



Climate Action Tracker

Wind and Solar benchmarks for a 1.5°C world

MOROCCO

February 2026



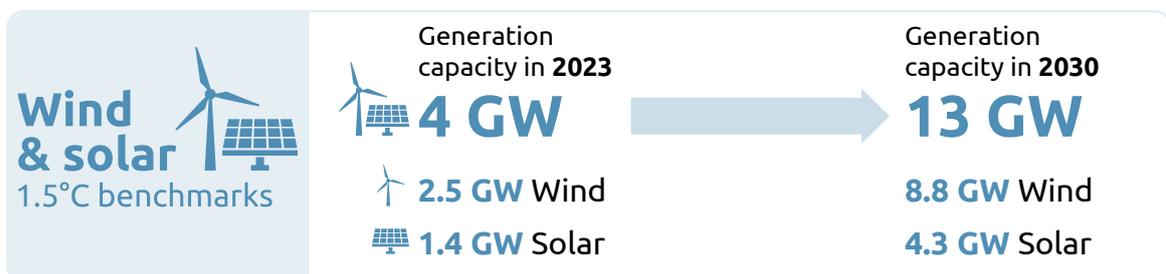
Executive Summary

Context

- ▶ Morocco's electricity generation is heavily dependent on coal power. Since the country has very limited proven fossil fuel reserves, it depends heavily on imported fuels, with imports meeting 90% of its total energy needs. But Morocco has enormous renewable energy potential at its disposal – both solar and wind – that could facilitate the decarbonisation of the power sector and enhance energy security.
- ▶ Morocco has set an indicative target in its 2035 nationally determined contribution (NDC) of achieving 15 GW of renewable installed capacity by 2030. Under its long-term strategy, it indicates that renewable sources could reach 80% of both electricity generation and installed capacity by 2050.
- ▶ In this report, we look at national studies and global energy system models to assess how much Morocco's wind and solar capacity needs 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

- ▶ Morocco's wind and solar generation needs to grow between four and five times by 2030 to align with 1.5°C. This equates to 32–48 TWh of wind and solar generation in 2030, up from 9 TWh in 2023.
- ▶ At least 9 GW of new wind and solar would be needed by 2030 (3 GW solar, 6 GW wind). This would require average annual capacity additions of 0.4 GW/yr of solar and 0.8 GW/yr of wind from 2023-2030.
- ▶ Morocco's current rollout of wind and solar is not progressing fast enough to achieve this. Under current policies and market conditions, 70% of the solar and only 35% 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 [Morocco](#).

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 ambition and is compatible with 1.5°C

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

Morocco's [2030 National Determined Contribution](#) (NDC) commits to reducing net greenhouse gas (GHG) emissions by 18.3% below BAU by 2030 and a conditional target of 45.5% below BAU levels (including LULUCF). Morocco's [2035 NDC](#) commits to reducing GHG emissions by 21.6% below BAU by 2030 and a conditional target of 53% below BAU levels (including LULUCF). The country announced a [visionary statement](#) to achieve carbon neutrality by the second half of the century.

Morocco's 2035 NDC sets an indicative target to reach [15 GW of renewable installed capacity](#) by 2030, but [under current policies](#) will only reach 6 GW of installed capacity by that year. In its 2035 NDC, Morocco commits to exploring a phase-out of coal for electricity generation by 2040, conditional on adequate international support. Under its [long-term strategy](#) (LTS) Morocco aims to reach 80% of renewables in its electricity generation by 2050.

Under current policies and market conditions, [the IEA estimates](#) that **solar capacity in Morocco will reach 3 GW in 2030**, up from 1 GW of solar in 2023. Meanwhile, **wind capacity is projected to reach 3 GW in 2030**, up from 2 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 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

The disputed Saharawi Arab Democratic Republic (SADR) published an [indicative NDC for Western Sahara](#), here we only took into account the NDC provided by the Moroccan government, as the SADR is not a party to the United Nations framework convention on climate change (UNFCCC). However, it remains unclear to what extent Morocco's planned mitigation measures, in particular in the renewable energy sector, will also be implemented in the disputed Western Sahara region.

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).

