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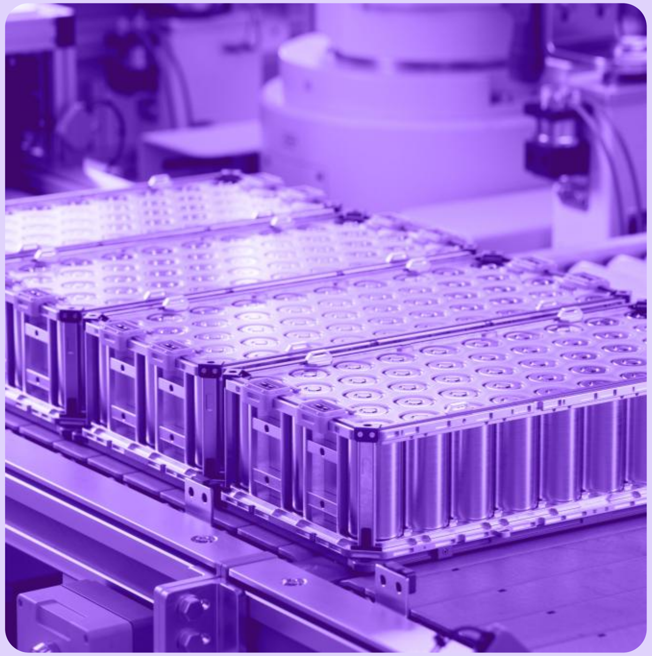
WELCOME TO THE SOLAR FLEX ERA

NATIONAL DEEP-DIVE: HOW ARE THE LEADING SOLAR MARKETS DEALING WITH NEGATIVE PRICES IN EUROPE?



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MICHAEL FUHS

Editor in Chief,
PV Magazine

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SPEAKERS

David Wedepohl

Managing Director International Affairs,

German Solar Association

Nold Jaeger

Head of Policy & Public Affairs,

Holland Solar

José Donoso

CEO,

UNEF

Vegard Wiik Vollset

Head of Renewables & Power, EMEA,

Rystad

Michael Fuhs

Editor in Chief,

PV Magazine

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VEGARD WIIK VOLLSET

Head of Renewables & Power,
EMEA, Rystad

RystadEnergy

Solar cannibalization & negative prices

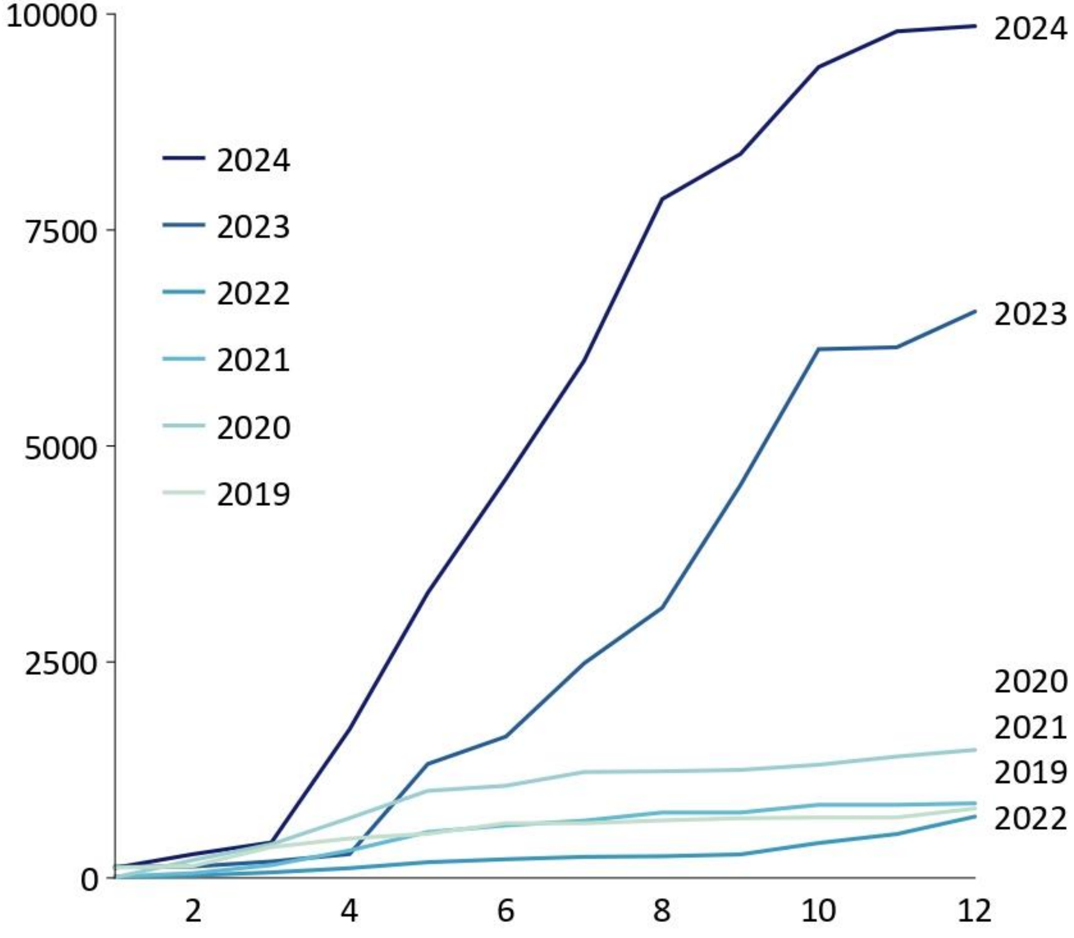
Solar Power Summit 2025

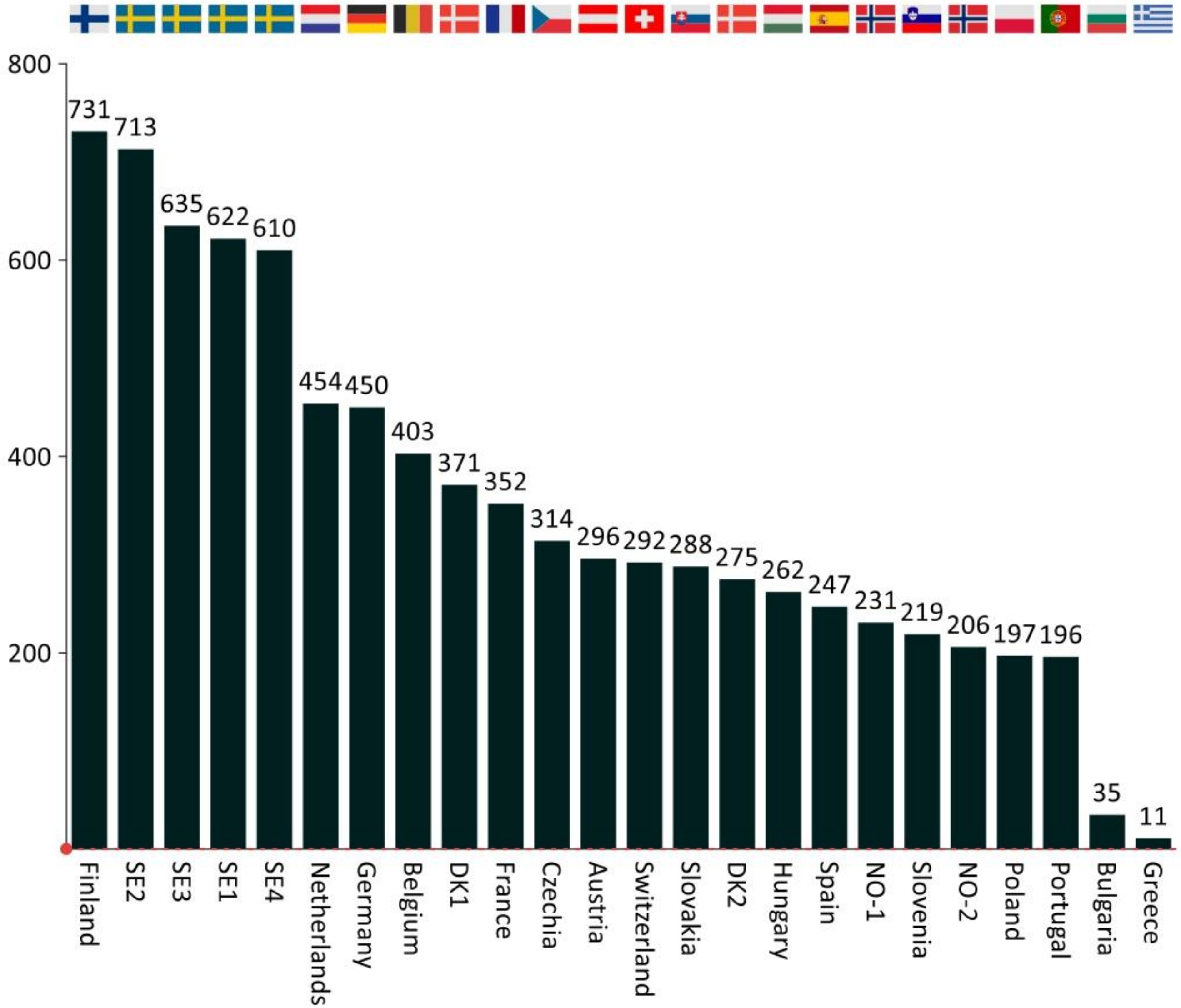
Vegard Wiik Vollset, Head of Renewables & Power - EMEA

