Alignment between Vietnam PDP8 and JETP commitment

Power system analysis 2030

Dimitri Pescia, Samarth Kumar

August 2023

Key objectives of the analysis

What are the implications of the JETP commitment of Vietnam to peak power sector emissions to 170 $MtCO_2$ in 2030 for the dimensioning of fossil fuel assets (particularly coal and gas) under the PDP8?

What are the implication in term of additional development of wind and solar energy capacities up to 2030?

These research objectives are further broken down into the following questions:

→ What impact would the JETP commitment have on the utilisation rate of planned coal and gas assets under PDP8 in 2025 and 2030?
→ How much gas-fired power is needed to reach 170 MtCO2 peak emission by 2030?
→ What is the cost-optimal capacity mix for solar and wind versus fossil fuels to reach 170 $MtCO_2$ peak emission by 2030?

Key Findings

1. **Without strict carbon pricing policies, PDP8 capacity mix would lead to about ≈52 Mt more CO_2 emissions than the JETP commitment of 170 Mt in 2030.**

2. **Compared to the PDP8, meeting JETP targets at lower costs would require 76GW of additional solar PV, 14GW of battery storage and 22 GW less gas capacity expansion (15 GW installed capacity in 2030).**

3. **Meeting JETP targets without re-dimensioning planned fossil fuel capacities requires radical policy instruments (e.g., aggressive CO_2 price) to significantly shift generation from coal to gas.** A failure in the market design would lead to higher coal generation, pushing up emissions and jeopardising the economic viability of gas assets.

4. **New capacities should be allocated closer to load centers in Northern and Southern regions.**

This analysis used fundamental cost optimisation modelling, utilising published PDP8 data wherever possible

Inputs

- Economic parameters like fuel costs, interest rates
- Availability factors for Wind and Solar
- Capacities for each technology and region
- Technology-specific parameters of technologies including , CAPEX, OPEX, efficiency, ramp limit, fuel use, emission factor, etc.
- Electricity demand timeseries
- …

Modelling

Total System Cost Minimisation
(using PyPSA Framework)

- Techno economic constraints
- Hourly Resolution
- Full-year co-optimisation of generation and capacity (myopic)
- Thailand represented by 5 regions

Outputs

- Optimised investments per region for each technology
- Average and hourly prices for each region
- Optimised hourly dispatch for the entire year
- Net electricity flows between each region
- Capacity factors for each technology by region
- CO_2 emission from each technology for each region
- …

Hydropower and import generations are kept at similar level as in PDP for meaningful comparison. Transmission capacities across regions are expanded according to PDP's planned numbers. Wind and solar generation in 2020 are low in PDP, possibly due to low load during covid year leading to curtailment

