



# Tracking national ambition towards a global tripling of renewables

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Tripling global renewables is the single biggest action the world can take for the climate in this decade. An analysis of 2030 national renewable targets shows that governments are already planning for a doubling, but there is room for much higher ambition.

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# About

This report analyses national 2030 renewable targets for the power sector to evaluate them against what is required to meet the proposed goal to triple global renewable capacity by 2030.

The report analyses renewables capacity and generation share targets for 57 countries and the EU as a bloc. These countries collectively represent 93% of the world's renewable capacity, 90% of global power sector emissions and 90% of global electricity demand.

National targets are sourced from national strategy or plans, executive orders, official projections, or credible third-party studies. The 2030 national target data were generated by consulting 73 policy documents, projections, laws, and third-party studies.

Ember's [Global Renewable Target Tracker 2030](#) is launched alongside this report, featuring an overview and detailed information on the national targets. This tracker will be continually updated with new policy announcements.

# Highlights

## 7.3

Global renewable capacity in 2030 based on current national targets (TW)

## 2.1x

Factor of increase in global renewable capacity by 2030 based on current national targets

## 3x

Factor of increase in global renewable capacity needed by 2030 to meet the tripling goal



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## Executive Summary

# Doubling renewables already planned by governments, now tripling within sight

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**A tripling of renewable capacity by 2030 is within reach if governments take into account the recent growth in renewables.**

For the first time, a global deal on renewables is on the table at the UN's COP climate conference this year, as the presidency [proposes](#) a global goal to triple renewables capacity this decade.

The International Renewable Energy Agency (IRENA), the International Energy Agency (IEA) and the COP presidency are all aligned that tripling renewables capacity to 11,000 GW by 2030 is required for a 1.5C pathway. Indeed, the IEA states that a [tripling of renewables](#) is the single biggest action the world can take by 2030 to keep 1.5C within reach. They show over 90% of the renewable capacity growth would be from [solar and wind](#), with wind capacity rising threefold from 2022 to 2030, and solar capacity fivefold.

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This report analyses national renewables targets to see how current plans align with a tripling of renewable capacity by 2030, while noting that a global tripling does not mean that every country is required to achieve a tripling of capacity. Starting close to zero and tripling is not ambitious, whereas some countries are beyond the point that tripling renewables capacity is realistic or needed.

## 01

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### **Government targets already aim for a doubling of renewable capacity**

Government targets already add up to a doubling of renewable capacity by 2030. According to national targets, governments around the world intend to collectively hit an estimated 7.3 TW in 2030, up from 3.4 TW in 2022. More than three-quarters of renewable capacity in 2030, where stated, will be from solar and wind.

## 02

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### **National targets do not account for the recent acceleration of renewables**

Many government targets do not reflect the recent acceleration in renewables deployment worldwide. For example, 12 countries are set to add capacity in 2023 faster than the pace required to meet their 2030 target. In 22 countries the prospective project development pipelines for wind and solar exceed the renewable capacity needed to meet their 2030 targets. The world could achieve its current targets—a doubling of renewables—just by continuing the 500 gigawatts of estimated deployment in 2023 from 2024 to 2030, but all signs point to a more rapid growth curve.

## 03

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### **Tripling renewables in sight**

To achieve a tripling of renewables by 2030, the world needs to increase renewables deployment by 17% every year, so that it rises from 500 GW in 2023 to about 1.5 TW in 2030. The world already achieved this annual growth rate over the period between 2016 and 2023. The gap between the doubling achieved by national targets and a global tripling is 3.7 TW. Governments need to raise their ambitions and set targets that reflect the true pace of renewable market growth in their respective countries.

# 04

## Room for higher ambition in many countries

Ten countries have targets that are at or exceed a tripling of their 2022 capacity, including India and Saudi Arabia. There are also 12 countries that have wind and solar generation share targets that exceed the 40% global average to meet net zero, including the United States. However, the report highlights four countries that could step up their targets: Australia, Japan, South Korea and the United Arab Emirates.

The analysis in this report highlights that if countries take stock of their own policy landscape, current annual renewable deployment, and the renewable capacity that is in the pipeline, a more ambitious and yet achievable set of targets for 2030 can be developed. This narrows the gap between where national targets are, where they could be, and what is needed to meet a global tripling goal.

“Tripling renewable capacity worldwide is the single biggest action required this decade for the climate. This goal is within sight if governments set targets that reflect the current pace of change and roll out robust new policies to supercharge the building of solar and wind power.”

“Governments have yet to understand the revolution that’s underway with renewables. The targets of today are already outdated and should be updated. As we approach COP28, leaders should be confident in supporting a global goal to triple renewables; it is looking more possible than ever to achieve.”

**Dr Katy Altieri**

Global Electricity Transition Analyst,  
Ember



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“A global energy transition that accelerates global renewable energy capacity to at least 11,000 GW by 2030 is the fastest and most cost-efficient way to build a clean, secure and just future.

“Ember’s report, *Tracking National Ambition Towards A Global Tripling Of Renewables*, shows clearly that current deployment rates won’t do – countries can and must increase their ambition and update their national targets.

“This increased ambition, combined with urgent action on the financing, permitting, grids and supply chains would deliver cleaner electricity systems, access to affordable energy and green jobs for millions of people. On top of that billions of dollars in public and private capital would be unlocked, reducing loss and damage for nature and people wrought by harmful climate change.”

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**Bruce Douglas**

CEO of the **Global Renewables Alliance**

“We know that there’s a potential explosion of wind and solar capacity, but we don’t know whether ambition will match this potential. Governments need to double down, put their full weight behind renewables projects in development and lead a just energy transition for all, before it’s too late.”

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**Ingrid Behrsin**

**Global Energy Monitor** Program Director for  
Renewables & Other Power

# Renewables supercharged

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**The boom in global renewable deployment in 2023 is building confidence that a tripling of renewables by 2030 is within reach.**

The UN COP28 climate conference in December 2023 may be a pivotal moment for renewables. The latest [COP presidency letter](#) published on 17th October expresses the desire to agree on a global goal to triple renewables and double energy efficiency.

It is a plan that is completely aligned with pathways set out by two of the world's intergovernmental energy agencies, the International Energy Agency (IEA) and the International Renewable Energy Agency (IRENA). According to the IEA, tripling renewables is the [single largest action](#) to cut emissions this decade and keep the 1.5C goal within reach.

The [IEA Net Zero report](#) shows that tripling renewables and doubling energy efficiency, including a large step up in electrification, will deliver two-thirds of the total emissions reductions needed by 2030 to put emissions on track. Their Net Zero scenario puts the economy on track for a rapid fossil phasedown, with large declines in carbon dioxide (CO<sub>2</sub>) emissions, which fall by 35% from 2022 to 2030, and 65% to 2035.



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Already, [G20 leaders](#) have backed the call for a tripling of renewables, and there is hope ahead of COP28 that a global agreement can be reached. This year's record-breaking renewables growth should give reassurance that this goal is achievable.

### **What is needed for a tripling?**

Total global renewable capacity needs to triple by 2030 to reach 11,000 GW. This is referred to as the global [goal of tripling renewables](#). The IEA and IRENA are both aligned on this: their latest Net Zero scenarios are 11,008 GW and 11,174 GW respectively by 2030.

It is solar and wind that provide the majority of the growth. In the [IEA Net Zero scenario](#), solar and wind provide over 90% of the rise in renewables capacity. Solar capacity sees a fivefold increase, wind threefold, and the remaining technologies rise by 22%.

A global tripling does not mean that every country is required to triple its renewables capacity—some will do more, some less—depending in part on their starting point. One useful metric is in the combined solar and wind share in the electricity mix. The IEA shows that the global generation share of wind and solar needs to rise to 40% in 2030 in the Net Zero scenario. Comparing this 40% to the national target gives some indication of the level of ambition, though of course countries are starting out at different points.

### **Record renewables growth in 2023**

2023 will set a new record for renewables deployment, with an additional 440–500 GW projected by the end of the year, according to the IEA's base and accelerated cases [published in June](#). This is more conservative than the latest forecast from Bloomberg New Energy Finance (BNEF), which puts [solar](#) at 392 GW and [wind](#) at 110 GW, with total renewables additions at over 500 GW. If deployment indeed reaches 500 GW in 2023, this would represent a year-on-year increase of 71%.

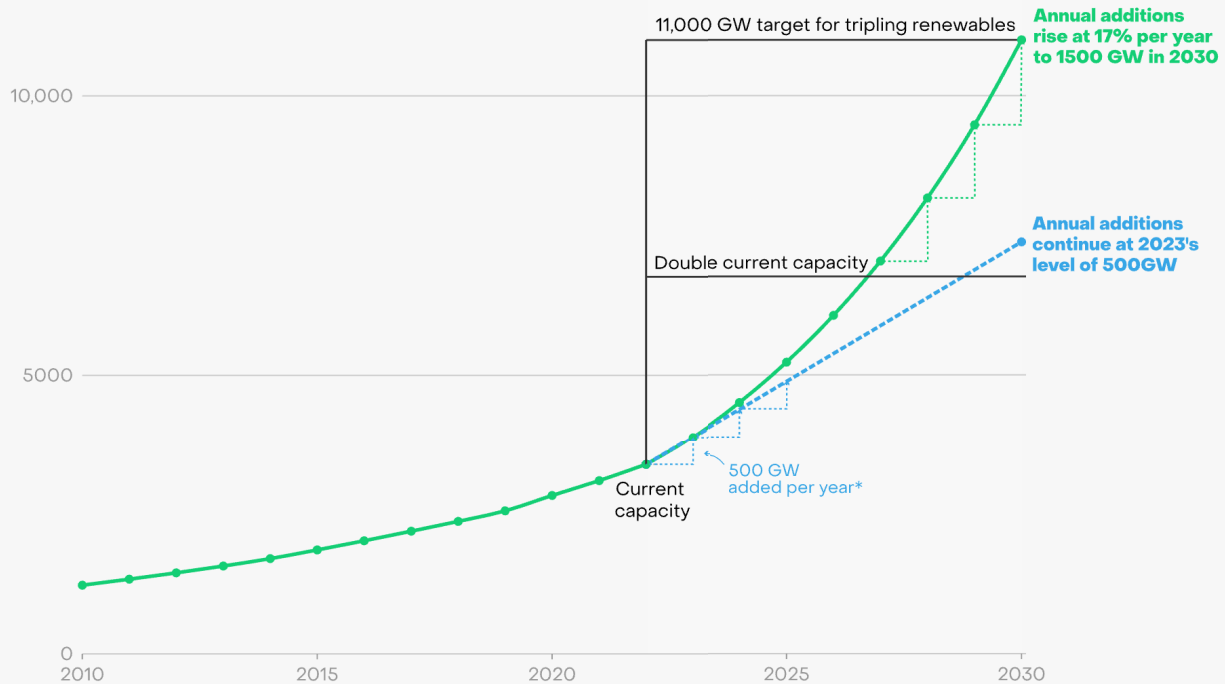
The growth this year will be dominated by solar additions, estimated at 392 GW [by BNEF](#). The solar added in 2023 is more than the current total installed renewable capacity of the US. This was enabled by an even faster increase in the manufacturing capacity of solar panels, which doubled in just over 2 years, and is expected to [exceed 1,000 GW in 2024](#). That means there is sufficient supply of solar panels to increase additions much faster. Indeed this oversupply has already pushed solar panel prices down to [an all-time low](#) of just \$0.14 per watt.

## What does the recent renewable growth tell us about tripling of renewables by 2030?

If the world continues to build renewables from 2024 to 2030 at the same scale as is likely to be achieved in 2023—i.e. 500 GW per year—then global renewable capacity would more than double by 2030. But to reach a tripling of total capacity to 11,000 GW, we need to bend the curve and raise annual additions from 500 GW in 2023 to around 1,500 GW in 2030.

