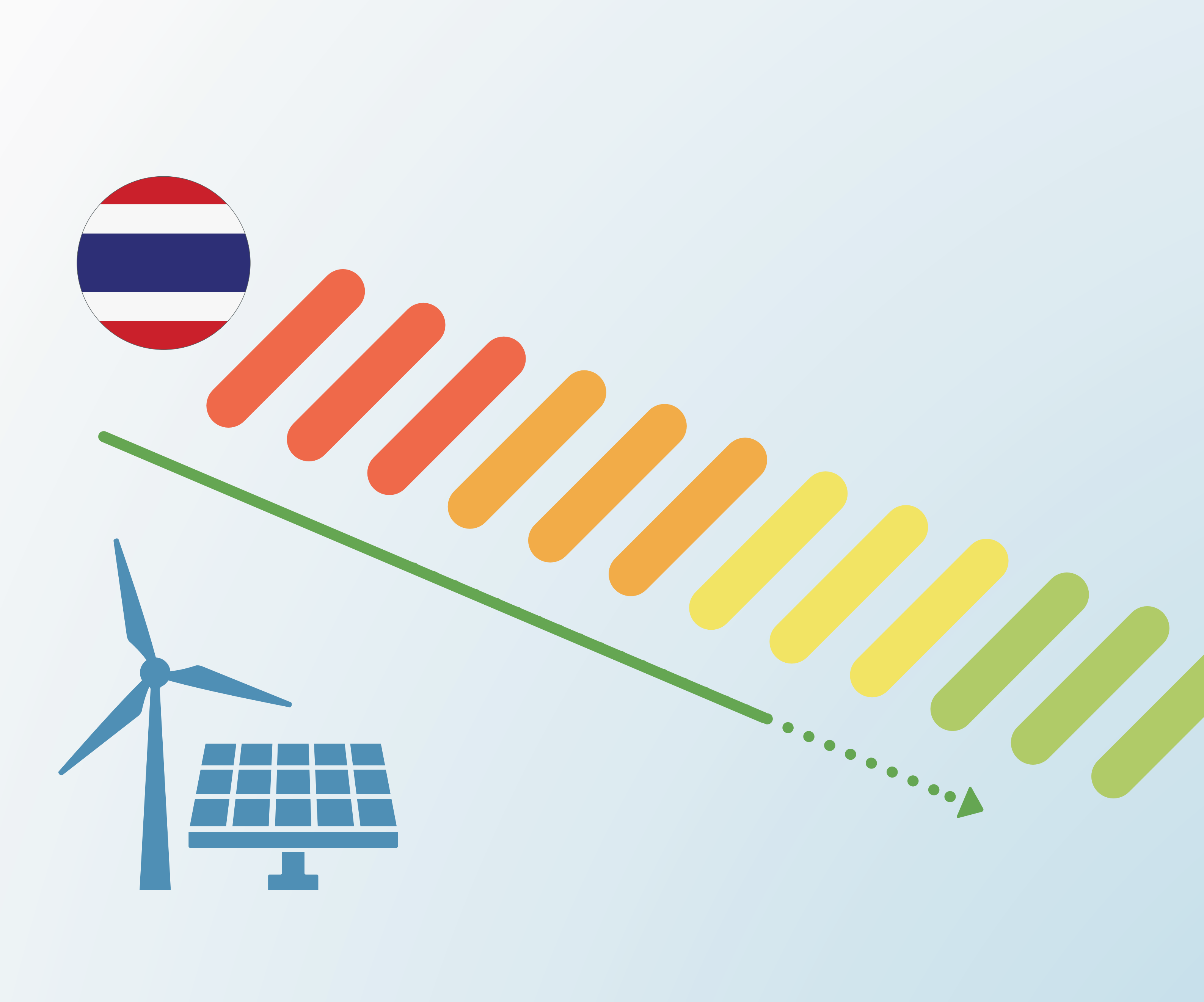
Climate Action Tracker



Climate Action Tracker

Wind and Solar benchmarks for a 1.5°C world

THAILAND

February 2026

CLIMATE ANALYTICS

NEW CLIMATE INSTITUTE

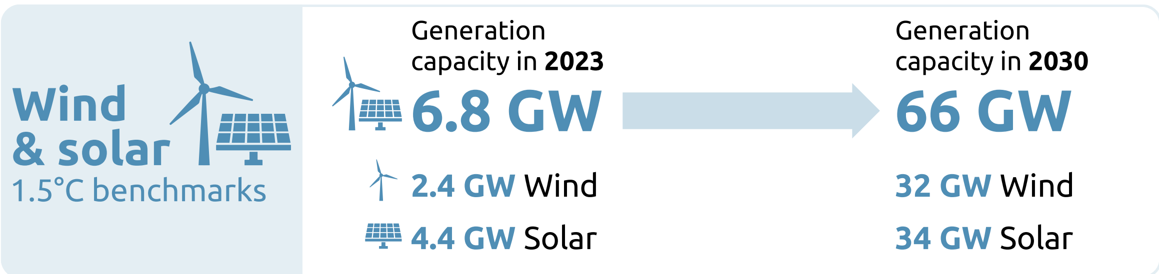
Executive Summary

Context

- Thailand has abundant potential for wind and solar, but it is heavily dependent on coal and gas, which still provided 80% of Thailand's electricity generation in 2023.
- The Thai Government has set a target of achieving 51% renewable electricity generation by 2037.
- In this report, we look at national studies and global energy system models to assess how much Thailand's wind and solar capacity need to grow to align with the global goal to triple renewables by 2030 and the Paris Agreement's 1.5°C warming limit.

