



Overview of Developments in Power Sector

Important role of existing TPS for the energy transition

20th May 2026, Lucknow

Average power share (energy terms not capacity) of Renewables in Germany

From 1st January to 31th Dec 2025

59% RE

Source: Anteil erneuerbarer Energien | Energy-Charts

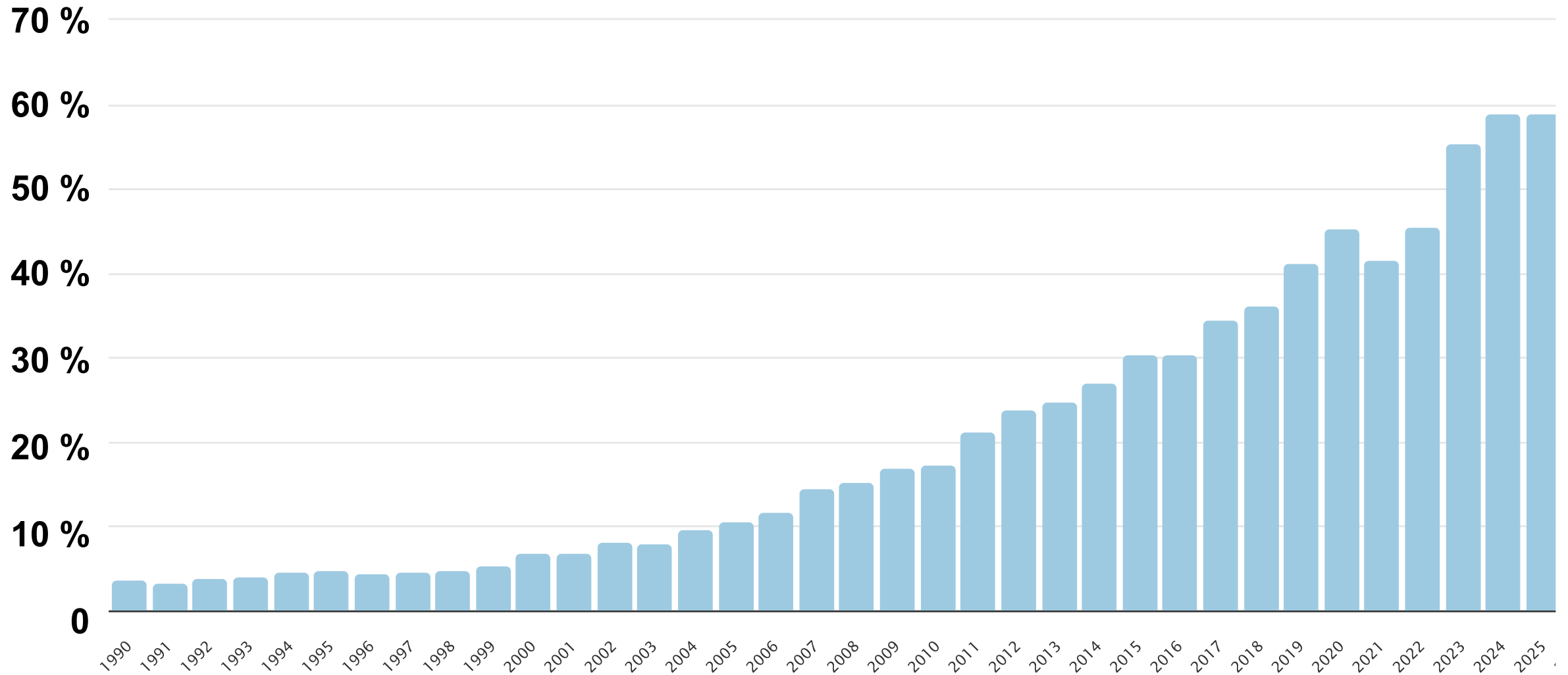
Annual avg. powercut duration (in min) in Germany in 2024

System Average Interruption Duration Index (SAIDI)

13 min.

Source: [Bundesnetzagentur 2023](#)

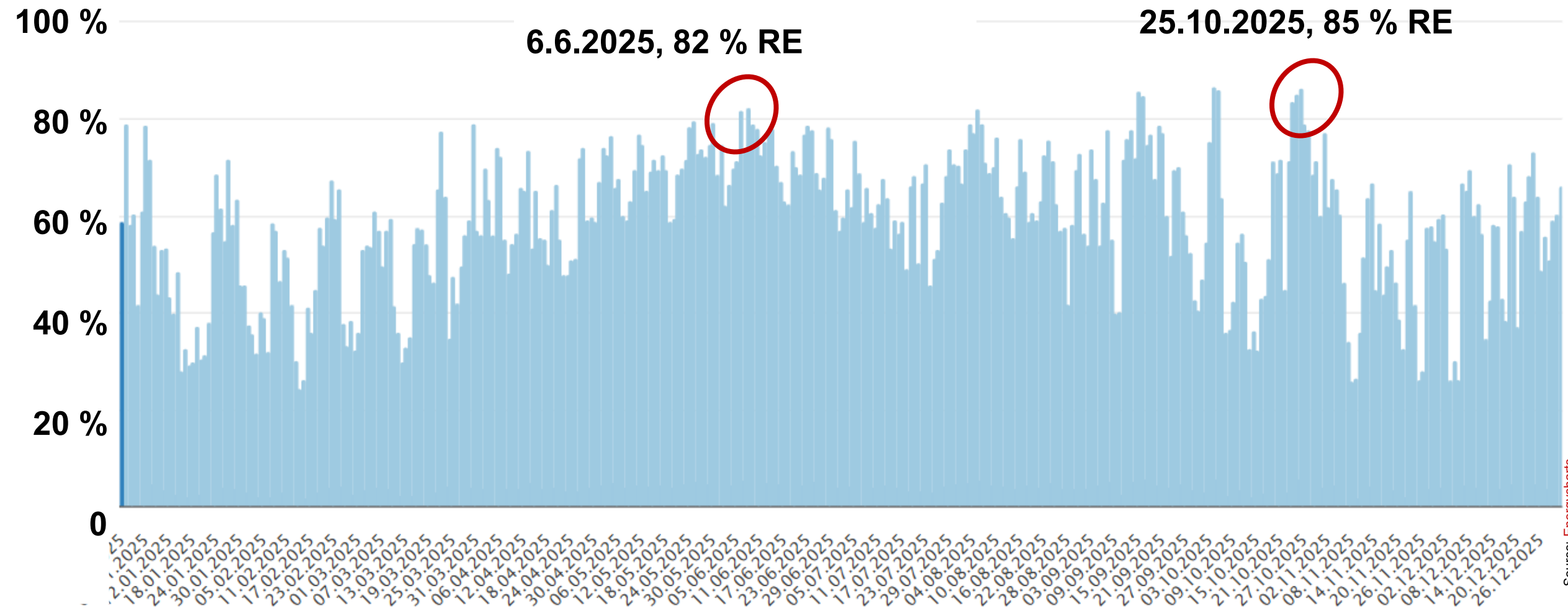
Annual Average RE Share in % of Power Generation in Germany



Source: [Energycharts](#)

Daily RE Share in % of Power Demand in Germany

On hourly basis there are several days in a year since 2018 with +100% RE power supply



Source: [Energycharts](#)

Wind and Solar Penetration Levels in India in 2022

Some states show penetration levels similar to Germany!