Explosion of negative prices across European geographies

Cumulative hours of negative prices in Europe

hours



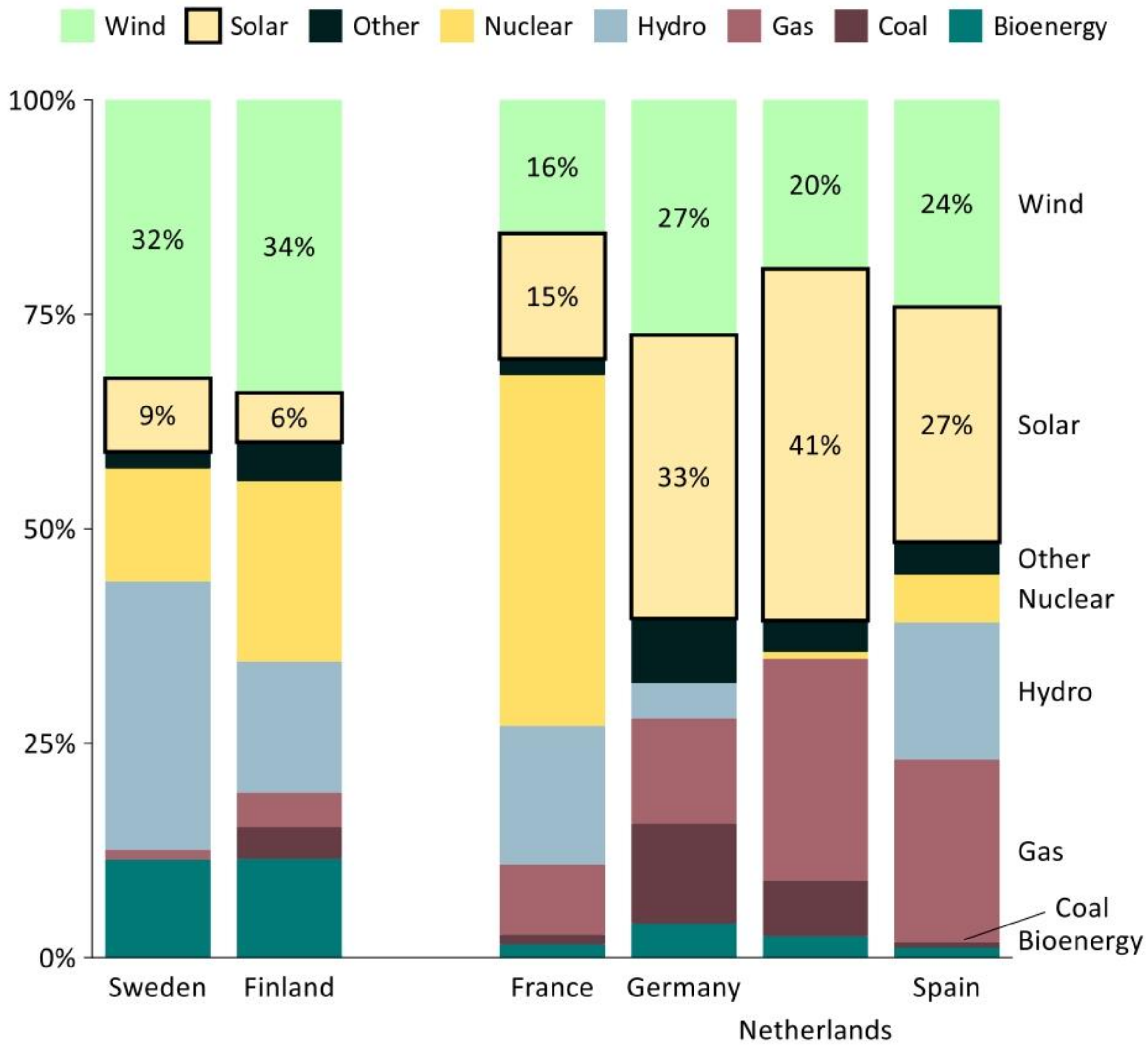


Source: Rystad Energy European Renewables & Power Solution; ENTSO-E

RystadEnergy

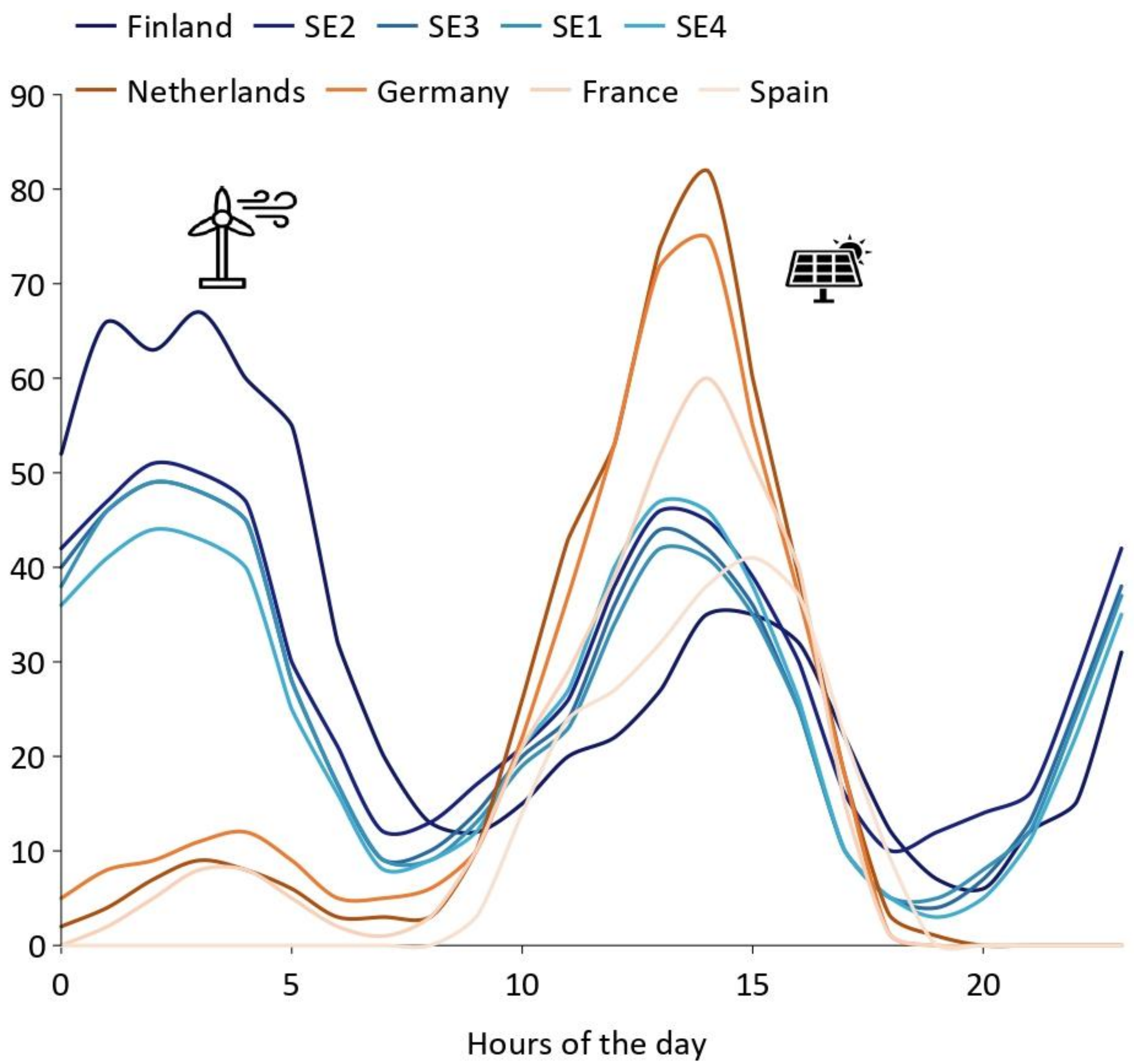
Wind or solar causing negative prices?

Share of installed capacity by energy source in power mix



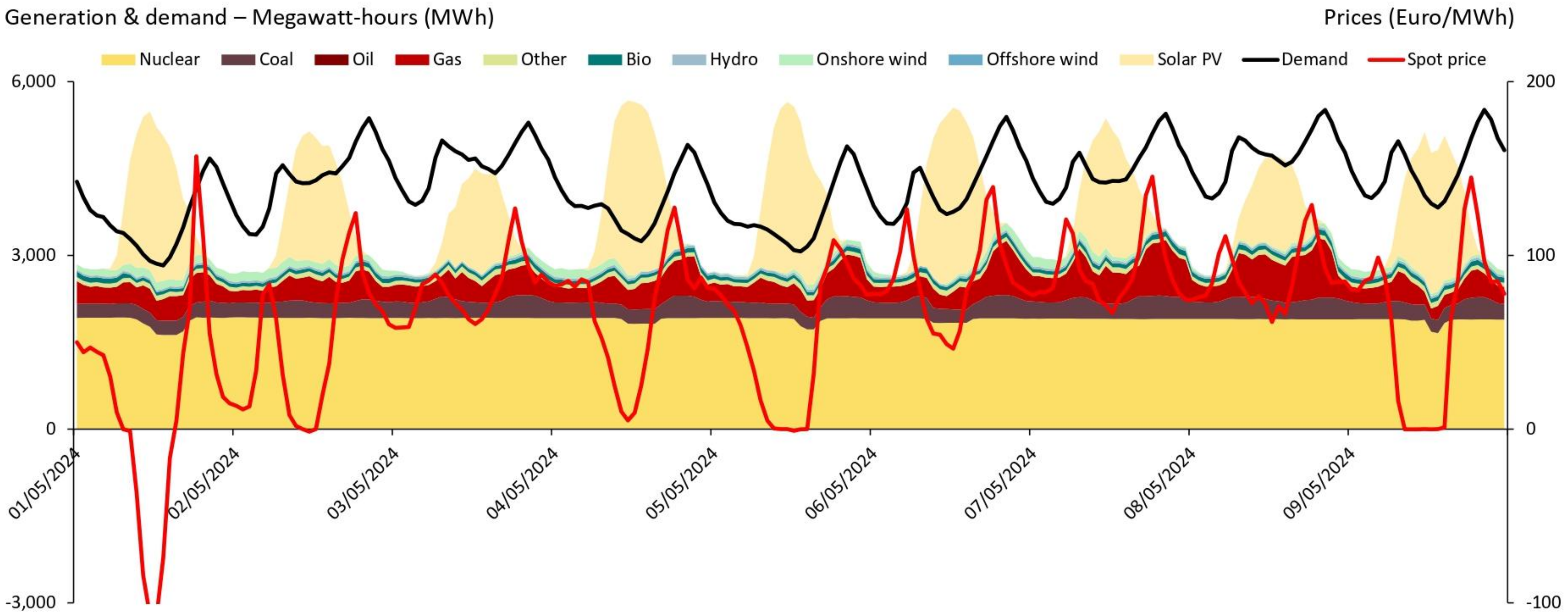
Source: Rystad Energy European Renewables & Power Solution

Distribution of hours with negative prices over the day - # of hours



RystadEnergy

Hungary – the prime example of solar and non-flexible baseload – extreme volatility



Source: Rystad Energy Europe Renewables & Power solution; ENTSO-e

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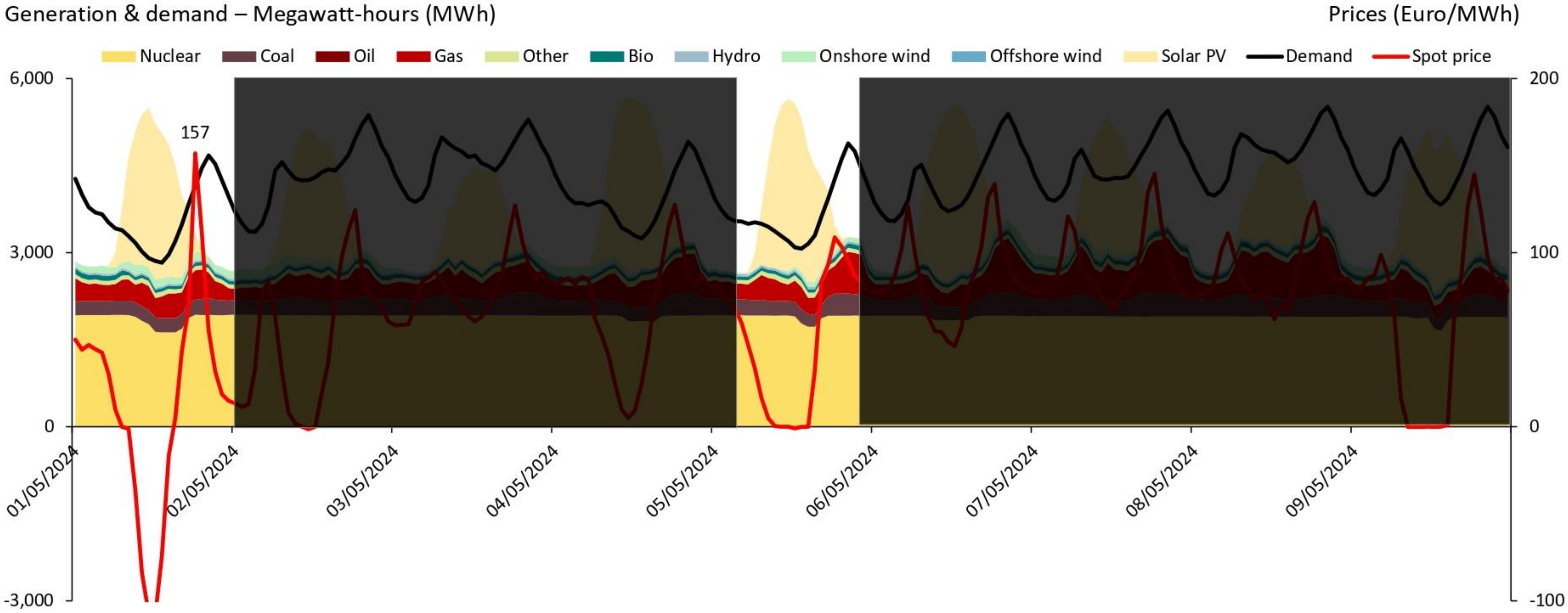
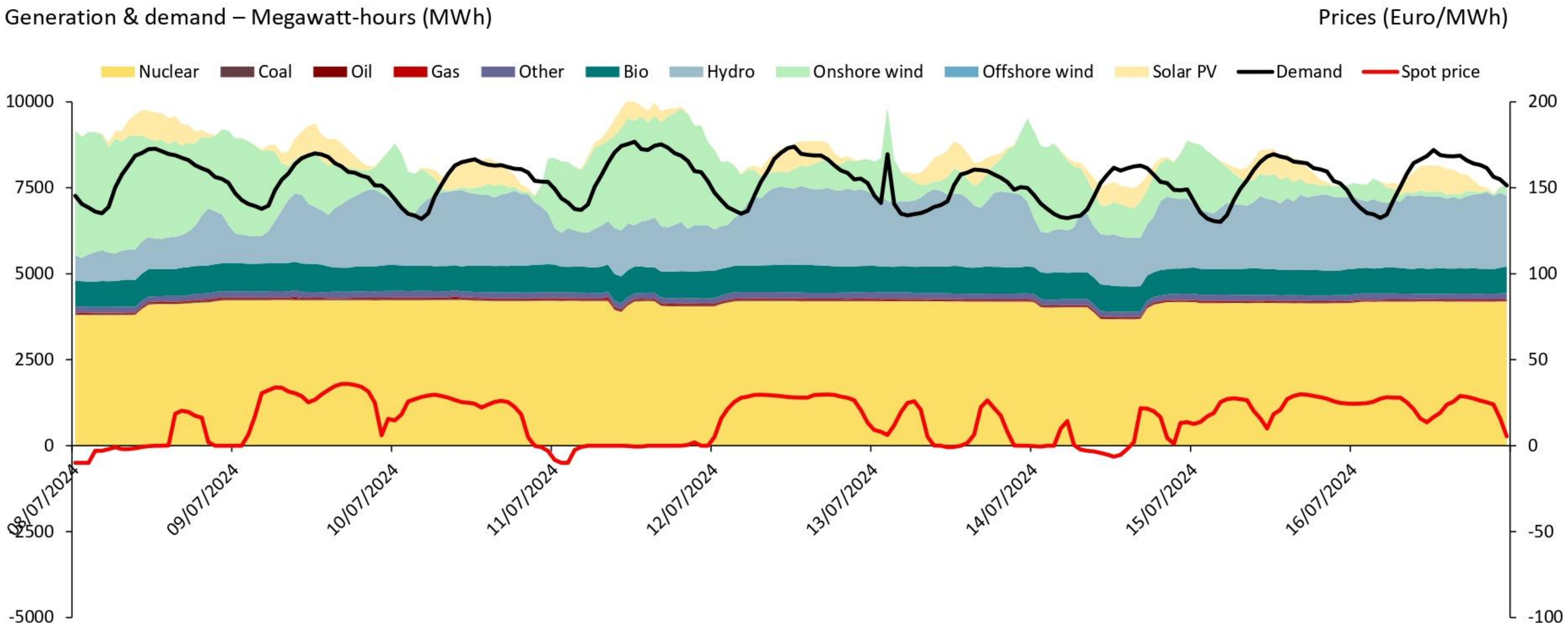