Key findings

- Thailand's wind and solar generation needs to grow between 11-17 times by 2030 to align with 1.5°C. This equates to 98-152 TWh of wind and solar generation in 2030, up from 9 TWh in 2023.
- Thailand would need almost 60 GW of new wind and solar by 2030 (30 GW solar, 30 GW wind). This would require average annual capacity additions of 3.3 GW/yr of solar and 3.4 GW/yr of wind from 2023-2030.
- Thailand's current rollout of wind and solar is not progressing fast enough to achieve this. Under current policies and market conditions, only a third of the solar and a tenth of the wind needed to align with 1.5°C will be installed by 2030.



Context

At COP28, governments agreed to triple global renewable capacity by 2030 globally to stay in line with 1.5°C. This report highlights the potential implications of this COP28 decision at the national level, focusing on **Thailand**.

Wind and solar deployment is accelerating around the world. However, expected wind and solar capacity deployment under current policies falls short of what is needed for 1.5°C, and is concentrated mainly in a few regions.

Research is needed to understand the pace of wind and solar deployment that aligns with the highest plausible climate ambition and 1.5°C compatibility.

This project aims at answering the following questions:

- **How much wind and solar generation is needed (TWh) at the national level?**
- **How much wind and solar needs to be built (GW of capacity)?**
- **When does it need to be built by, and how quickly?**

Policy context

Thailand's 2030 Nationally Determined Contribution (NDC) is to cut emissions 47% below 2019 levels (including LULUCF) by 2035. The country aims to reach carbon neutrality by 2050 and net zero GHGs by 2065.

Thailand also aims to reach 33% of renewables in electricity generation by 2030, but under current policies, it will reach less than 19% share in 2030.

Under current policies and market conditions, the IEA estimates that **solar capacity in Thailand will reach 11 GW in 2030**, up from 4.4 GW of solar in 2023. Meanwhile, **wind capacity is projected to reach 3.4 GW in 2030**, up from 2.4 GW in 2023.

International support

The key analytical elements (high ambition country-level studies and downscaled 1.5°C compatible global pathways, see Methods) do not consider financing requirements.

Significant global resource transfers will be required in line with 'common but differentiated responsibilities and respective capabilities' to achieve these benchmarks.

We do not quantify the technical and financial support needed to achieve the wind and solar rollout presented in this report. This should be a country-driven exercise and some governments have already initiated such processes.

High-income countries will need to provide substantially increased climate finance to support emissions reduction abroad, in line with their 'fair share' of climate action.

Achieving these benchmarks in lower-income countries is therefore a global responsibility, rather than a domestic responsibility. Therefore, ambitious climate finance commitments and delivery are essential to support high ambition at the national level.

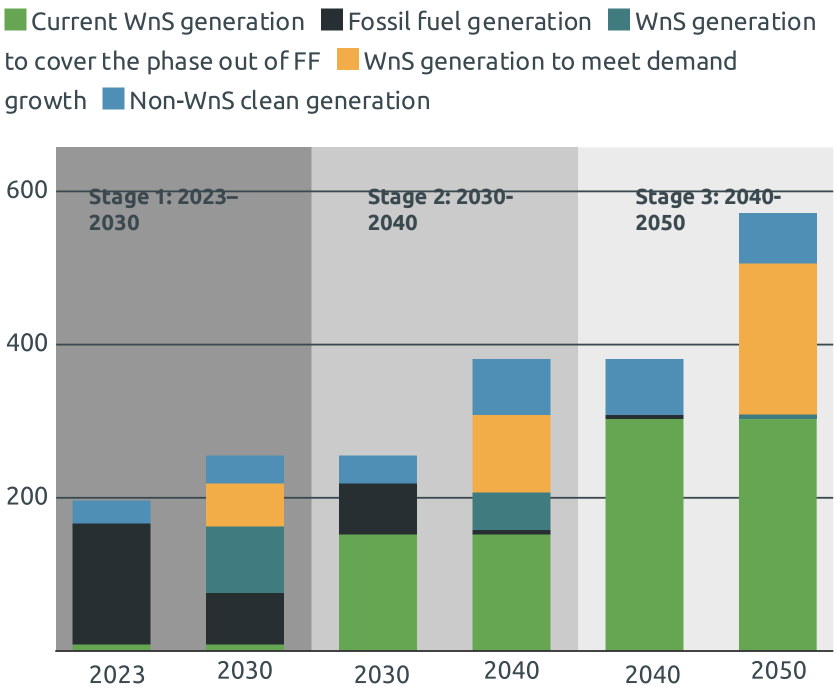
National enabling factors

Key enabling factors for ambitious wind and solar rollout include:

- **Institutional capacity.** A rapid build-out of wind and solar will require the governance and institutional capacity to develop, implement and enforce policy frameworks.
- **Just transition.** A just transition will be needed to take along all stakeholders, particularly those employed by the fossil economy.
- **Grid development.** Substantial increases in both transmission and distribution grid infrastructure will be necessary to integrate large-scale new wind and solar generation into the power system.
- **Fossil fuel phase-out.** Existing fossil fuel infrastructure often will need to be retired earlier than its economic lifetime. Policies need to be developed to achieve the early phase out of fossil fuel plants.
- **System flexibility.** Energy storage (diurnal and seasonal), flexible generation technologies such as hydro and geothermal, and increased demand side flexibility will all be crucial.
- **Market design.** Reform of market designs and regulation adapted to renewable energy-based systems that incentivise and mobilise investments to install renewable energy at the scale needed (e.g., minimise cost of capital, ensure revenue certainty, etc).