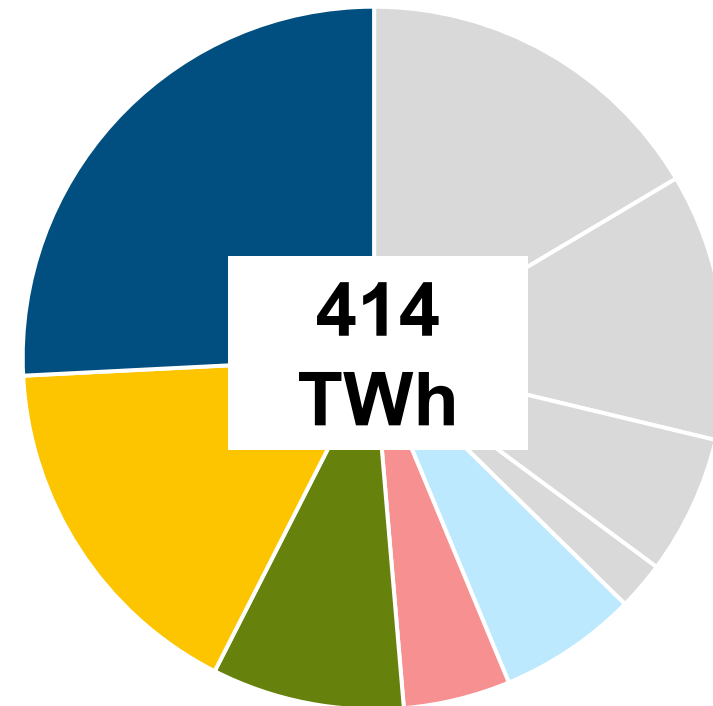
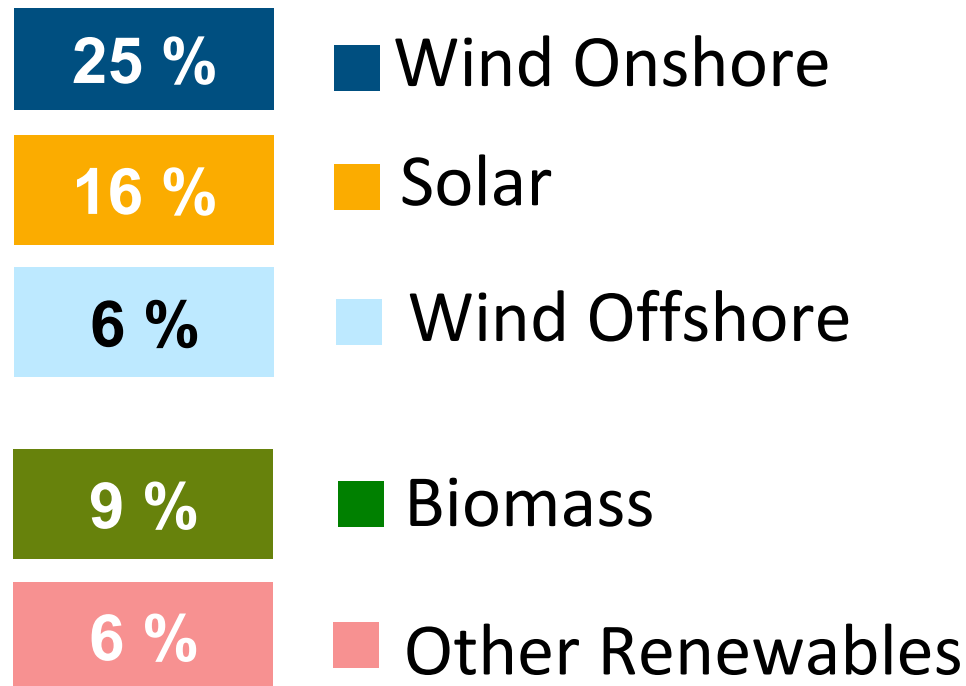
Region/State (FY 2022-23)	Annual Solar+Wind Penetration (Electricity in %)	Max. Daily Solar+Wind Penetration (Electricity in %)	Max. Instantaneous Solar+Wind Penetration (Electricity in %)
Karnataka	27.52	65.38	132.00
Andhra Pradesh	20.50	58.59	81.00
Tamil Nadu	18.42	50.08	77.00
Southern Region	16.91	36.32	61.00
Rajasthan	14.57	35.81	56.00
Gujarat	15.44	35.80	55.80
Madhya Pradesh	11.01	32.40	53.90
Telangana	12.17	17.63	49.00
Northern Region	10.56	18.36	46.75
Maharashtra	10.10	23.00	37.21
Western Region	11.03	23.10	35.13
All India	11.01	20.40	31.80

...in some states some days already exceed 50 % RE power

Wind and Solar drive the transformation of Germany's electricity production

Share of Renewables on Electricity Production in Germany

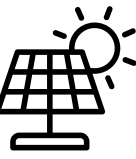
RES / 260 TWh



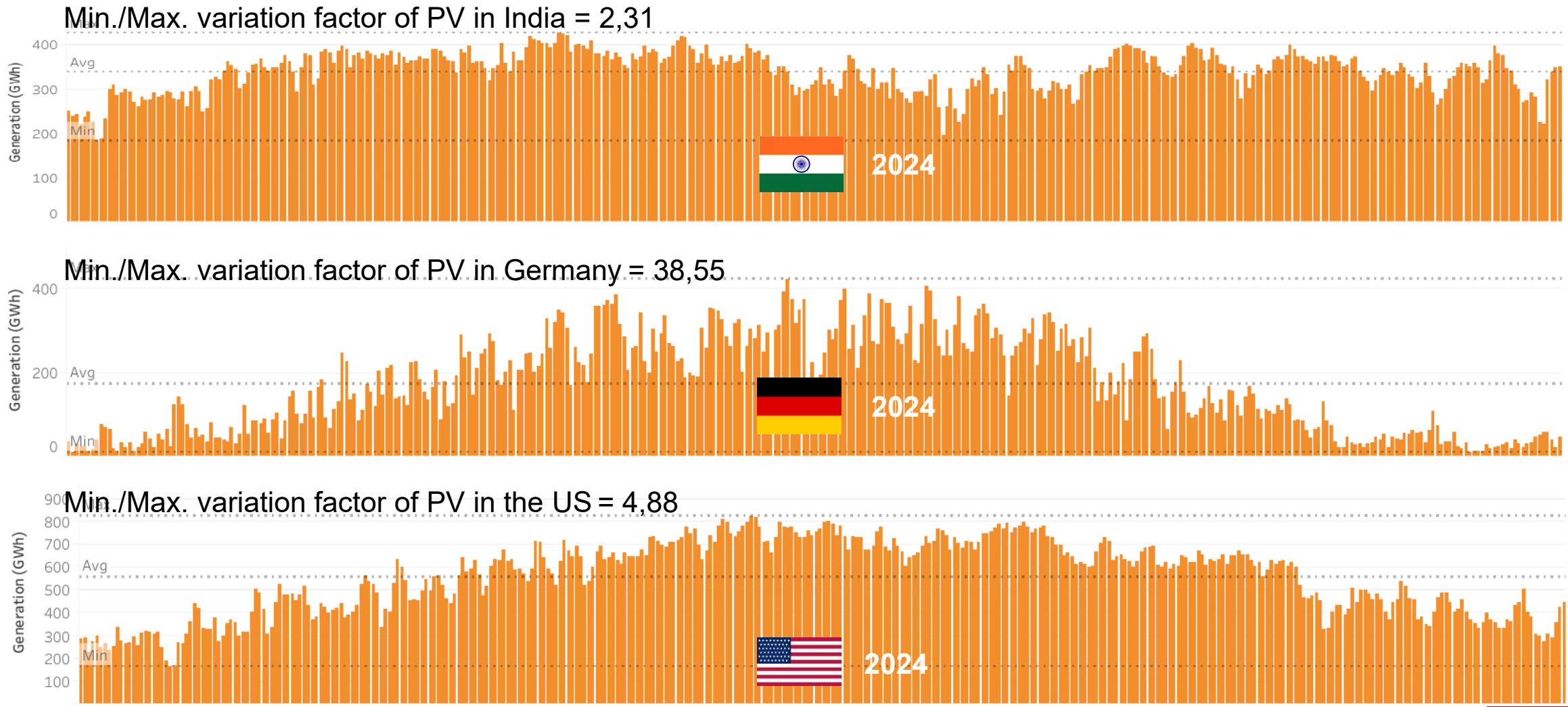
2025

Source: GIZ based Energy Charts; [Kreisdiagramme zur Stromerzeugung](#)
Energy-Charts