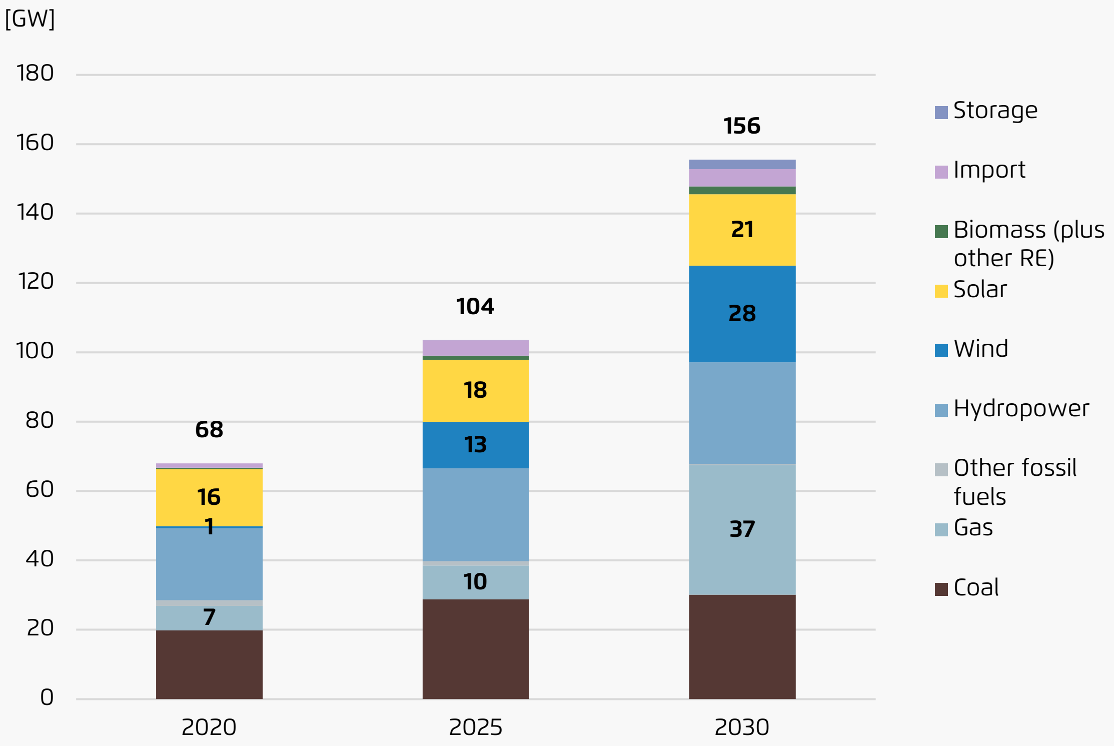
Overview of the designed scenarios

	[PDP8] **Calibration** [BAU]	**PDP8 cap with JETP emissions** [JETP-1]	**Capacity follows cost optimal** [JETP-2]
Narrative	Calibration. Results from the BAU confirm that the PDP8 results follows least cost dispatch optimi-sation under pre-JETP objectives	Meeting the JETP target without re-dimensioning the PDP8 capacity mix, will result in a very low utilisation of coal and gas assets, questioning their economic viability	Meeting the JETP targets at lower costs require cutting down investments in gas power plants and increasing wind and solar capacities
Capacity mix	Fixed as PDP8 (No capacity optimisation)	Fixed as PDP8	Freely optimised for solar, wind, gas and storage capacities
Coal*	Capacity – fixed as in PDP8 Generation constrained by PDP yearly CFs		
Gas	Capacity – fixed as in PDP8 Dispatch – Optimisation	Cap – fixed as in PDP8 Gen – Modelled	Gen and Cap – Modelled
Emission Constraint	No **	Yes, maximum total emission of 170Mt by 2030	Yes, maximum total emission of 170Mt by 2030

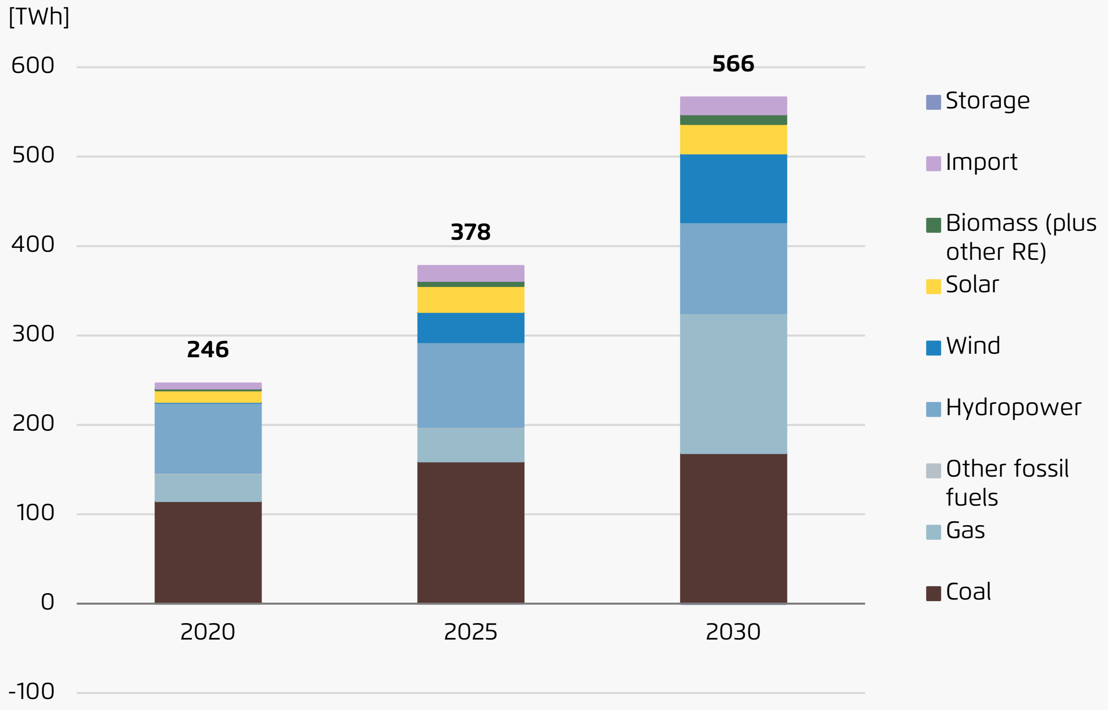
*In all scenarios, the coal capacities remain consistent with PDP8 levels since this planned capacity is already in the pipeline, and the total amount aligns with the JETP announcement. Maximum generation from coal is constrained by PDP's utilisation rate (ca. 70%). **The range of emission mentioned in PDP8 is 204 - 254Mt by 2030.

The PDP8 foresees a significant boost in fossil fuel power plants (+ 30 GW of gas and + 9 GW of coal), which is incompatible with meeting JETP targets

Capacity mix in Vietnam
[PDP8]