Results

Stages of power sector decarbonisation



The stages of the electricity system transition in Thailand

WnS = Wind and Solar

Figure 1 – Electricity generation in each stage in TWh

In a 1.5°C pathway, countries must add solar, wind, and other clean technologies to meet rising power demand while replacing phased-out fossil fuels. The evolution of the power capacity mix over successive decades varies across countries.

By 2030, Thailand would need to add almost 12 GW of wind and 12 GW of solar capacity to meet growing demand alone. Another 18 GW of wind and 18 GW of solar will be needed to displace the share of fossil fuels in the generation mix.

Power sector transformation and the increasing participation of variable renewable energy (VRE) – mainly wind and solar – in a country's power mix gives rise to a set of technical challenges linked to the integration of VRE sources. Six phases can be distinguished here, from phase 0 (pre-development with negligible amount of VRE shares) to phase E (with over 80% VRE shares). More information about the phases can be found in Annex A.

Meeting the benchmarks for 2030 will put the Thailand in Phase D, with wind and solar making up 60% of the generation mix. Periods where VRE availability exceeds demand occur more frequently than in earlier phases. Ensuring system stability while continuing to increase renewable penetration requires additional measures, such as expanded demand response, stronger interconnections and large-scale energy storage. Market design and regulatory frameworks become increasingly important to enable these solutions. Although particularly critical in this phase, many of these measures should begin in earlier phases (B and C) to provide long-term investment signals and facilitate a smoother system transformation.

Figure 1 and Table 1 both show the stages of the transition to a decarbonised power sector in terms of the volumes of existing wind and solar and what is needed to displace fossil fuels and meet demand increases. Figure 1 shows the stages in terms of electricity generation, and Table 1 shows it in terms of generation, capacity and share of the electricity mix.

Table 1: Stages of the electricity system transition detailing how much generation capacity of wind and solar will be needed to displace fossil fuels in the system and meet growing electricity demand

	2023		2030		2040		2050
Grid integration phase (share of variable renewable energy in total electricity generation)							
Phase	Phase 0		Phase D		Phase D		Phase E
Share of VRE	**< 5%**		**< 40%**		**< 40%**		**> 85%**
Share of electricity generation							
Wind & Solar	**4.5 %**		**60 %**		**79 %**		**89 %**
Other renewables	15 %		14 %		19 %		11 %
Fossil Fuels	**81 %**		**26 %**		**1.5 %**		**0 %**
Generation capacity							
To displace fossil fuels		**+36 GW**		**+42 GW**		**+5.4 GW**	
Wind & Solar	**6.8 GW**	**+8.5 GW/yr**	**66 GW**	**+13 GW/yr**	**200 GW**	**+18 GW/yr**	**380 GW**
To meet demand increase		**+23 GW**		**+87 GW**		**+180 GW**	
Generation							
Total	**200 TWh**	30%	**260 TWh**	46%	**380 TWh**	50%	**570 TWh**
Wind & Solar	8.9 TWh		150 TWh		300 TWh		510 TWh
Generation Capacity of VRE (variable renewable energy)							
To displace fossil fuels			18 GW		10 GW		0 GW
Wind capacity	**2.4 GW**		**32 GW**		**63 GW**		**62 GW**
To meet demand increase			12 GW		21 GW		0 GW
To displace fossil fuels			18 GW		32 GW		5.4 GW
Solar capacity	**4.4 GW**		**34 GW**		**130 GW**		**310 GW**
To meet demand increase			12 GW		66 GW		180 GW

Note: Numbers are rounded to two significant figures, which may contribute to minor differences in totals. The calculations assume that wind, solar, and other renewables contribute equally and proportionally to displacing fossil fuels and meeting demand growth

Future electricity demand

Electricity demand is taken from Waite et al., 2024, a research paper exploring carbon neutral pathways for Thailand. We take demand from the Carbon Neutral 2050 (CN 2050) scenario. This scenario imposes net zero CO_2 emissions from fossil fuels and industry by 2050, in addition to policies in the power, buildings and transportation sectors consistent with Thailand's current plans and targets.

In this scenario, total electricity generation in Thailand almost triples by 2050 relative to 2023 levels, reaching 572 TWh.

However, there is a significant range - 415 TWh to 892 TWh - in the studies in terms of the expected electricity generation in 2050. This considerably affects the required scale of wind and solar deployment. Our demand estimate is at the lower half of the range of estimates found in country-level studies.

Electricity generation grows 3x in Thailand

The solid line shows the electricity generation projection used to develop the benchmarks

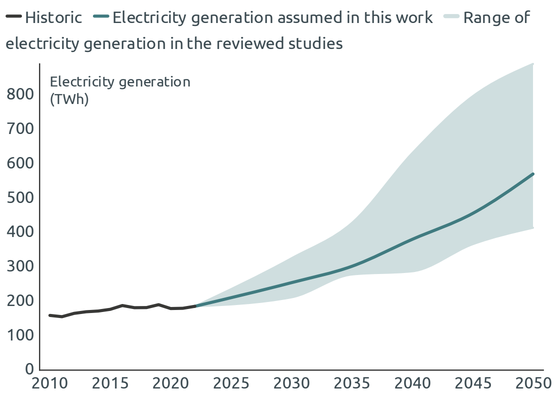


Figure 2 – Total electricity demand in TWh

Pace of fossil fuel phase-out needed

The rate of fossil fuel phase-out is set by the overlap between country-level studies, downscaled 1.5°C compatible global pathways and the global milestones of the [IEA's Net Zero roadmap](), where Thailand achieves a clean power system by 2045.