### If 2023 renewable capacity additions were maintained, global capacity would more than double by 2030

Global renewable capacity (gigawatts)



Source: Ember's analysis of tripling renewables goal, Renewable Energy Market Update – June 2023 (IEA, 2023), Renewable capacity statistics (IRENA, 2023)  
\*2023 estimate based on IEA projections

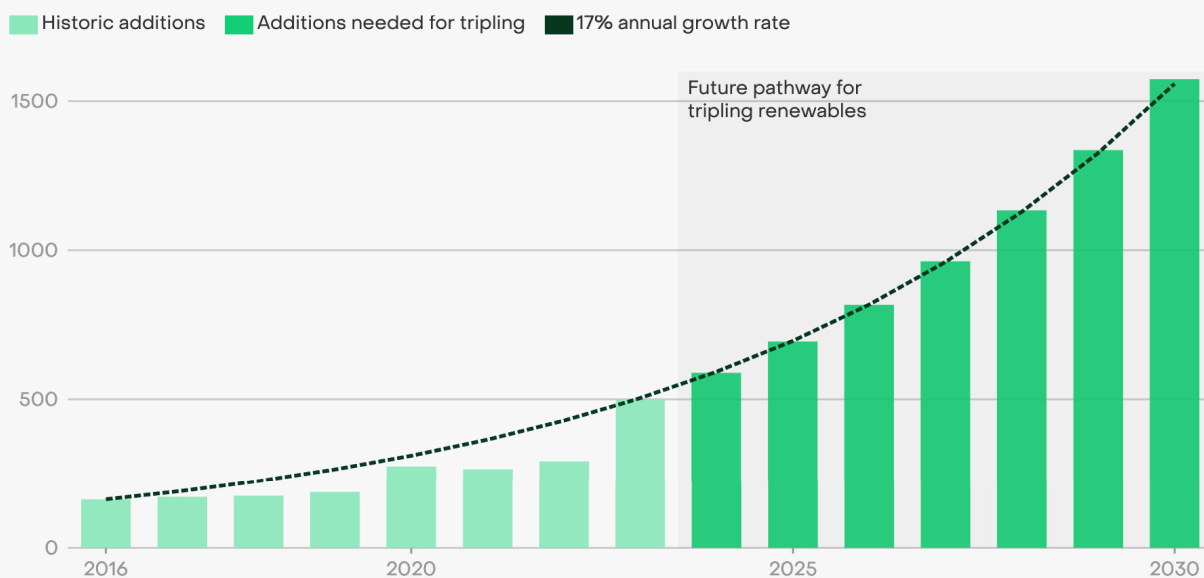
**EMBER**

It is, of course, likely that annual additions will rise. Annual additions rose by 10% on average per year from 2016 to 2022, and are expected to rise 71% in 2023. The average annual growth rate of additions in the period including the 2023 acceleration—i.e. from 2016 to 2023—was 17%.

Annual additions need to continue to rise by 17% per year from 2024 to 2030 to reach 11,000 GW total installed capacity by 2030. Therefore, to reach a tripling of total renewable capacity, the world needs to maintain the same growth rate in annual additions from 2023 to 2030 as it has achieved since 2016.

## Annual additions need to continue rising at the historical rate to triple global renewable capacity to 11,000GW

Annual renewable capacity additions (in gigawatts)



Source: Projected additions in 2023: IEA Renewable Energy Market Update 2023, Capacity additions 2016–2022: IRENA Renewable Capacity Statistics 2023

**EMBER**

The dramatic rise in renewable additions in 2023 has built confidence that a tripling of renewables by 2030 is in sight, signalling that renewable annual additions can continue to rapidly grow and bend the curve to reach 11,000 GW of total renewable capacity by 2030.

This report analyses the latest national targets for 2030 to see how close government targets get to a tripling of global renewable capacity and where there is room for higher ambition given the rapid growth in renewables we are witnessing.

# Assessing national ambition for renewables

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To measure country-level ambition for renewables, we collected 2030 renewable targets from 57 countries and the EU as a bloc, which represent 90% of global emissions from the power sector.

Targets are expressed in terms of cumulative capacity (GW) and share in total generation (%). In this report, we have categorised national targets into three different types depending on how the targets are identified.

- **Explicit** targets are identified clearly in national strategy or plans, executive orders, legal texts, and policy proposals nearing approval. 39 countries have explicit capacity targets and 33 countries have explicit renewable share targets.
- **Implicit** targets are sourced from official projections or credible third-party studies based on current renewable support policies and net zero targets. Although implicit targets are not legislative or legal targets, they act as a proxy for current ambition for renewables in the absence of an explicit target. There are 16 countries whose capacity targets are implicit. 7 countries have implicit targets for share of generation.

- **Derived** targets are estimates for 2030 based on explicit targets for other years. One country has derived targets for both capacity and share of generation (India).

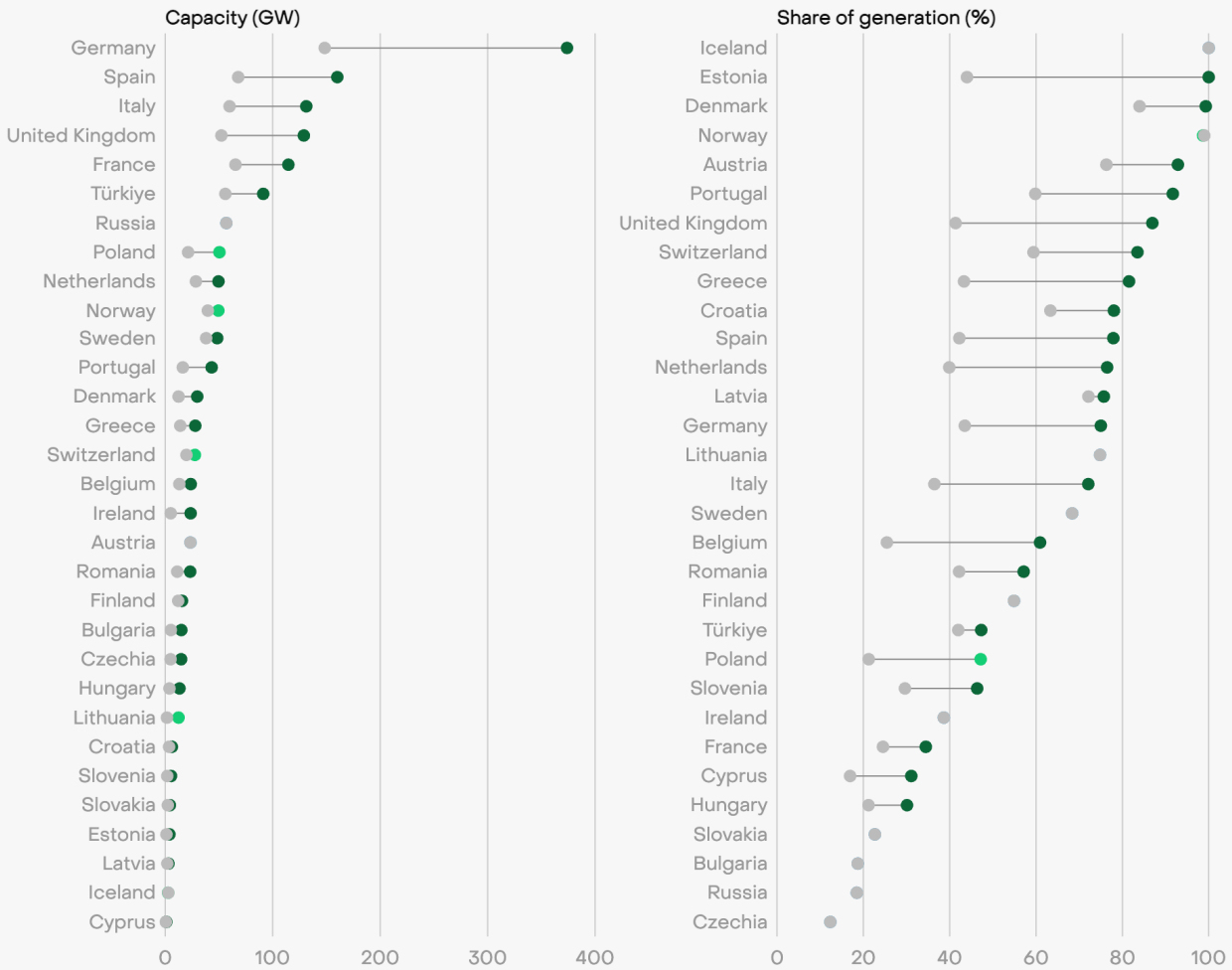
Depending on the legislative power, credibility, and/or up-to-dateness of the source, each target is assigned a confidence level (low, medium, high). Please visit [Ember's 2030 Renewable Target Tracker](#) to get detailed information on targets, sources and confidence level by country. The tracker also allows you to compare countries by region and economic groups.

## Compare and explore national renewable targets for 2030

Power capacity and share of total electricity generated by renewables: current (2022) and target (2030)

Select group/region: Europe

● 2022 ● Explicit target ● Implicit target ● Derived target



Source: Ember's Global Renewable Targets Data (2030)

"Explicit" targets are identified clearly in national strategy or plans, executive orders, legal texts, and policy proposals nearing approval. "Implicit" targets are sourced from official projections, roadmaps or credible third-party studies based on current renewable support policies and net zero targets. "Derived" targets are estimates for 2030 based on explicit targets for other years.

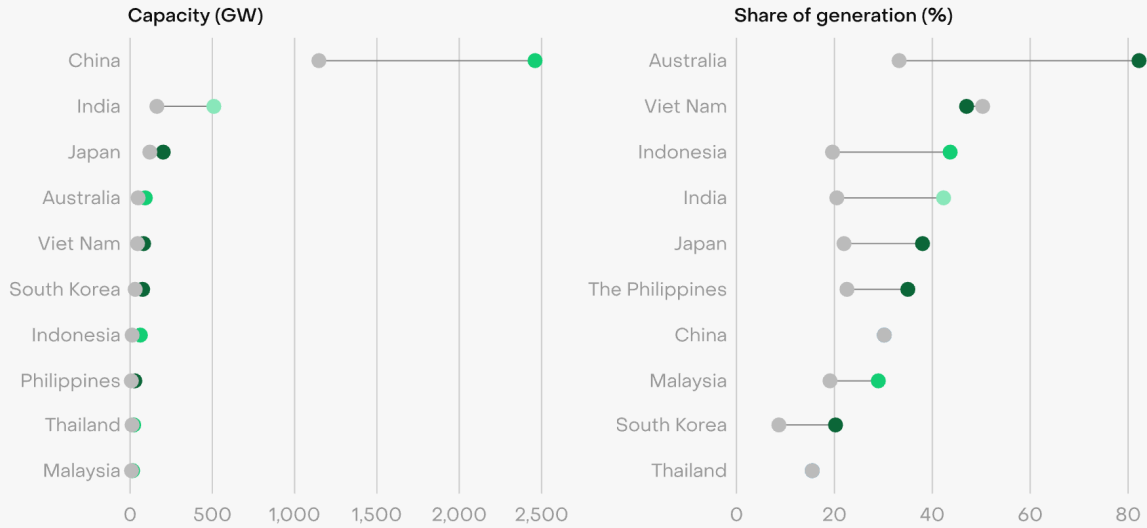


# Compare and explore national renewables targets

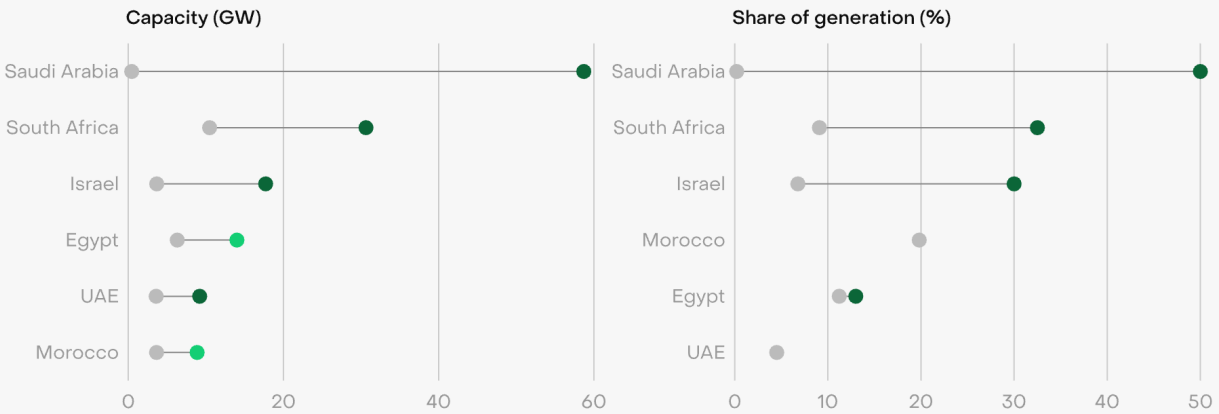
Power capacity and share of total electricity generated by renewables: latest year vs 2030 target

