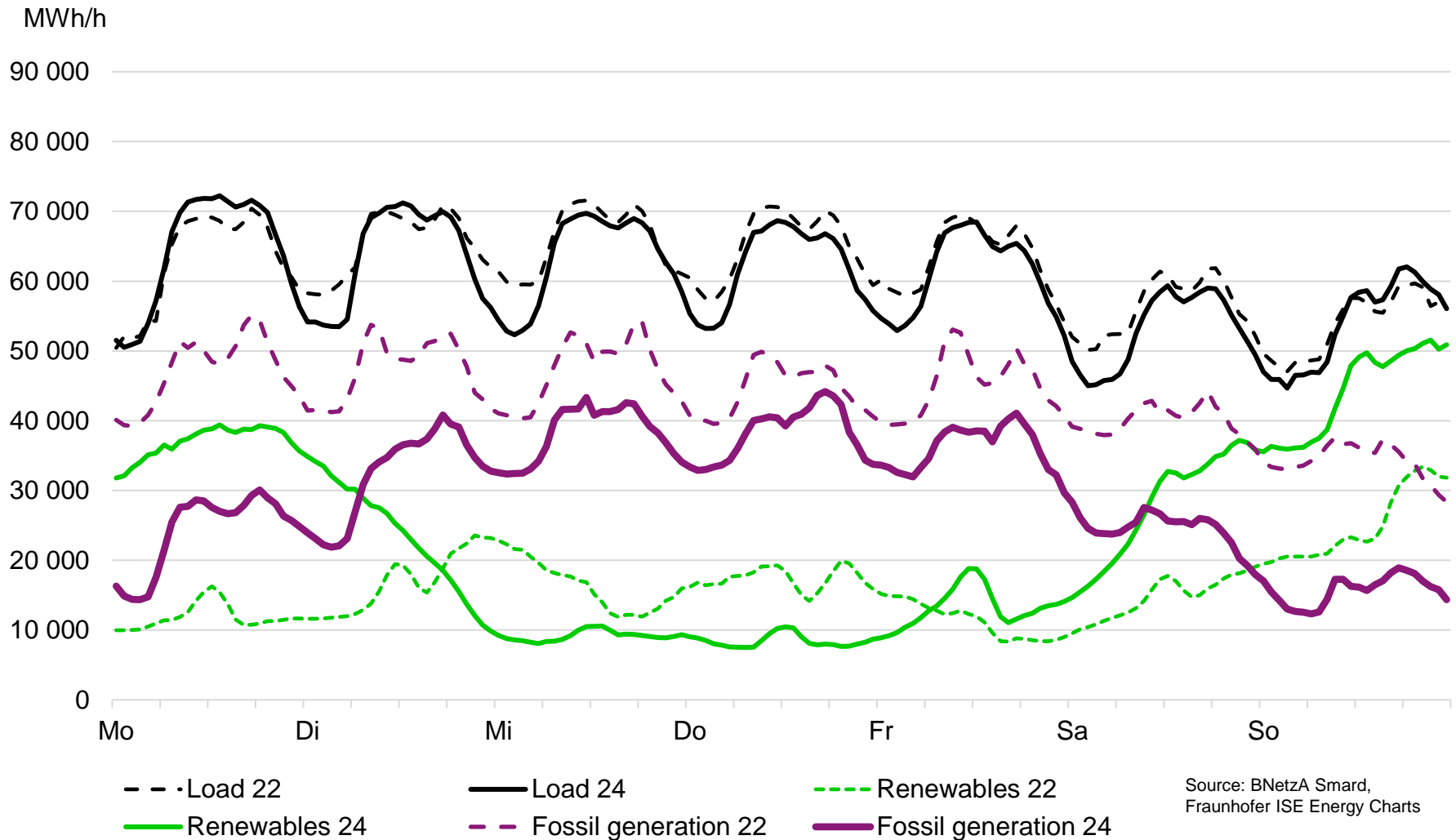
„Kalte Dunkelflaute“ Calendar Week 50, 2024