To align with 1.5°C, fossil fuels must exit the Thai power sector by 2045. Fossil fuel generation falls by 23 to 58% between 2023 and 2030. Coal and fossil gas will have differentiated phase-out pathways in Thailand. Gas-fired generation will decline much faster, due to its higher share in the current power mix, while coal decreases more gradually from a lower base. Coal is still fully phased out earlier than gas in the transition.

To align with 1.5°C, fossil fuels must exit the power sector in Thailand by 2045 and renewables must expand to meet growing electricity demand

Thailand would need to achieve clean electricity by 2045

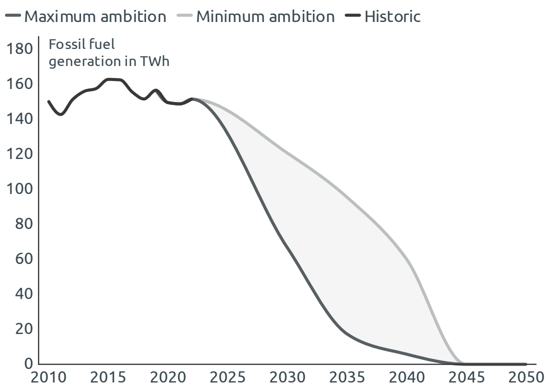


Figure 3 – Fossil fuel generation in TWh

Coal and gas phase-out in Thailand

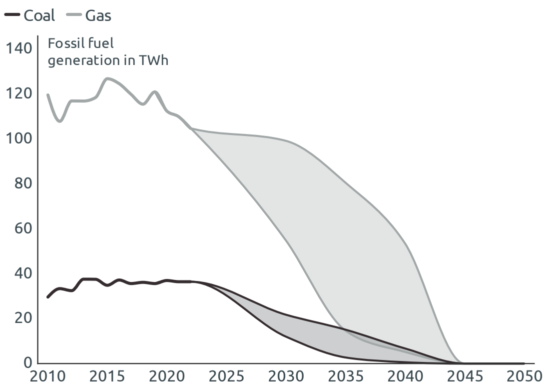


Figure 4 – Fossil fuel generation by fuel type in TWh

The role of other clean electricity generation

While wind and solar will be the workhorse of the energy transition, other clean electricity generation may play a role. We estimate the role of non- wind and solar clean electricity generation* (largely hydro, biomass, nuclear and geothermal) from country-level studies.

In our modelling, we assume that generation from clean technologies other than wind and solar in Thailand would reach 36 TWh by 2030 and 65 TWh by 2050. This generation is provided largely from bioenergy, with a small amount of hydropower. The benchmarks do not assume any deployment of nuclear in the Thai power sector.

Total wind and solar generation needed to align with 1.5°C

The wind and solar rollout is then calculated by combining projected electricity demand growth, the fossil phase-out necessary to align with 1.5°C, and the assumed generation from other clean technologies.

To align with 1.5°C, **wind and solar generation in Thailand would need to reach between 98 and 152 TWh by 2030**. Generation in 2023 was nearly 9 TWh. This is therefore a 11 to 17-fold growth in wind and solar.

Wind and solar provide 38–60% of overall electricity generation in 2030, and 89% of overall generation in 2050. A grid powered almost entirely by wind and solar would require substantial rollout of batteries and energy storage, support from dispatchable generation such as hydro and bioenergy, flexible demand and grid extension to ensure reliability of the system.

To align with 1.5°C, wind and solar generation would need to grow rapidly in Thailand

Wind and solar generation needs to grow 11-17x by 2030 relative to 2023 in Thailand

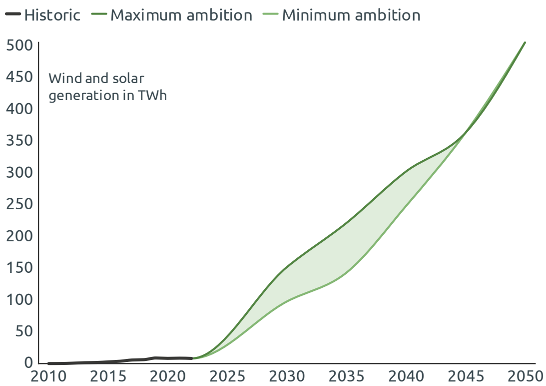


Figure 5 – Wind and solar electricity generation in TWh

Wind and solar need to provide almost 90% of electricity generation in Thailand by 2050

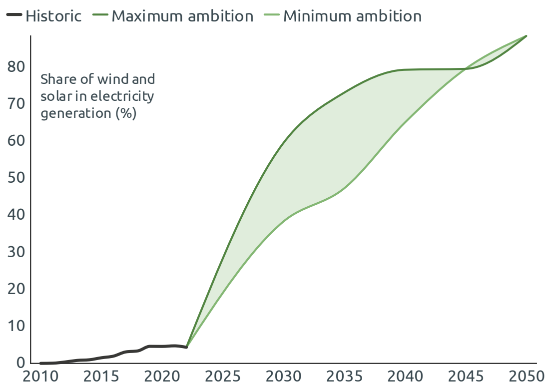


Figure 6 – Wind and solar electricity generation share (%)

* We do not consider CCS in the power sector, as we do not consider CCS a viable source of large-scale emissions reductions in the power sector.