India has high solar energy security

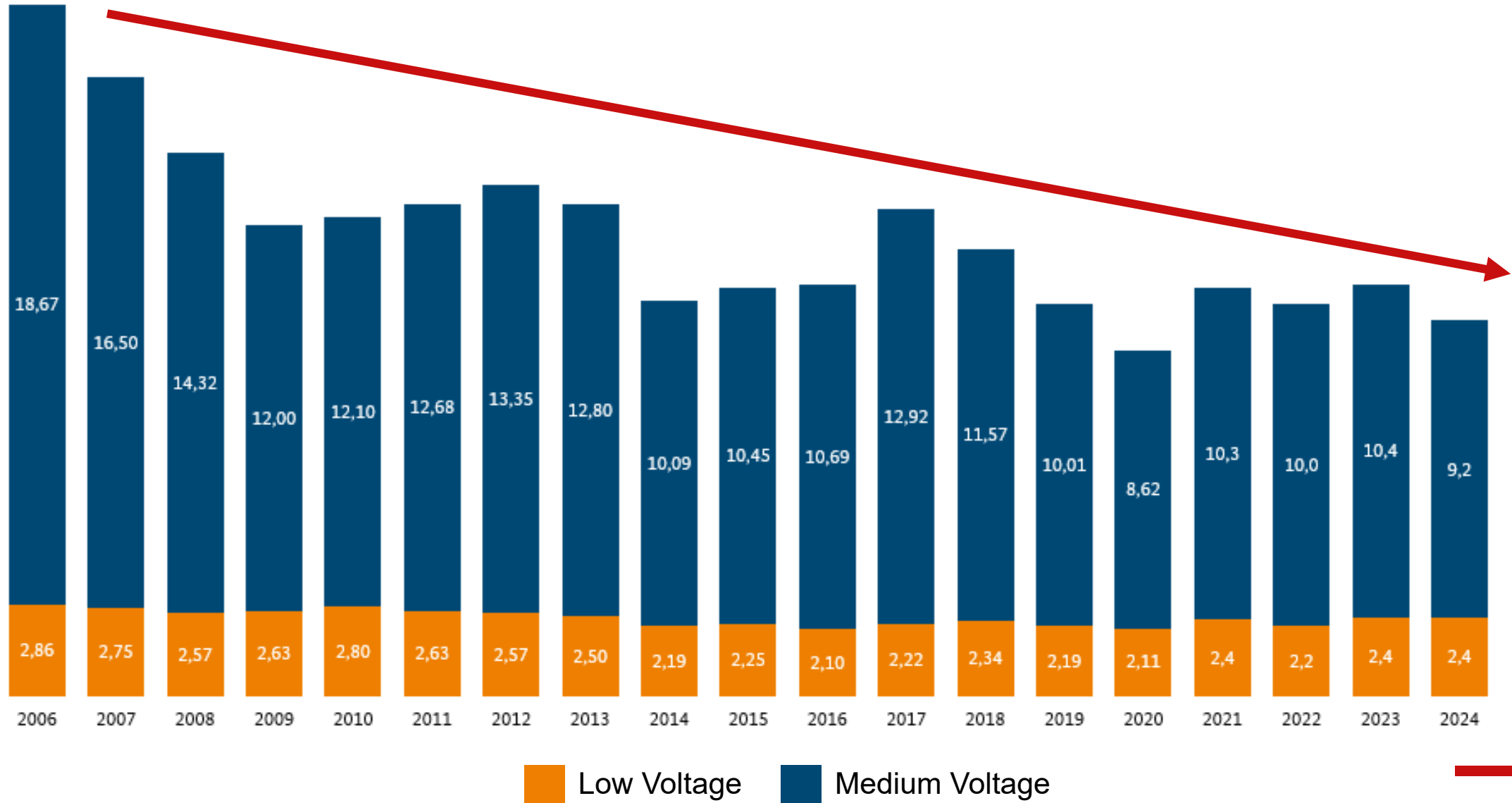


365 days of PV generation in India, Germany and USA in 2024



Annual avg. powercut duration (in min) per connection in Germany

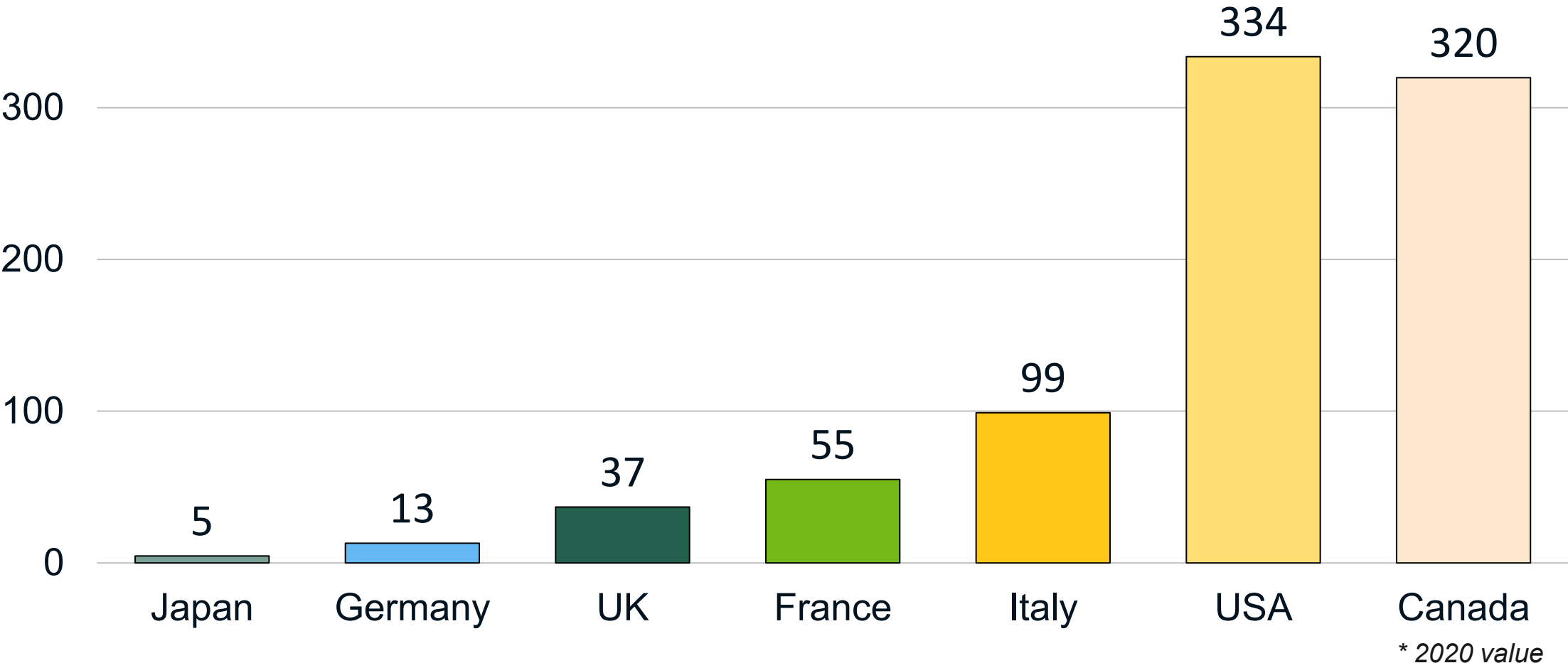
SAIDI development in minutes from 2006 to 2023, improvement despite massive increase of RE



Source: [Bundesnetzagentur 2024](#)