Stages of power sector decarbonisation

■ Current WnS generation
 ■ Fossil fuel generation
 ■ WnS generation to cover the phase out of FF
 ■ WnS generation to meet demand growth
 ■ Non-WnS clean generation

The stages of the electricity system transition in Morocco

WnS = Wind and Solar

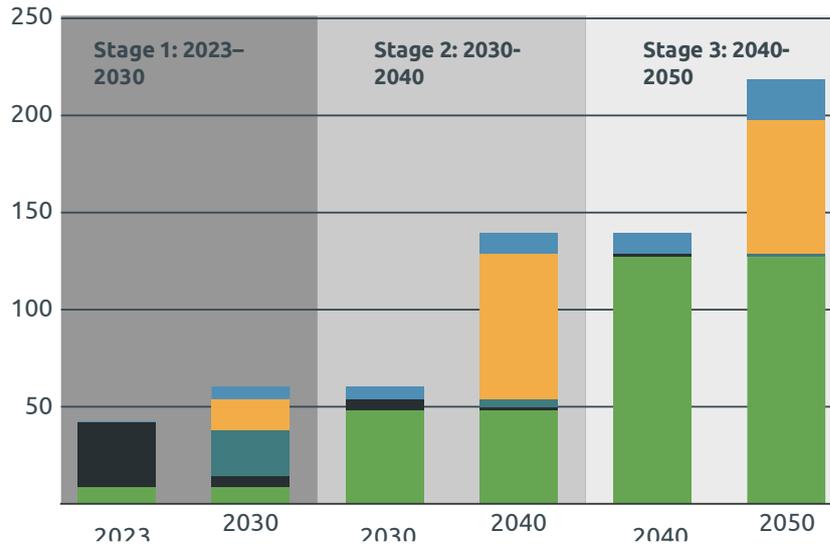


Figure 1 – Electricity generation in each stage in TWh

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.

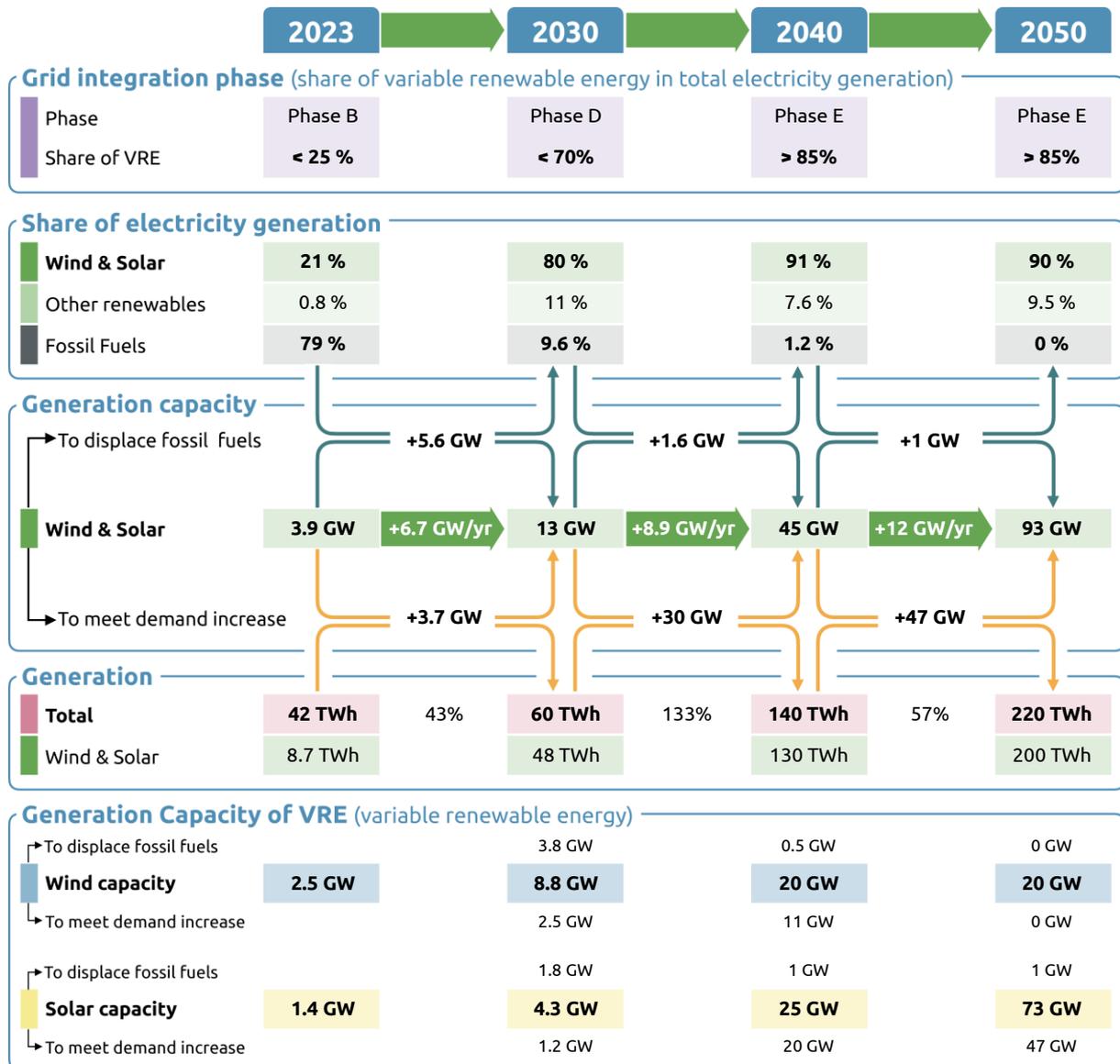
From now until 2030, Morocco would need to add 2.5 GW of wind and 1.2 GW of solar capacity to meet growing demand alone. Another 3.8 GW of wind and 1.8 GW of solar will be needed to displace the share of fossil fuels in the electricity generation mix.