Possible splits between wind and solar

The relative share of wind and solar deployment will vary depending on how various factors develop in the future. We explore one key uncertainty, the relative cost of solar and wind electricity generation (see methods). When accounting for this uncertainty, we see a range of possible future generation mixes between wind and solar.

We highlight the median of the range as our **central benchmark**, but do not suggest that this is the only possible breakdown into wind vs. solar. Our modelling favours solar due to its higher cost-effectiveness under current assumptions – which do not fully capture transmission constraints, spatial effects, curtailment or detailed integration costs, and could influence the relative balance between solar and wind. In the central benchmarking scenario, there is a far greater contribution of solar than wind in the electricity mix by 2050. However, wind ramps up relatively faster in the near-term, providing nearly 1.5 times as much electricity as solar in 2035.

In this scenario, **Thailand would need to deploy almost 66 GW of wind and solar by 2030 to align with the 1.5°C temperature limit**. By 2050, total wind and solar capacity would need to increase to nearly 380 GW.

Importantly, these are cost-optimised modelled pathways that give a useful indication of the pace and scale of wind and solar deployment needed for 1.5°C, but they cannot fully the capture real-world context, where industry development, supply chains, workforce, and infrastructure will require stable and sustained development.

Thailand needs to reach almost 66 GW of wind and solar by 2030 to align with a 1.5°C pathway

Solar capacity in Thailand would reach 34 GW by 2030 in a 1.5°C-aligned scenario

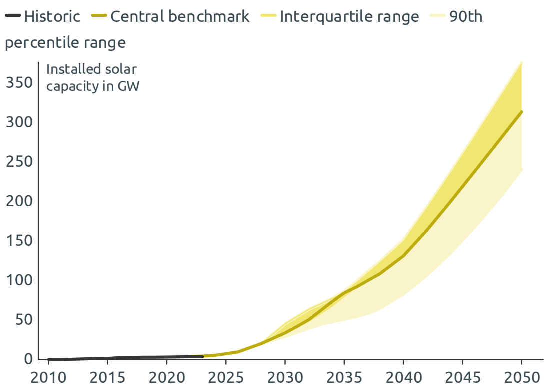


Figure 7 – 1.5°C compatible capacity benchmarks for solar in GW

Wind capacity in Thailand would reach 32 GW by 2030 in a 1.5°C-aligned scenario

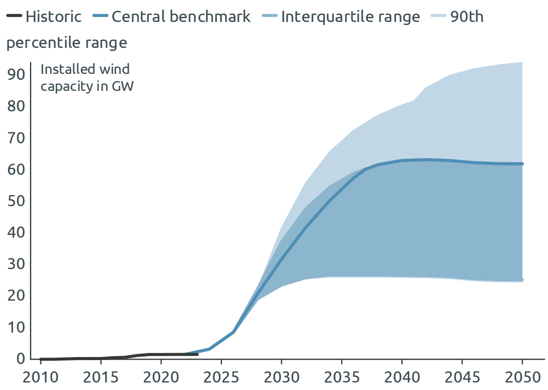


Figure 8 – 1.5°C compatible capacity benchmarks for wind in GW

The following table shows the wind and solar deployment needed to align with the central 1.5°C compatible benchmark produced. 2023 is historical data. All benchmark data from 2030 onwards is reported to two significant figures.

Table 2: Wind and solar electricity generation and capacity (2023–2050)

Scenario	Variable	Unit	2023	2030	2035	2040	2050
Central 1.5°C benchmark	Solar generation	TWh	5	40	95	150	370
Central 1.5°C benchmark	Wind generation	TWh	5	84	140	160	140
Central 1.5°C benchmark	Solar capacity	GW	4	34	85	130	310
Central 1.5°C benchmark	Wind capacity	GW	2	32	54	63	62

Table 3: Benchmarks translated into CAT format

Variable	Ambition	Unit	2030	2035	2040	2045	2050
Share of coal	Minimum	%	9	5	2	0	0
	Maximum	%	5	1	0	0	0
Share of gas	Minimum	%	39	27	14	0	0
	Maximum	%	22	5	1	0	0
Share of renewables	Minimum	%	53	68	84	100	100
	Maximum	%	74	94	98	100	100
Share of wind and solar	Minimum	%	38	38	65	65	89
	Maximum	%	60	60	79	79	89

Comparison to current rollout and country target

Under current policies and market conditions, deployment of wind and solar PV in Thailand would not align with 1.5°C. There would be a capacity gap of **23 GW of solar PV** and **28 GW of wind** missing in 2030 between current rollout and the 1.5°C compatible benchmarks highlighted here.

This compares to the government target of installing about 11.5 GW solar and 4 GW of wind by 2030. While the projected deployment of wind power is broadly consistent with the government's 2030 targets, solar deployment must increase by at least 1.1 GW to align with the solar targets. However, **both wind and solar targets need a significant ramp-up to be aligned with a 1.5°C pathway**: solar and wind capacity targets must increase by three and eight times, respectively, by 2030.

Further policy action and market measures will therefore be needed to align solar and wind deployment in Thailand with the pace needed for a 1.5°C-aligned pathway.