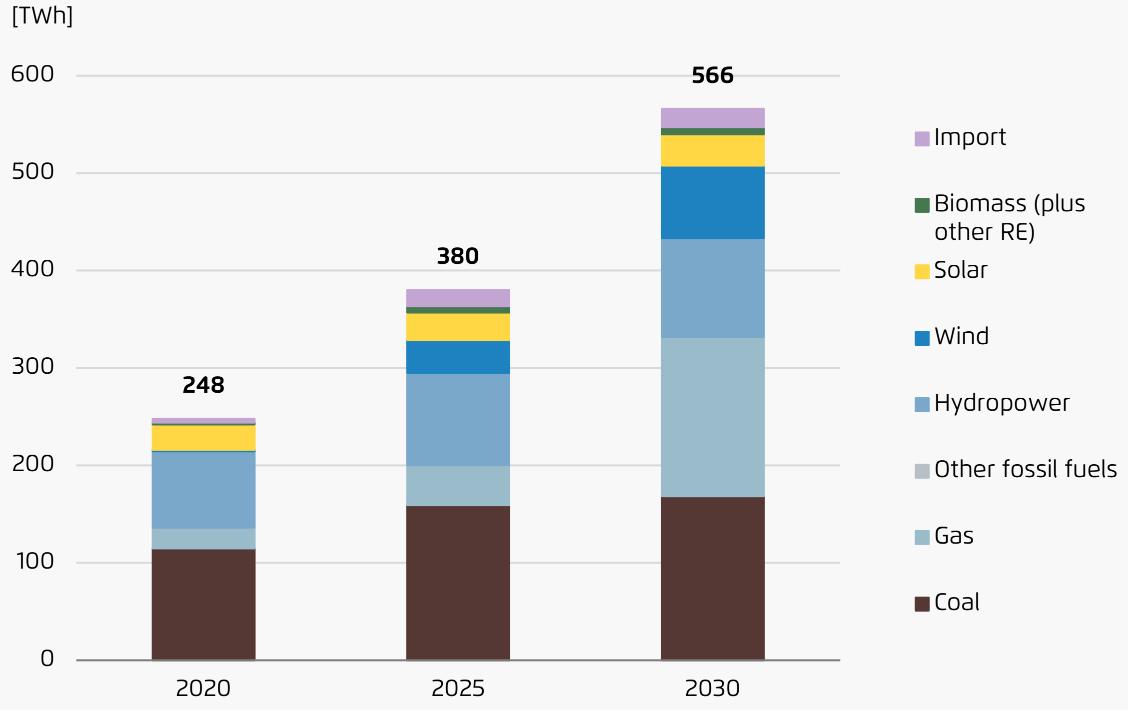


Generation mix in Vietnam
[PDP8]

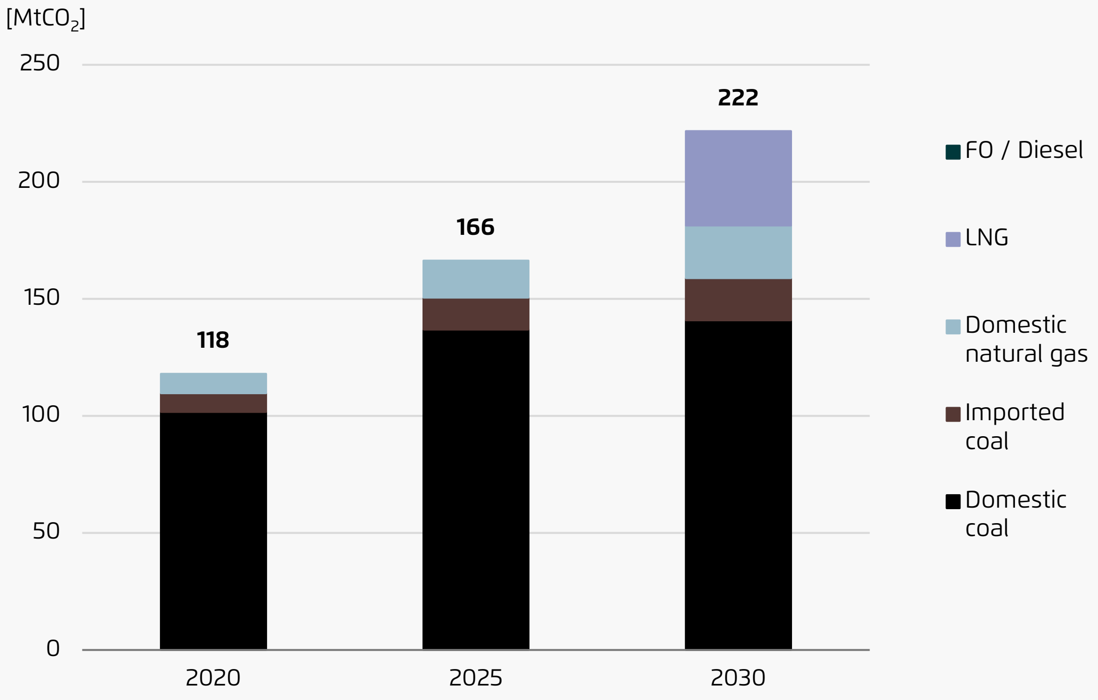


Without strict constraints on the dispatch of coal power plants, the PDP8 emits about ≈ 52 Mt more CO_2 emissions than the JETP commitment of 170 Mt