Duration of unplanned electricity outages per year based on SAIDI

in minutes per year in 2023 for G7 countries

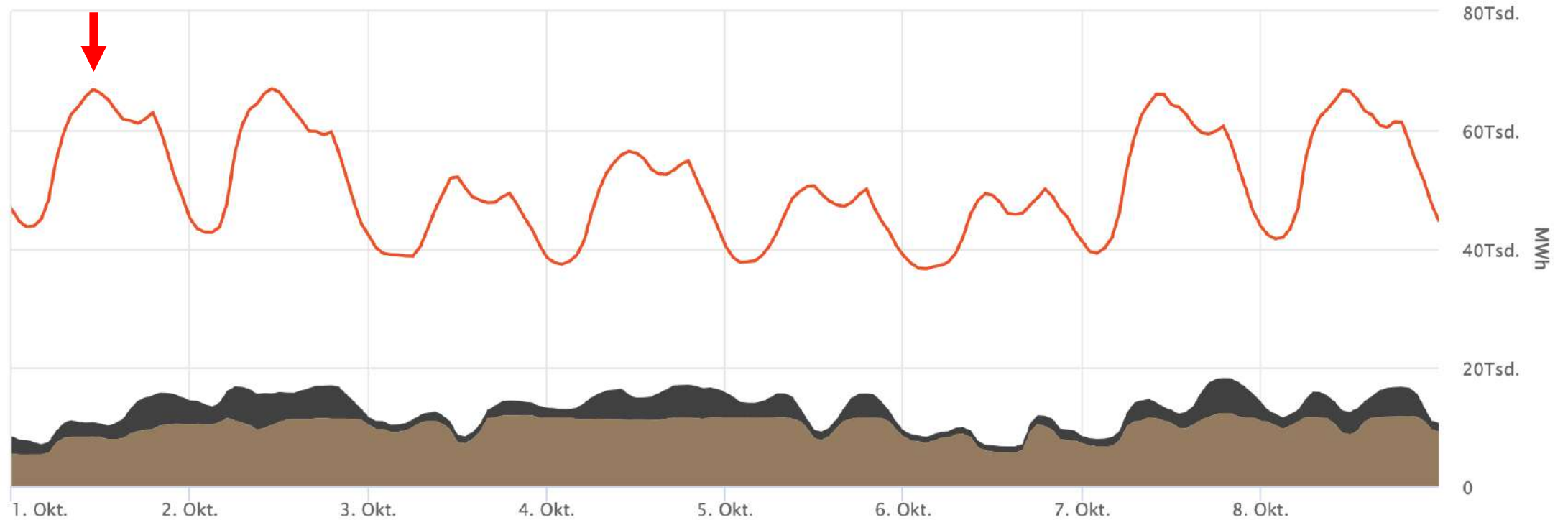


Source: GIZ based on BNetzA 2024, Ofgem 2022, Enedis 2024, AFRERA 2024, OCCTO 2023, TEPCO 2024 & EIA 2024