Thailand's rollout of wind and solar needs to accelerate to align with 1.5°C

In Thailand, current rollout of solar is lagging behind 1.5°C-aligned levels

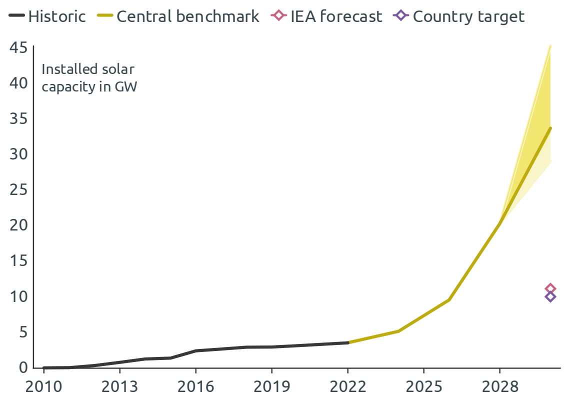


Figure 9 – Installed solar capacity in 2030 compared to targets and current policy projections in GW

In Thailand, current rollout of wind is lagging behind 1.5°C-aligned levels

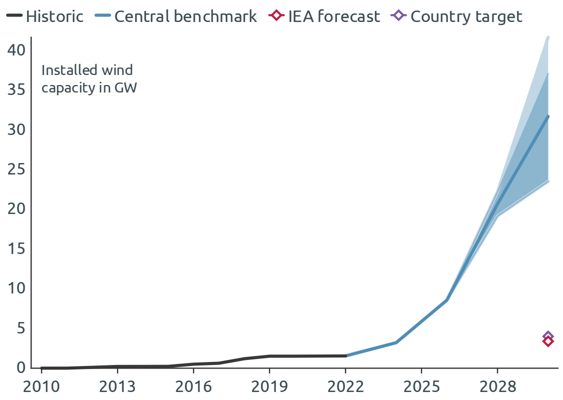


Figure 10 – Installed wind capacity in 2030 compared to targets and current policy projections in GW

Note: The target data was last pulled from Ember in January 2025. The current policies data was last pulled from the IEA in June 2025.

Wind and solar capacity additions in Thailand need to accelerate to align with 1.5°C

Thailand would need to add an average of 3.3 GW/yr of solar capacity until 2030, and 13.4 GW/yr over 2030–2050, compared to 0.13 GW/yr from 2020–2023

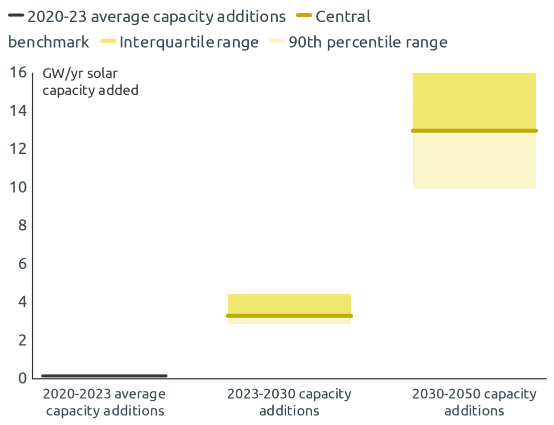


Figure 11 – Solar capacity additions per year in GW/y

Thailand would need to add an average of 3.4 GW/yr of wind capacity until 2030, and 1.8 GW/yr over 2030–2050, compared to 0.07 GW/yr from 2020–2023

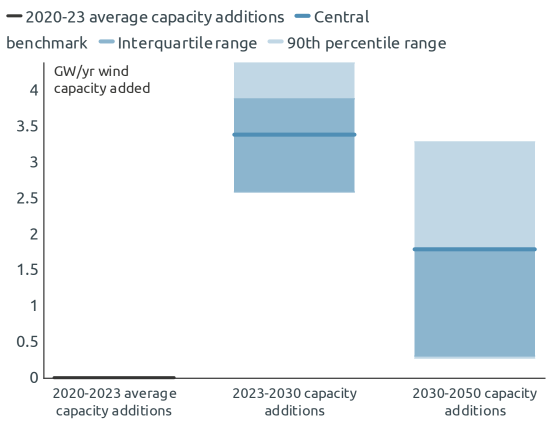


Figure 12 – Wind capacity additions per year in GW/y

Comparison with other studies

We compare the wind and solar generation seen in our analysis to that in the literature review of country-level studies. We compare our results with those of the Waite et al., 2024 study exploring carbon neutral pathways for Thailand, focusing particularly on the results of the *Carbon Neutral 2050* scenario (CN 2050).

We see that the wind and solar generation that our method produces is broadly comparable to the Waite et al. modelling in 2050. However, our benchmarks envisage a stronger near-term role for wind in the 2030s, before solar overtakes wind as the dominant electricity generation source by 2050.

Our benchmarks are broadly aligned with the literature

Electricity generation from solar: comparison with literature in Thailand

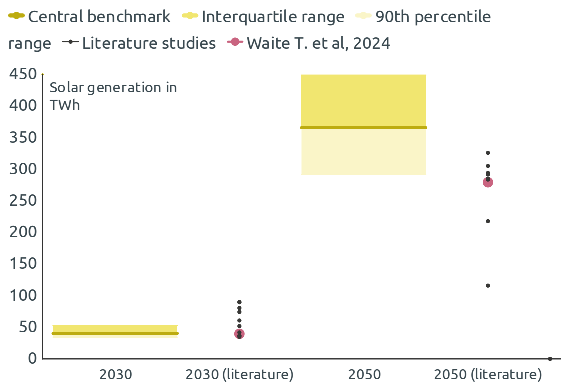


Figure 13– Solar electricity generation in TWh

Electricity generation from wind: comparison with literature in Thailand

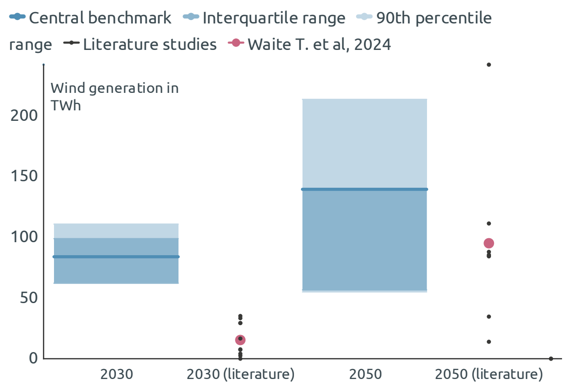


Figure 14 – Wind electricity generation in TWh

In Thailand, our benchmarks suggest that solar will contribute more generation than wind in 2050