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 these phases can be found in Annex A.

Meeting the benchmarks for 2030 will put Morocco in Phase D, with wind and solar making up 80% of the 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.

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 for Morocco. 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



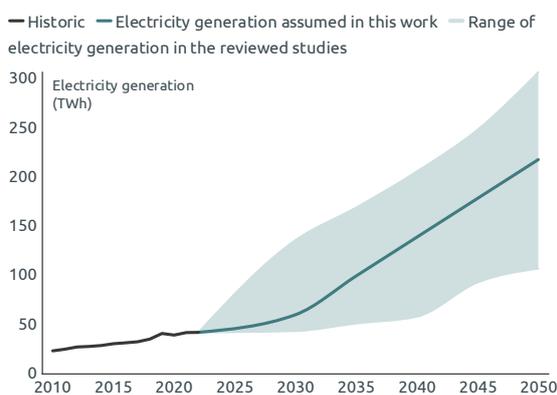
Note: Numbers are rounded to two significant figures, which may contribute to minor differences in totals. The calculations assume that wind, solar, and other renewables contribute equally and proportionally to displacing fossil fuels and meeting demand growth.

Future electricity demand

Electricity demand is taken from [Morocco's Decarbonisation Pathway](#) study exploring energy transition pathways towards achieving net zero by the second half of the century in the country. We take demand from the green development scenario, which harnesses all possible decarbonisation levers, and achieves nearly full electrification of transport and buildings by 2050, with large-scale renewables build out.

In this scenario, total electricity generation in Morocco grows more than fivefold by 2050 relative to 2023 levels, reaching 219 TWh. This is driven by increased electrification of the Moroccan economy, and demand for electricity to produce clean fuels (particularly green hydrogen).

However, there is a significant range in the studies in terms of the expected electricity generation in 2050, ranging from 107 TWh to 308 TWh. This variation is largely driven by different assumptions, especially around the role of green hydrogen production, whether intended primarily for domestic consumption or export. This would significantly affect the necessary growth of wind and solar. Our demand estimate falls within the mid-range of projections from country-level studies.



Electricity generation grows fivefold in Morocco, by increased electrification and demand to produce clean fuels

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

Figure 2 – Total electricity generation 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 Morocco achieves a clean power system by 2045 (see [methods](#)).

To align with 1.5°C, our modelling shows fossil fuel generation in Morocco declining by 32% to 83% between 2023 and 2030, with a full fossil fuel phase-out from the power sector before 2040.