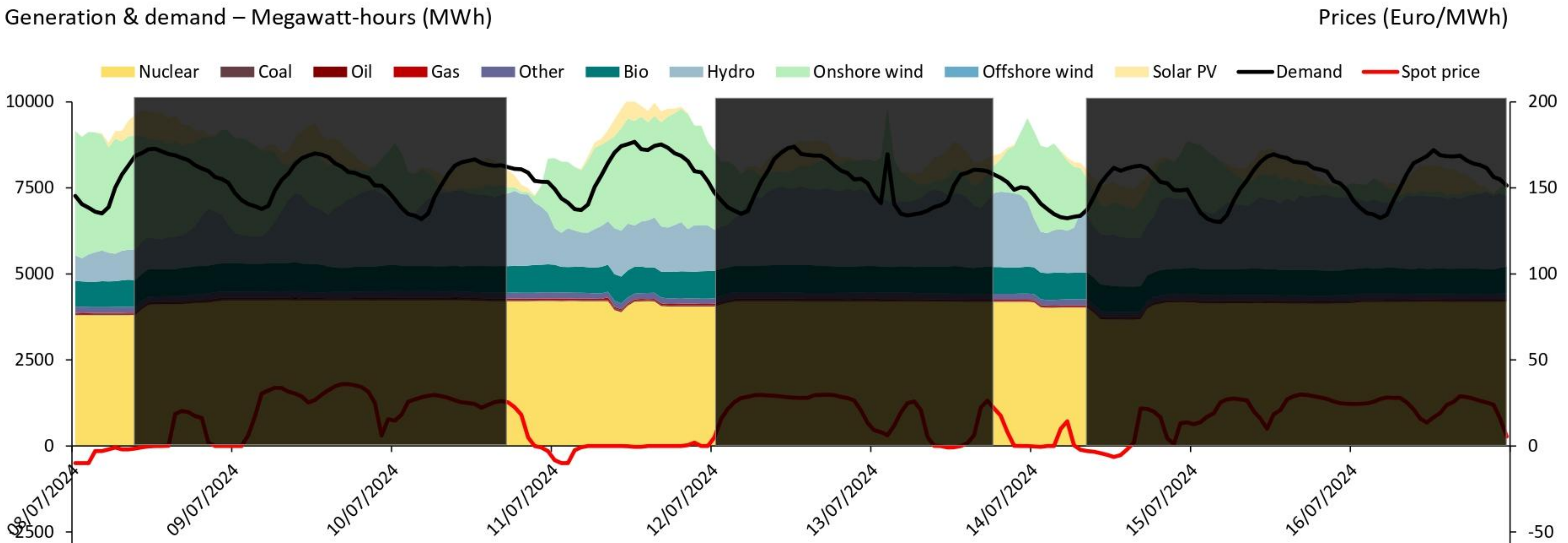
Source: Rystad Energy Europe Renewables & Power solution; ENTSO-e

Finland – variable wind meets inflexible nuclear



Source: Rystad Energy Europe Renewables & Power solution; ENTSO-e

Finland – variable wind meets inflexible nuclear

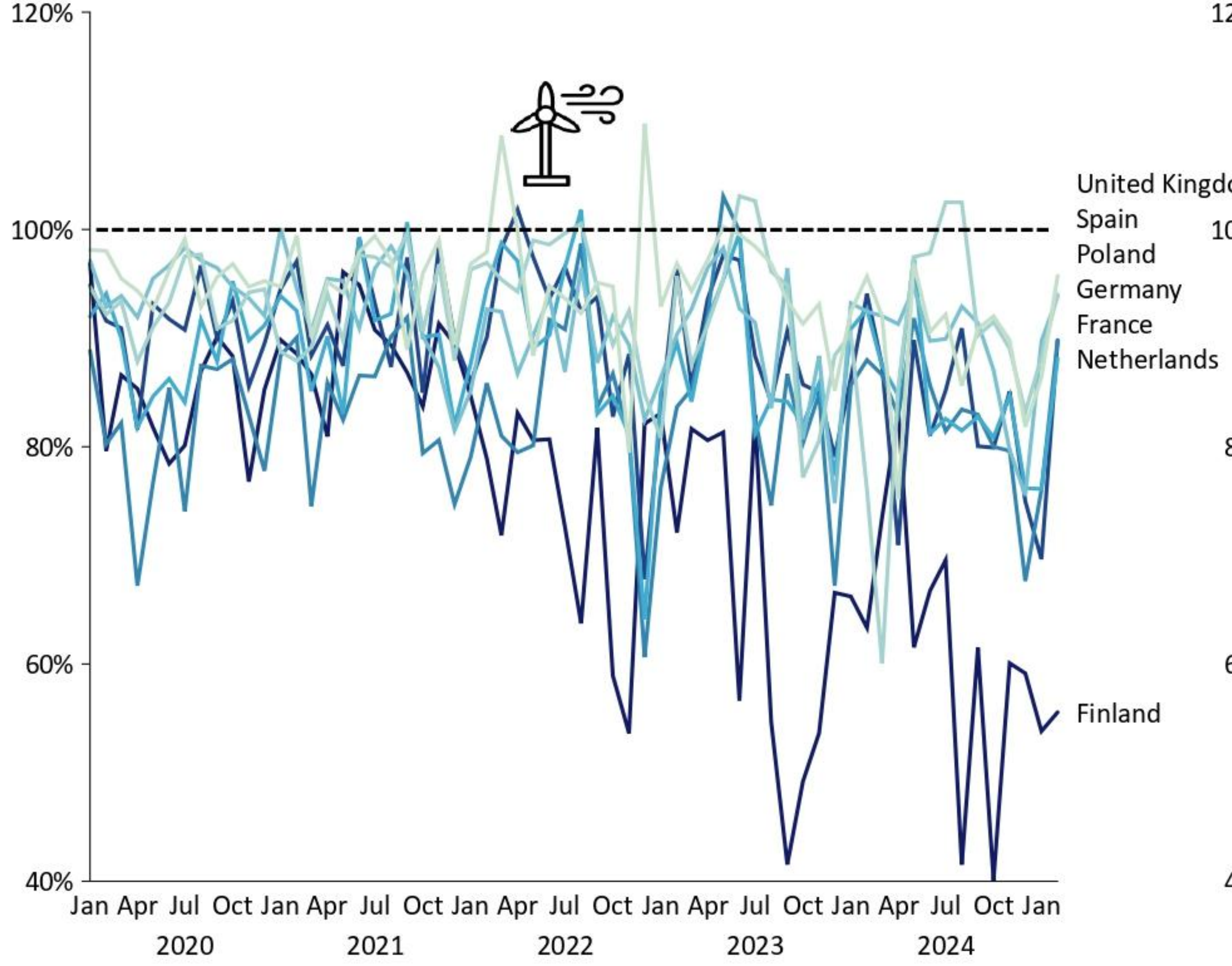


Source: Rystad Energy Europe Renewables & Power solution; ENTSO-e

Negative prices is one thing but key challenge is overall cannibalization of revenues

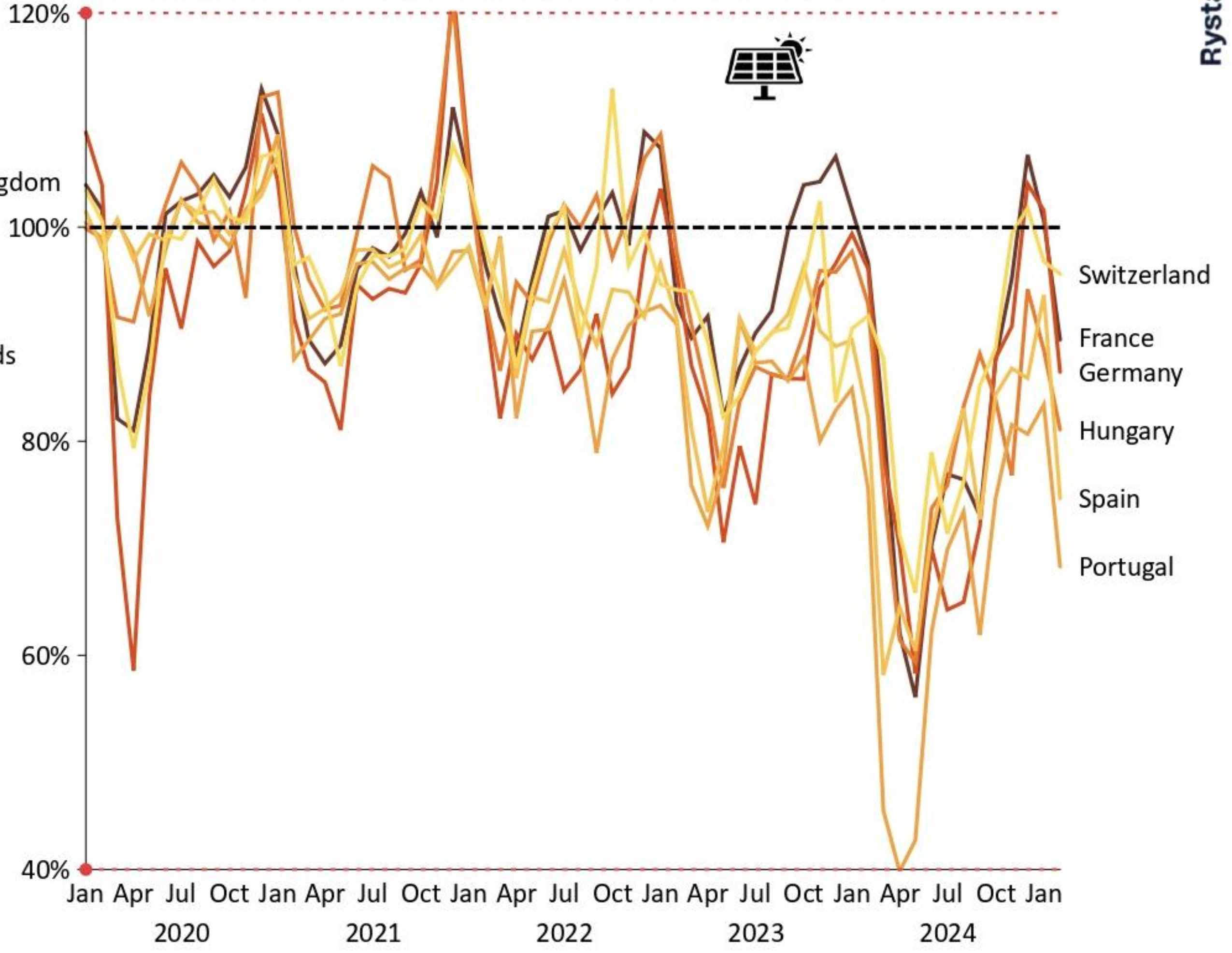
Onshore wind capture rates – 2020 - 2025