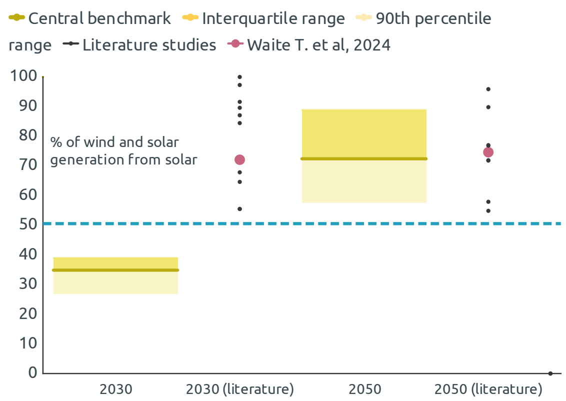


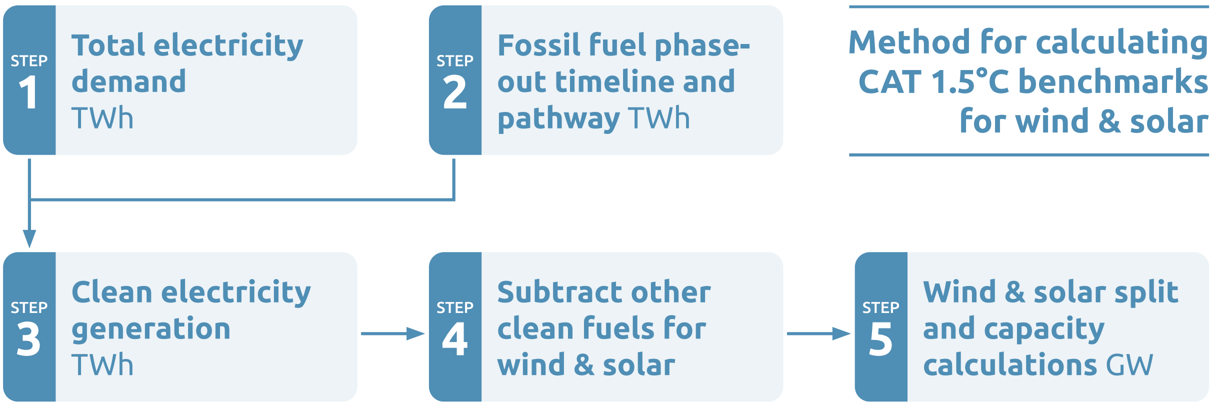
Figure 15 – Generation split between wind and solar (%)

Share of wind and solar generation that comes from solar: comparison with literature in Thailand

The area above the blue dashed line represents a power system in which solar provides more electricity generation than wind

Methodology

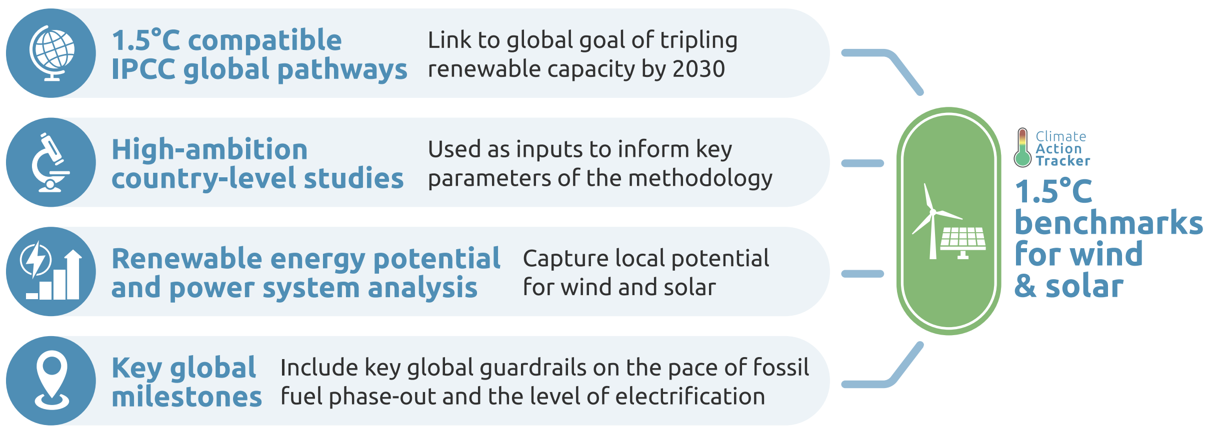
Summary of our method



Our method takes a series of steps to calculate the wind and solar generation needed for 1.5°C, and the resulting capacity deployment. The key methodological steps are highlighted below.

1. We project future electricity demand in the country.
2. We calculate the pace of fossil fuel phase-out needed to align with 1.5°C.
3. Bringing these trajectories together defines the level of clean electricity generation required to meet electricity demand growth while phasing out fossil fuels in the power sector.
4. We project non-wind and solar clean electricity generation based on country-level literature. This allows us to identify the wind and solar generation necessary to align with 1.5°C.
5. Having produced this wind and solar generation trajectory, we feed it into a simplified electricity system model (PyPSA), which calculates for a given set of cost assumptions around wind and solar, a split into wind versus solar and the associated capacity requirements.