**Flexibility is
needed!**

Thermal power plants complete FLEXIBLE Renewable production

Realized power consumption, week in October 2024

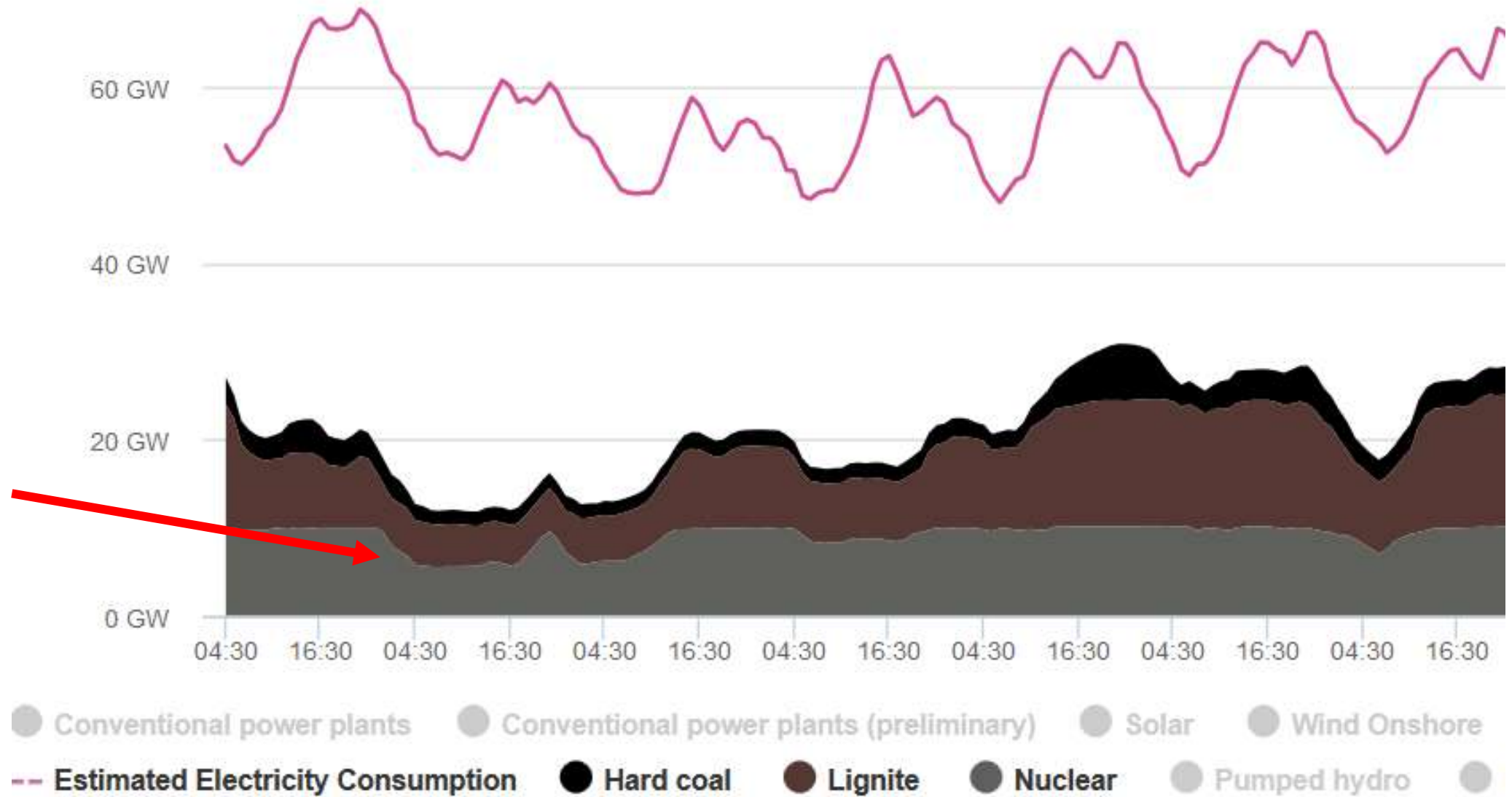


Power generation - realized generation

- Nuclear energy
- Lignite
- Hard coal

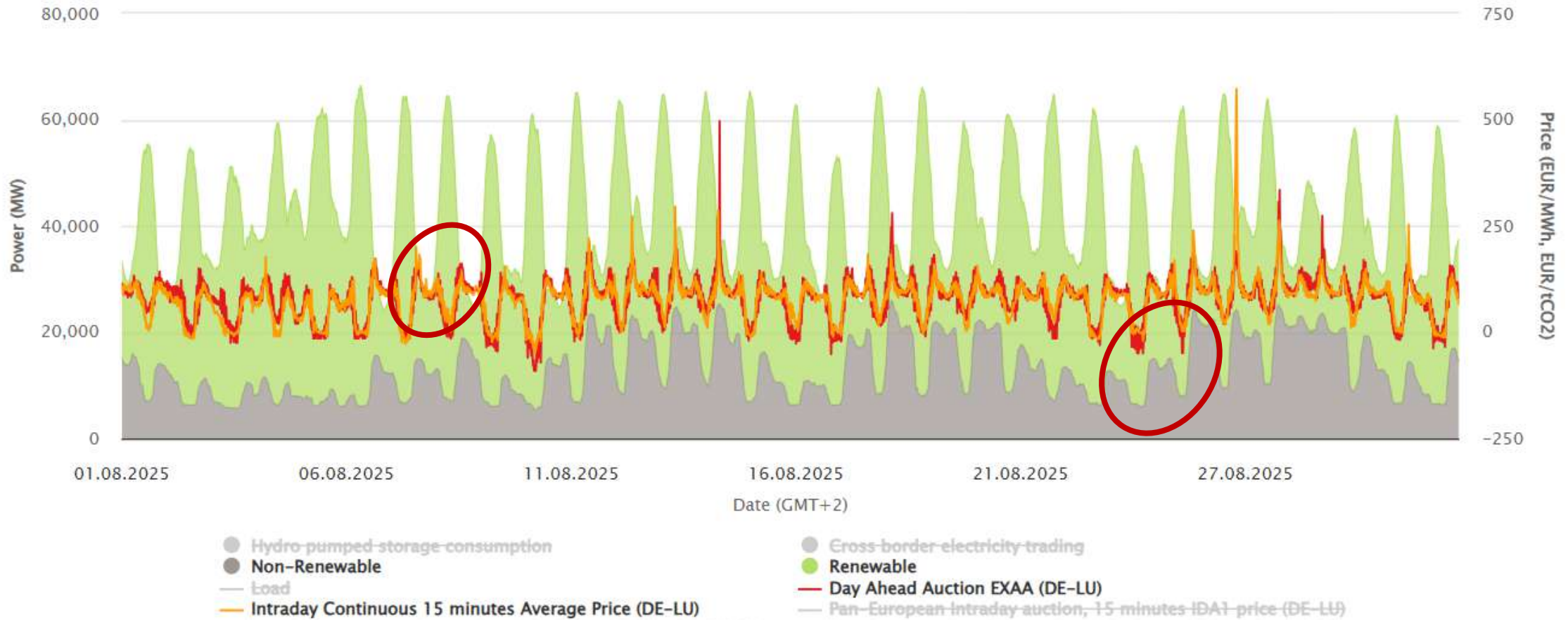
Source: SMARD Data

Even NUCLEAR is ramping up and down, a week in December in Germany



Market Prices in Germany give INCENTIVES for flexibilisation

Electricity production and spot prices in Germany in August 2025



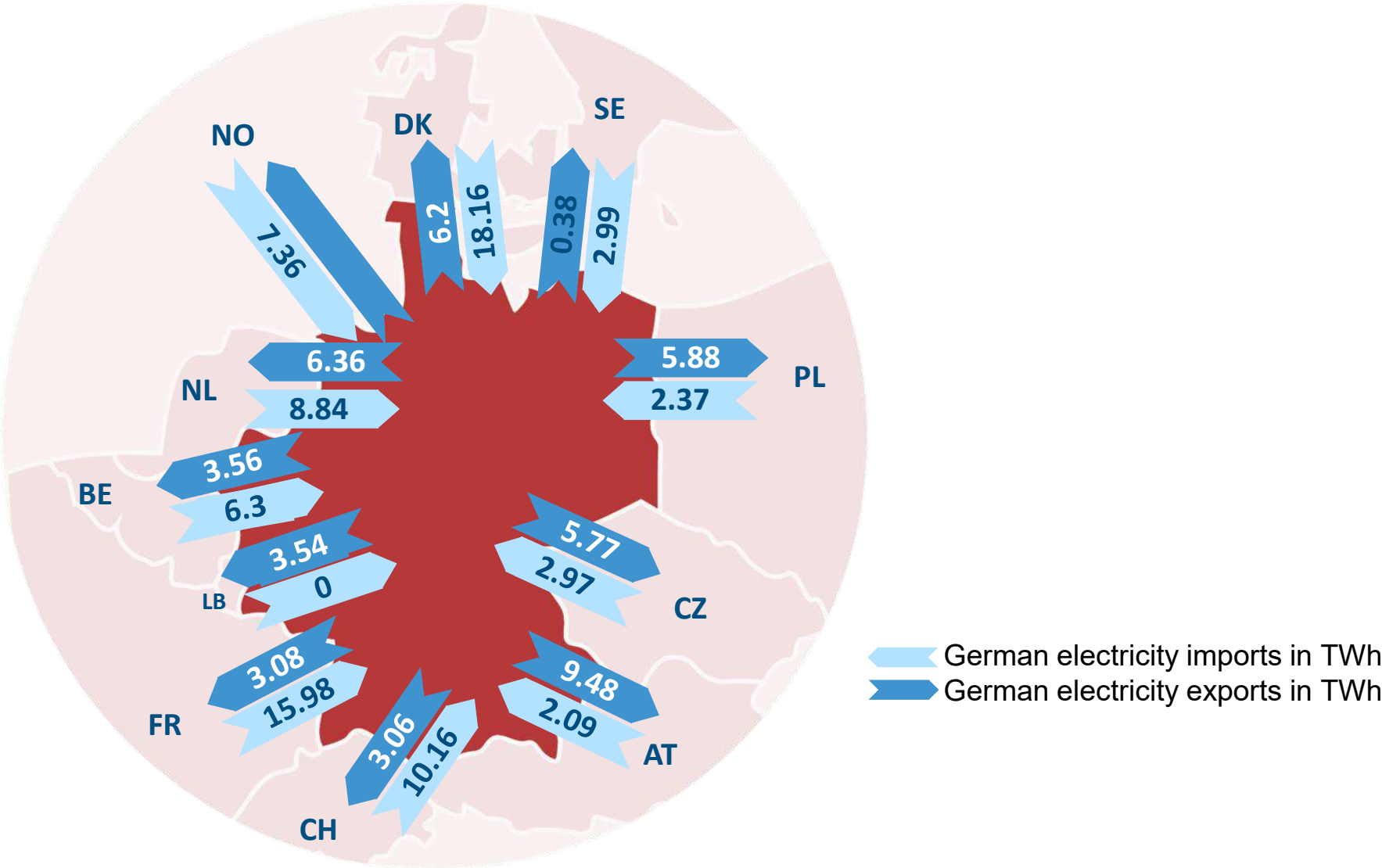
Source: Spot Market Prices | Energy-Charts

Flexibility is Value

- 1. Value Flexibility and give it a Premium**
- 2. Incentivise Demand Shift + Exports**
- 3. Flexibilise Thermal Units**
- 4. Establish Pumped Storage**
- 5. Establish Battery Storage**