- **Peak Load @ 75 GW**
- **Min. Generation from Renewables @ 8,3 GW**

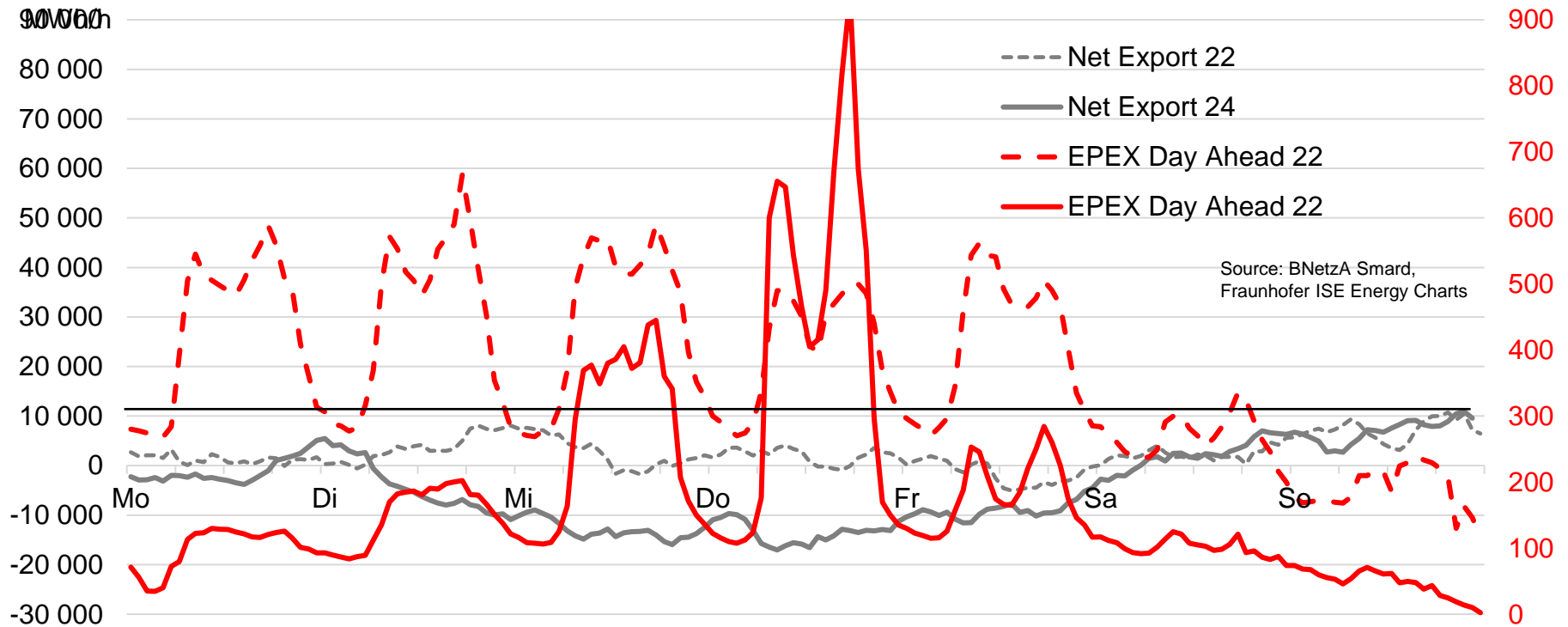
- **Fossil Generation never above 50 GW**
- **Power Price above 900 EUR/MWh**
- **Max. Net Import @ 17 GW (all-time high)**

Deja Vu – Calendar Week 50, 2022 vs. 2024



- **Consumption almost identical**
- **Renewables generation 2024 slightly below 2022**
- **Maximum fossil generation 2024: 12 GW below 2022**

