CLIMATE ANALYTICS

Tripling renewables by 2030

Interpreting the global goal at the regional level

February 2024

AUTHORS

Neil Grant, Tina Aboumahboub, Lara Welder, Claire Fyson

ABOUT CLIMATE ANALYTICS

Climate Analytics is a global climate science and policy institute. Our mission is to deliver cutting-edge science, analysis and support to accelerate climate action and keep warming below 1.5°C.

How to cite: Climate Analytics (2024). Tripling renewables by 2030: Interpreting the global goal at the regional level.

Summary

At COP28, governments agreed to triple global renewable capacity by 2030. This, alongside doubling energy efficiency, is possibly the most powerful action the world can take in the transition away from fossil fuels this critical decade.

To guide efforts towards the goal, governments need a clear roadmap and information on investment and climate finance needs, while civil society needs benchmarks to hold governments to account.

In this report, we break down what a 1.5°C-aligned renewables rollout would look like at the regional level and calculate the associated investment needs.

In keeping with the tripling target and the Paris Agreement's temperature goal, global renewable capacity needs to grow to 11.5 TW by 2030 – up 3.4x from 2022 levels. To achieve this, different regions scale at different rates relative to their current renewable capacity, driven by the pace of fossil phase-out needed and future electricity demand growth.

We find:

- **Asia makes the biggest overall contribution, providing around half (47%) of the 8.1 TW of renewable capacity additions needed globally by 2030.**

  This represents a 3.6x regional growth rate relative to 2022 levels.

  Asia is the only region which is broadly on track to triple renewables in line with 1.5°C by 2030. This is primarily driven by growth in China and India which compensates for laggards like South Korea, where renewable capacity is set to grow at half the rate of the region as a whole.

  However, the spree of coal-fired power plant construction in China and India is a huge concern. If this continues, it will either jeopardise a 1.5°C-aligned power sector transition, or create large-scale stranded assets.

- **The OECD provides the next biggest share of global capacity additions at around a third (36%).**

Renewables in the region scale at a slower rate of 3.1x due to lower electricity demand growth and a higher level of existing renewable capacity installed in 2022.

Based on current policies, the OECD will fall around a third short of this target. Addressing this shortfall would close around 60% of the 2 TW global gap between forecast renewable growth and a 1.5°C-aligned tripling. There is particularly slow growth in Japan, where capacity will grow only 50% over the decade.

- **Sub-Saharan Africa scales relatively quickly at 6.6x due to low levels of existing renewable capacity and high energy access needs**.

  Electricity demand is forecast to grow 66% per capita between 2020-2030 in the region, resulting in a renewables scale up rate that is double the global average. Achieving such a rapid renewables rollout in Sub-Saharan Africa would require significantly upscaled international climate finance.

$12 trillion needed to triple renewables in line with 1.5°C

Overall, tripling renewables in line with the 1.5°C temperature limit would require $12 trillion of investment in the power system up until 2030 – an average of $2 trillion per year starting in 2024.

Two-thirds ($8 trillion) would be invested in the installation of renewables, while around a third ($4 trillion) would be for the grid and storage infrastructure needed to support renewables. Without modernised, flexible and expanded grids, there can be no tripling.

Investment in renewables and grid expansion needs to be massively upscaled to ensure a 1.5ºC aligned transition in the power sector. In 2023, global investment reached $1 trillion, around half of annual investment needed on average between 2024-2030.

Over 2024-2030, the world is on track to invest $6.6 trillion in renewables and grids, leaving an investment shortfall of just over $5 trillion. However, the world is also set to invest over $6 trillion in fossil fuels under current policies. Shifting this money to renewables and grids could cover the investment gap entirely and put the power sector on track for 1.5ºC.

Some regions are at risk of falling behind in the effort to triple renewables due to a chronic lack of investment and international support.

This is particularly the case in Sub-Saharan Africa, where annual investment in renewables and grid expansion was around $20 billion in 2023 – just a fifth of the ~$100 billion needed each year between 2024-2030.