Germany is part of European electricity grid

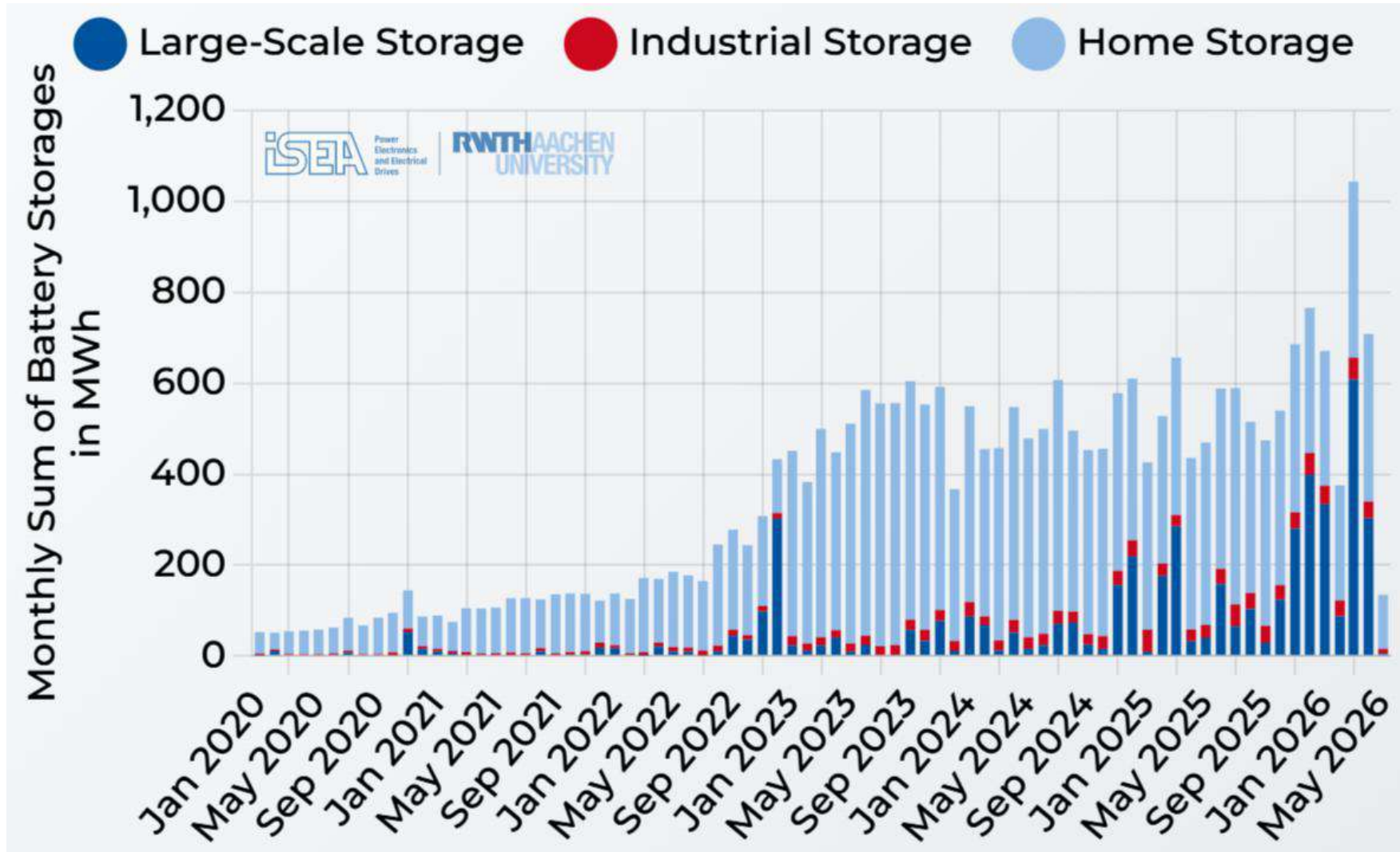
Germany's electricity Import and Export with the neighboring countries in 2024



Source: GIZ based on SMARD 2025, Fraunhofer ISE 2025, Bundesnetzagentur 2025, European Commission 2025

Battery storage in Germany (new installations)

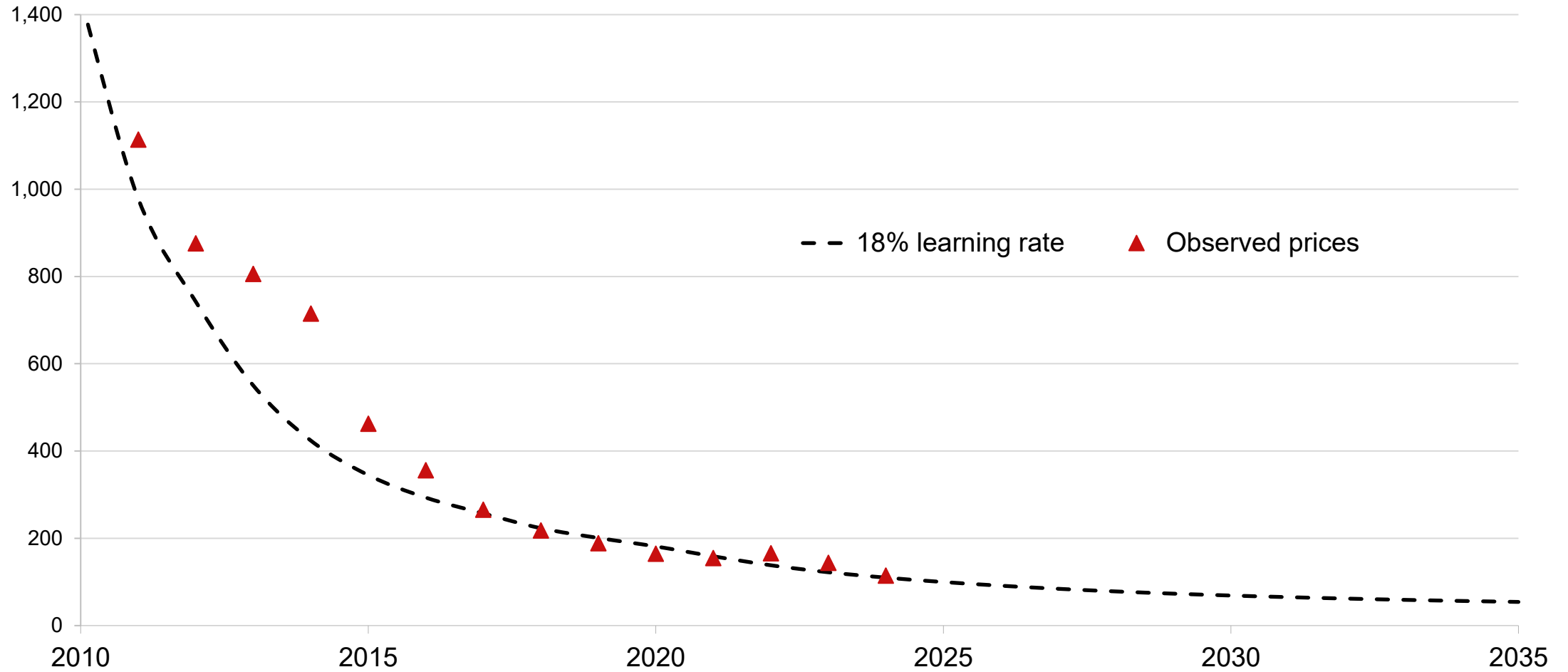
Every month Germany installs around 400- 600 MWh of storage capacity mainly in residential sector



Source: <https://battery-charts.de/battery-charts/>

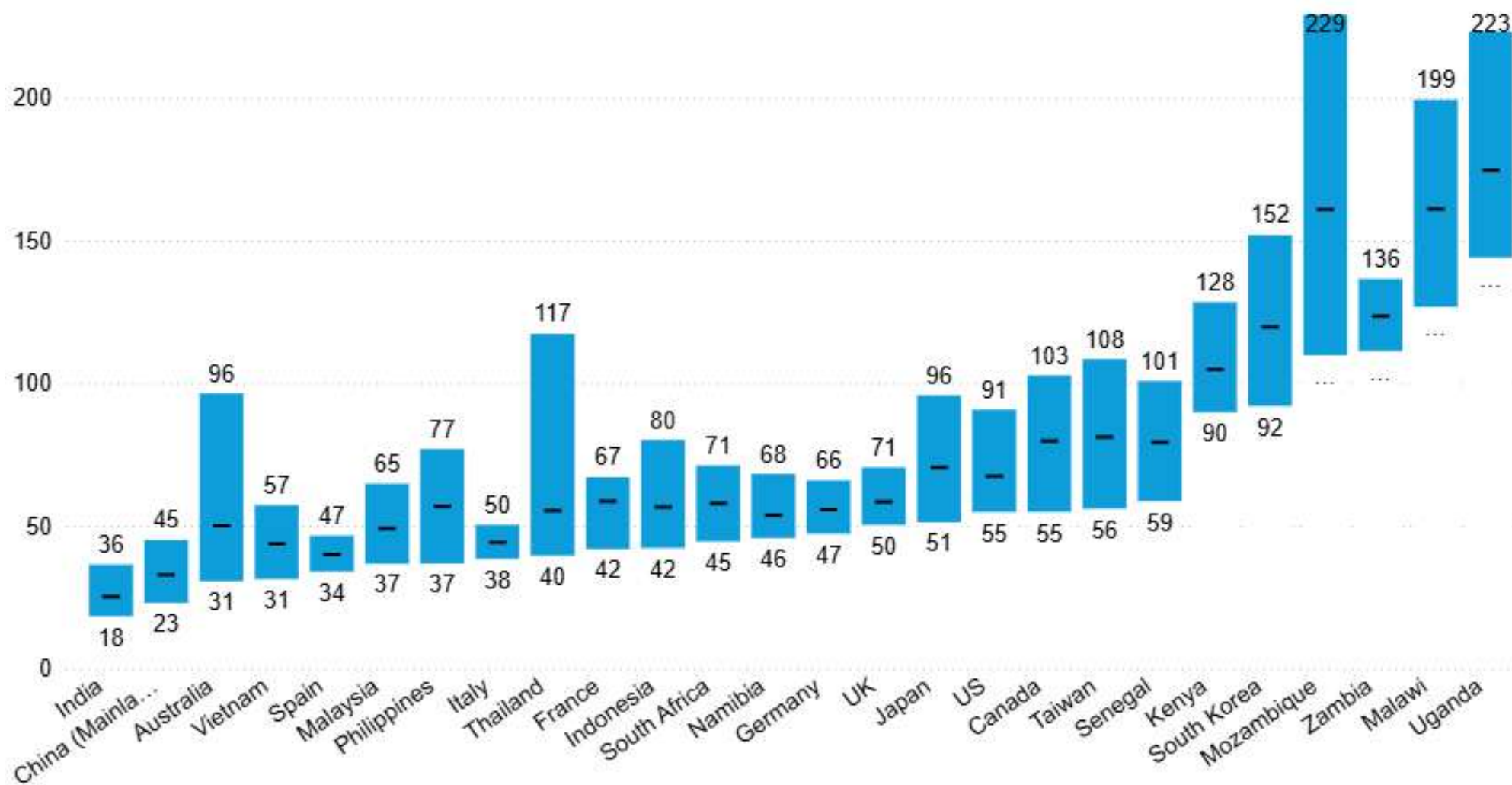
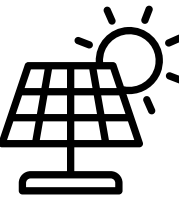
Lithium-ion battery pack price (real 2024 USD/kWh)