● 2022 ● Explicit target ● Implicit target ● Derived target

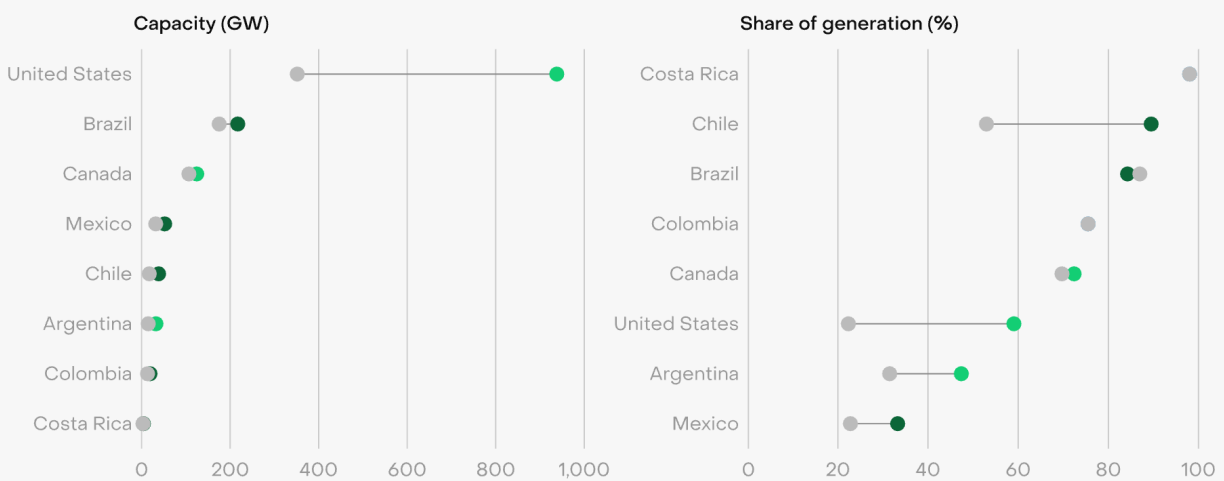
## Asia Pacific



## Africa and the Middle East



## North, Central and South America



Source: Ember's Global Renewable Targets Data (2030)  
 'Explicit' targets are identified in official government policies; 'Implicit' targets are identified from official projections, as a proxy for a target; 'Derived' targets are derived based on explicit targets beyond 2030.

# Progress towards tripling

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Renewable capacity targets as they currently stand in national strategy and policy documents put the world on track for a more than doubling of renewables by 2030.

## World already targeting a doubling

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This analysis finds that national targets already set the world on course for 7,250 GW of renewable capacity in 2030, which represents more than a doubling compared to 2022.

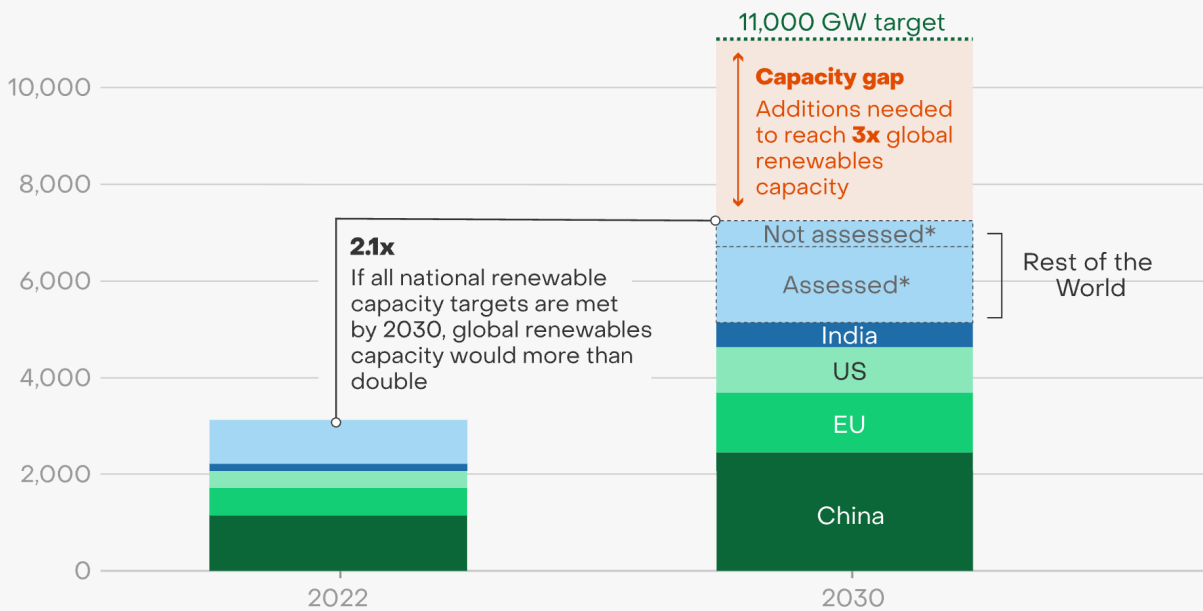
The sum of the 2030 renewable energy capacity targets analysed in this report, which represent 93% of global renewable capacity as of 2022, is 6,714 GW. To calculate an estimated global target, we have adjusted the target to account for the missing 7% of global renewable capacity. The estimated global figure is 7,250 GW in 2030, up from 3,382 GW in 2022. As such, global renewable capacity would more than double if governments deliver their 2030 targets stated either explicitly or implicitly. China, the EU, the US and India together contribute 71% of the global renewable capacity target in 2030.



Among the 54 countries and regions that provided a breakdown of types of renewables, the vast majority of growth is coming from a scale up of wind and solar. Solar and wind combined comprise 76% of the renewables capacity target for 2030 summed across countries (6,714 GW). This aligns with the [Net Zero Scenario from IEA](#) which states that 80% of the 11,000 GW of renewable capacity in 2030 will be from solar and wind.

### Current national plans would more than double renewable power capacity, but need to accelerate to triple by 2030

Global renewable capacity in 2022 and 2030 targets (in gigawatts)



Source: Ember analysis of 2030 renewable targets in 30 countries and the EU as a bloc, representing 90% of global emissions.

\*Assessed countries include the remaining 26 countries. 'Not assessed' is an estimate for missing capacity data.

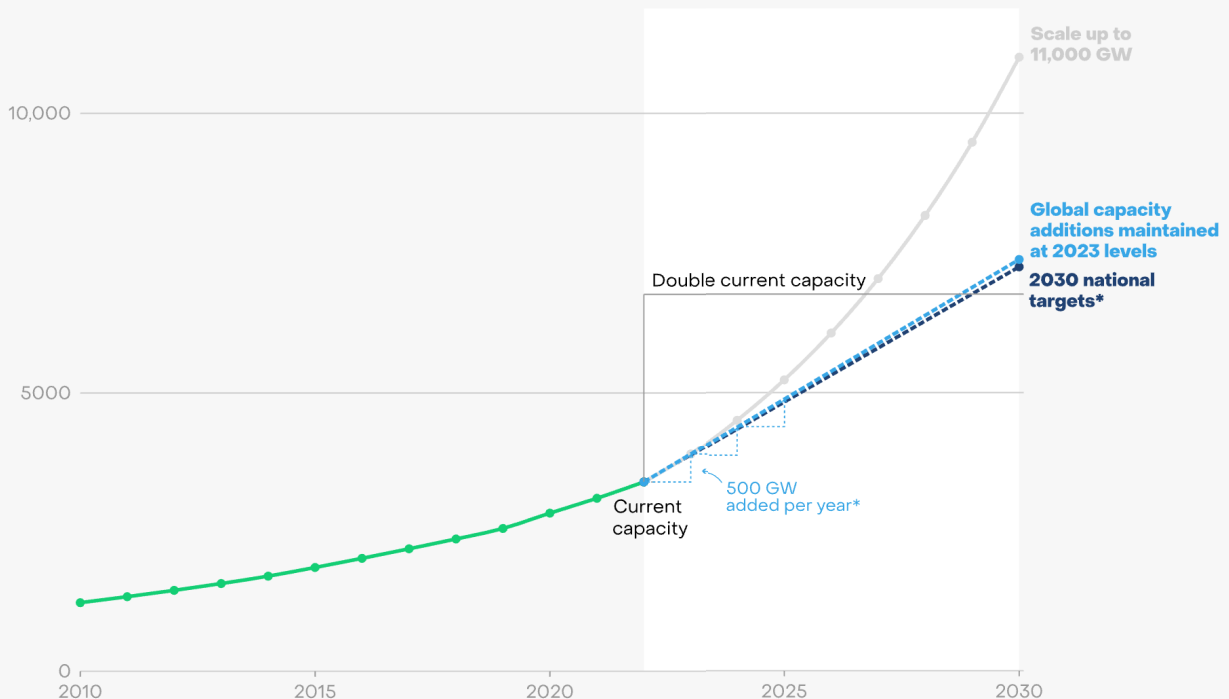
# Targets don't reflect renewables boom

It is clear from the analysis that national targets do not reflect the recent boom in renewables deployment.

The world could achieve its current targets—a doubling of renewables—just by continuing the 500 gigawatts of estimated deployment in 2023 from 2024 to 2030. If this year's projected annual deployment continues at a constant value, then global renewable capacity would amount to 7,382 GW, about 132 GW higher than the estimate of global collective national targets. However, all signs point to a more rapid growth curve, and the world would reach a tripling if the 17% annual growth rate achieved since 2016 is continued. Moreover, many countries are already deploying renewables more quickly than required to achieve their 2030 targets.

## If 2030 national renewable targets are met, global capacity would more than double by 2030

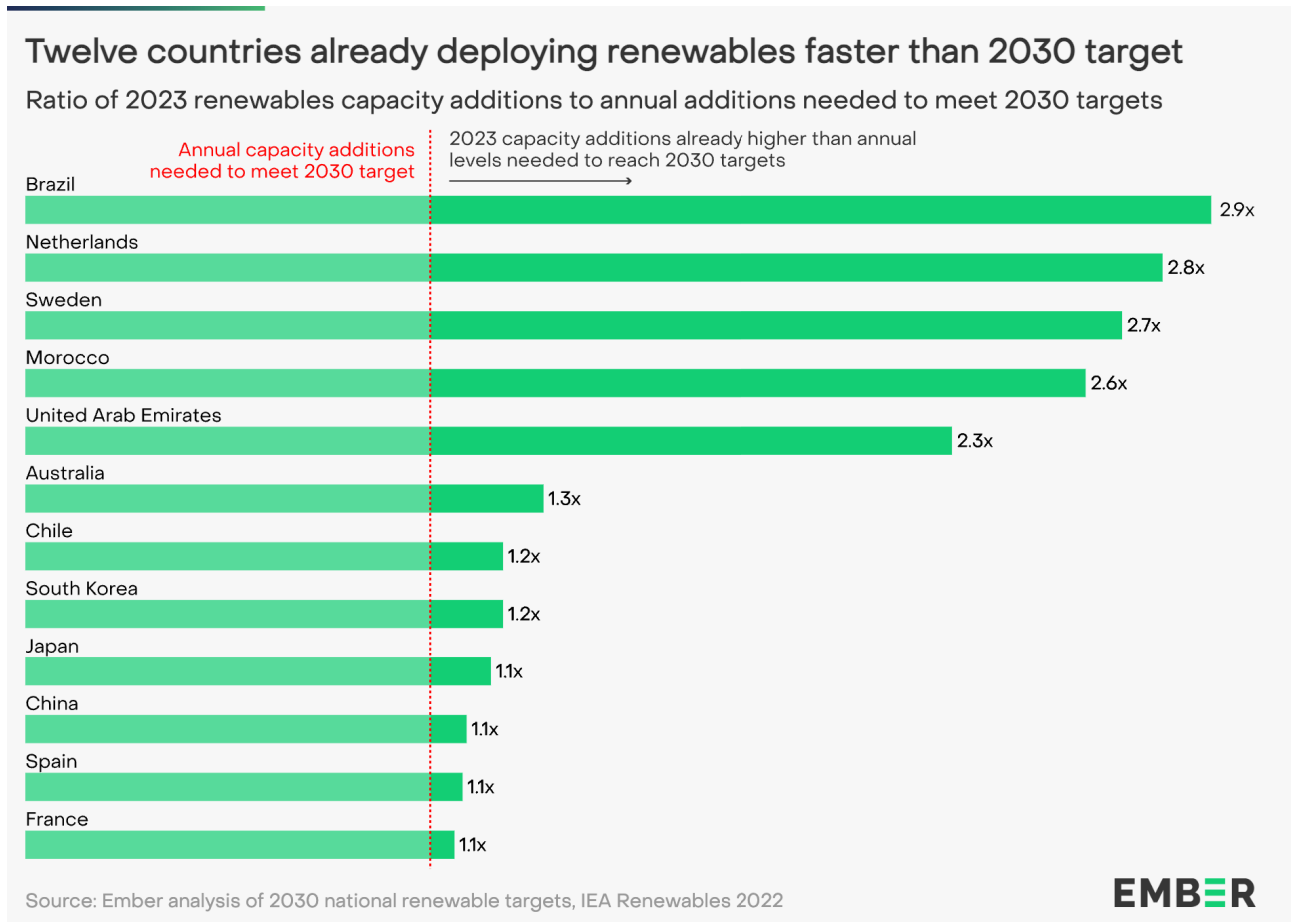
Capacity pathways: sustained annual additions vs national targets (GW)



Source: 2010–2022 IRENA, 2023 estimate based on IEA projections  
\*Ember analysis of 2030 national renewable targets

## Twelve countries already deploying renewables faster than 2030 target

Twelve countries are set to add more capacity in 2023, according to the [IEA's projections](#), than the average annual additions required to meet their 2030 targets: Australia, Brazil, Chile, China, France, Japan, Morocco, the Netherlands, South Korea, Spain, Sweden, and the United Arab Emirates.