Generation by fuel type

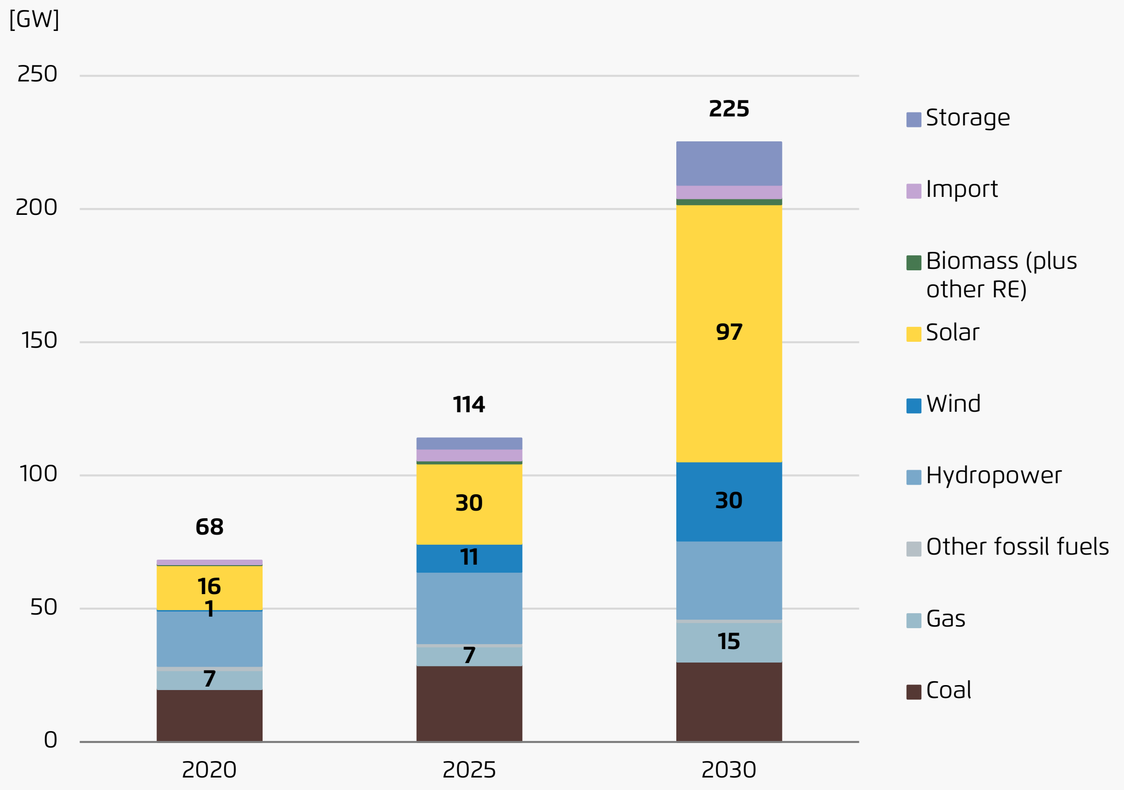


Emission by fuel



Compared to PDP8, meeting JETP targets at lower costs would require 76 GW more solar PV capacity, 14 GW of battery storage and a reduction of gas capacity by 22 GW by 2030

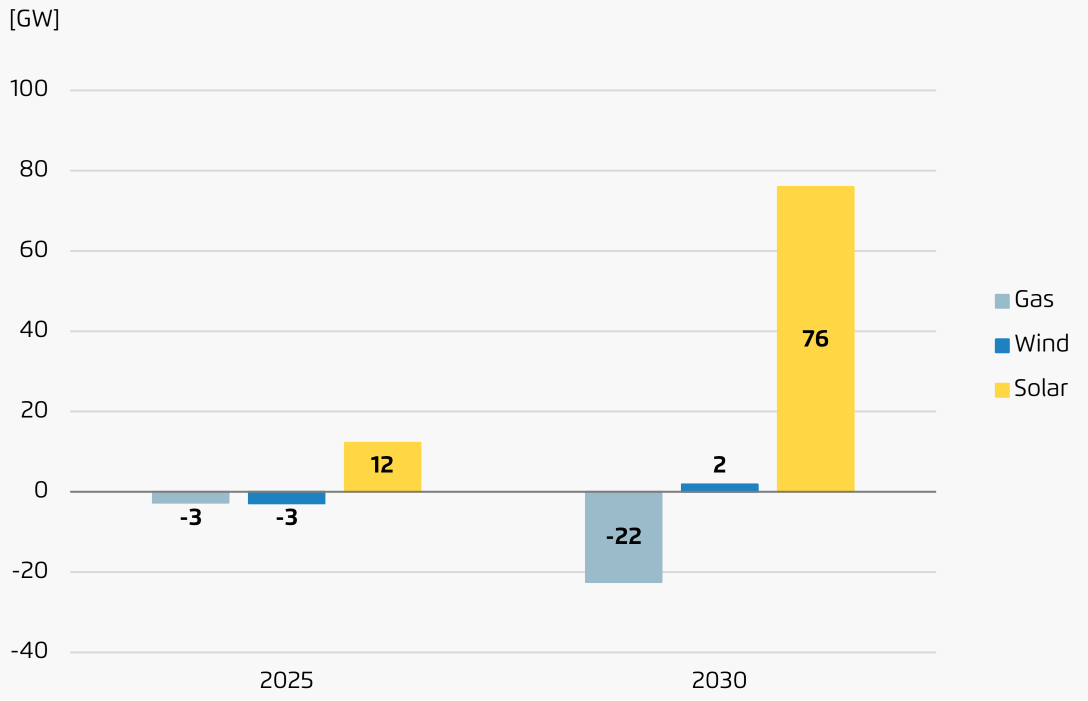
Cost-optimal capacity mix to meet the **JETP** targets