Coal remains the primary source of electricity generation in Morocco. To align with a 1.5°C pathway, coal generation would need to peak immediately, decline rapidly this decade, and be fully phased out between 2040 and 2045.

Gas-fired electricity generation declined in 2022 following [Algeria's closure of the Maghreb-Europe gas pipeline](#), which disrupted Morocco's fossil gas supply. Fossil gas supply has since partially recovered through alternative import arrangements. Under a 1.5°C-aligned pathway, gas generation would also need to decline progressively and be phased out between 2040 and 2045.

To align with 1.5°C, fossil fuels must exit the power sector in Morocco by 2045, even as electricity demand grows rapidly.

Morocco would need to achieve clean electricity by 2045

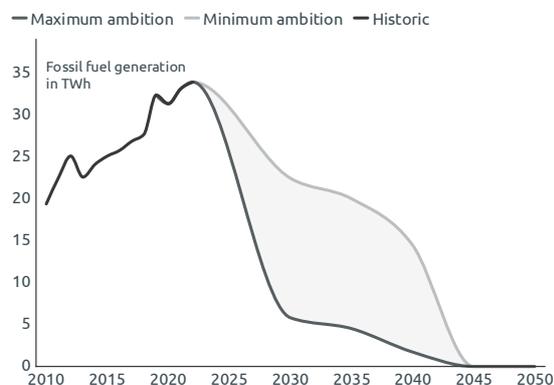


Figure 3 – Fossil fuel generation in TWh

Coal and gas phase-out in Morocco

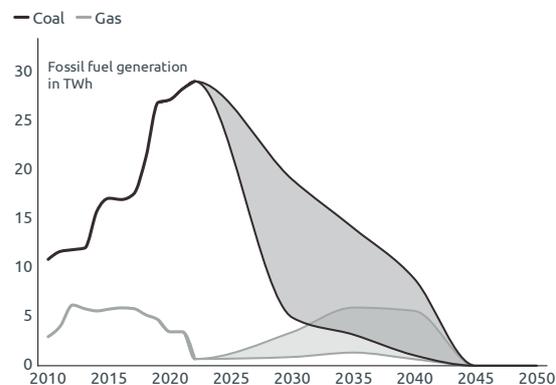


Figure 4 – Fossil fuel generation by fuel type in TWh

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 Morocco would reach 6 TWh by 2030 (11% of total generation) and 21 TWh by 2050 (10% of total generation). This generation is provided largely from hydropower and biomass.

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

We then calculate the wind and solar rollout 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 Morocco would need to reach between 32 and 48 TWh by 2030**. Generation in 2023 was 9 TWh. This is therefore a four to six-fold growth in wind and solar.

Wind and solar provide 52–80% of overall electricity generation in 2030, and 90% 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, flexible demand and grid extension to ensure reliability of the system.

* 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](#).

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

Wind and solar generation needs to grow four to six times by 2030 relative to 2023 in Morocco

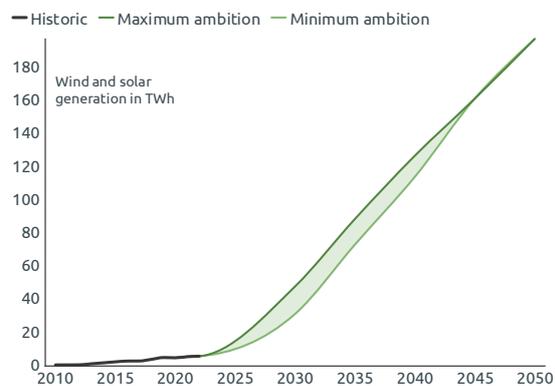


Figure 5 – Wind and solar electricity generation in TWh

Wind and solar need to provide over 90% of electricity generation in Morocco by 2050