## Prospective solar and wind capacity in 22 countries greater than solar and wind additions required to meet 2030 targets

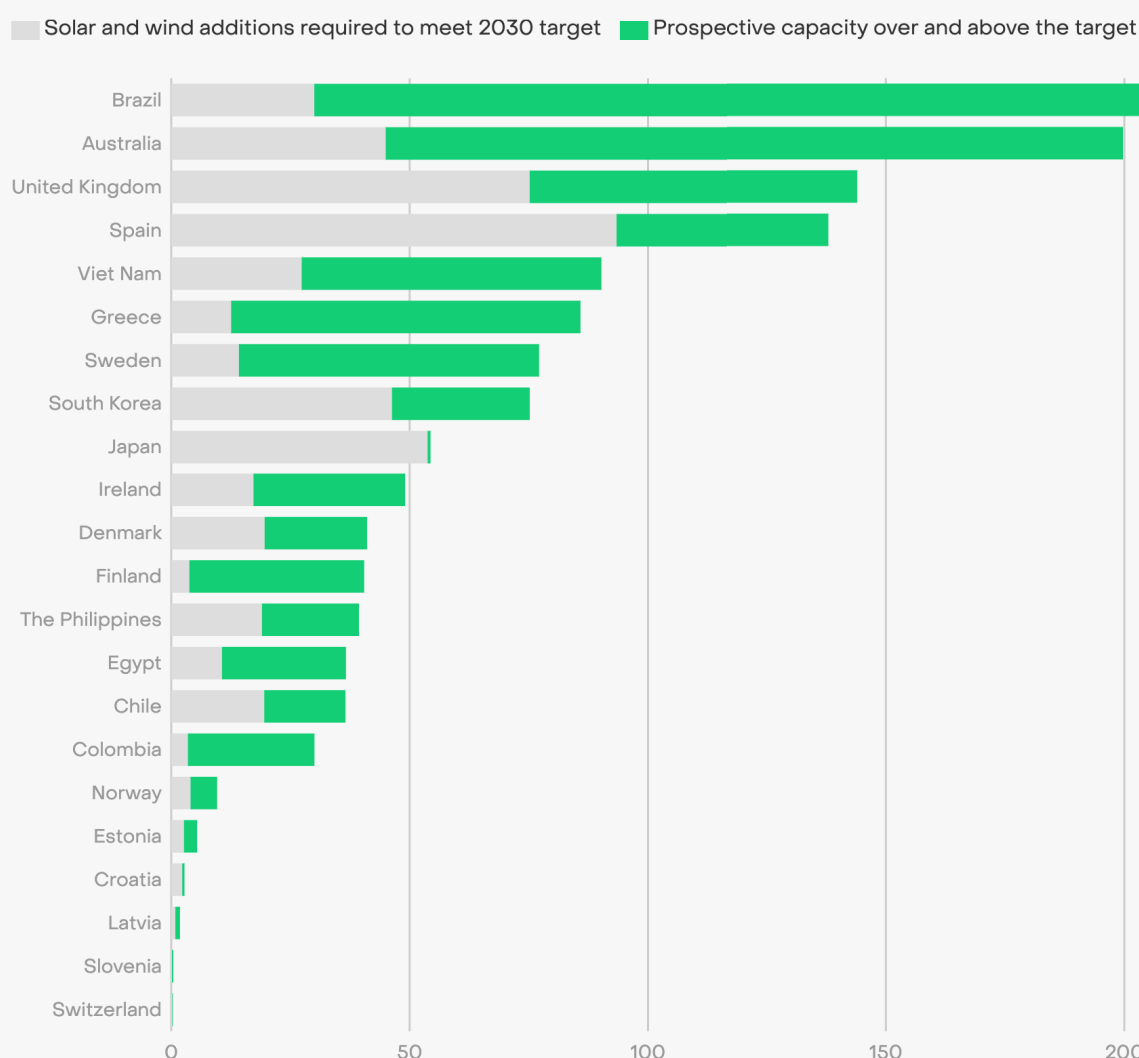
For 22 countries, prospective project development pipelines for wind and utility-scale solar alone exceed the total renewables capacity that needs to be built from 2023 to 2030, suggesting that it would be possible to raise the target further. Fifteen of those countries have more than double the prospective capacity than additions required to meet their 2030 target including Colombia, Brazil, Australia and Viet Nam.

Although it is the best available data on the pipeline of renewables projects, it is important to note that the prospective capacity data used in the analysis comes with an array of caveats and therefore should be understood as a rough indication of what is currently happening on the ground. The prospective capacity data provided by [Global Energy Monitor \(GEM\)](#) includes proposed projects

that have been described in corporate or government plans at the pre-permit stage, projects that are actively moving forward in seeking approvals, land rights, or finance, and projects that are under construction. This analysis includes prospective capacities that are announced to come online in 2023–2030, and those without an announced operation year, although not all prospective capacities are expected to come online by 2030. GEM's solar data covers 40–60% of existing solar capacity and excludes rooftop and distributed solar.

## 22 countries already have more prospective utility-scale solar and wind projects than is needed to meet their total renewable target

Capacity in 2030 (gigawatts)



Source: Global Energy Monitor · Ember analysis of national renewable targets for 2030

'Prospective' capacity refers to those under construction, pre-construction or announced, whose operation begins in 2023–2030 or in unknown year. Not all prospective capacity is expected to come online.

# Room for higher ambition in many countries

The analysis shows that many countries do have ambitious renewables targets in place. Ten countries have 2030 targets that are triple their 2022 renewable capacity. Some countries plan to completely transform their electricity sector whereby renewables will dominate generation by 2030. A number of countries have targets for the share of total electricity generation from wind and solar in 2030 that exceed the 40% global average in the IEA Net Zero scenario.

## Ten countries targeting tripling of their renewables capacity

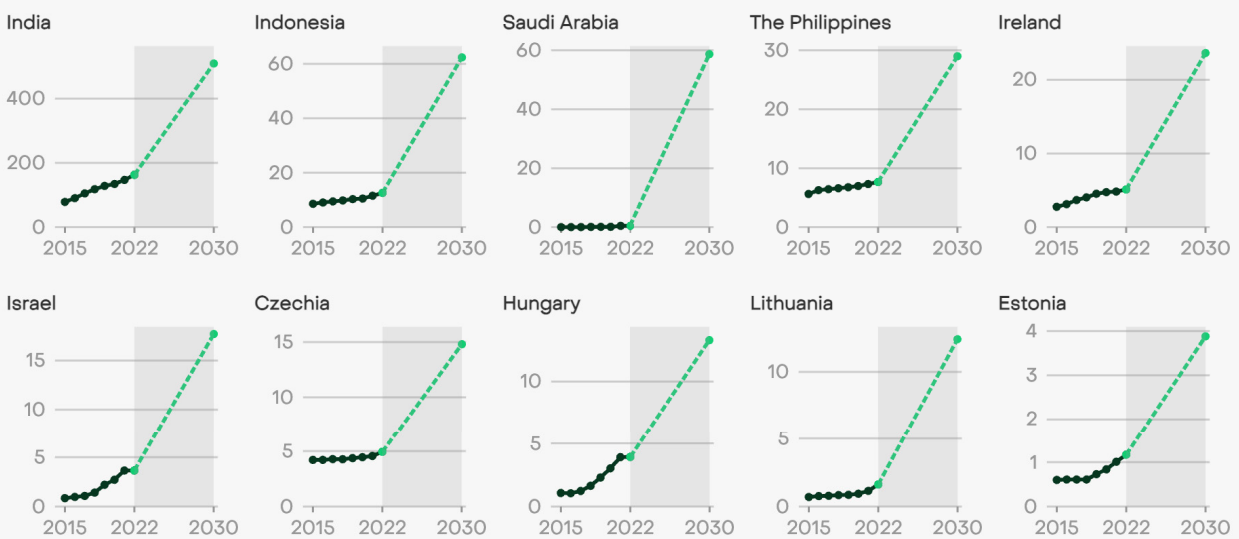
Although it is not necessary for every country to triple their renewables capacity, it is interesting to note which countries have set out a target that matches this ambition.

The countries with targets that aim for a tripling or more of their 2022 capacity include Saudi Arabia, India, Indonesia, the Philippines, Ireland, Israel, Czechia, Hungary, Lithuania and Estonia. South Africa is currently just under a tripling as their capacity target reflects an increase of 2.9 times the 2022 level.

### Ten countries are aiming to more than triple their renewables capacity by 2030

GW

Actual Linear pathway to target



Source: Ember's global renewable target tracker

A global tripling does not mean that every country is required to triple its renewables capacity—some will do more, some less—depending in part on their starting point. It is also worth noting that tripling at a national level is not enough to assess if a country's plan is sufficiently ambitious or not. Some countries have room to triple as they are starting from a low base and/or have been less ambitious historically, whereas some countries can not triple capacity as they have accelerated past the point where this is achievable or domestically needed.

Some of the ten countries targeting a tripling are starting from a very low base—making the growth rates more significant—and yet there remain many uncertainties about whether implementation will be followed through. For example, although Saudi Arabia tops the list, it is from a very low base and the path to implementation remains unclear. Similarly, Czechia and Hungary have not seen significant wind capacity additions within the last decade due to barriers such as Hungary's extremely restrictive [spatial planning](#) law, which effectively bans new wind power plants. There is therefore no guarantee that their targets will be delivered without significant policy changes.

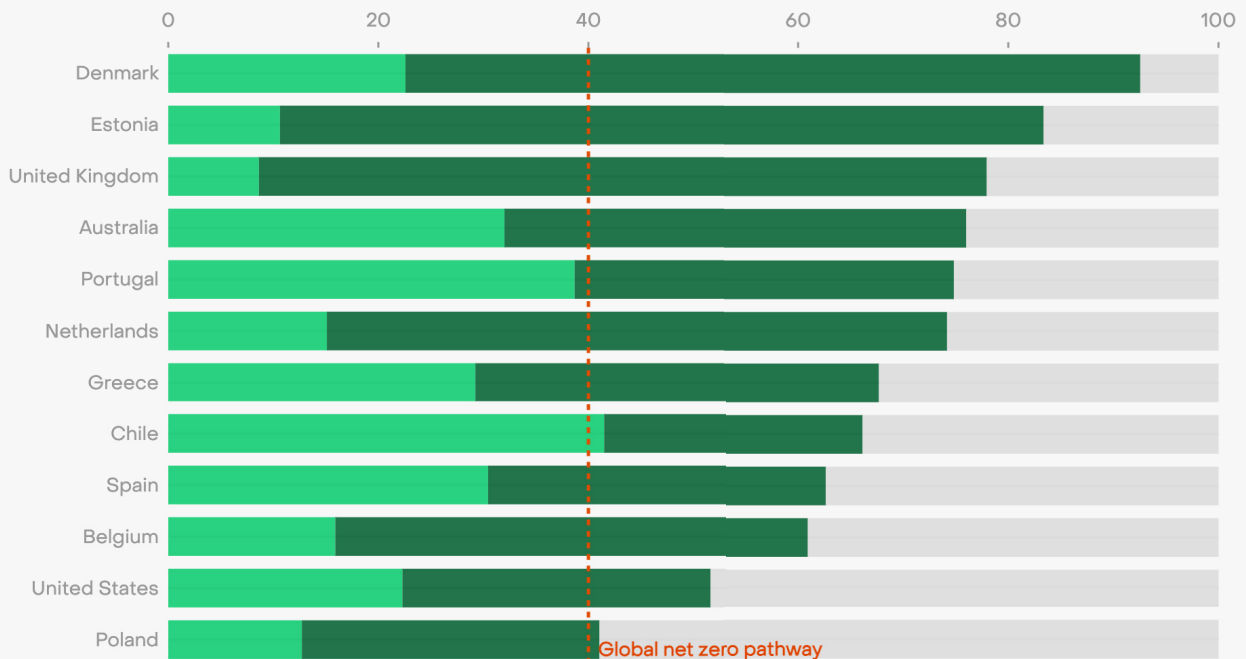
### **Twelve countries targeting more than 40% wind and solar by 2030**

Solar and wind are expected to be the major drivers of growth in renewables this decade. In the [Net Zero scenario](#) presented by IEA, global solar and wind share in total generation reaches 40% by 2030. Only 32 countries have specific targets for solar and wind, which range from 13% (Egypt) to 93% (Denmark). Twelve of the countries have wind and solar share targets that exceed 40% by 2030. It is important to note that the Net Zero scenario does not require all countries to meet 40%, some need to do more to meet their fair share and some emerging economies may take longer to reach this level.