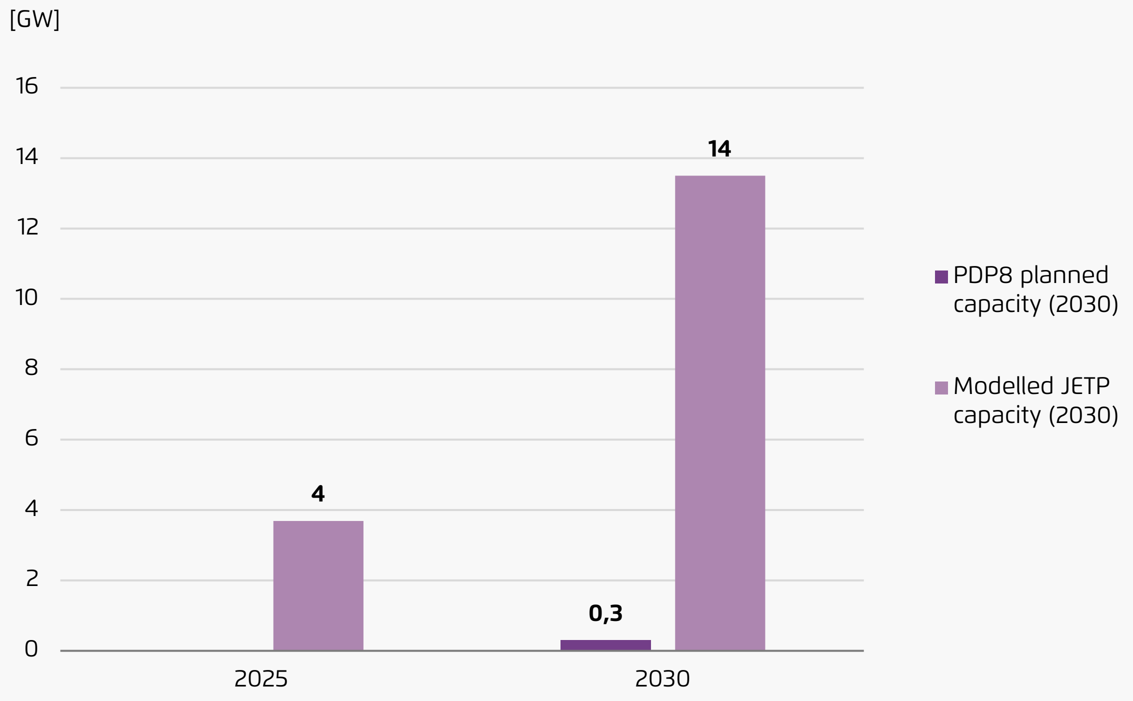
- → JETP targets require **76 GW more** (97 GW instead of 21 GW) than PDP8 of **solar PV** capacity.
- → The additional solar capacity to meet JETP targets means re-dimensioning the planned **gas capacity** from 37 GW to 15 GW (-22 GW).
- → Cost-effective integration of solar into the power system means ramping up the capacity expansion of battery storage from the negligible planned PDP8 to **14 GW by 2030.**
- → Optimally locating power plants in combination with battery storage ensures low-level curtailments (<1%) of renewables.

Compared to PDP8, meeting JETP targets at lower costs would require 76 GW more solar PV capacity, 14 GW of battery storage and a reduction of gas capacity by 22 GW by 2030