Estimated received prices as % of monthly spot prices



Solar PV capture rates – 2020 - 2025

Estimated received prices as % of monthly spot prices

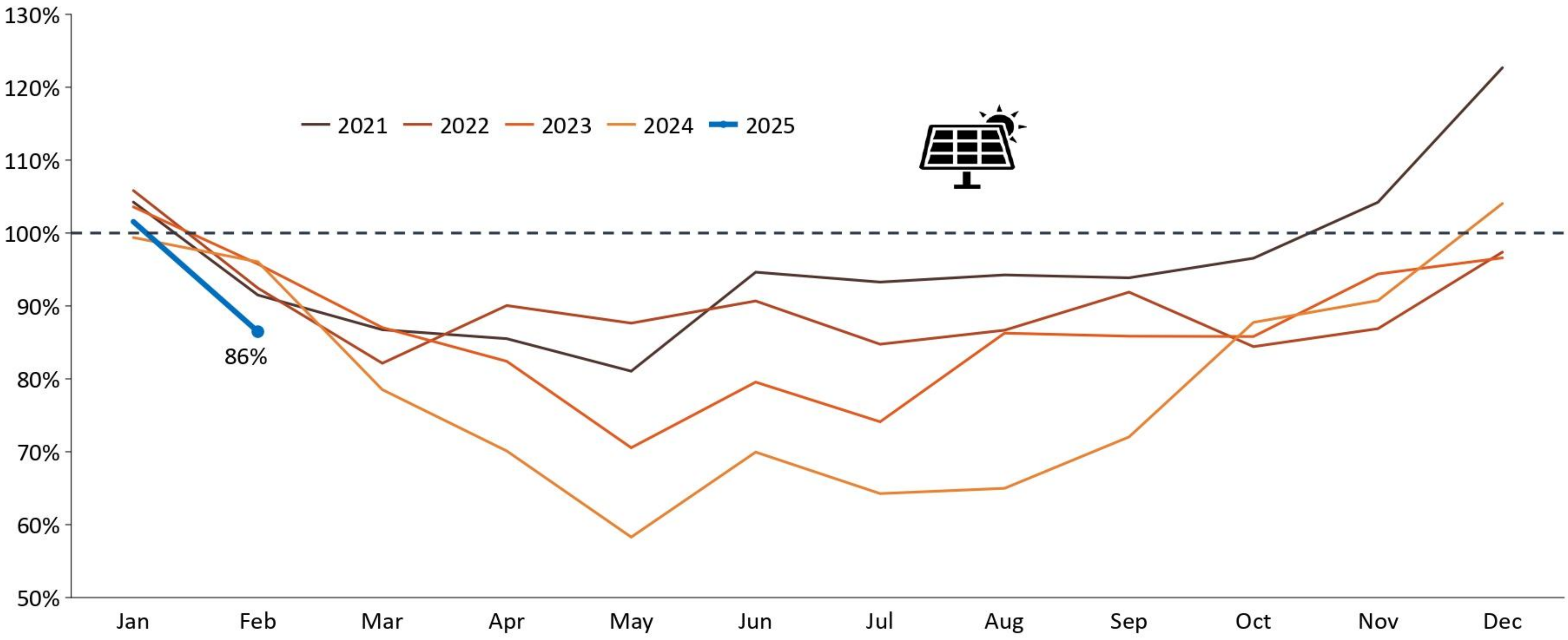


Source: Rystad Energy European Renewables & Power Solution; ENTSO-E

No signs of slowing down in 2025

Solar PV capture rates – 2021- 2025

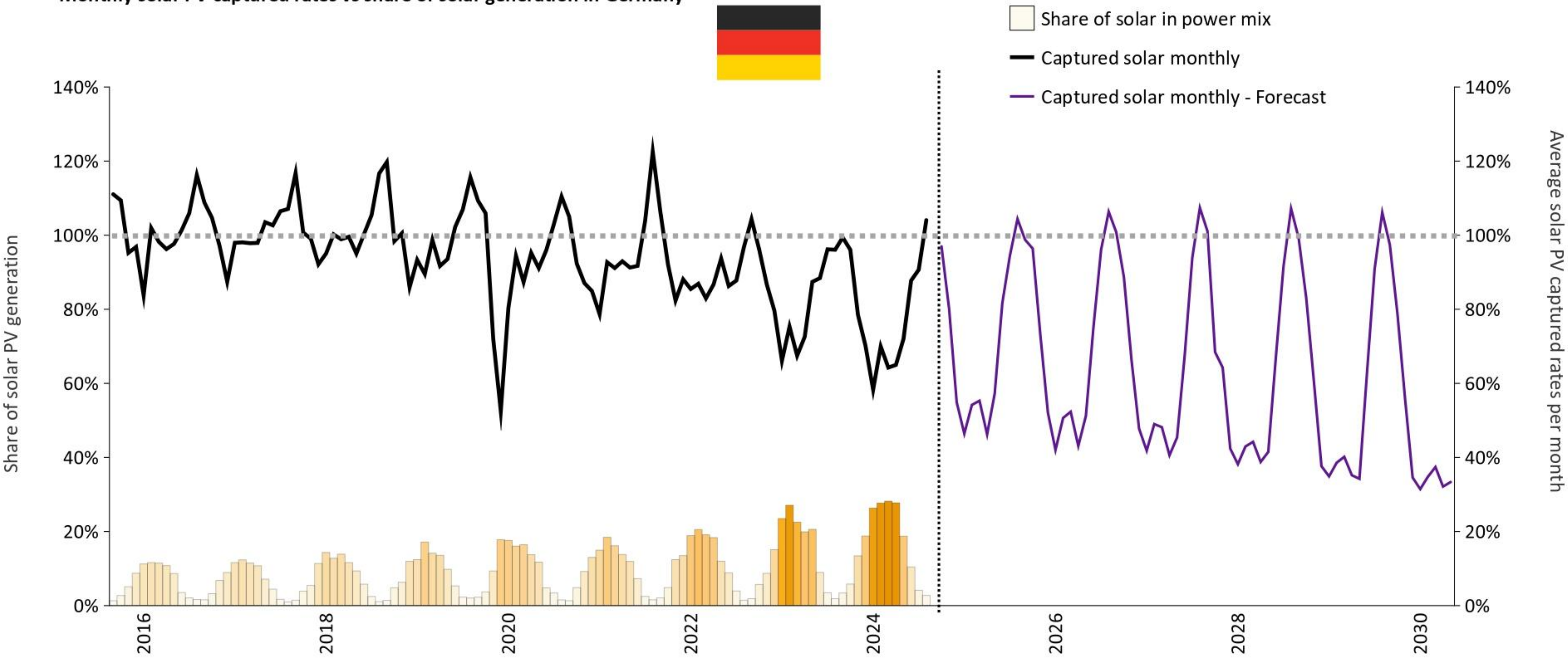
Estimated received prices as % of monthly spot prices



Source: Rystad Energy Europe Renewables & Power solution; ENTSO-e

Cannibalization will only continue with increasing solar PV penetration

Monthly solar PV captured rates vs share of solar generation in Germany

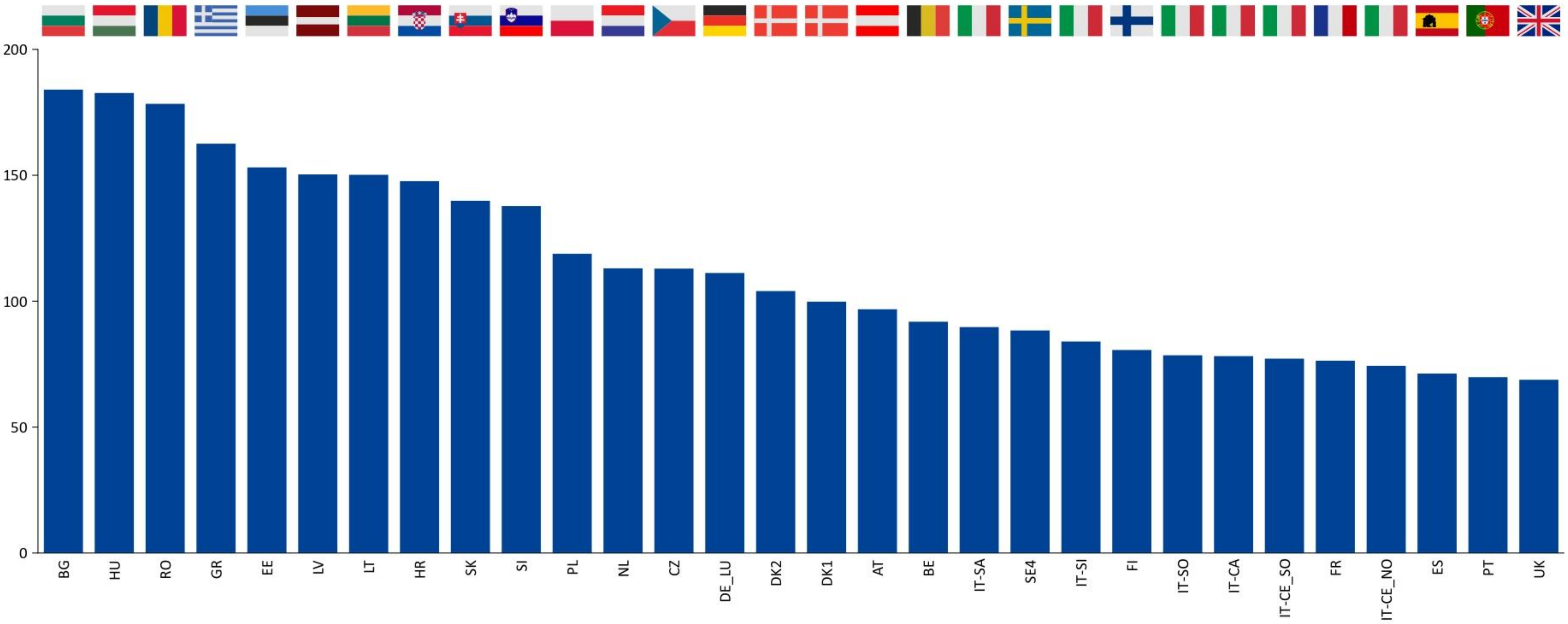


Sources: Rystad Energy European Renewables & Power Solution

Solar growth is opening the arbitrage game – batteries sweep up the revenues?

Energy arbitrage potential for 1-hour system in selected European markets for 2024

Euros per megawatt-hour (€ per MWh)



Sources: ENTSO-E; Rystad Energy European Renewables & Power Solution

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DAVID WEDEPOHL

Managing Director International Affairs, BSW (Germany)

Solar Power Summit 2025

"Solarspitzengesetz" and beyond: How is Germany dealing with negative prices?

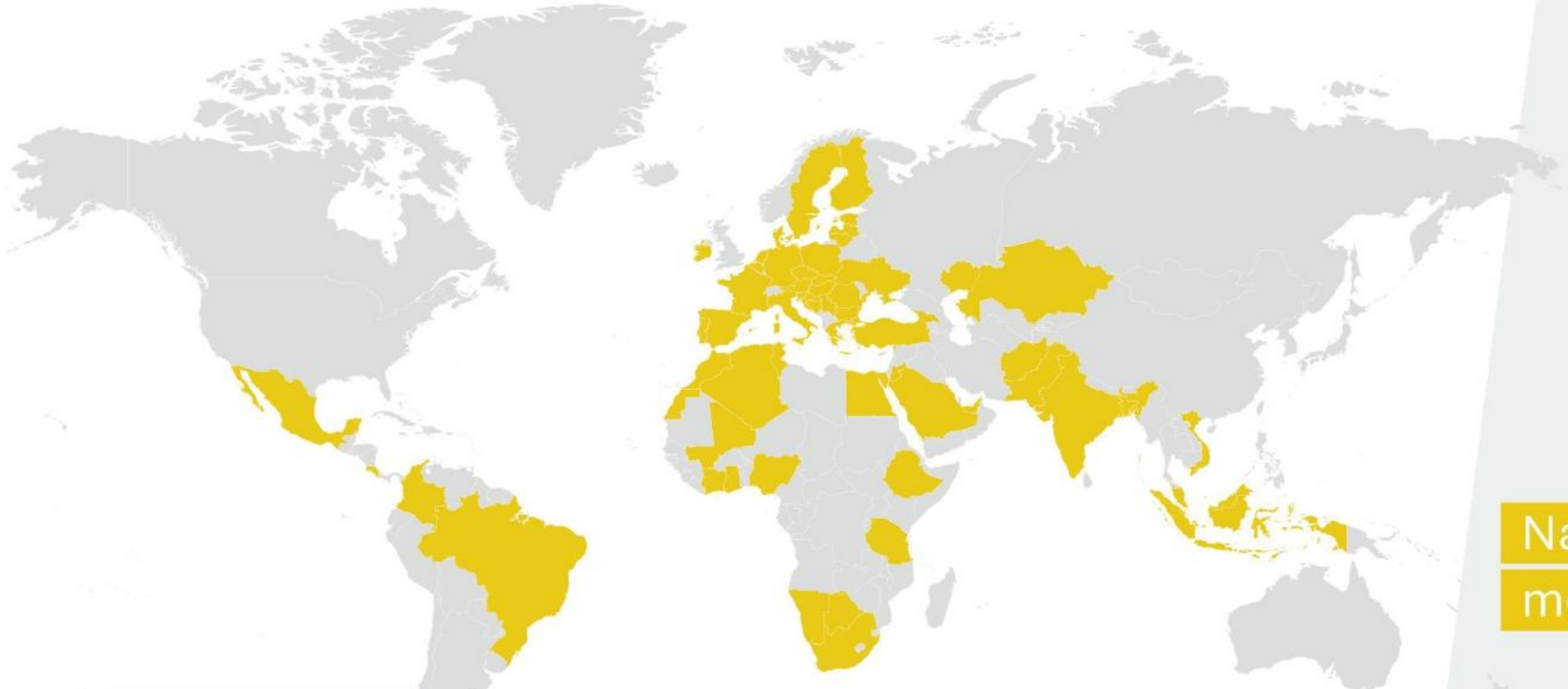
David Wedepohl, Managing Director International Affairs