## Solar and wind 2030 targets exceed the global net zero pathway in 12 countries

Share of total electricity generation (%)

■ Solar ■ Wind ■ Other electricity sources



Source: Ember Global Renewable Target Tracker  
 "Other fuels" include bio, hydro, nuclear, coal, gas and other renewables and fossil.

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According to the recent update of the [IEA Net Zero report](#), the share of renewables (solar, wind, and other renewables) in global electricity generation must rise from 30% in 2022 to 60% in 2030. Among the countries we surveyed, only 43 countries have a target for the renewables share of generation in 2030. On average, they aim to reach 49% renewables share of generation by 2030. National targets show high variance, ranging from 13% in Egypt to 100% in Estonia.

### Some countries plan a big shift in their electricity mix

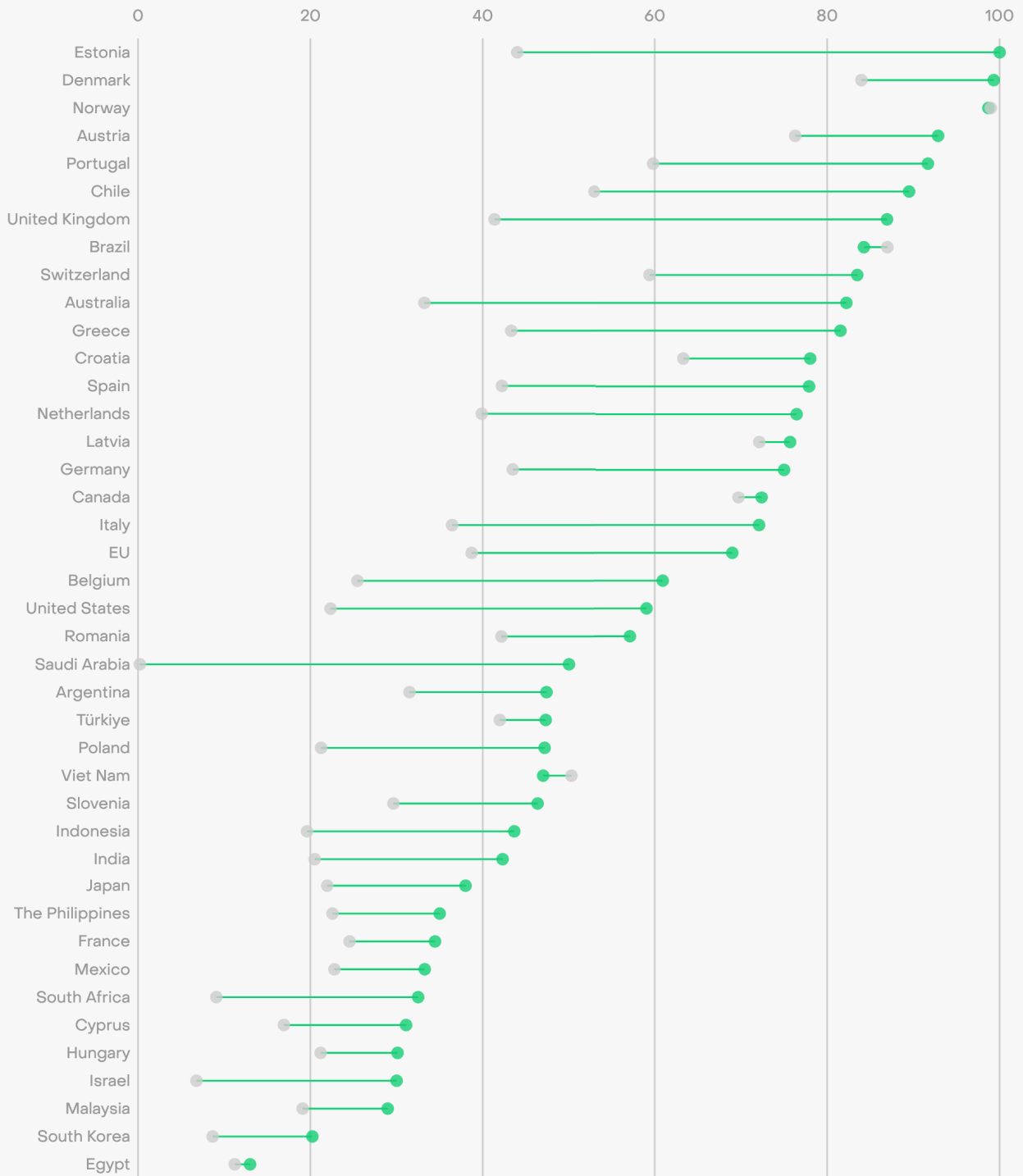
Some countries are planning a major change in their electricity mix from 2022 to 2030, with 20 countries planning to increase their share of renewable generation by more than 20 percentage points.

Three major countries plan to transform almost half of their total electricity production to run on renewable electricity. Saudi Arabia is targeting to increase from near-zero in 2022 to 50% renewables in 2030. Australia is targeting renewables to increase by 48 percentage points, from 34% to 82% of total electricity generation. The UK is projected to increase renewable share by 46 percentage points from 41% to 87% by 2030.

## Huge shift in electricity mix towards renewables is targeted by many countries

Renewables share in electricity generation (%)

● 2022 ● 2030 national target



Source: Ember's calculation using data from Global Renewable Target Tracker · United States, Canada, Poland, Norway, Indonesia, Argentina, Malaysia have implicit targets.



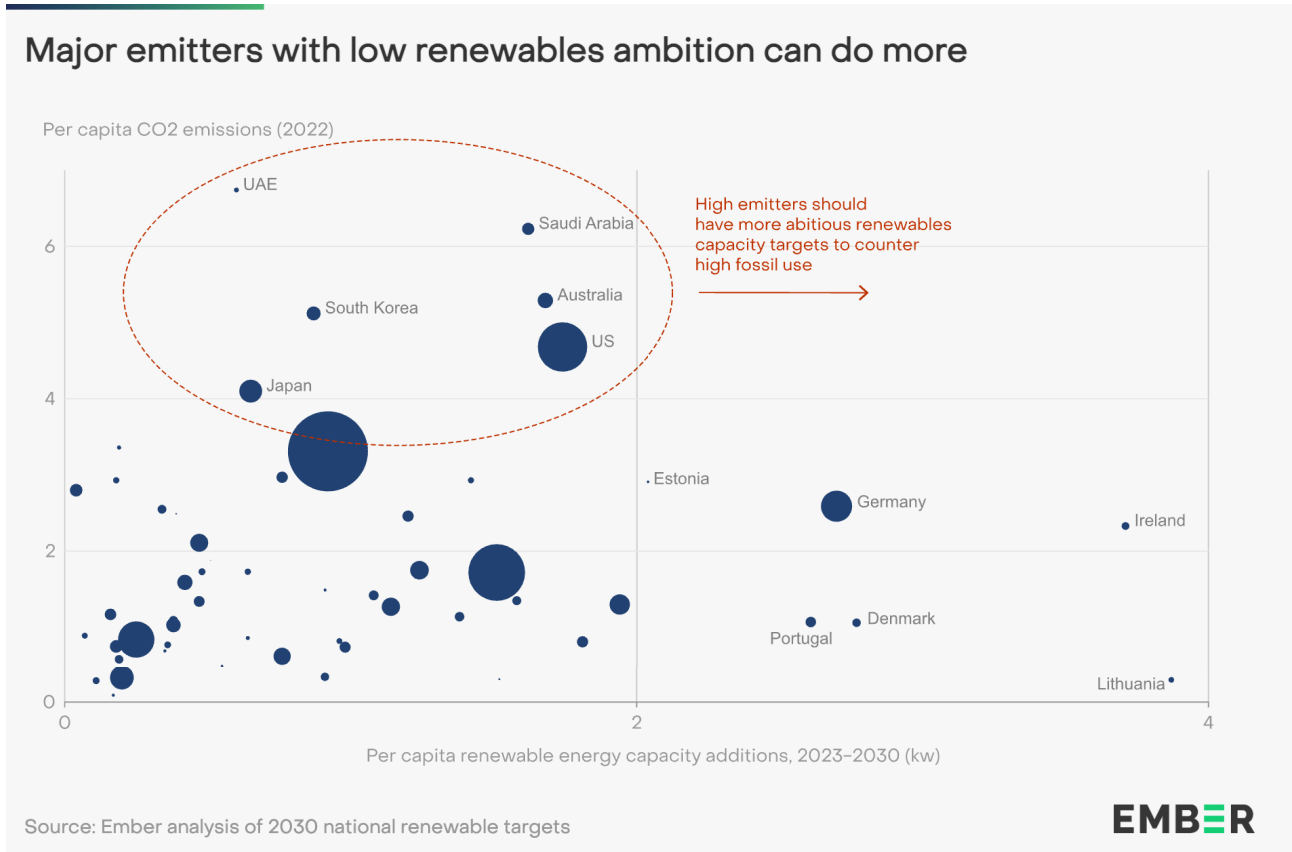
### Some major per capita emitters have relatively low renewable targets

A global goal to triple renewable capacity requires increased ambition across the globe, particularly among countries with high CO2 emissions and fossil-heavy electricity sectors.

United Arab Emirates, South Korea, Australia and Japan are high per capita emitters that are planning on relatively low renewable additions per capita by 2030. Yet these countries have targets that are behind the curve of their own current renewables growth, indicating that there is potential for setting higher targets.

Australia, Japan and South Korea have prospective wind and solar capacity in the pipeline that exceeds what is needed to meet their 2030 renewable target, with a caveat that not all of the prospective capacity is expected to come online. The United Arab Emirates target is achievable if current forecasted deployment continues.

In contrast, Saudi Arabia is a country with a fossil-heavy electricity sector that is planning large additions of renewable capacity by 2030. However, no new renewable capacity was added in 2022, therefore policy support to articulate and implement a deployment plan is critical for Saudi Arabia to reach its 2030 target. The US also has an implicit target that is a big increase in renewable capacity and share of generation, but current annual deployments need to ramp up if the target is to be met.



# Tripling renewables requires countries to increase ambition... and many can

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**There is a gap of 3,750 GW between collective national targets for renewables and a global tripling. This gap must be made up by increased ambition and accelerated renewable deployment.**

In this section, we highlight countries that must play a big role in closing the gap between collective national targets and the global tripling of renewable goal. We also evaluate whether they can raise their ambition even further.

Below we discuss China, the EU, the US, and India, who combined account for 71% of the global 2030 capacity target. As of 2022, they accounted for 66% of renewables capacity and 62% of electricity demand. We also use the analysis in Chapter 3 to identify five additional countries to explore further based on the fact they are relatively high per capita emitters with either big planned increases in ambition but little progress to date (Saudi Arabia), or low stated targets but big potential to increase renewables ambition (Australia, Japan, South Korea, and the United Arab Emirates).

## China

The latest projections suggest that China is on track to double its renewable capacity, reaching 2,461 GW by 2030 according to government-affiliated think tank GEIDCO. China is already on track to install at least 26% more renewable capacity in 2023 than it would need to install on average annually to meet the 2,461 GW forecast. Against a backdrop of fast-rising annual additions, China has the ability to increase substantially more than is forecast by GEIDCO.