Power capacity difference between cost-optimal capacities and PDP8

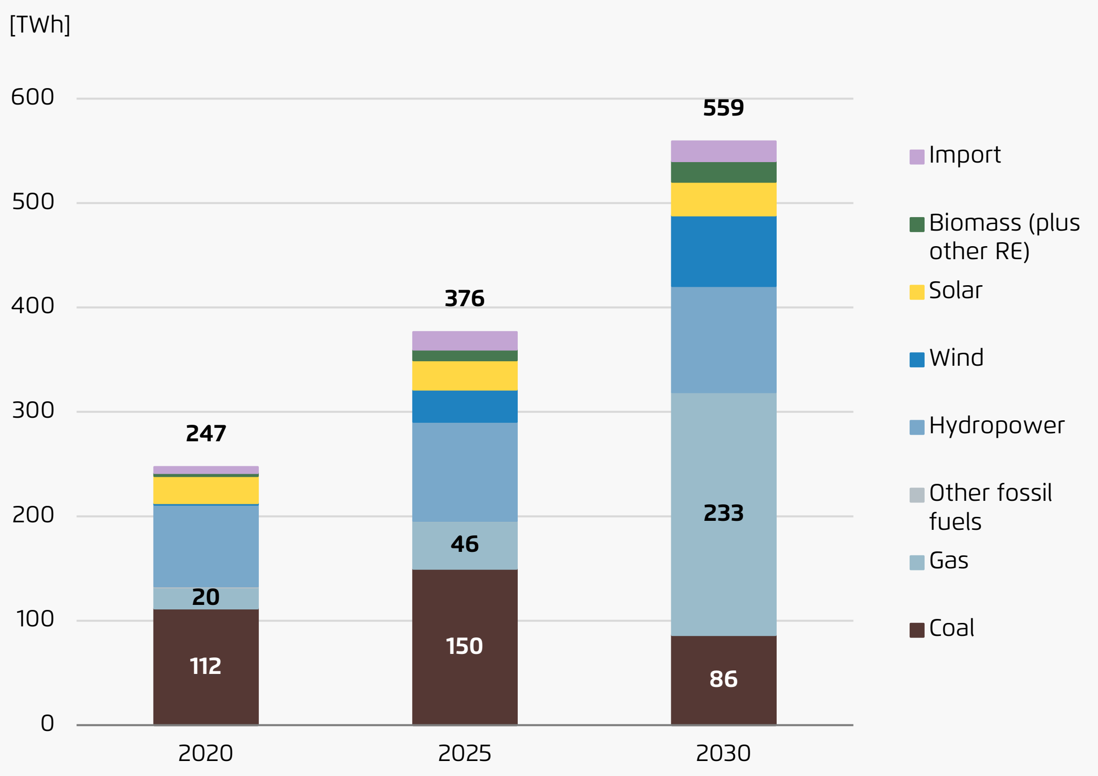


Battery storage requirement between cost-optimal capacities and PDP8

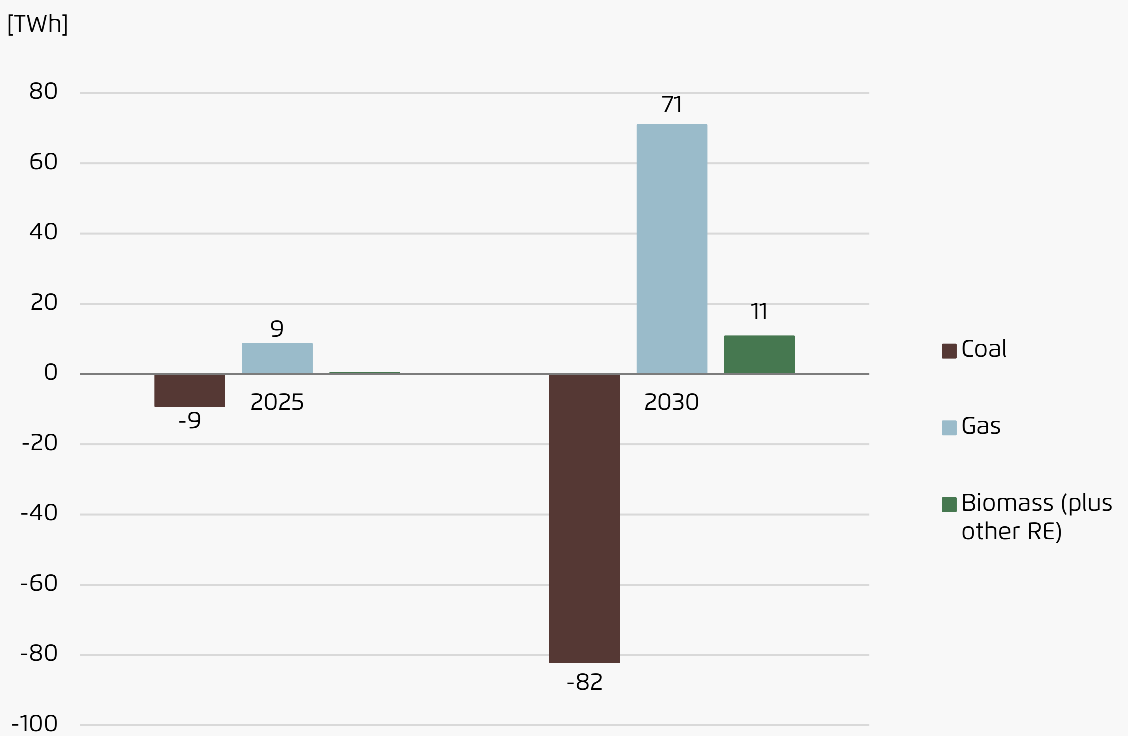


Meeting the JETP target without re-dimensioning the PDP8 capacity mix will require radical policy instruments (e.g. aggressive CO2 price) to significantly shift generation from coal to gas

Generation by fuel (Capacity same as PDP)



Difference in generation compared to BAU

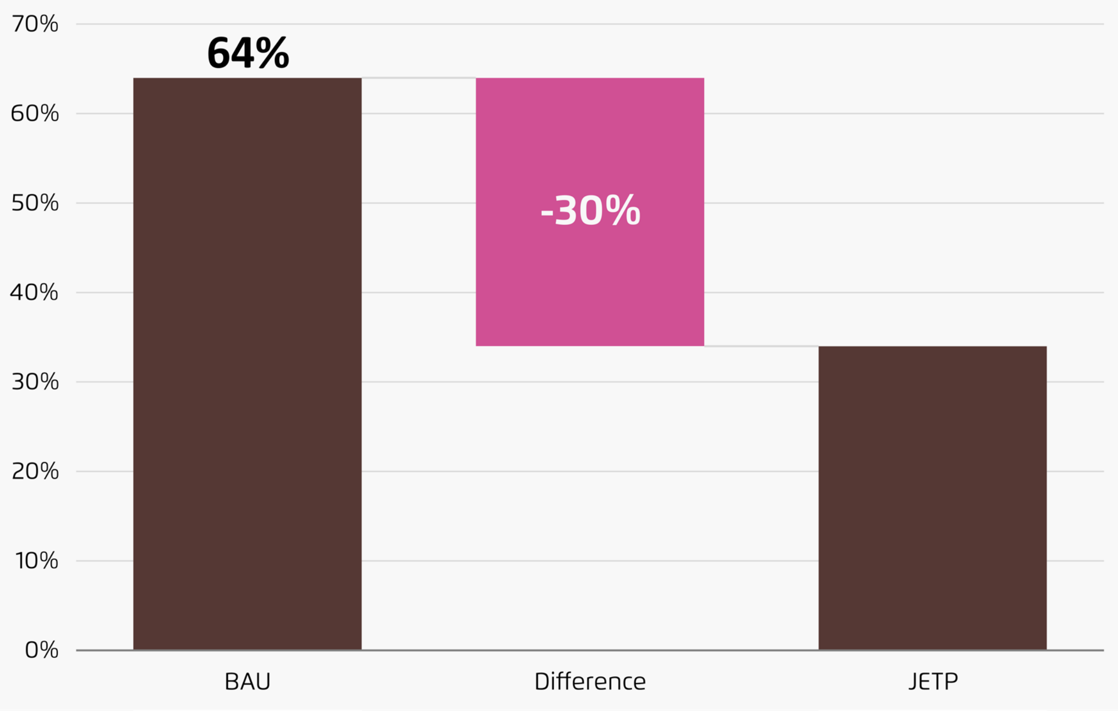


The utilisation of coal power plants would need to decrease by 30%, and that of gas power plants would need to increase by 21%