Overlap of different elements



Our method focuses on the overlap between different elements. By looking at the range of fossil fuel phase-out which is outlined in both high ambition country-level studies and downscaled 1.5°Ccompatible global pathways, and is informed by key global milestones, we identify benchmarks which are both consistent with a global least cost pathway to limiting warming to 1.5°C but are also aligned with national–level modelling.

Combining multiple different analytical elements can help identify the most robust path to achieving a zero-carbon energy system.

For more details see the Methods Annex.

List of scenarios selected

Table 4: Country level studies for Thailand

Study	Publication	Scenario selected
Junlankarn and Pujantoro, 2022	Towards a collective vision of Thai energy transition: National long-term scenarios and socioeconomic implications	CN 2050
Pradhan et al., 2022	Energy system transformation for attainability of net zero emissions in Thailand	NZE-GHG
Waite T. et al, 2024	Stakeholder-driven carbon neutral pathways for Thailand and Bangkok: integrated assessment modeling to inform multilevel climate governance	CN 2050
Lorm R. and B. Limmeechokchai, 2024	Thailand Net Zero Emissions 2050: Analyses of Decarbonized Energy System Beyond the NDC	NZE 2050
Rajbhandari et al., 2024	Decarbonization of Power Sector in Thailand to Achieve Carbon Neutrality by 2050	CN 2050
Chaichaloempreecha and Limmeechokchai, 2022	Transition of Thailand's Power Sector toward Carbon Neutrality 2050	CN2050_SSP1
Pradhan et al., 2024	Role of green hydrogen in the decarbonization of the energy system in Thailand	NZE_LH
Diewvilai and Audomvongseree, 2022	Possible Pathways toward Carbon Neutrality in Thailand's Electricity Sector by 2050 through the	0% hydrogen blending with natural gas

	Introduction of H2 Blending in Natural Gas and Solar PV with BESS	
BloombergNEF, 2025	Thailand: Turning Point for a Net-Zero Power Grid	Net Zero
IEA, 2023	Thailand's Clean Electricity Transition	VRE Plus

Annex A

Phases of grid integration

The grid integration phase is adapted from a de Vivero et al. report detailing a qualitative assessment framework for power system transformation and an IEA report on integrating solar and wind. We use the share of VRE sources in electricity generation to classify countries into a phase. More information about the characteristics and key challenges of each phase can be found in the report.

Phase 0 (less than 5% annual VRE share): we assign this phase when wind and solar make up 0-5% of a country's electricity generation mix. Installed VRE capacity is limited, and the impact on power system operation is negligible. Integration does not require significant operational or structural changes.

Phase A (between 5% and 15% annual VRE share): we assign this phase when wind and solar make up 5-15% of a country's electricity generation mix. Conventional power system operation remains largely sufficient for day-to-day system management. However, system planning must anticipate higher future VRE shares. This includes improving forecasting tools, integrating forecasting into dispatch decisions and moving toward shorter scheduling intervals and more real-time system operation.

Phase B (between 15% and 25% of annual VRE share): we assign this phase when wind and solar make up 15-25% of a country's electricity generation mix. The contribution of VRE varies significantly over time, with periods of very low output and periods of high penetration. This variability increases the need for operational flexibility. Enhanced coordination between system operators, network operators, and distribution system operators becomes critical to maintain system efficiency and security.

Phase C (between 25% and 40% of annual VRE share): we assign this phase when wind and solar make up 25-45% of a country's electricity generation mix. Periods in which VRE dominates system behaviour become increasingly frequent. A key operational challenge is maintaining system stability during sudden disruptions in supply or demand. Curtailment of VRE may become necessary to preserve system security. Without structural adjustments, integration constraints of VRE into the system may slow further increases in renewable energy shares despite additional installed capacity.

Phase D (between 40% and 70% of annual VRE share): we assign this phase when wind and solar make up 45-80% of a country's electricity generation mix. Periods in which VRE availability exceeds demand occur more frequently than in earlier phases. Ensuring system stability while continuing to increase renewable penetration requires additional measures, such as expanded demand response, stronger interconnections and large-scale energy storage. Market design and regulatory frameworks become increasingly important to enable these solutions. Although particularly critical in this phase, many of these measures should begin in earlier phases (B and C) to provide long-term investment signals and facilitate a smoother system transformation.

Phase E (more than 70% share of annual VRE share): we assign this phase when wind and solar make up 80-100% of a country's electricity generation mix. The power system reaches very high VRE penetration. The primary challenge becomes ensuring adequacy during extended periods of low wind and solar availability. Addressing this requires long-duration energy storage, sector coupling allowing for export and import of power between economic sectors in the same country and extensive electricity trade both within regions and between countries.

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Design Designers For Climate

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Author names are listed with country lead first, then alphabetically.

The Consortium

The Climate Action Tracker (CAT) is an independent scientific analysis produced by three research organisations tracking climate action since 2009. We track progress towards the globally agreed aim of holding warming well below 2°C, and pursuing efforts to limit warming to 1.5°C.

climateactiontracker.org

Climate Analytics is a non-profit institute leading research on climate science and policy in relation to the 1.5°Climit in the Paris Agreement. It has offices in Germany, the United States, Togo, Australia, Nepal and Trinidad and Tobago.

climateanalytics.org

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