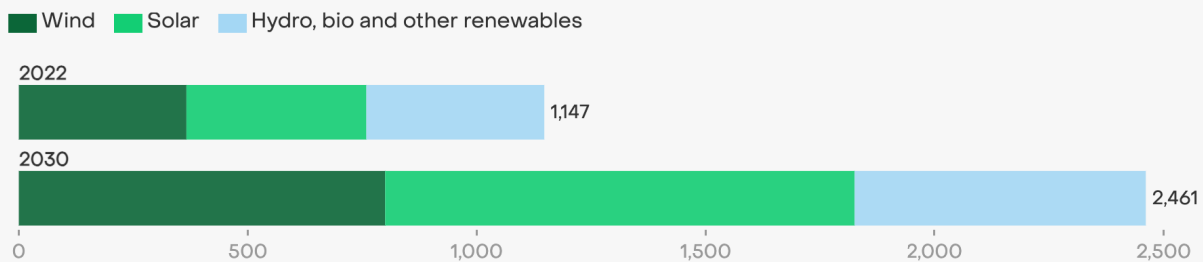
### Current target

The implicit target used here of 2,461 GW comes from the GEIDCO model. In 2020, President Xi [announced](#) that China's solar and wind capacity will reach 1,200 GW by 2030 and this was affirmed in 2022 in the [14th Five-year Plan for Renewable Energy Development](#). However, [recent studies](#) have shown that China will likely reach this target by 2025 at the latest.

As a proxy for an updated target, we used a 2021 national energy forecast [study](#) conducted by GEIDCO, a government-affiliated think-tank chaired by the Chairman of State Grid Corporation of China and China Electricity Council. The study projects power capacity development pathways for 2030 including 2,461 GW of renewable capacity. The 2030 target is a doubling of capacity compared to 2022, when China's renewable capacity was 1,147 GW, providing 30% of total generation.

### China is projected to double its renewable capacity by 2030

Current renewable capacity compared to 2030 targets (GW)



Source: Global Energy Interconnection Development and Cooperation Organisation (GEIDCO), 中国2030年能源电力发展规划研究及2060年展望 (2030 Energy and power development planning research and 2060 outlook) · Renewable capacity statistics (IRENA, 2023)

## Potential for higher ambition

It is likely that China will build even more renewables than projected in the GEIDCO study. To reach the 2030 capacity as forecast by GEIDCO, China needs to add 164 GW of renewables each year from 2023 to 2030.

On the ground, China's deployment continues to exceed expectations. The [IEA had projected](#) that China would add 178 GW of total renewables capacity in 2023. In a more recent [IEA market update](#), the projection was adjusted upward to 207 GW of wind and solar alone in 2023. This amount of solar and wind is 26% (43 GW) more than the average annual addition of total renewables that would be needed to achieve the GEIDCO renewable forecast (164 GW).

China has been increasing their renewable additions at a compound annual growth rate of 12% since 2015, adding [a record 138 GW in 2022](#), suggesting that annual capacity additions will rise further.

## European Union

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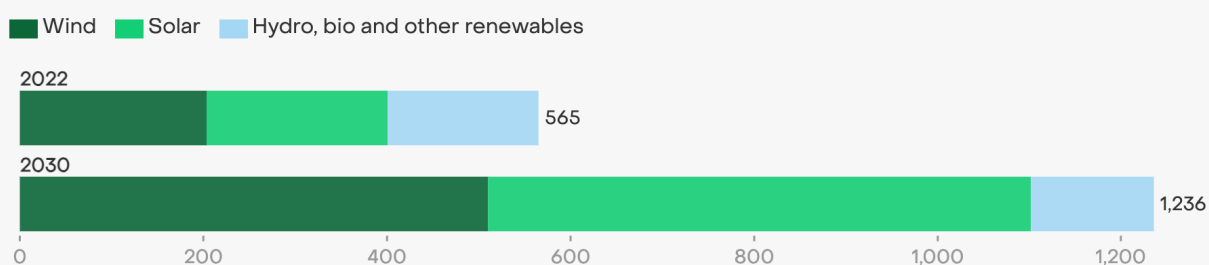
The EU aims to reach 1,236 GW of renewable capacity by 2030 and 69% of renewable share in total generation as proposed in the [REPowerEU](#) plan. This target is achievable if annual capacity additions continue to grow at recent levels.

### Current target

This study uses 1,236 GW from the REPowerEU policy. The European Commission presented [REPowerEU](#) in May 2022, a detailed plan to reduce reliance on Russian gas supplies, predominantly through the accelerated deployment of renewables. Building on the [Fit for 55](#) package announced in July 2021, the policy actions proposed in REPowerEU increase the share of renewable electricity to 69% and increase total installed renewable capacity to 1,236 GW. The 2030 target is a doubling of renewable capacity compared to 2022 when the EU's renewable capacity was 565 GW.

## The EU aims to increase its renewable capacity by 70% by 2030.

Current renewable capacity compared to 2030 targets (GW)



Source: Commission Staff Working Document: Implementing the RePower EU Action Plan (European Commission, 2022), Renewable capacity statistics (IRENA, 2023)

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### Potential for higher ambition

To meet the 2030 target, the EU will have to add 84 GW on average per year from 2023 to 2030. According to IRENA, the EU added [49 GW of renewable capacity in 2022](#), and the [IEA forecast in December 2022](#) that 66 GW of total renewable capacity additions will be added in 2023. This projection was adjusted upward further in a [recent IEA market update](#) in June 2023, which suggested that 63 GW of solar and wind alone will be added in 2023.

In the EU, annual renewable deployment grew by 15% on average every year from 2015 to 2022. The IEA forecast for annual deployment in 2023 (66 GW) would represent a 35% increase compared to 2022 (49 GW). The current 2030 target of 1,236 GW requires annual additions to increase at a compound growth rate of 8% from 2023 to 2030, which should be achievable given the consistent increase in capacity over the past few years.

However, the REPowerEU renewables target is for the entire bloc and it can only be achieved through action at the national level. All Member States must not only confirm commitments that are aligned with the EU target but, more importantly, enable the required scale of renewables deployment. Detailed information on current Member States' plans is available in Ember's [EU NECP target tracker](#).

## United States

The policies implemented by the United States are expected to set the country on course for 938 GW of renewable capacity by 2030, reaching a 59% share of renewable electricity. The United States is not yet deploying renewables at the pace required and needs to scale up deployment to meet this 2030 capacity target.

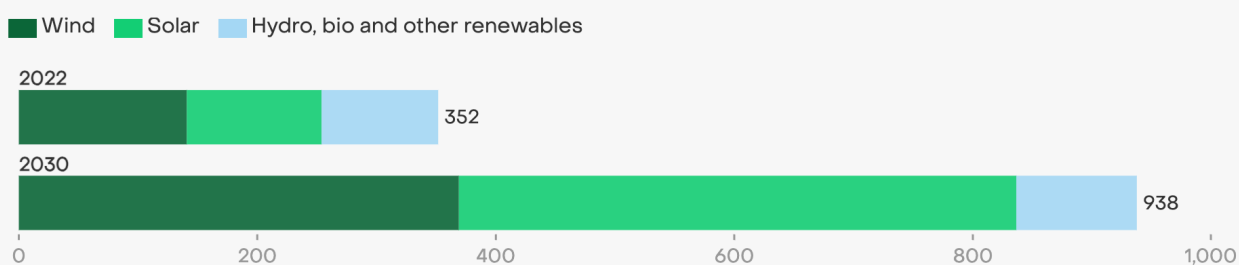
### Current target

This study uses an implicit target of 938 GW for renewable capacity generation from a National Renewable Energy Laboratory (NREL) projection. While the United States does not have explicit targets for renewable capacity or share of generation, it has implemented various support policies for clean power. Most notably, the Inflation Reduction Act (IRA) and Bipartisan Infrastructure Law (BIL). We capture the US' implicit target by referring to a [study conducted by the NREL](#) in 2023 that simulated changes to the US power system through 2030 based on the IRA and BIL.

The US implicit target used in this study for renewable capacity generation from the NREL projection is 938 GW, with 468 GW from solar, 334 GW of onshore wind, and 35 GW of offshore wind. The implicit target suggests that the renewable capacity would increase by a factor of 2.7 from 2022 to 2030. It is projected that renewables would account for 59% of total generation in 2030, up from 22% in 2022. Solar and wind alone would reach 52%. This share is eight percentage points higher than what the [IEA Net Zero scenario](#) shows for the US in 2030, which is 44%.

### Renewable capacity in the US is expected to grow 2.7 times by 2030.

Current renewable capacity compared to 2030 targets (GW)



Source: Evaluating Impacts of the Inflation Reduction Act and Bipartisan Infrastructure Law on the US Power System (NREL, 2023), Renewable capacity statistics (IRENA, 2023)

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## Potential for higher ambition

In order to meet the NREL projection of 938 GW, the US needs to add 73 GW of renewable capacity on average every year to 2030. This is almost three times the additions in 2022 (26 GW), and higher than the [IEA's forecast](#) for additions in 2023 (39 GW). To meet the 2030 target the US will have to increase annual renewable capacity additions at a compound growth rate of 14%. The compound annual growth rate from 2015 to 2022 has been 8%. The NREL projection means the US would build fewer renewables every year than the EU is targeting (73 GW versus 84 GW), despite the fact that the US power sector has [double](#) the CO2 emissions of the EU power sector, indicating more effort may be required.

## India

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India is one of only ten countries that is currently planning for a tripling of renewables by 2030. However, barriers to renewables uptake continue to exist and need to be addressed in order to ramp up the build-rates needed to meet its targets.

### Current target

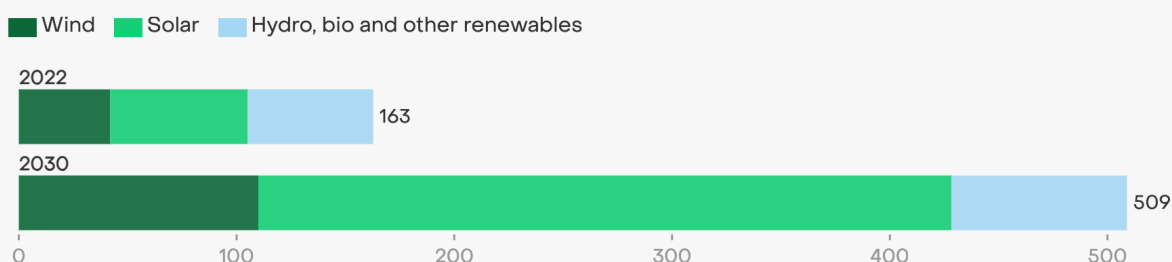
India's plans indicate that it would more than triple its renewable capacity, from 163 GW in 2022 to 509 GW by 2030, which will see renewables provide 42% of total generation by 2030.

The 509 GW comes from an interpolation of technology-specific targets for fiscal year (FY) 2026–27 and 2031–32 presented in the [India National Electricity Plan 2022–32 \(NEP\)](#). By March 2032, India plans to reach 570 GW of renewable capacity and to reach 44% of renewables in total generation.

The latest plans represent an increase compared to plans set out two years prior. In 2021, India's Ministry of New and Renewable Energy announced that the country aims to reach 450 GW of renewable capacity by 2030, excluding large hydro. In the following year during [COP26](#), Prime Minister Modi pledged that India will reach 500 GW of non-fossil generation capacity by 2030. Neither of these targets are stated in [India's Nationally Determined Contribution](#) (NDC) submitted to UNFCCC in 2022. The NDC sets a goal to achieve 50% of power generation capacity non-fossil by 2030.

## India is estimated to triple its renewable capacity by 2030.

Current renewable capacity compared to 2030 targets (GW)



Source: India National Electricity Plan 2022–32 (Central Electricity Authority, 2023), Renewable capacity statistics (IRENA, 2023)  
The data shown in this graph was interpolated based on targets for FY2026–27 and FY2031–32.

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### Potential for higher ambition

Annual capacity additions need to significantly increase for India to meet its 2030 target.

According to IRENA, India added 16 GW of renewable capacity in 2022. The [IEA forecast in 2022](#) suggested that India will add 26 GW of renewables in 2023. During the first three quarters in 2023, India added 22 GW, drawing close to the projected total for 2023.

On average, 43 GW per year of renewable capacity additions from 2023 through to 2030 are required to meet the 2030 target. However, linear growth is not expected. Since 2015, annual capacity additions have been growing at a compound annual growth rate of 13%, with 16 GW of renewable capacity added in 2022. This was the highest annual addition ever seen in India. Yet, to meet the more than tripling goal of 509 GW, India needs to see an increase in annual capacity additions of 15% every year between 2023 and 2030, reaching 67 GW of annual renewables additions by 2030.

India's ambitious plan means that 33% of electricity would come from solar and wind by 2031. This is below the global average of 40% in 2030, if global renewables were to triple. The [IEA Net Zero report](#) shows more ambition is required from India in the Net Zero scenario, with solar and wind providing 42% of total electricity in 2030.