German Solar Association (BSW-Solar)

www.solarwirtschaft.de

German Solar Association

The Network of the Solar Energy and Storage Sectors



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among others

International memberships

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among others

www.solarwirtschaft.de

German Solar Association

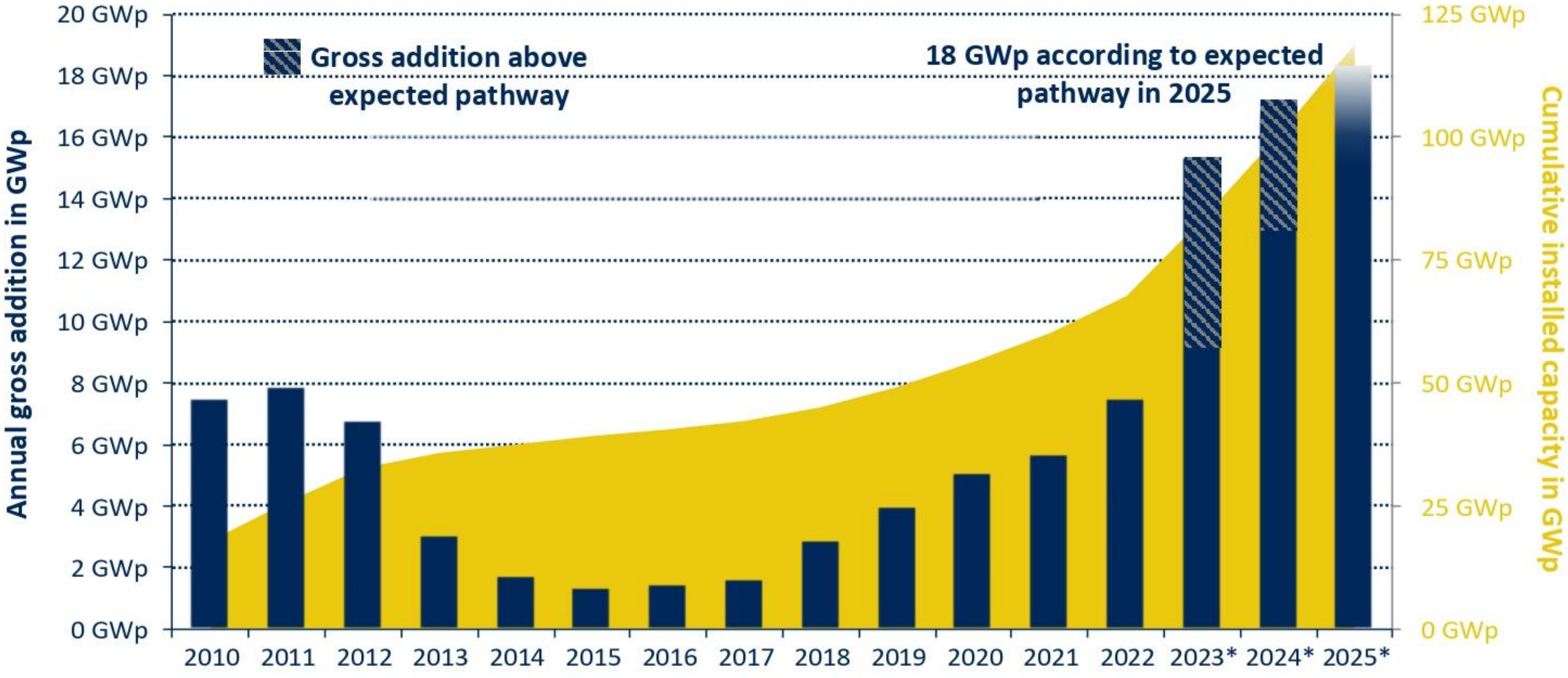
BSW SOLAR

TASK	To represent the solar industry in Germany in the photovoltaic, thermal and storage sector
VISION	A sustainable global energy supply provided by solar (renewable) energy
ACTIVITIES	Lobbying, political advice, public relations, market observation, standardization
EXPERIENCE	Active in the solar energy sector for over four decades
REPRESENTS	More than 1000 solar producers, suppliers, wholesalers, installers and other companies active in the solar business from all over the world
HEADQUARTER	Berlin, Germany

EQUIPMENT | MATERIALS | SYSTEM COMPONENTS | WHOLESALE & DISTRIBUTION | PROJECT DEVELOPMENT | CONSTRUCTION | O&M

PV deployment on track for 215 GWp target in 2030

Two years exceeding expectations → 100 GWp in 2024

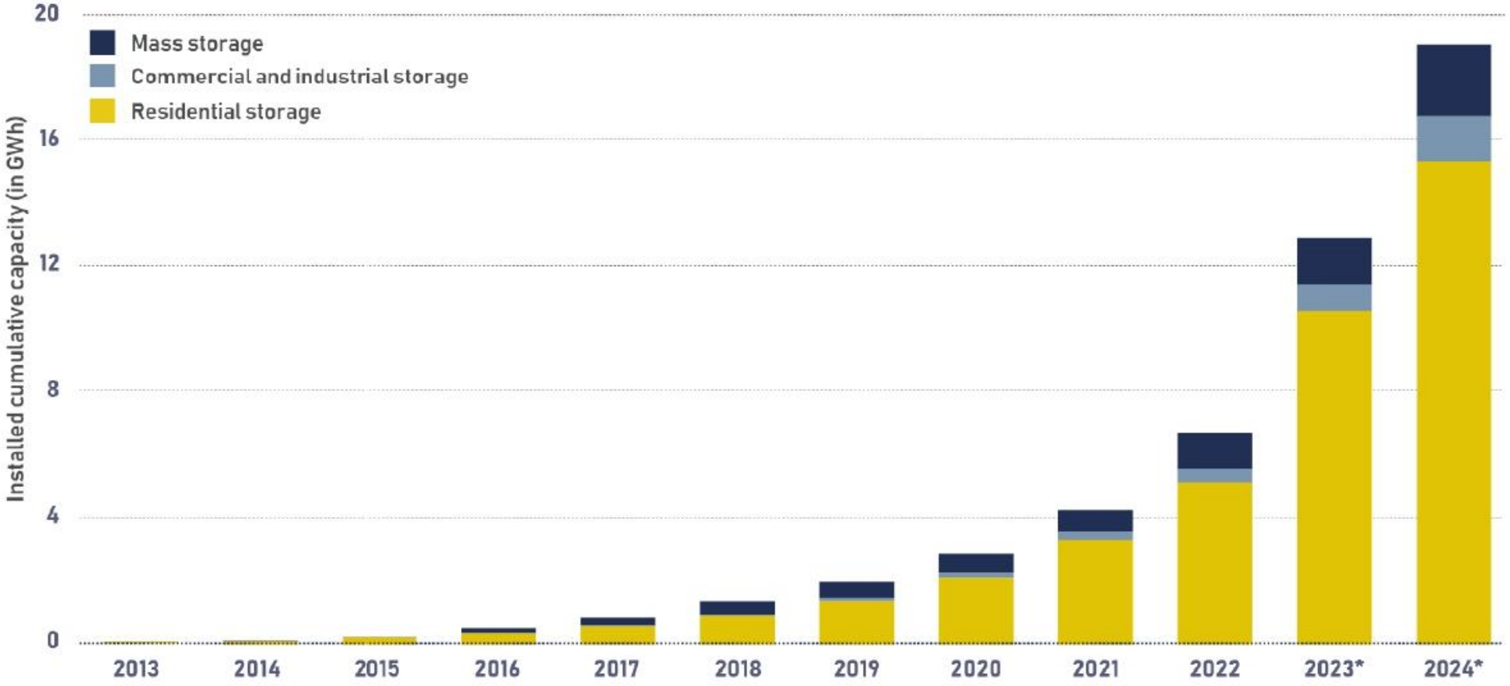


Sources: BSW-Solar based on MaStR as of February 24th, EEG 2023, BMWK (2022)

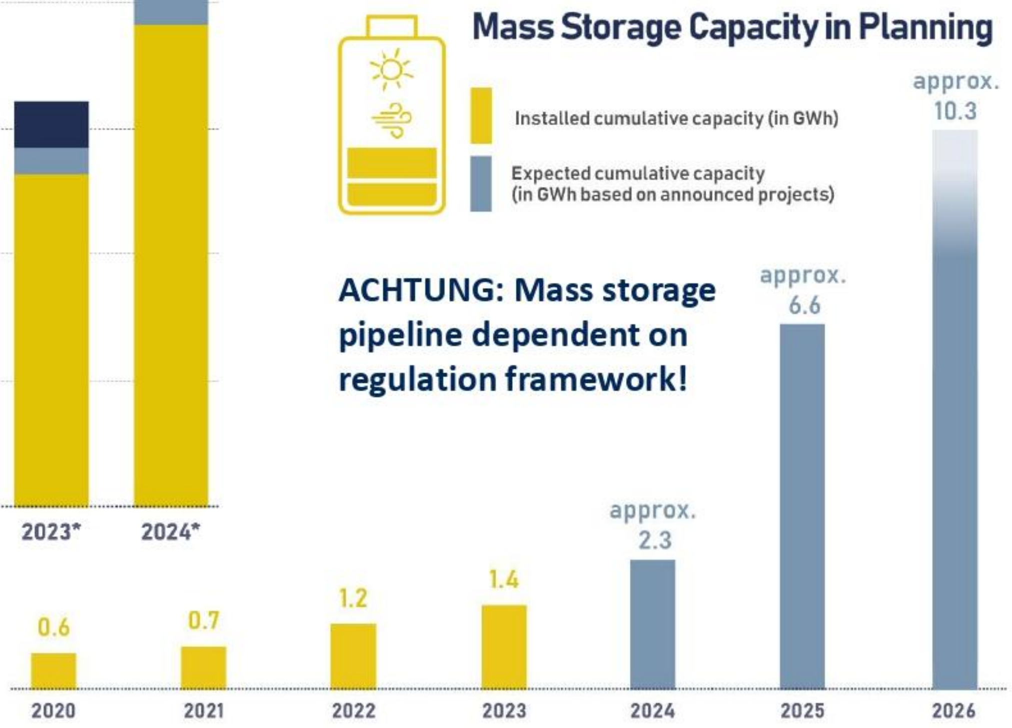
* Revisions to be expected, includes estimates of late registrations and extrapolation for 2025

Battery storage capacity is nearing 20 GWh

Mass storage to increase fivefold in 2 years according to pipeline



Source: BSW-Solar, own calculations based on MaStR as of 02/24/2025.



ACHTUNG: Mass storage pipeline dependent on regulation framework!

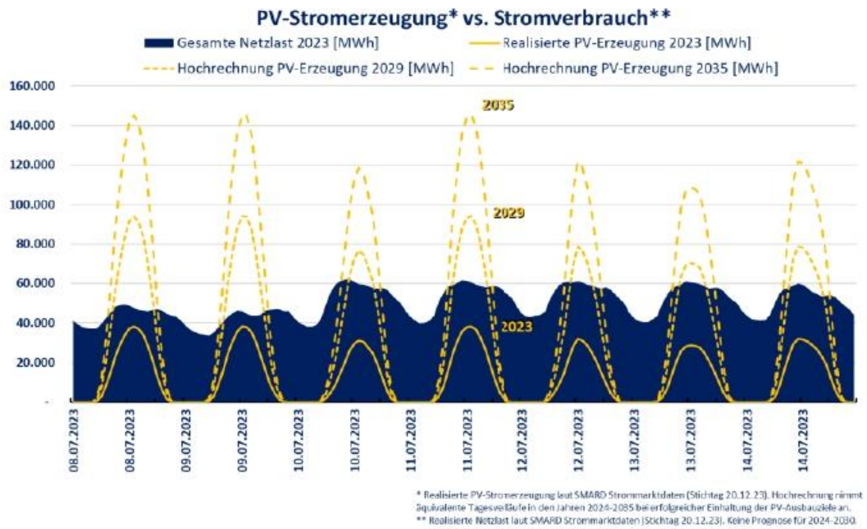
Source: Analysis by Enervis commissioned by BSW-Solar, data as of February 2025

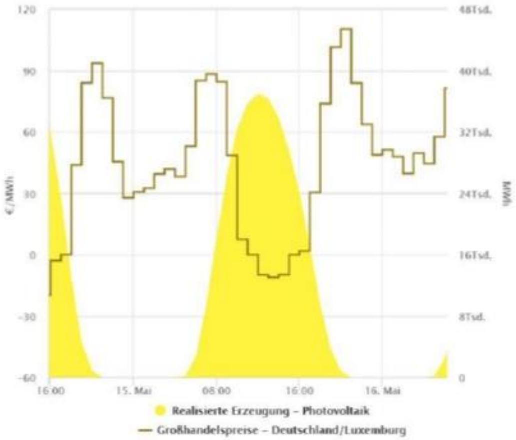
PV generation alone to exceed demand in summer peaks

Negative electricity prices & EEG budget debate since last year

- PV already supplies 15% of overall electricity demand in Germany
- German EEG based on fixed feed-in tariffs and market premiums
- Generation peaks will increasingly exceed grid demand
- Increasing prevalence of negative prices
- Existing feed-in tariff suspension for > 400kWp systems (EEG 2023)

- Solution: **Synchronization of production and demand**
- **No "Silver Bullet" → Combination of**
  - **Demand-side management**
  - **Storage expansion and system-serviceability**
  - **Closer alignment of PV systems to market signals**
- Current storage deployment of ~6 GWh per year already impressive but further flexibilization needed





Source: SMARD, BNetzA

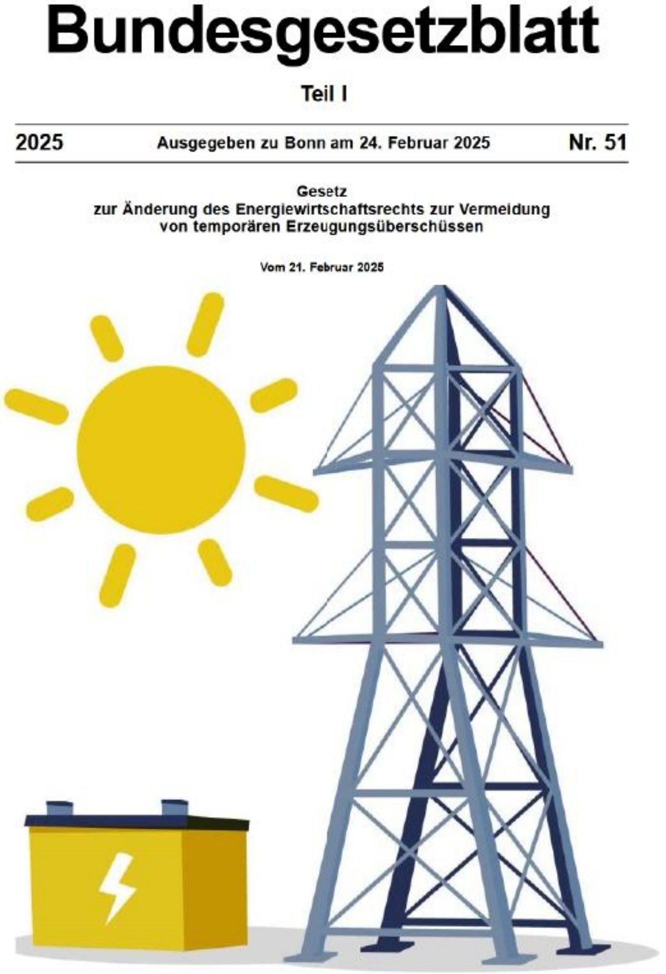
„Solarspitzengesetz“ = „Peak Shaving Law“ (February 25th 2025) adopted by the outgoing German parliament