Approx 115 USD/kWh in 2024, cost for packs continues to fall



India generates the cheapest solar power in the world

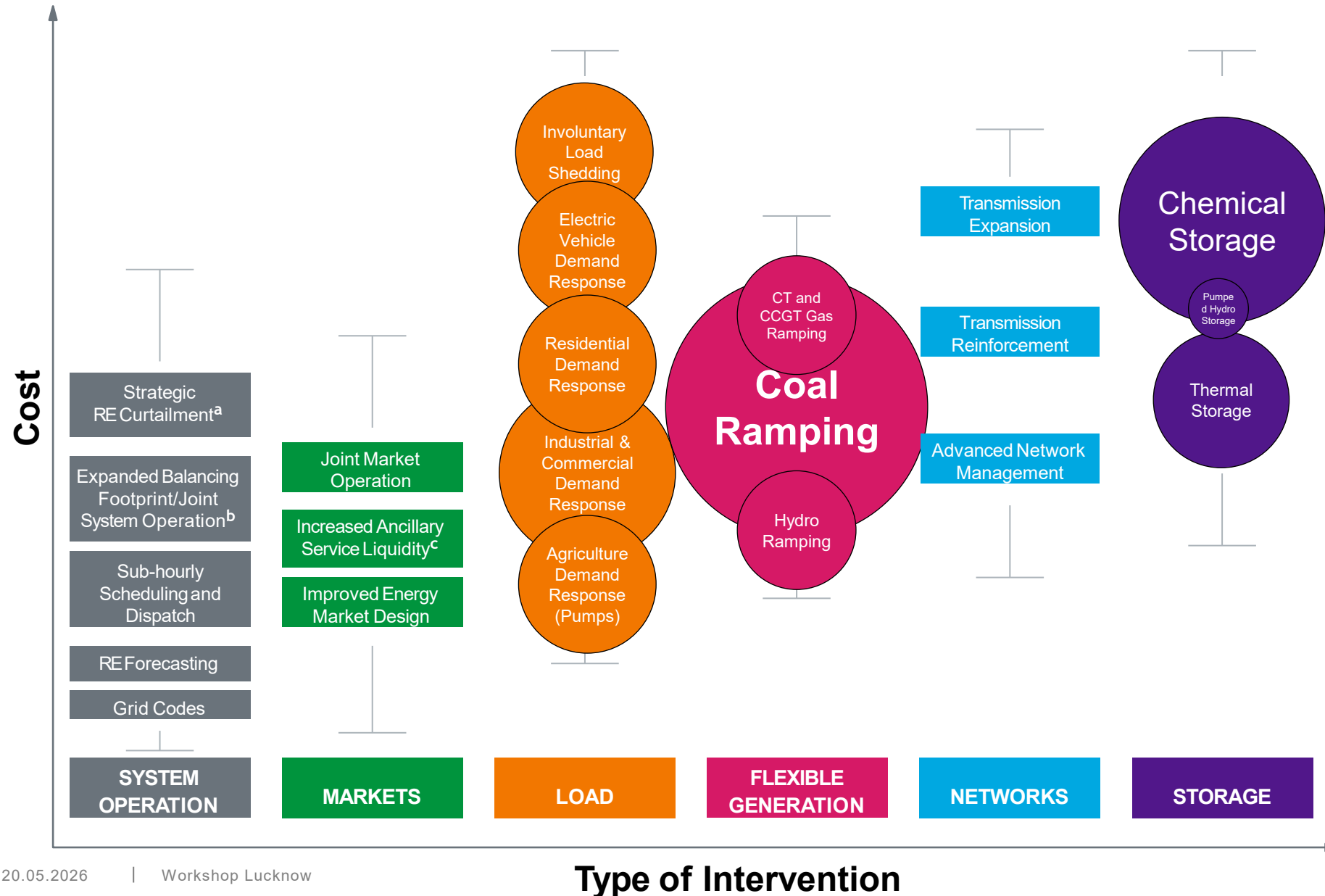
Price comparison for PV - fixed axis LCOE (in USD/MWh) in 2025 2H



Quelle: BNEF 2025

What is the largest energy storage available in India?

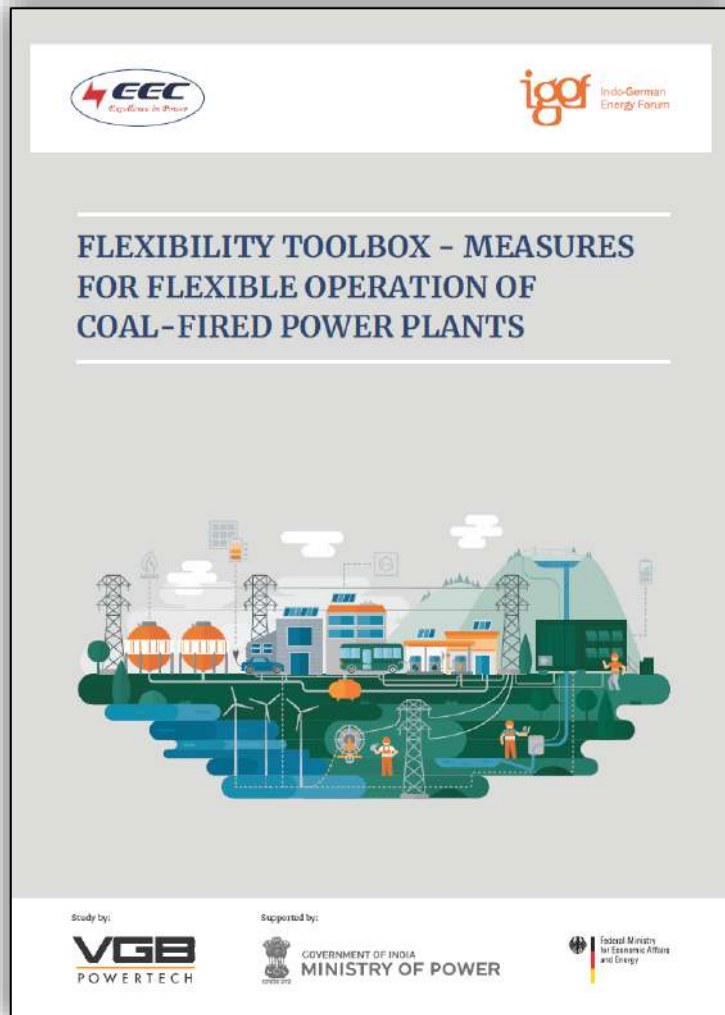
Coal is largest RE-Integration Option available at reasonable price