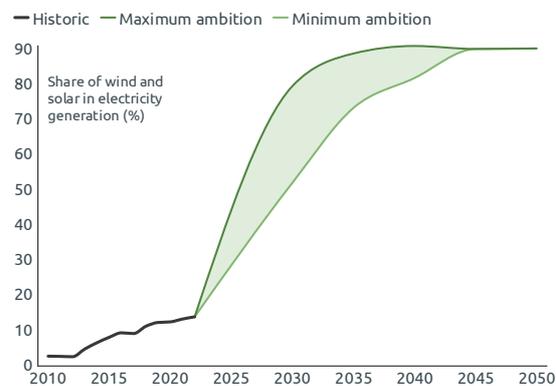


Figure 6 – Wind and solar electricity generation share (%)

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 between wind vs. solar. In the central benchmarking scenario, wind becomes the main source of electricity generation in the mix by 2030 and continues to grow until reaching its peak generation in 2040. By 2030, wind provides around eight times as much generation as solar in the electricity mix.

Our model allocates wind and solar based on cost-effectiveness and technical potential for each source, and for Morocco, it projects a significant increase in wind capacity by 2030 due to its lower levelised cost of energy (LCOE) compared to solar. By 2045, solar overtakes wind to become the dominant source of generation, delivering roughly twice as much electricity as wind in 2050.

In this scenario, **Morocco would need to deploy 9 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 reach to over 90 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 capture real-world context, where industry development, supply chains, workforce, and infrastructure will require stable and sustained development.

Morocco needs to install almost 10 GW of wind and solar by 2030 to align with 1.5°C

Solar capacity in Morocco would reach 4 GW by 2030 in a 1.5°C-aligned scenario

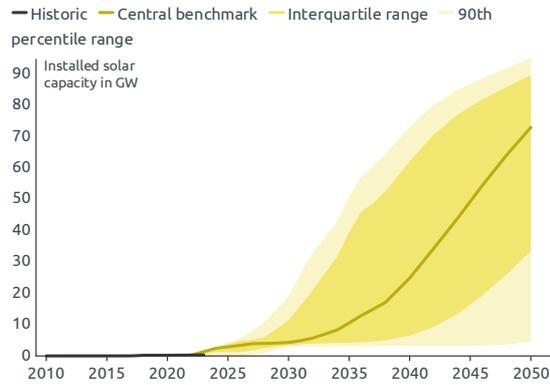


Figure 7 – 1.5°C compatible capacity benchmarks for solar in GW

Wind capacity in Morocco would reach almost 9 GW by 2030 in a 1.5°C-aligned scenario

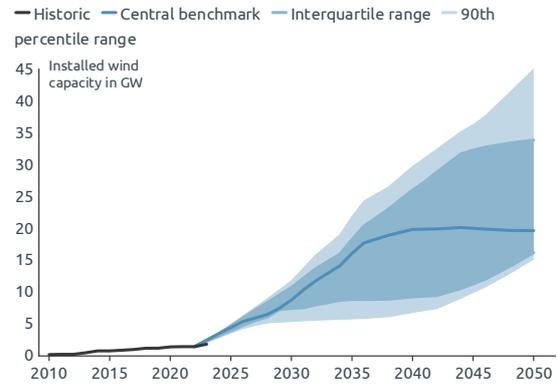


Figure 8 – 1.5°C compatible capacity benchmarks for wind in GW

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	1.4	4.5	14	37	130
Central 1.5°C benchmark	Wind generation	TWh	8.6	34	67	82	77
Central 1.5°C benchmark	Solar capacity	GW	1.4	4.3	11	25	73
Central 1.5°C benchmark	Wind capacity	GW	2.5	8.8	16	20	20

Table 3: Benchmarks translated into CAT format

Variable	Ambition	Unit	2030	2035	2040	2045	2050
Share of coal	Minimum	%	31	14	6	0	0
	Maximum	%	8	3	1	0	0
Share of gas	Minimum	%	6	6	4	0	0
	Maximum	%	1	1	0	0	0
Share of renewables	Minimum	%	63	80	90	100	100
	Maximum	%	90	95	99	100	100
Share of wind and solar	Minimum	%	52	52	82	82	90
	Maximum	%	80	80	90	100	100

Comparison to current rollout and country target

Under current policies and market conditions, deployment of wind and solar in Morocco would not align with 1.5°C. There would be a capacity gap of **1.2 GW of solar** and **5.8 GW of wind** missing in 2030 between current rollout and the 1.5°C compatible benchmarks highlighted here.