Main Aspects

- Shift PV feed-in away from times of negative prices → **„Use, don‘t curtail!“**
- Steering of PV systems (> 7 kWp)
- Flexibilization of grid connection capacities and storage operation

Individual Measures for better system-integration

- Prolongue eligibility period when pausing feed-in tariffs due to negative prices
  → **Compensation mechanism** ($51a EEG) to activate private investments
- iMSys (intelligent measuring) and “Smart Meter” roll-out to be accelerated
  → **Curtailment only during transition** (until adoption)
- Flexible grid operator tariffs for steerable systems
- Quarter-hourly accounting (15min)
- **Strategic goal:** Direct Marketing facilitation, while resolving technical challenges
- **Digitalization/Flexibilization:** Mass roll-out aspired, faster progress needed



„Solarspitzengesetz“ (and beyond)
How the EU can aid Germany accelerate flexibility & adoption

BSW SOLAR

Flexibility

- **Enable multi-use of storage** to improve system-serviceability (§19 EEG)
  - Separation of green from grid electricity <u>**or**</u> flat feed-in allowance (500 Wh/Wp)
  - EU state-aid approval required → crucial for flexibilization and storage pipeline
- **Steerability** of consumption devices
  - Incentives for steerable devices more conducive than pure obligations (§14a EEG)
  - Measuring point fees must remain low & voluntary **“SmartMetering” affordable**

→ **Results: Reduction in EEG costs, fewer <u>negative</u> BUT overall <u>lower</u> electricity prices!**

→ **Example:** Feed-in during morning hours, charge battery during daytime peak, store affordable grid electricity in winter for later use (e.g. EV/HP)

EU-level coordination

- **BSW-Recommendation:** Expedite state-aid approval for **„Solarpaket I“**
- Approval by EU COM pending → would allow for Agri-PV auctions, bid limits of 50 MWp, repowering, multi-use …

  → **Crucial for 10.3 GWh mass storage pipeline**

Join us on our path.

German Solar Association
Bundesverband Solarwirtschaft e.V.

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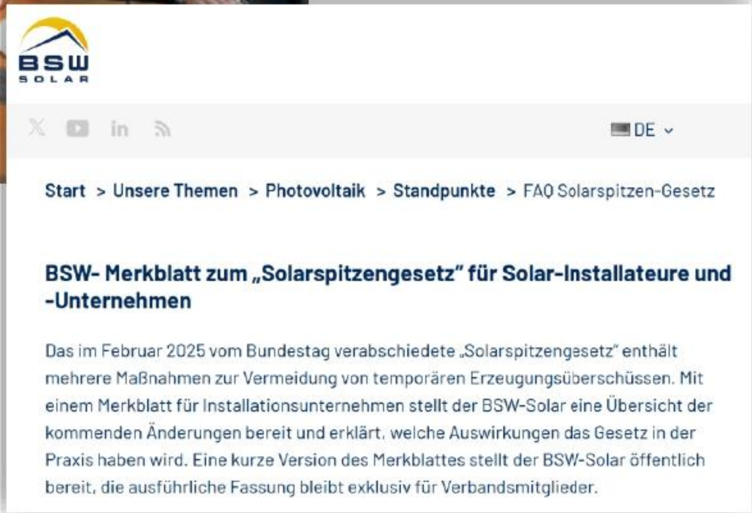
https://www.solarwirtschaft.de/en/press/market-data/

bsw.li/4bTjsHf bsw.li/3QYcpom bsw.li/1JDrtPl bsw.li/2VsDOS4

Appendix: „Solarspitzengesetz“ (and beyond)
BSW explains complex legislation

- Several interlinking pieces of legislation
- Many problematic proposals avoided
- Questions by experts, policy makers and installers
- Public misperceptions require clarification


Start > Unsere Themen > Photovoltaik > Standpunkte > FAQ Solarspitzen-Gesetz

BSW- Merkblatt zum „Solarspitzengesetz“ für Solar-Installateure und -Unternehmen

Das im Februar 2025 vom Bundestag verabschiedete „Solarspitzengesetz“ enthält mehrere Maßnahmen zur Vermeidung von temporären Erzeugungsüberschüssen. Mit einem Merkblatt für Installationsunternehmen stellt der BSW-Solar eine Übersicht der kommenden Änderungen bereit und erklärt, welche Auswirkungen das Gesetz in der Praxis haben wird. Eine kurze Version des Merkblattes stellt der BSW-Solar öffentlich bereit, die ausführliche Fassung bleibt exklusiv für Verbandsmitglieder.

→ **More than 700 participants in BSW webinar on the topic**
→ **BSW-FAQ** publicly available (in German)

https://www.solarwirtschaft.de/unsere-themen/photovoltaik/standpunkte/faq-solarspitzengesetz/

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NOLD JAEGER

Head of Policy & Public Affairs,
Holland Solar

Holland Solar

Negative prices – state of play in the Netherlands

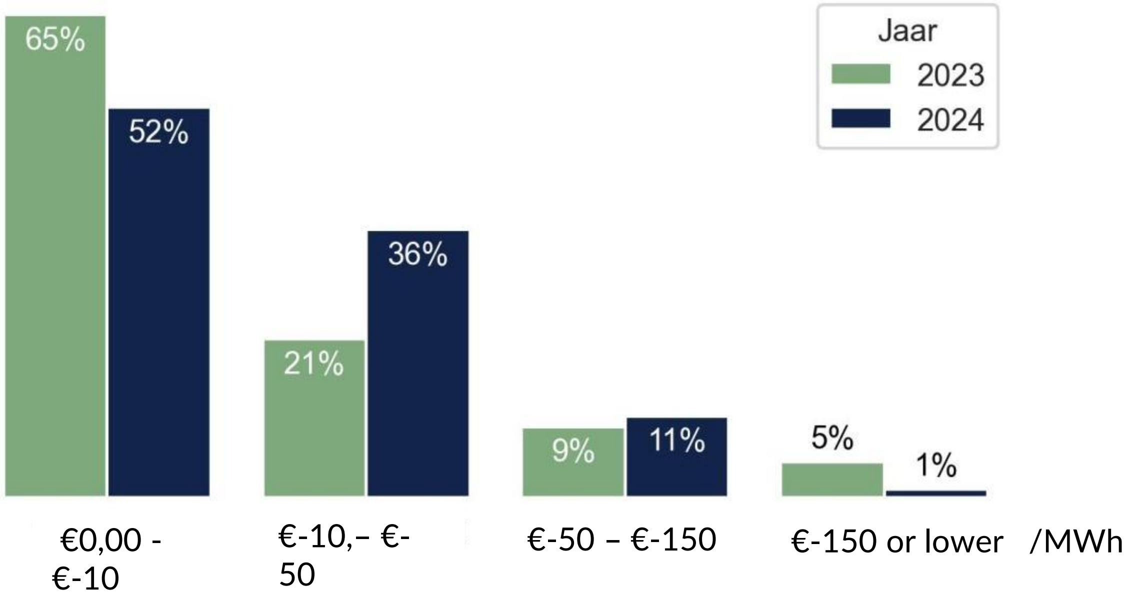
March 27th, 2025, Brussels

Nold Jaeger
Head of Policy and Public Affairs

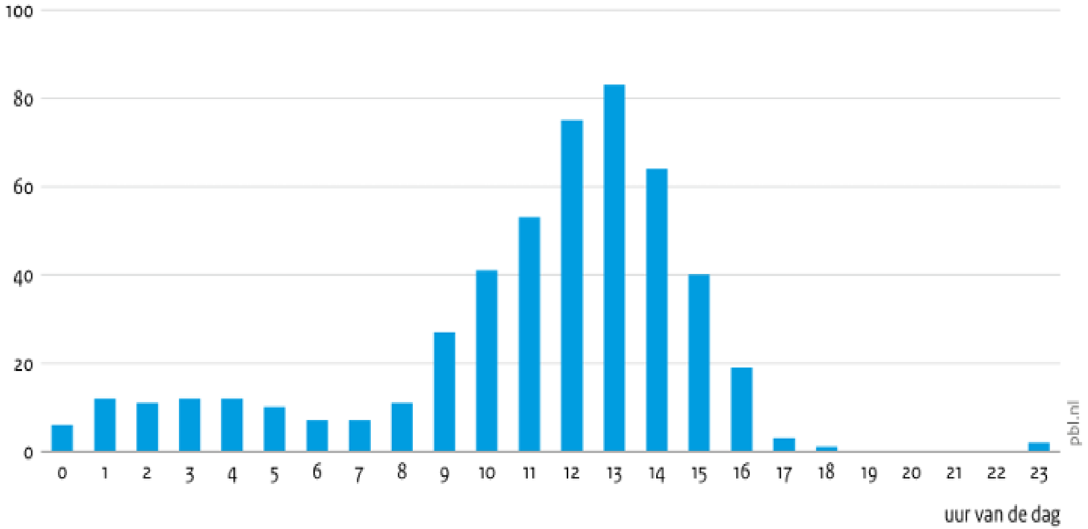
Holland Solar

Current situation

Year	# negative prices (of which solar hours)	Average hourly price	Lowest hourly price	Highest hourly price	Average price spread during day
2019	3	4			
2020	97	32	-79	200	31
2021	70	103	-66	620	83
2022	83	242	-222	871	205
2023	316 (241)	95	-500	463	108
2024	458 (397)	77	-200	870	110