Thank you

Key message: Low minimum load most important flexibility dimension

10 steps to achieve flexibility, start with low cost retrofit measures which have highest effect

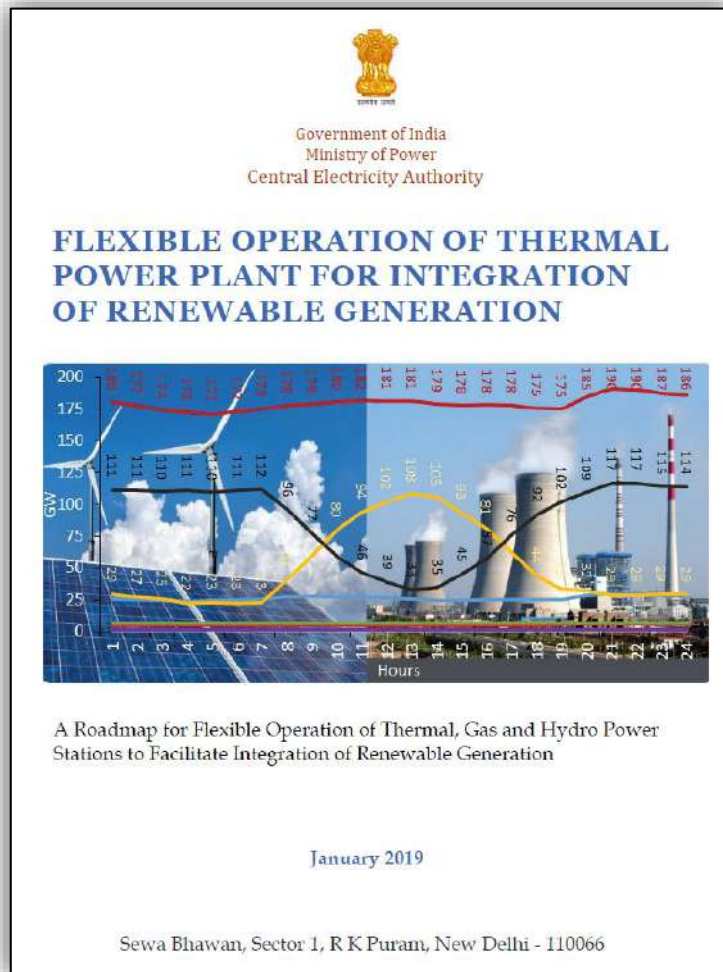


On behalf of MoP by Task Force Flexibility (NTPC, BHEL, POSOCO, IGEF+VGB+EEC) Lead author: Dr. Claudia Weise, VGB PowerTech e.V.

Plant type in Europe	Hard Coal	Lignite	CCGT
	Conservative / state of the art / very advanced		
Ramp rate [% / min]	2 / 4 / 9	2 / 4 / 8	4 / 8 / 12
in the load range [%]	40 to 90	50 to 90	40* to 90
Minimum load [%]	40 / 25 / 10	60 / 40 / 20	50 / 40 / 30*
Start-up time hot start <8 h [h]	3 / 2 / 1	6 / 4 / 2	1.5 / 1 / 0.5
Start-up time cold start >48 h [h]	7 / 4 / 2	8 / 6 / 3	3 / 2 / 1

Key message: 175 GW RE require min. 80 GW Flexibility in the System

...to avoid curtailment of RE



By committee (CEA, POSOCO, NTPC) under Ministry of Power, 2019
Lead author: B.C. Mallick, Chief Engineer (TPRM), CEA

- 108 GW peak generation from 175 GW RE assumed in July
- **Daily RE load swings of up to 86 GW**
- Balancing ramp rates of ~300 MW/min. at 9 am and 4 pm

If also considering other generation running in flexible mode as support:

- hydro (+/- 10 GW in July), gas (+/- 5 GW) & pump + battery (+/- 13 GW)
- with old and small size thermal units in two shift operation (+/- 5 GW)
- with up to 1% annual RE curtailment

➔ **at least 50 GW coal ramping required**

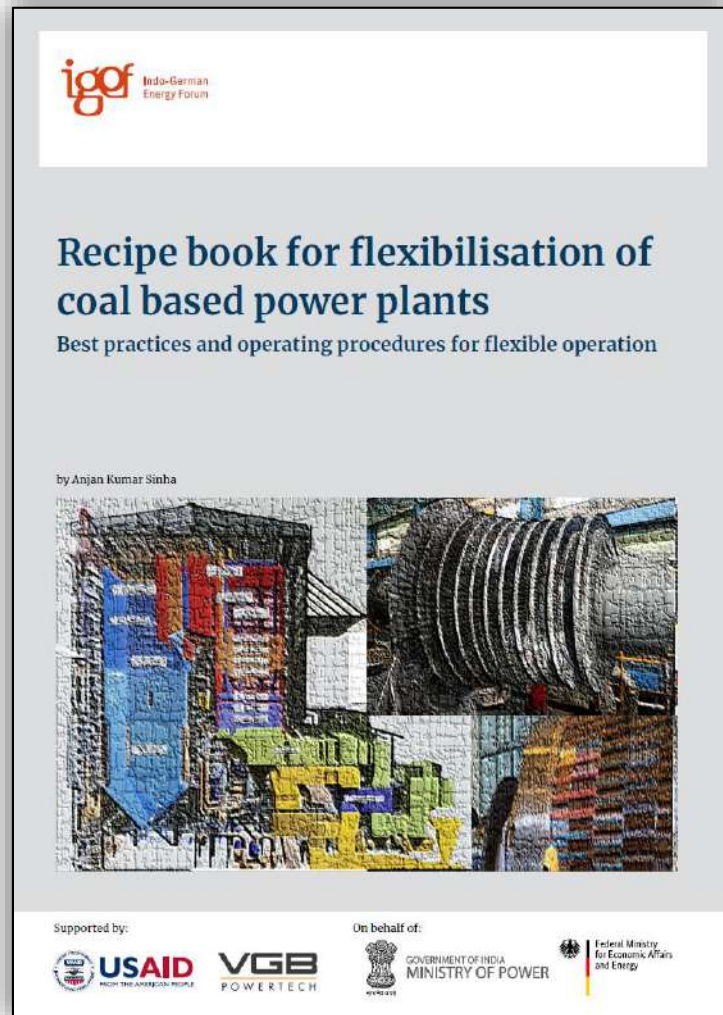
➔ **with all coal down to ~57% minimum thermal load (MTL)**

➔ **without flexible support of hydro etc. MTL ~45% for coal**

➔ **without 1% curtailment MTL of ~38% for coal estimated**

➔ **without flexible support and without curtailment MTL ~26%**

36% stable minimum load of coal achieved in India – national record!



On behalf of MoP by Task Force Flexibility (NTPC, BHEL, POSOCO, IGEF+VGB+EEC) Lead author: Mr. Anjan Kumar Sinha, Retd. NTPC

Findings from pilot studies and test runs conducted at various coal-based units in India over the last five (5) years.

Test runs conducted in India by IGEF Task Force Flexibility on request of Shri Dewanganji. **40% stable minimum load achieved and can be sustained with minimum retrofits** like improved C&I systems, boiler condition monitoring, combustion optimizer, coal analysers etc.

List of **potential damages** which may occur to the power plant **if the power plant operator is not properly trained** in minimum load running and ramping of coal fired plants.

Update: **New national record at JV DVC+TATA Maithon of 36% Minimum Load** achieved by Task Force Flexibility.