Current deployment of solar power and wind is almost on track to meet the government's 2030 targets, needing to slightly increase their deployment by 0.5 GW and 0.7 GW, respectively.

However, **wind targets need ramping-up to be aligned with a 1.5°C pathway**: wind capacity targets must increase by almost 2.5 times, while **solar targets are almost aligned with a 1.5°C pathway**.

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

In Morocco, the current rollout of solar lags behind 1.5°C-aligned levels

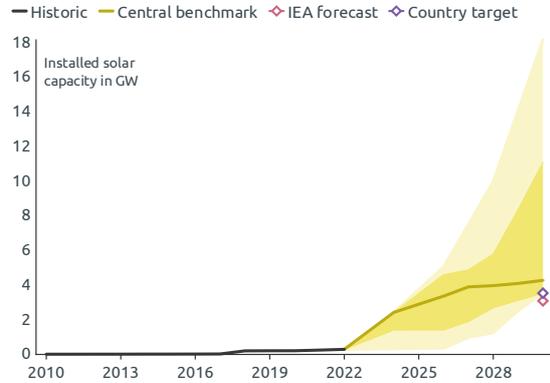


Figure 9 – Installed solar capacity in 2030 compared to targets and current policy projections in GW

In Morocco, the current rollout of wind lags behind 1.5°C-aligned levels

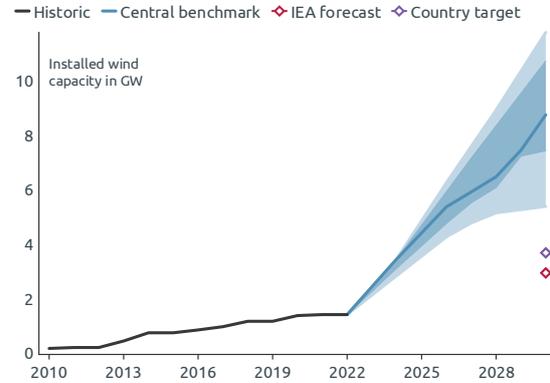


Figure 10 – Installed wind capacity in 2030 compared to targets and current policy projections in GW

Note: The target data was last pulled from [Ember](#) in January 2025. The current policies data was last pulled from the [IEA](#) in February 2026.

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

Morocco would need to add, on average, 0.4 GW/yr of solar capacity until 2030, and 3.3 GW/yr over 2030–2050, compared to 0.03 GW/yr from 2020–2023

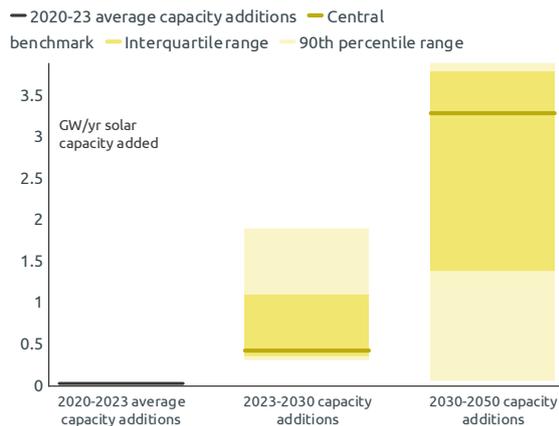


Figure 11 – Solar capacity additions per year in GW/y

Morocco would need to add, on average, 0.8 GW/yr of wind capacity until 2030, and 0.7 GW/yr over 2030–2050, compared to 0.14 GW/yr from 2020–2023

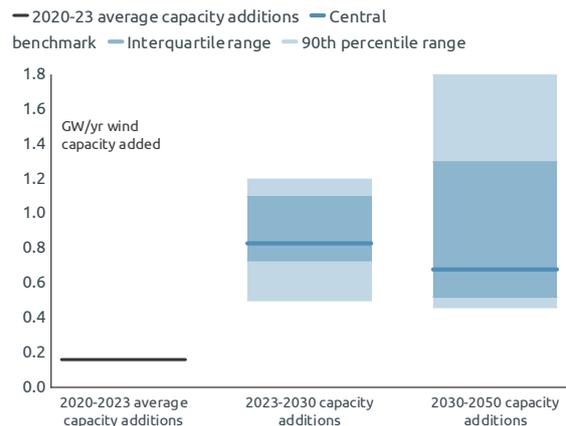


Figure 12 – Wind capacity additions per year in GW/y

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 highlight the results of modelling from [Morocco's Decarbonisation Pathway](#), exploring net zero pathways for Morocco by the second half of the century, where we particularly highlight the results from the green development scenario.