The current plans from India are likely not enough to initiate a fall in coal power, but it is enough to prevent a significant increase in coal power. [Ember's recent report](#) based on the analysis from India's National Electricity Plan showed that coal power met 83% of the rise in electricity demand in the last decade (from 2012 to 2022), but will meet just 22% of the demand rise in the next decade (from 2022 to 2032). Solar and wind will meet 66% of the rise in electricity demand.



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International financing to support achieving these targets—or raising ambition—may be available to India through a similar mechanism to the Just Energy Transition Partnership (JETP) programme, which has funded progress to begin a phase down of coal in South Africa, Viet Nam and Indonesia.

However, to unlock more ambition, India would need to increase its annual build rates even higher in future years to achieve the target for FY 2031–32. This limits the potential for India to increase further ambition prior to 2030.

## Australia

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By 2030, Australia aims to reach 82% of renewable share in total generation. Power market operator AEMO projects that Australia will have 92 GW of renewable capacity under this target. Australia has more prospective wind and solar in the pipeline than is needed to meet its 2030 renewable target, and if it continues to add capacity at the 2023 level the target will be exceeded.

### Current target

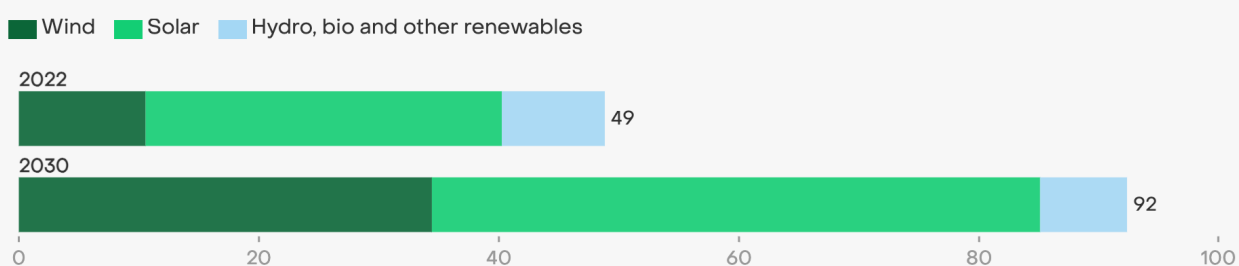
After enshrining a net zero by 2050 target, Australia's Department of Climate Change, Energy, the Environment and Water developed the [Powering Australia Plan](#) that lays out action plans to meet net zero. The Plan reiterates its target to reach 82% of renewables in total generation by 2030, up from 33% in 2022.

In line with this goal, the [Australia Electricity Market Operator \(AEMO\)](#) updated its Integrated System Plan to provide a pathway to reach these goals. The AEMO modelling study suggests renewable capacity of 92 GW is required to meet the renewables share of generation target: 51 GW of solar, 34 GW of wind and 7 GW of hydro.

Australia's implicit capacity target would mean that its renewable capacity would almost double by 2030. In 2022, its renewable capacity was 49 GW.

## Australia is projected increase its renewable capacity by 88% by 2030.

Current renewable capacity compared to 2030 targets (GW)



Source: 2022 Integrated System Plan (AEMO, 2022), Renewable capacity statistics (IRENA, 2023)

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### Potential for higher ambition

Australia is already adding renewables at a pace that exceeds what is needed to meet the 2030 target. Australia added 4 GW of renewable capacity in 2022, and the [IEA forecasts](#) that 7 GW of capacity could be added in 2023. To meet the 2030 target, Australia needs to add 5 GW of renewables on average every year until 2030. Since 2015 annual renewable capacity additions have increased at a compound annual growth rate of 21%.

Furthermore, Global Energy Monitor's data on prospective solar and wind capacity for Australia shows that there is potentially three times more capacity already under construction or announced than its 2030 target, even though it excludes rooftop solar. A more ambitious target is highly achievable, and to ensure a smooth transition there is a need for renewed policy support for energy storage and upgraded transmission.

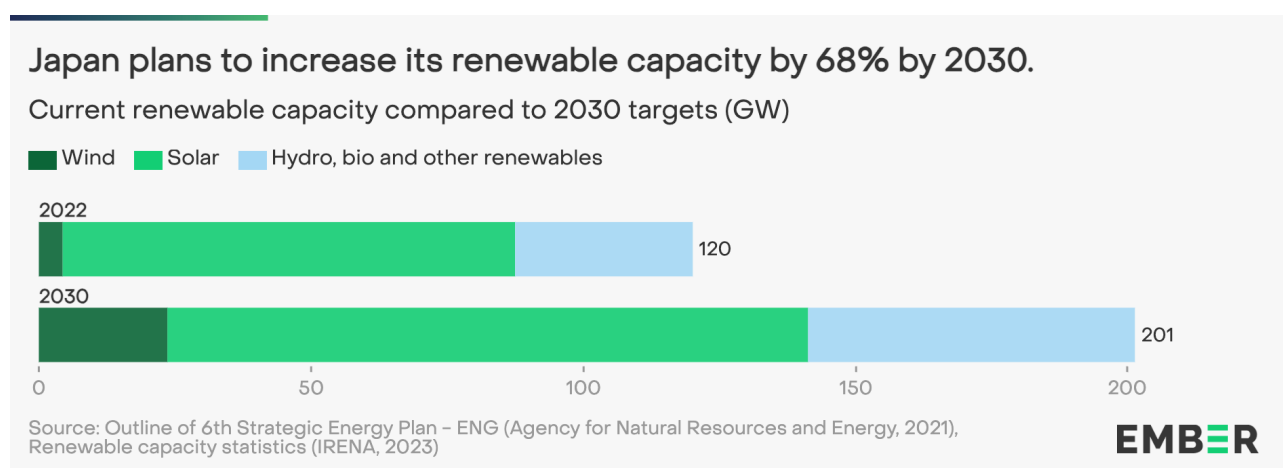
## Japan

By 2030, Japan aims to reach 201 GW of renewable capacity, providing 38% of total generation. Japan is planning only half the rise in renewables share as compared to the US and EU, and the IEA Net Zero scenario suggests it should be higher. It is currently building faster than needed to meet the existing target, which suggests the target could be raised. Slower nuclear restarts are a real risk that could be mitigated with a higher renewables target.

## Current target

[Japan's 6th Strategic Energy Plan](#) presented in 2021 by the Agency for Natural Resources and Energy includes a goal to reach 36–38% share of generation from renewables by 2030. In its supplementary document, Japan lays out a capacity development plan for 2030 of 201 GW including 118 GW of solar, 24 GW of wind and 60 GW of hydro, bioenergy and other renewables.

Japan's target is to increase renewable capacity by a factor of only 1.7, from 120 GW in 2022 to 201 GW by 2030. Its market share of renewables would increase by only 14–16 percentage points from 2022 to 2030 (from 22% to 36–38%), roughly half the 30 percentage point increase for the EU and 37 for the US.



## Potential for higher ambition

Japan's current target for solar and wind share in 2030 is 21%, falling short of what is needed to meet the [IEA Net Zero Scenario](#), which suggests that Japan should reach 30% solar and wind share of total electricity generation in 2030.

However, Japan's renewables target does not reflect the rapid growth in renewables the country is achieving. The [IEA estimated](#) that Japan could add up to 12 GW of renewable capacity in 2023, which is higher than the 10 GW per year needed from 2023 to 2030 to meet its national target assuming linear growth. Furthermore, there are 142 GW of prospective [solar](#) and [wind](#) projects (not including rooftop solar) in the pipeline, which is enough alone to meet the target. The 2030 capacity target only includes 24 GW of wind, and this is an area of untapped potential that Japan could harness to come in line with the rest of the G7.

Japan's target for clean power is planned from a rise in both nuclear power, which is planned to increase from 5% in 2022 to 22% in 2030, and renewable electricity, which is planned to increase from 22% in 2022 to 36–38% in 2030. But [reactor restarts are lagging](#): only one unit was returned in 2021, none in 2022, two in 2023, and two planned for 2024. This delay poses a risk to Japan's climate targets, a risk which could be mitigated with a higher renewable target.

## Saudi Arabia

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By 2030, Saudi Arabia aims to reach 59 GW of renewable capacity and 50% of renewables in total generation. The rise from 0.2% renewables in 2022 to 50% renewables represents the biggest rise in renewables share of any of the 32 countries that have renewable share targets: and rightly so, given the high CO<sub>2</sub> emissions per capita of their power sector. Saudi Arabia's power sector emissions per capita are close to four times that of the world (6.2 tCO<sub>2</sub>). Therefore, it is of crucial importance that Saudi Arabia implements tangible policies to achieve this target.

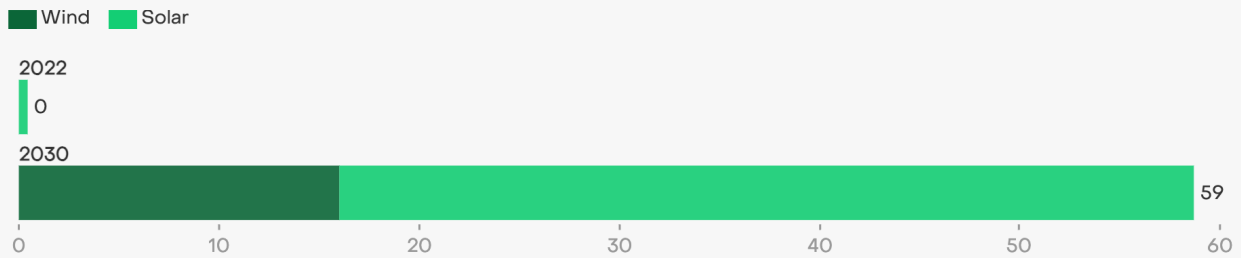
### Current target

In 2016, Saudi Arabia presented a [Vision 2030](#) document with a target to deploy 9.5 GW of renewable energy by 2023. In 2019, the state Renewable Energy Project Development Office released an updated target of 59 GW by 2030, of which 43 GW is solar and 16 GW is wind. More recently, on March 31, 2021 Saudi Arabia's Crown Prince announced the [Saudi Green Initiative](#), which includes a plan to generate 50% of Saudi Arabia's energy from renewables by 2030.

Saudi Arabia plans the biggest increase in renewables capacity from 2022 to 2030 of all countries analysed, albeit from a low base. Their renewables capacity in 2022 was 0.4 GW and their target for 2030 is 59 GW, 73% of which will be solar capacity. Their capacity target was suggested by the Renewable Energy Project Development Office to support their national goal to increase the share of renewable generation from 0.2% in 2022 to 50% by 2030, made official in the [Saudi Green Initiative](#).

## Saudi Arabia aims to reach 59 GW of renewable capacity by 2030

Current renewable capacity compared to 2030 targets (GW)



Source: National Renewable Energy Programme (Renewable Energy Project Development Office, 2019), Renewable capacity statistics (IRENA, 2023)

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### Potential for higher ambition

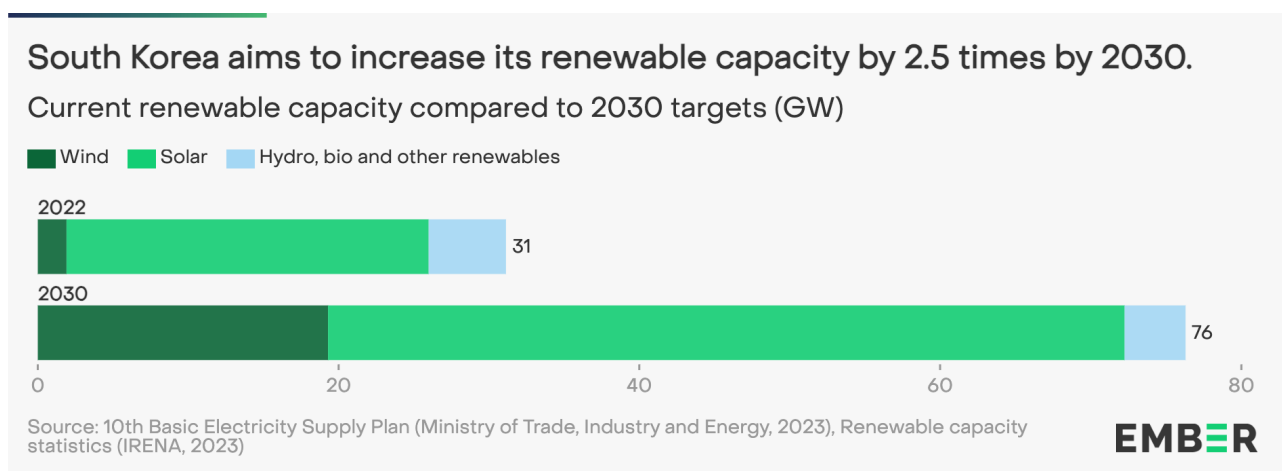
If this plan follows through, it would be a major transformation of the power system. In 2022, solar capacity, currently the only renewable source in Saudi Arabia, accounted for 0.2% of total generation. However, there is no detailed information on how the target translates into national policies and development plans. According to their [capacity development plan](#), Saudi Arabia will have to add on average 7 GW per year from 2023 to 2030. The [IEA](#) estimates 2023 renewables capacity additions of 2 GW for 2023, which highlights that progress needs to start soon. To meet this target, Saudi Arabia has to articulate and implement its deployment plans fast, as it did not add any additional renewable capacity in 2022.