A failure in the market design would lead to higher generation of coal, pushing up emissions and jeopardising the economic viability of gas assets

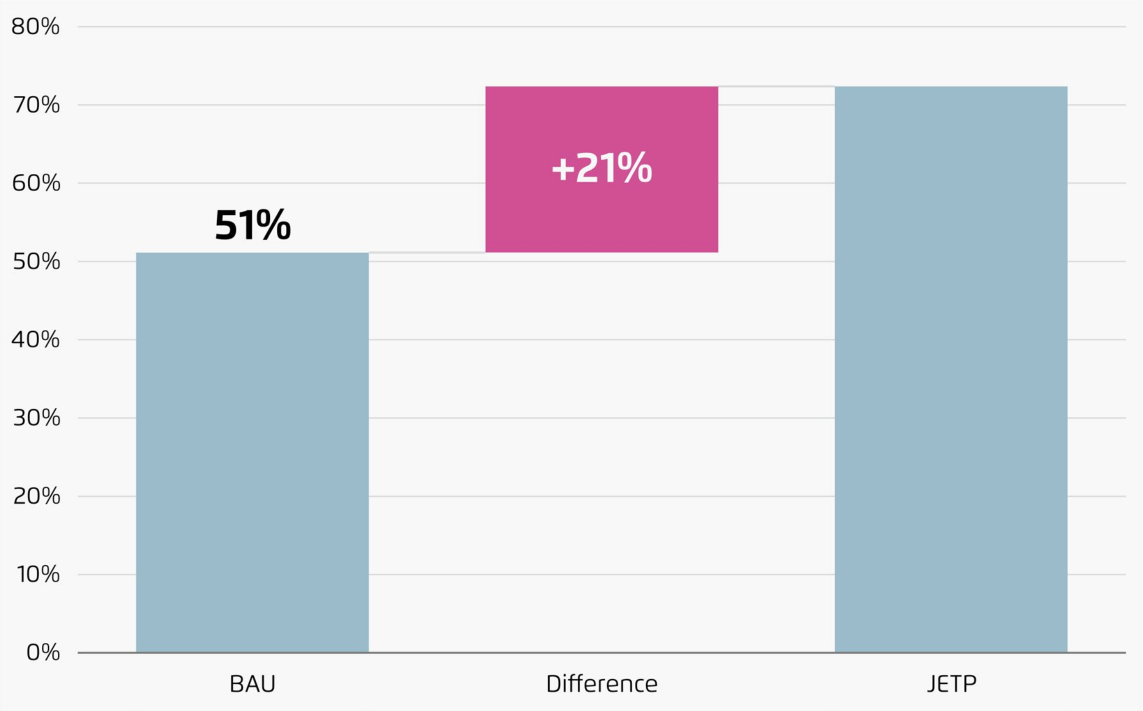
Change in utilisation of coal power plants to meet JETP targets

Utilization rate of coal power plants (2030)



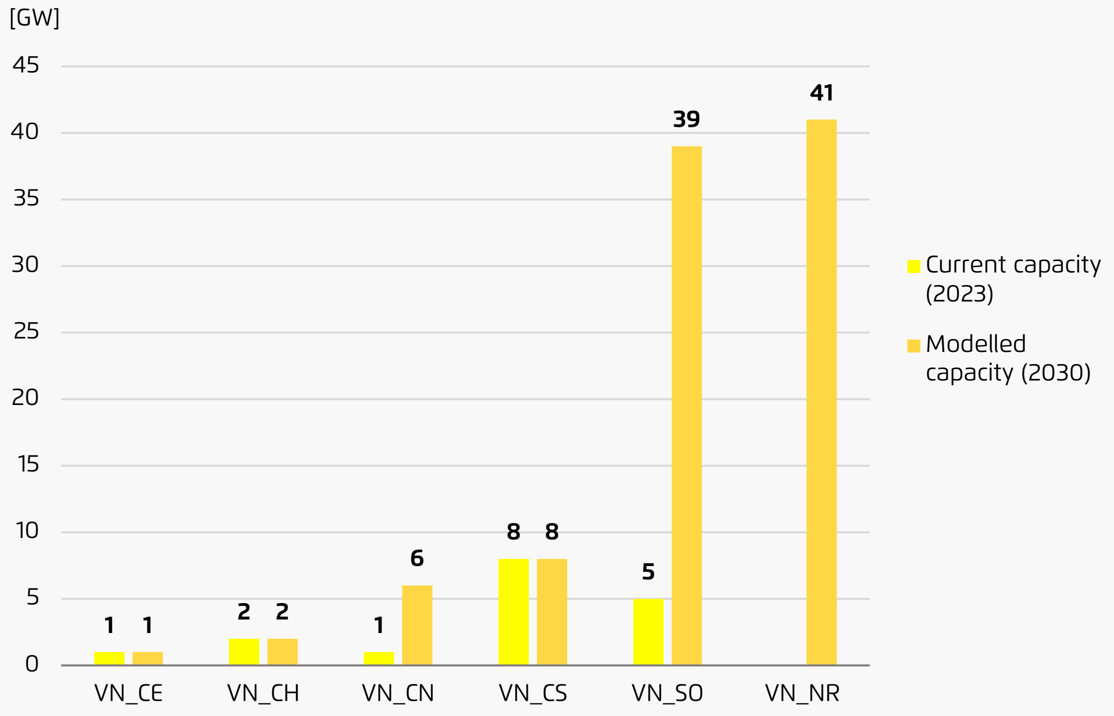
Change in utilisation of gas power plants to meet JETP targets