We see that the wind and solar generation that our method produces is broadly comparable to the Morocco's Decarbonisation Pathway in 2050. Our benchmark envisages a slower rollout of solar in the 2030s but ultimately achieves a higher installed capacity by 2050. For wind, deployment happens more quickly in the 2030s and 2040s, but the total capacity converges with the Decarbonisation Pathway study by 2050.

Our benchmarks are broadly aligned with the literature

Electricity generation from solar: comparison with literature in Morocco

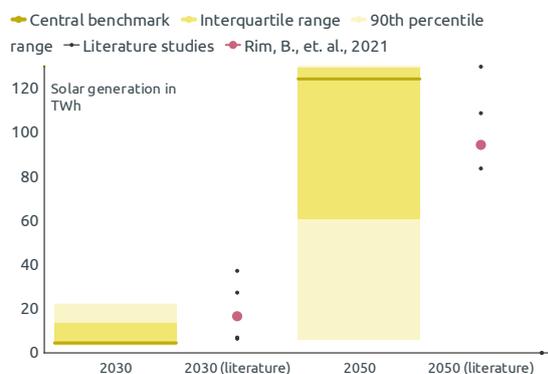


Figure 13 – Solar electricity generation in TWh

Electricity generation from wind: comparison with literature in Morocco

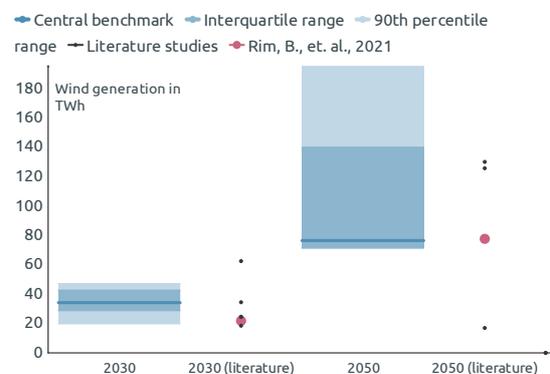


Figure 14 – Wind electricity generation in TWh

In Morocco, our benchmarks show that wind will have a greater share from 2030 to 2040, but solar will be the most relevant in 2050

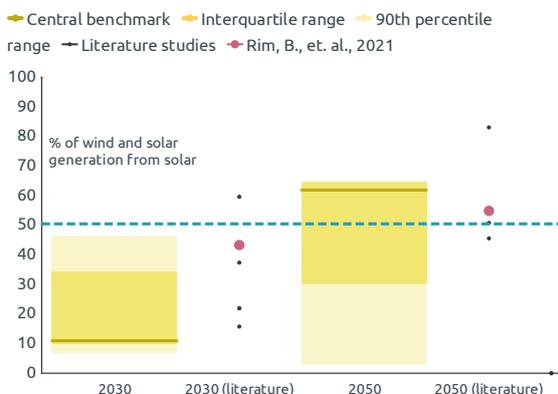


Figure 15 – Generation split between wind and solar (%)