## South Korea

By 2030, South Korea aims to more than double renewable capacity to 76 GW, providing 20% of total generation. South Korea has the potential to raise its renewable ambition. The 2023 projected deployment exceeds the annual additions needed to meet its 2030 target, and the country's pipeline of prospective wind and solar capacity is three times the 2030 target.

## Current target

South Korea's [10th Electricity Supply Basic Plan](#) sets a high-level target to reach 80 GW of renewable capacity and 30% share of total generation by 2036. The Plan introduces the pathway to reach the target for each year until 2030. By 2030, South Korea plans to reach 53 GW of solar, 19 GW of wind and 4 GW of hydro, bioenergy and other renewables. South Korea's capacity target would increase its total renewable capacity by a factor of 2.5. South Korea aims to increase the share of renewables in total generation from 9% in 2022 to 20% by 2030.



## Potential for higher ambition

South Korea is already adding renewables at the pace required to exceed its 2030 target. To reach its target, South Korea needs to add 5.6 GW of renewable capacity every year until 2030. The [IEA projects](#) that South Korea will add 6 GW of renewables in 2023, already more than the annual additions to meet the 2030 target. Furthermore, South Korea has 101 GW of prospective wind and solar capacity in the pipeline as of May 2023, which is more than their 2030 target.

South Korea's Electricity Supply Basic Plans have typically been conservative in their forecasts for the deployment of solar capacity. For instance, [the 8th Electricity Supply Basic Plan](#), published in 2017, underestimated the projected solar capacity for 2022 by 41%. The plan anticipated 13 GW in 2022, compared to the 22 GW actually achieved, which surpassed the capacity expected in 2026.

South Korea's emissions per capita are three times higher than that of the world (5.1 tCO<sub>2</sub>). A more ambitious target is achievable and would help South Korea make a larger contribution to the global tripling goal.

## United Arab Emirates

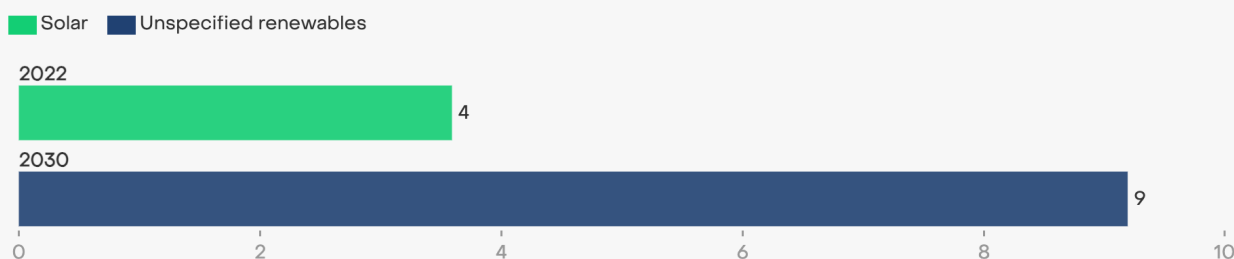
By 2030, the UAE aims to reach 9.2 GW of renewable capacity. The UAE can set a more ambitious renewable target for 2030, given it is a high per capita emitter and has less ambitious plans than other countries.

### Current target

As stated in its [Updated UAE Energy Strategy 2050](#), the UAE aims to reach 9.2 GW in renewable capacity by 2030. By then, the UAE aims to make 32% of its grid carbon-free, which includes renewables and nuclear. It is unknown how the renewable target breaks down into different technologies. The 2030 target represents a more than doubling from 4 GW of renewable capacity in 2022. The 2022 renewable capacity is all solar, which provides 4.5% of total generation.

### The UAE aims to almost double its renewable capacity by 2030.

Current renewable capacity compared to 2030 targets (GW)



Source: Updated UAE Energy Strategy 2050 (Ministry of Energy & Infrastructure, 2023), Renewable capacity statistics (IRENA, 2023)

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### Potential for higher ambition

To meet the 2030 target, the UAE needs to add 0.7 GW of renewable capacity every year until 2030. This is clearly within reach. The UAE added 0.6 GW of solar capacity in 2022, and the [IEA forecasts](#) it will add 2 GW of renewables in 2023.

The UAE has much to contribute to the tripling of renewables, as its per capita CO<sub>2</sub> emissions are four times higher than that of the world (6.7 tCO<sub>2</sub>) and it is the host nation of COP28. However, its current renewable ambition is far less than what it could achieve. Where Saudi Arabia is planning to convert half of total electricity generation to renewables, the UAE is planning to only increase renewables by 27 percentage points from 5% in 2022 to 32% in 2030.

## Conclusion

# Governments must raise their ambition to match pace of renewables growth

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**Many countries are already on track to exceed their national targets for renewable capacity by 2030 and more ambition is entirely achievable.**

While it is true that stated national targets fall short of the tripling needed to get back on track to 1.5C, these targets appear to be out of touch with the new reality of renewables. Country targets lead to a doubling of capacity by 2030, but they are systematically underestimating the speed of the transition that is already occurring.



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The unprecedented increase in solar deployment in 2023 suggests we are in a new era of renewables growth. The sum of collective national targets would be exceeded simply by continuing this year's projected annual deployment every year through to 2030. The changes are happening rapidly, and although some countries set their 2030 targets in 2022 or early 2023, they are already outdated and need revising upwards to reflect recent developments. An increase in targets could signal to investors and the renewable energy industry that the market will grow even larger, encouraging this pipeline to expand even more.

The IEA's recent [World Energy Outlook](#) shows that stated policies and announced pledges move the world even closer to a tripling of renewables and the benchmark of 11,000 GW by 2030. The IEA estimates global renewable capacity of 8,611 GW in 2030 based on stated policies and 9,786 GW on announced pledges, compared to 7,250 GW in this study which focuses on official targets. It highlights that countries are not comprehensively considering all of their own energy-related policies, standards, programs, and projects, nor announced pledges in their target setting.

Closing the gap between the current trajectory based on national targets and the goal of global tripling will require increased ambition on the national level. The first step for governments is setting targets that reflect the pace of change. A continuation of current deployment leads to more than the sum of national 2030 targets, so increased ambition is clearly achievable if governments are willing.

But targets alone cannot achieve the necessary progress to triple renewables unless they are supported by robust policy mechanisms. Last month, IRENA, the Global Renewables Alliance and the COP28 presidency released an authoritative report on the [Pathway to Tripling Renewables and Doubling Energy Efficiency](#), which lays out a thorough analysis of policies needed to enable this transformation. Grid expansion in particular is a major enabler, to get cheap renewable electricity from the areas it is being produced to the areas it is being used. The IEA recently highlighted in their [first ever report on grids](#) that at least 3,000 GW of renewable power projects are waiting in grid connection queues. These, and other issues such as system flexibility, need to be included when planning for increased renewable capacity.

The analysis in this report highlights that if countries took stock of their own policy landscape, current annual renewable deployment, and the renewable capacity that is in the pipeline, a more ambitious and yet achievable set of targets for 2030 could be developed. This could close the gap between where national targets are, where they could be, and what is needed to meet a global tripling goal.

A rapid acceleration of renewables worldwide will not only bring the 1.5C climate goal within reach, but also bring down energy costs, boost energy security, create jobs and reduce health-harming pollution. It's a big goal, but the benefits far outweigh the costs.

## Supporting Material

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### Methodology

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#### Data collection

The underlying dataset for this report is Ember's collection of national ambitions for renewable deployment for the power sector in 57 countries and the EU. In this report, we define national ambition as national targets expressed in terms of cumulative renewable capacity (GW) and/or share of renewables in total generation (%) that the government aims to achieve by 2030. The 2030 renewable energy capacity targets are summed across 57 countries, plus the EU as an individual entity and excluding individual EU countries.

To collect this data, we reviewed government-issued policy documents of the following types: national laws, national strategy or plans, executive orders and policy proposals undergoing legislative process. If there was no target data available in explicit terms in such a document, we used projections provided by the government or third-party studies that simulate power sector development trajectories based on current policies for renewable development or net zero targets.

#### Target categorisation

Targets are categorised into three different types depending on how the targets are identified.

- Explicit targets are identified clearly in official government policy documents.
- Implicit targets are identified based on official projections or credible third-party studies. They are used as a proxy for measuring the country's ambition for renewable deployment.
- Derived targets are Ember's estimation for 2030 based on explicit targets for other years.

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These targets were then assigned a confidence-level of the country's ambition based on the following criteria:

- Has the source document for the target been updated in the last 1–3 years?
- (if the target is implicit) is the source study conducted by a government agency? If the projections are made by a third-party, how reliable is it?

## Countries with no targets

Two countries have no capacity targets (Russia and Austria). 17 countries have no share of generation targets.

## Global estimates for renewable capacity target

The sum of the national targets collected in this report is 6,738 GW. The EU countries' national targets are excluded, using the EU's target as a representation of all the member countries.

Since we have not collected data for every country in the world, not having a data point does not necessarily mean a country has no target. To account for the missing data, we adjusted the aggregate targets for 58 countries and regions against their share of global renewable capacity as of 2022 (93%).

To account for countries without capacity targets (Russia, Austria), we consulted projections provided in the following sources:

- Russia: [the EIA's International Energy Outlook 2023](#)
- Austria: Ember's Pypsa model

## Reporting of solar capacity in alternating and direct current

Historical renewable capacity data is from [IRENA's Renewable Capacity Statistics 2023](#), reported as the operating capacity delivered to the grid in alternating current (AC). Meanwhile, the International Energy Agency's future projections and solar manufacturing capacity are reported in DC (total wattage of the solar panels). Capacity ratings of prospective projects in the GEM's data is usually unknown, as this information is often not specified. It is not clear whether national targets are reported in AC or DC.

Solar capacity reported in DC is about 10 to 30% higher than that reported in AC. However, due to the lack of clarity on the reporting standards and their differences, this analysis used data as reported by the data provider without any conversion.

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## Definitions

- **Bioenergy:** Energy content in solid, liquid and gaseous products derived from biomass feedstocks and biogas. It includes solid bioenergy, liquid biofuels and biogases. Bioenergy as a form of renewables is often [not carbon neutral and has other risks](#).
- **Clean energy:** Clean energy includes electricity generation from wind, solar, hydro, nuclear, biomass and other renewables.
- **Compound annual growth rate (CAGR):** Mean annual growth rate over a specified period of time assuming growth takes place at an exponentially compounded rate.
- **Derived targets:** Targets estimated by Ember for 2030 based on explicit targets for other years.
- **Electricity generation:** The total amount of electricity generated by power only or combined heat and power plants including generation required for own use.
- **Explicit targets:** Targets that are identified clearly in national strategy or plans, executive orders, legal texts, and policy proposals nearing approval.
- **IEA Net Zero Emissions by 2050 Scenario (NZE Scenario):** A normative scenario put forward by the IEA that shows a pathway for the global energy sector to achieve net zero CO<sub>2</sub> emissions by 2050. It is consistent with limiting the global temperature rise to 1.5 degrees Celsius.
- **Implicit targets:** Targets that are sourced from official projections or credible third-party studies based on current renewable support policies and net zero targets. Although implicit targets are not legislative or legal targets, they act as a proxy for current ambition for renewables in the absence of an explicit target.
- **Renewable capacity:** Renewable power generation capacity is measured as the maximum net generating capacity of power plants and other installations that use renewable energy sources to produce electricity. Includes solar photovoltaics, solar thermal, offshore and onshore wind, large hydro, small hydro, bioenergy, and other renewables (ie. geothermal). Usually measured as a kilowatt, megawatt, or gigawatt.
- **Renewable capacity factor:** How much energy is produced by a renewable generation source compared to its maximum theoretical output, which varies across technologies.
- **1.5C:** Limiting warming to 1.5 degrees Celsius implies reaching net zero CO<sub>2</sub> emissions globally around 2050 and concurrent deep reductions in emissions of non-CO<sub>2</sub> forcers, particularly methane.

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# Acknowledgements

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## Cover Image

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