Utilization rate of gas power plants (2030)

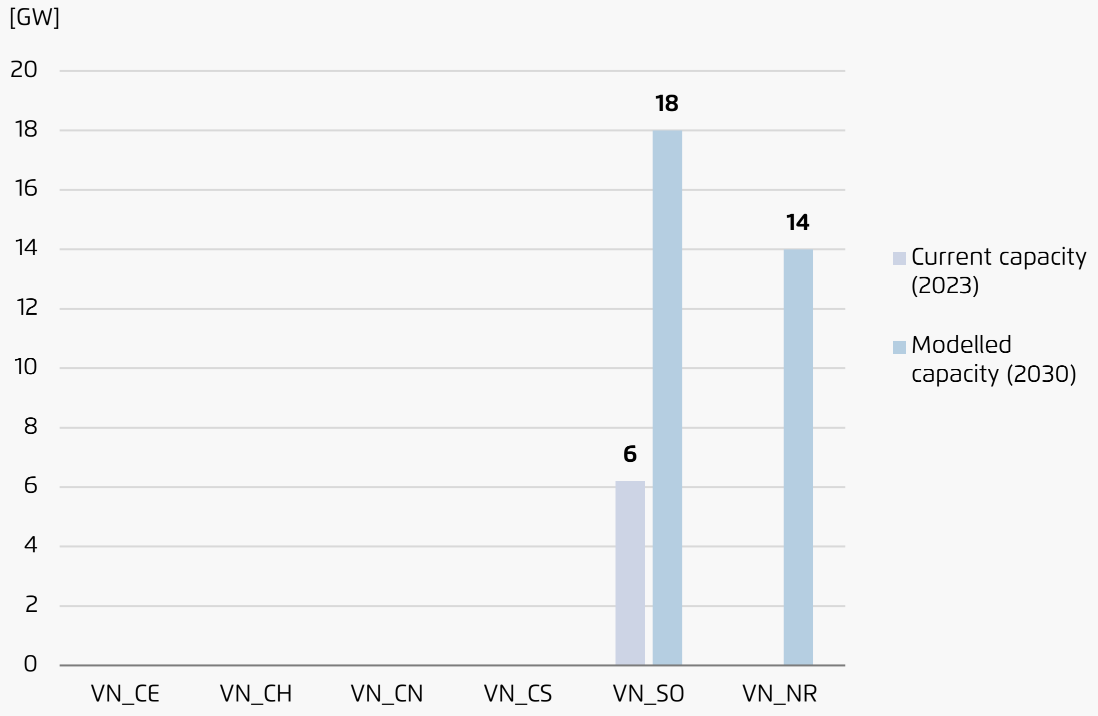


Compared to PDP8, meeting JETP targets at lower costs would require 76 GW more solar PV capacity, 14 GW of battery storage and a reduction of gas capacity by 22 GW by 2030

Cost-optimal solar PV capacity for 2030 compared to the present situation



Cost-optimal gas capacity for 2030 compared to the present situation



 | Agora Energiewende (2024) based on PyPSA-Agora-VN (Scenario: JETP-2); NR - North, CN - Central North, CE - Central, CH - Central Highlands, CS - Central South, SO - South

Open questions and further analysis

Open questions related to PDP8 methodology:

→ Do the Build-Operate-Transfer (BOT) contracts for new coal specify a minimum number of dispatch hours? If this isn't met, what are the associated compensation costs?

→ Is there a minimum must-run baseload hydropower to ensure water supply?

→ PDP8 plans to export clean energy to neighbouring countries, yet there's no evidence of this in any official plans. Considering that nearby nations have low demand and deal with over-capacity issues, is exporting power feasible?

Further analysis/improvement to the modelling framework:

→ Better assessment of flexibility options, battery, and grid reinforcement.

→ Economic viability and risk assessment of stranded investments in both coal and gas.

→ Further assessment of RES zoning, need for grid reinforcement and curtailment measures.

→ Updated cost assumptions. PDP8's fuel prices and technology costs appear overly conservative and outdated.

→ The electricity demand forecast should be revisited, considering the implementation of energy efficiency and demand response measures.

→ Implement linearised UC modelling to better reflect ramping/inflexibility characteristics of fossil power plants.

Thank you for your attention!

Do you have any questions or comments?

Dimitri Pescia
dimitri.pescia@agora-energiewende.de

www.agora-energiewende.de

Imprint

Agora Think Tanks gGmbH
29 Vanissa Building (Tower B-19A)
Chidlom Rd, Lumphini, Pathum Wan
10330 Bangkok
Thailand

www.agora-energiewende.de
info@agora-energiewende.de

Project Lead
Dimitri Pescia
dimitri.pescia@agora-energiewende.de

Authors
Dimitri Pescia (Agora Energiewende)
Samarth Kumar (Agora Energiewende)

Modelling
Conducted using PyPSA-Agora by Samarth Kumar and Yu-Chi Chang (all Agora Energiewende)