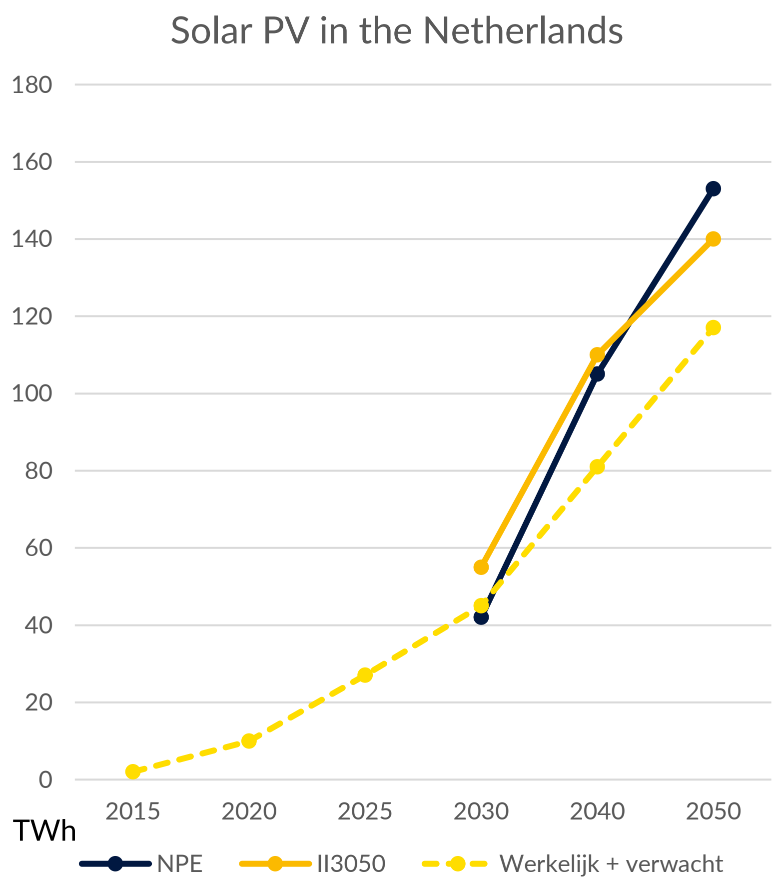


Hours of negative price occurrence Nov. 2023- Nov. 2024

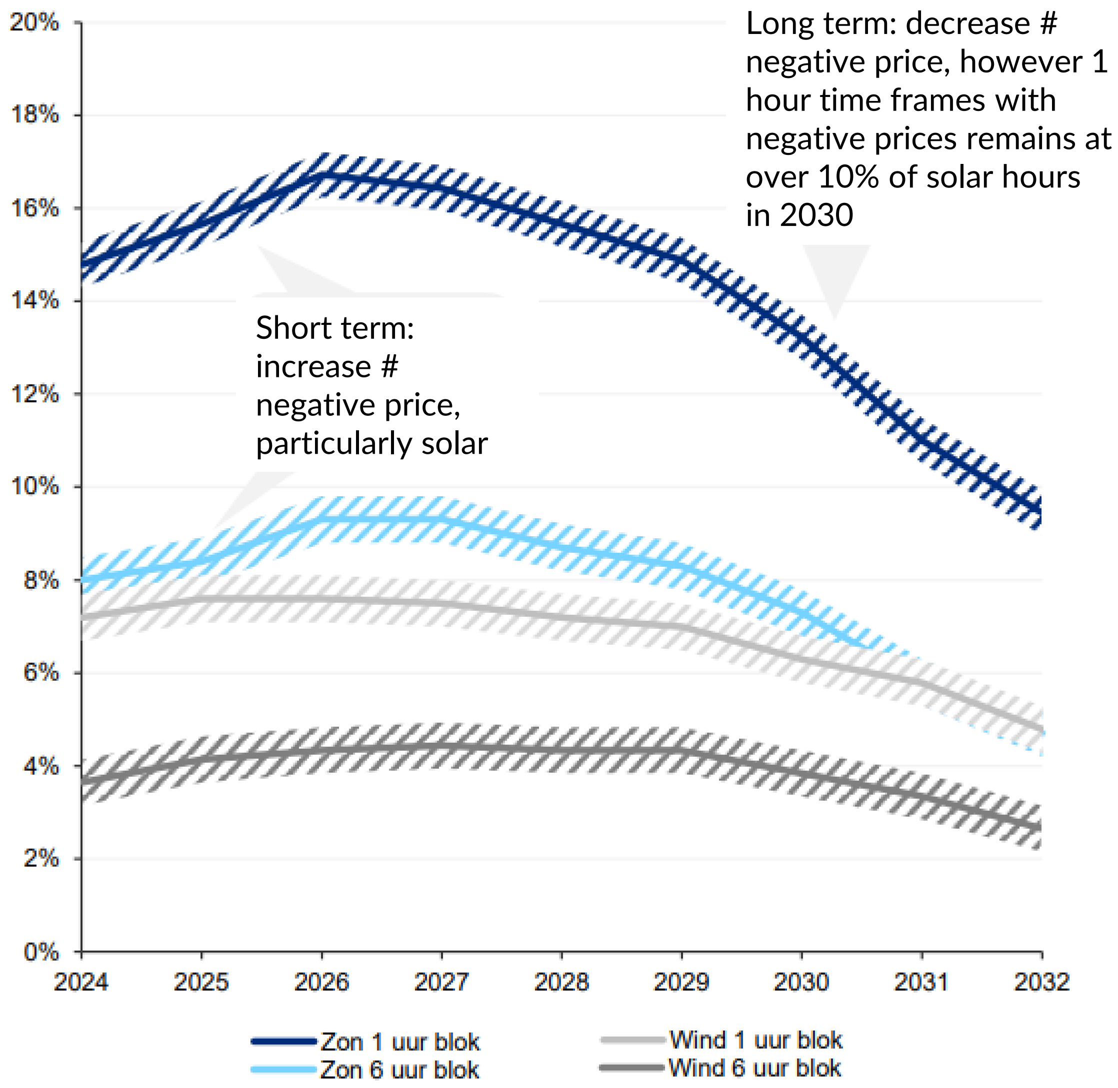


ENTSO-E, Datadame, PBL Eindadvies 2025

Future



Expected curtailment in the Netherlands (%)

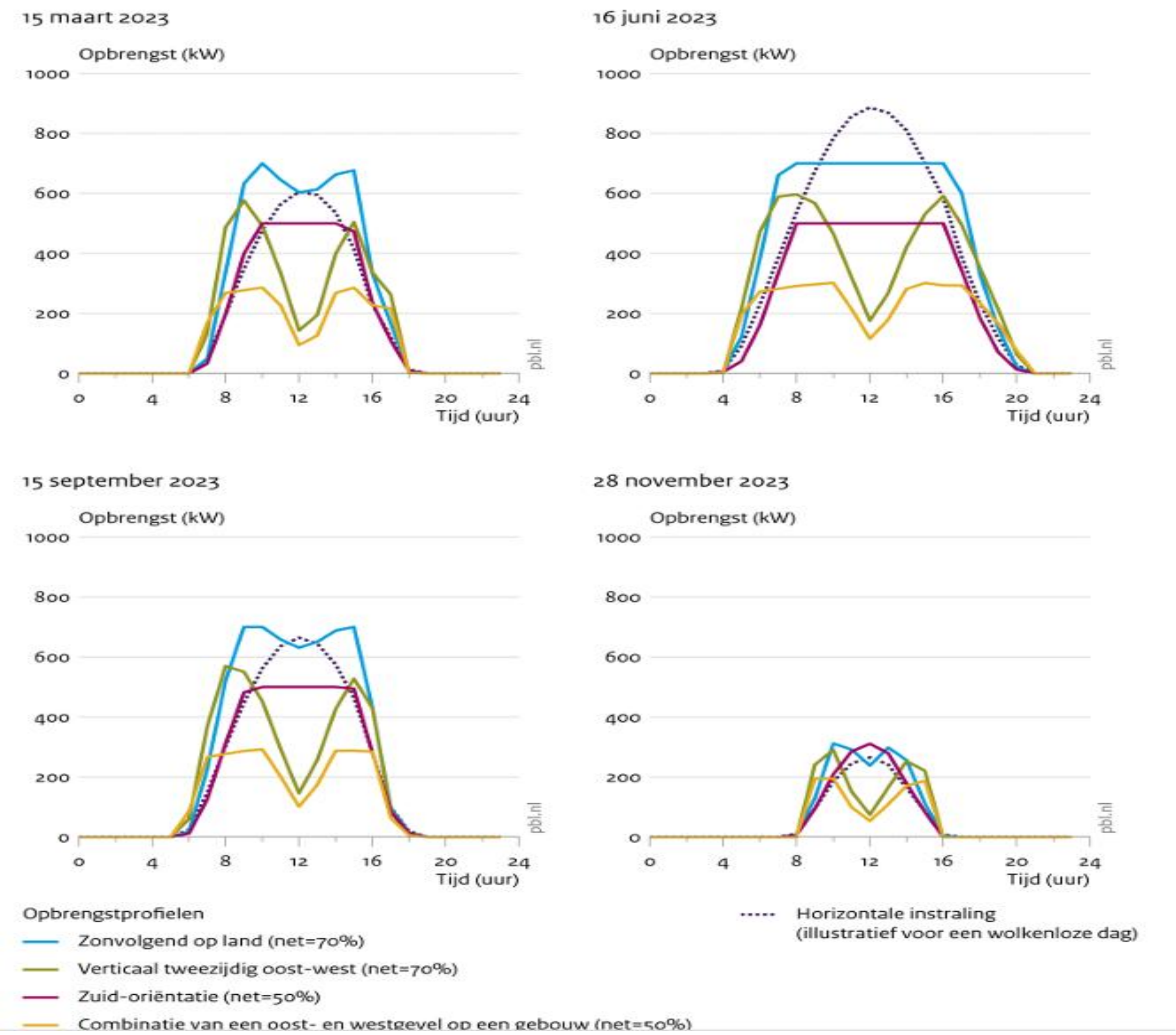


Holland Solar, ©KPMG, still under revision!

Changing the status-quo

Market driven

- Batteries and behind the meter solutions
- Different configurations
- Free electricity for sale!
- Strengthening the PPA market – *to whom do we sell?*
- Local flexibility markets accessible for prosumers



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JOSÉ DONOSO

CEO,
UNEF

UNEF
Unión Española Fotovoltaica

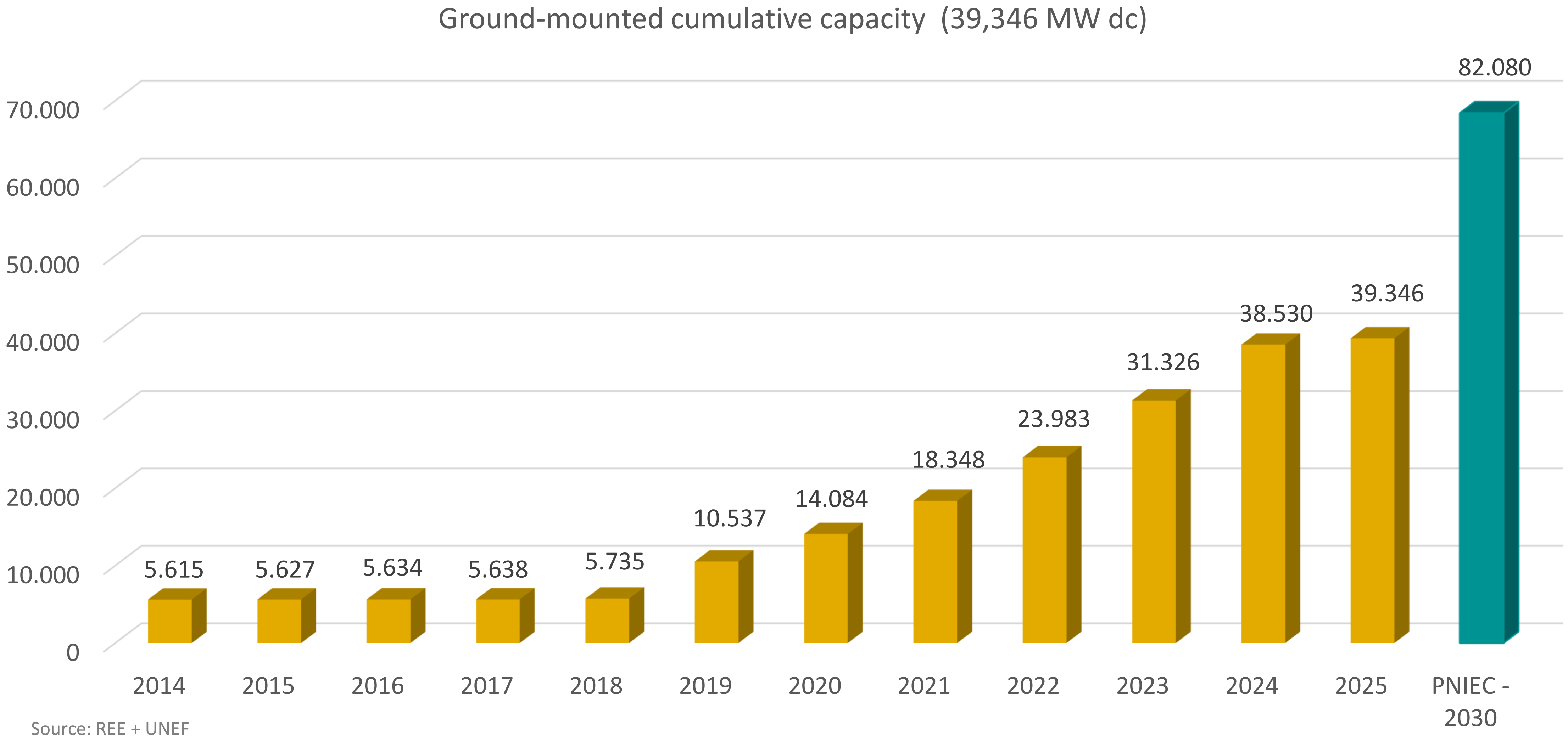
National deep-dive: How are the leading solar markets dealing with negative prices in Europe?