EPEX Day Ahead and Net Export Calendar Week 50, 2022 vs. 2024



- **Historically highest net import in 2024 approx. 12 GW above 2022**
- **Decline in fossil fuel capacity compensated by imports**

- BNetzA comment:

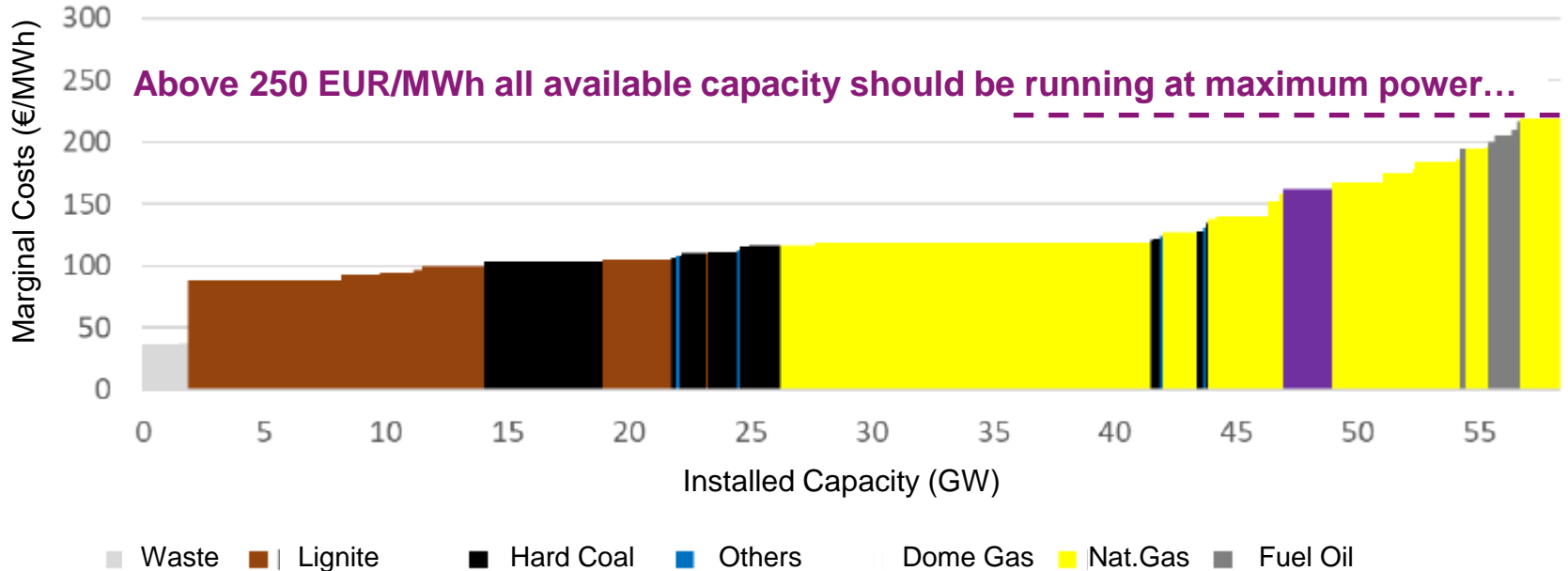
<https://www.bundesnetzagentur.de/1040776>

“This means that it made economic sense to import electricity cheaper from abroad than to generate it at higher prices in Germany...

Power supply is not at risk. Germany has sufficient generation capacities.”

Occurrence of Price Peaks increasing – not only in Germany

Merit Order for 2024/25 as assumed by NetzA:



Quelle: BNetzA Feststellung des Bedarfs an Netzreserve für den Winter 2024/2025 sowie den Betrachtungszeitraum April 2026 bis März 2027

In fact, prices above 250 EUR/MWh are increasing significantly:
Imports are increasing and industrial plants start curtailing their production...