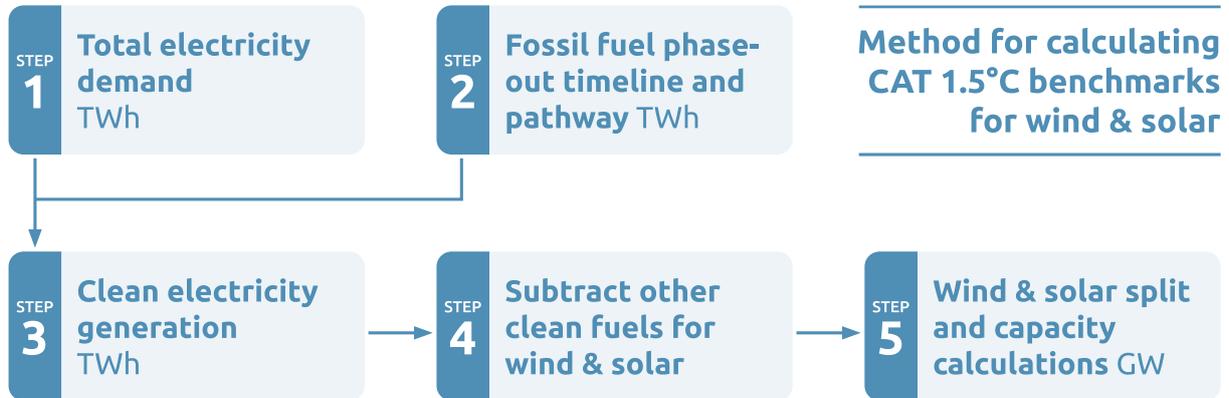
Share of wind and solar generation that comes from solar: comparison with literature in Morocco

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



Methodology

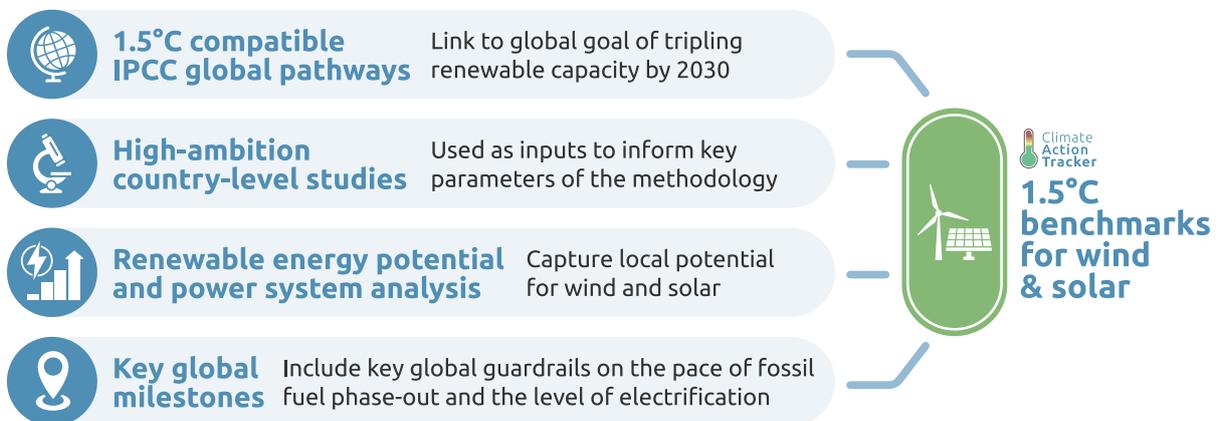
Summary of our method



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°C compatible 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 Morocco

Study	Publication	Scenario selected
Ram et. al., 2017	Global 100% RE System: MENA	LUT energy system model
Policy Center for the New South, 2021	Morocco's decarbonization pathway	Green Development
IRENA, 2023	Planning and prospects for renewable power: North Africa	Transition
World Bank, 2022	Morocco, country climate and development report	Decarbonization
Harland et. al., 2023	Morocco's coal to clean journey	No gas



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.

Authors



Climate Analytics

Corbin Cerny
Fadil Abdul Razak
Tommaso Ficara
Neil Grant
Anna Kanduth
Alexandra Pröpper
Danial Riaz
Baltazar Solano Rodriguez
Olivia Waterton
Lara Welder



NewClimate Institute

Pablo Blasco Ladrero

Emily Daly
Markus Hagemann
Gustavo de Vivero
Chetna Hareesh Kumar
Judith Hecke

Editing

Cindy Baxter

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°C limit in the Paris Agreement. It has offices in Germany, the United States, Togo, Australia, Nepal and Trinidad and Tobago.

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NewClimate Institute is an independent non-profit organisation that develops solutions to tackle climate change and drives their implementation worldwide. Through research, policy advice and knowledge sharing, we aim to raise the ambition for climate action and support sustainable development.

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