Jose Donoso, CEO

SolarPower Summit 2025

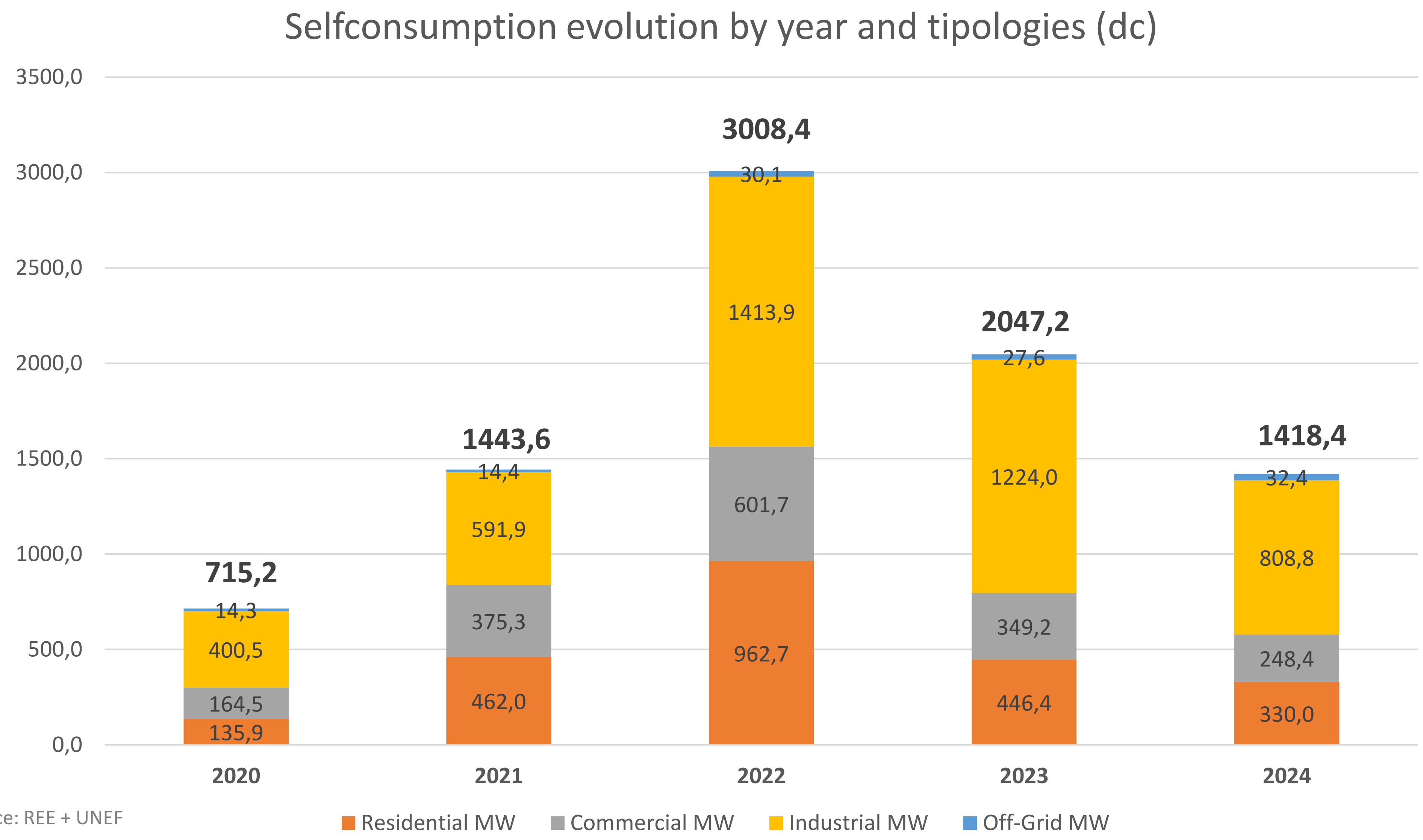
March, 26-27, Brussels

Spanish market evolution: ground-mounted



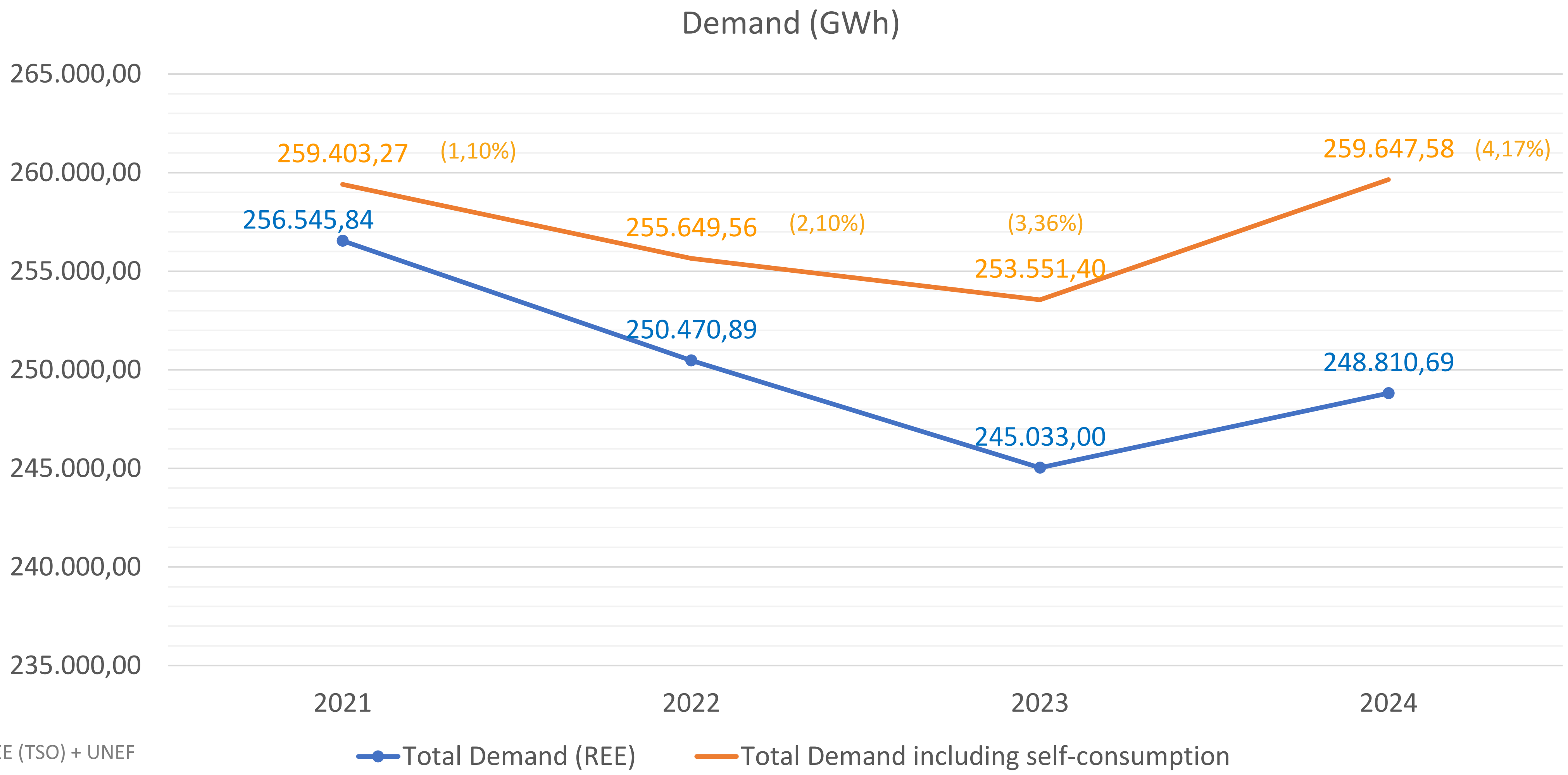
Source: REE + UNEF

Spanish market evolution: self-consumption



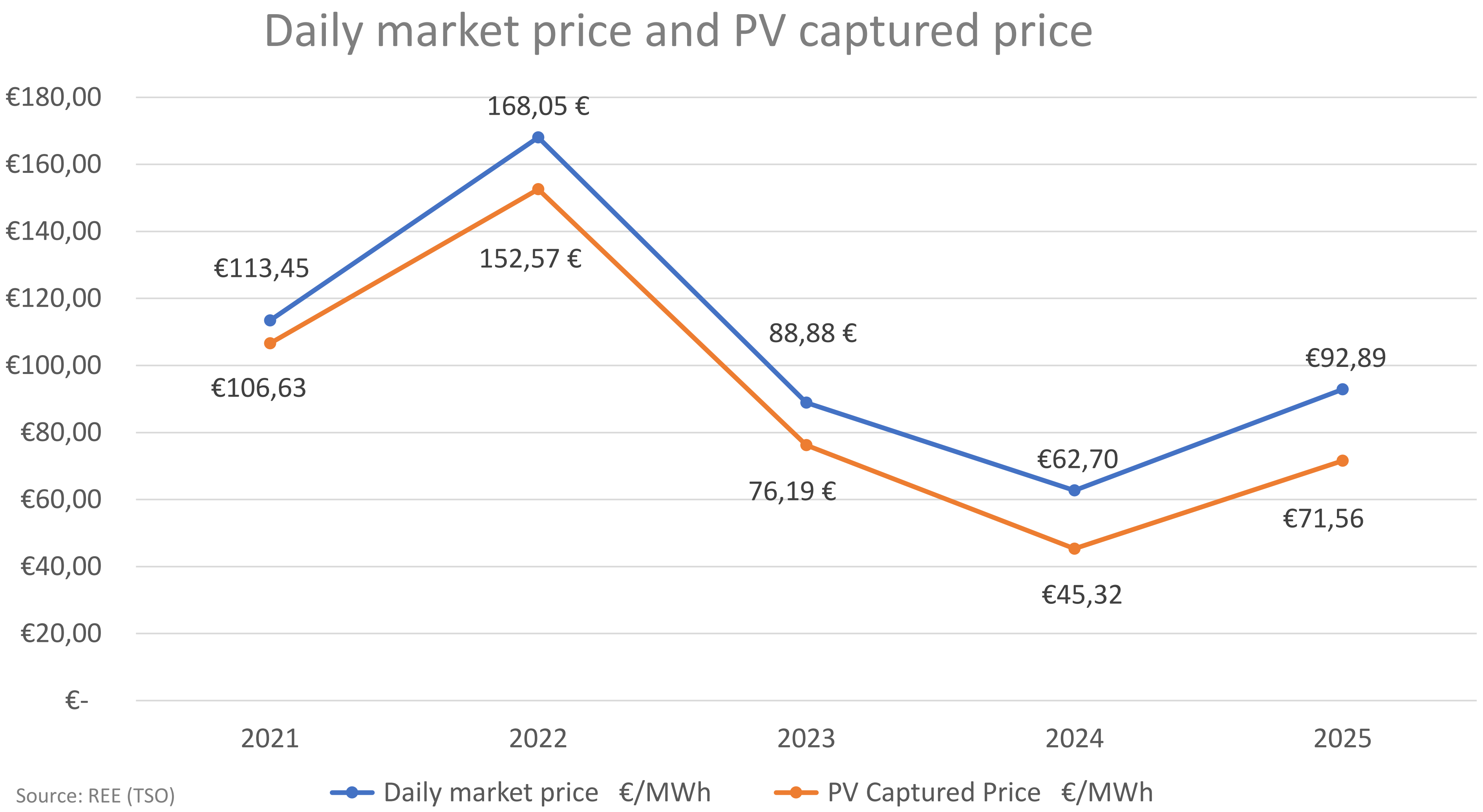
Source: REE + UNEF

Evolution of the demand and self-consumption



Source: REE (TSO) + UNEF

Spanish market prices



Source: REE (TSO)

Cero or negative prices at the Spot market in 2024:

784 hours (8,59%)

Negative prices in Spain

RECORE

RD 413/2014 (art.21):

No retribution if the market prices hold cero prices during 6 or more consecutive hours

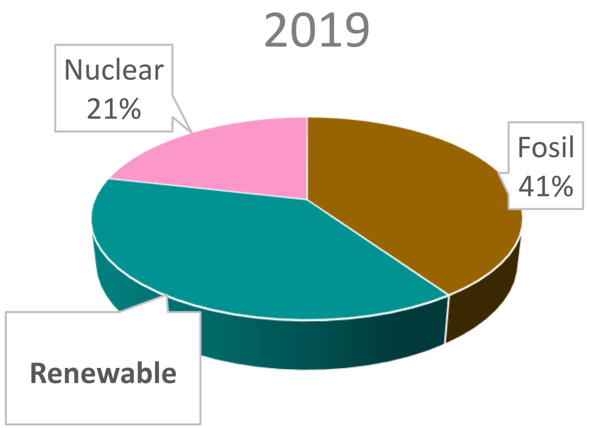
Solutions to negative prices

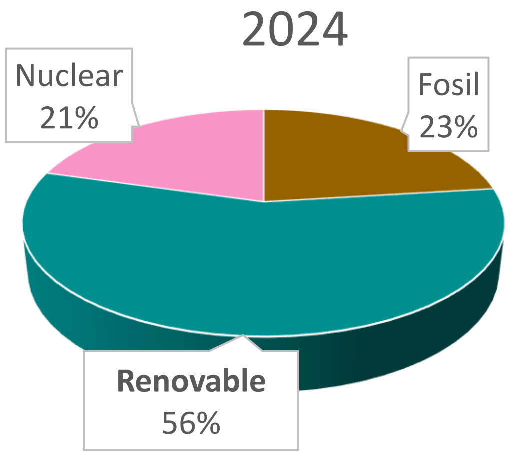
- Electrification
- Increase investments in infrastructure
- Storage and hydrogen
- Flexibility mechanisms, and grid-forming
- Market-based system reform (PPA)
- Auctions:
  - Stable frequency
  - Volumes according to objectives

Progress in descarbonization

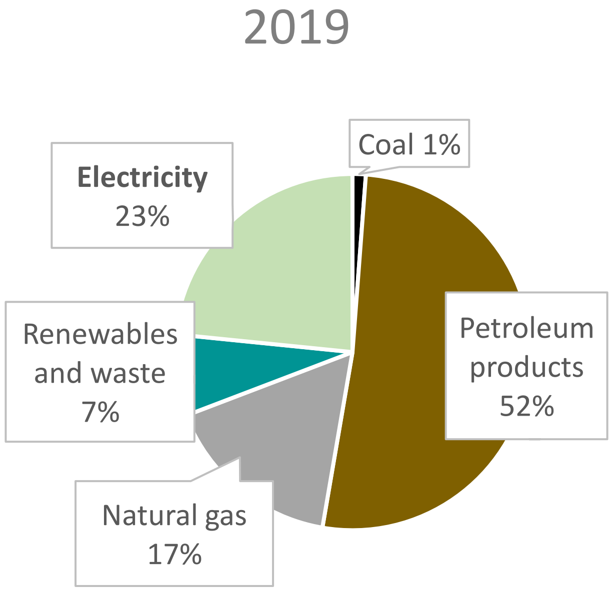
UNEF Unión Española Fotovoltaica

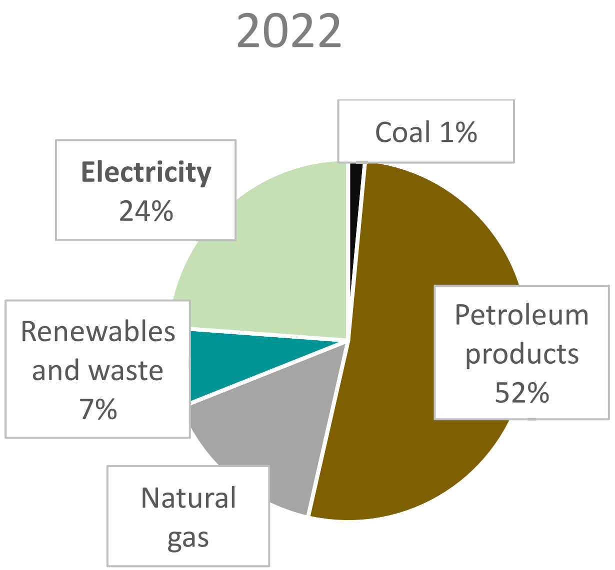
Evolution of renewable and non-renewable electricity generation





Breakdown of final energy consumption





Fósil 2019: 69,5%
Fósil 2022: 68,9%

Sources: Red Eléctrica: REDATA

MITERD: Balances energéticos de España 2021 y 2022

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