November-January	23/24	24/25
Prices > 250 EUR/MWh	1	73
Net Imports > 10 GWh	29	229
Both conditions applying:	0	60

Do we need “Dark Forces” in order understand what is going on?

Reduction of (assured) Fossil Power Plant Capacity, End of 2024 vs. 2022	Capacity (GW)
Release of reserve capacity for market participation (by legal action)	
Lignite	1,7
Hard Coal	4,8
Delay of coal-fired power plant decommissioning (by legal action)	2,1
Decommissioning of assured capacity	
Nuclear	4,1
Lignite	1,3
Transfer of coal-fired plants into „capacity reserve“	1,3
Total	13,6

Source: BNetzA Kraftwerksliste

Reduction of Assured Capacity 2023/24 (Net Capacity in GW)

- **Irreversibly Decommissioned**
 - Nuclear: 4,1
 - Lignite: 3,2
 - Hard Coal: 2,7
 - **Total:** **10,0** , thereof 5,9 in 2024
- **Present Reserves (withheld from market)** **9,9**
thereof
 - **„Capacity Reserve“** (Natural Gas) **1,3**
 - **„Grid Reserve“** **8,6**
thereof
 - Hard Coal: 6,4
 - Natural Gas 1,3
 - Fuel Oil 0,9

Source: BNetzA Kraftwerksliste

(Not included: 1,3 GW of gas and oil fired power capacity operated by TSOs as „special network equipment“)

Reserve Capacity may only be operated in order to guarantee system stability at the discretion of TSOs – no influence on power market!

Required Reserve Capacity („Grid Reserve“)

Required Reserve Capacity as decided by BNetzA
for future Winter Period 26.02.25 reaching **All-time High**

Report of	2021/2022	2022/2023	2023/2024	2024/2025	2025/2026	2026/2027
30. April 2024				6.947		9.202
31. Mai 2023					10.202	
28. April 2023			4.616			
29. April 2022		8.264	5.361			
28. April 2021	5.670		4.169			
30. April 2020				8.042		
30. April 2019		10.647				
27. April 2018						
28. April 2017						
29. April 2016						
4. Mai 2015						
26. September 2014						
2. Mai 2014						
30. September 2013						

BNetzA Feststellung des Bedarfs an Netzreserve für den Betrachtungszeitraum April 2025 bis März 2026:

“The remaining additional demand for generation capacity as grid reserve amounting to 4322 MW would have to be covered by foreign power plants.”

More and Higher Price Spikes...

- ... unsettle the market and present an **incalculable risk to industrial spot market procurement**
- ... **drive prices up also in the futures market** (risk premiums, regulatory measures against negative prices will reduce downside effect)
- ... are "exported" from Germany to neighbouring countries and **torpedo intra-European solidarity** (s. Sweden's reaction)
- ... are **not decisive for the profitability of electricity storage projects** (whose main driver are day-night price differences in summer!)
- ... have **outlived themselves as a necessity to foster market investments in power plants** (obviously substantial subsidies are required anyway in order to incentivize new gas/H₂-fired power stations)

and will further increase if

- ... **German industry recovers** and **electrification increases** (peak power still approx 10 GW below 2021/22 levels)
- ... climate change related **stationary high pressure areas in winter increase** (cold & calm weather)
- ... **coal phaseout continues w/o simultaneous compensation** by other power generation with assured capacity

Logical Consequences...

Stop further reduction of assured power plant capacity!

- Temporary interruption of regulatory driven coal phase-out
- Power stations intended for decommissioning by owner's decision should be assigned to reserve capacity pool – exception only if assured capacity is simultaneously substituted

Allow power stations in the reserve capacity pool to participate in the market during winter season!

...until additional assured capacity will become available in the **German power market** (e.g. by the regulatory driven „Kraftwerksstrategie“ and/or a functioning capacity market)!

*If we already have to pay for power capacity
(as in a capacity market) -
why shouldn't we also have the benefit?*