Without an urgent and rapid increase in finance to support renewables deployment in Africa, millions will miss out on the benefits of the renewables revolution – cleaner air, cheaper power, and increased energy security.

As governments come together to negotiate a new climate finance goal for the post-2025 period, much more needs to be done to mobilise investment in renewables and grid expansion in less wealthy countries. Without this, the pledge to triple renewables made at COP28 will ring increasingly hollow.

While scaling up renewables is key, emissions will only fall if they displace fossil fuels in the power system. As well as investing in renewables, governments must take action to end public support and subsidises for fossil fuels. COP28 fired the starting gun on a global race to triple renewables by 2030. This report sets out a roadmap at the regional level to guide the way.

Table of Contents

Summary

Introduction 1

Methods 2

The global picture 4

A breakdown of the global goal 7

Regional renewables benchmarks 7

What about after 2030? 9

Are we on track to triple renewable capacity by 2030? 10

Investments needed for the renewables revolution 15

Global investments in grids and renewables 15

A regional breakdown of investments in renewables and grids 17

Conclusions 22

References 24

Annex 26

Historical capacity and investment estimates 26

Estimating renewables deployment under current policies / current targets 26

Calculating investment requirements 27

Investment in wind and solar 27

Investments in other renewables and nuclear 28

Investments in grids and storage 28

Introduction

At COP28 in Dubai, countries committed collectively to 'tripling renewable energy capacity globally and doubling the global average rate of energy efficiency improvements by 2030'. This is crucial, because renewables and energy efficiency are the most effective levers for slashing emissions over this critical decade. Together, they lay the foundations for the rapid, orderly phase out of fossil fuels urgently needed to keep the 1.5ºC warming limit in reach.

The agreement to triple renewable capacity represents a political commitment for action on renewables. As COP28 set 1.5ºC as the benchmark for action, it needs to then be compared to the best available science on 1.5ºC compatibility and translated into concrete quantitative benchmarks.

The science shows that we need to *at least* triple renewable capacity by 2030 in order to align with 1.5ºC pathways. Over the last year, a range of global pathways, including the International Energy Agency's (IEA) net zero scenario, the International Renewable Energy Agency's (IRENA) 1.5ºC compatible pathway and analysis of the Intergovernmental Panel on Climate Change's (IPCC) 1.5ºC compatible pathways have shown that renewable capacity needs to reach at least 11 TW by 2030 (IEA 2023c, IRENA 2023c, Climate Analytics 2023).

However, as the renewables goal is global, what individual countries and regions need to do as part of the collective effort remains unclear. Providing clarity on this is essential, both for **accountability** and **means of implementation.**

A regional/national breakdown of renewables deployment can help civil society hold governments to account for their share of the effort to triple renewables. It can also help identify where the need for support is greatest, ensuring that low-income countries are not left behind in the global race towards a renewable economy.

National and regional roadmaps are urgently needed to translate this global target to the pace and scale of progress needed on the ground.

This report provides a regional breakdown of 1.5ºC compatible renewables deployment, showing what six major world regions – the OECD, Asia, Latin America, Eurasia, Sub-Saharan Africa and the Middle East and North Africa (MENA) – could contribute towards upscaling renewables by 2030. It compares these benchmarks to the latest IEA renewable forecasts to identify the gaps that need to be closed.

Finally, it provides an estimate of the investments in renewables and grid expansion that drives the power sector transition out to 2030 and identifies where additional finance is needed to support the transition.

Methods

In this report, we use a set of 1.5ºC compatible pathways from the IPCC's Sixth Assessment Report (AR6) (Byers *et al* 2022). These provide some of the latest evidence on the system transformation needed to limit warming to 1.5ºC. Importantly, unlike the IEA and IRENA scenarios, they also provide a regional breakdown of results.

Not all pathways included in the IPCC's AR6 database are compatible with the Paris Agreement's call to achieve net zero greenhouse gas (GHG) emissions in the second half of the century, and some rely on unsustainable levels of carbon dioxide removal (CDR) (Climate Analytics 2023). We therefore focus our analysis on a subset of 24 1.5ºC compatible pathways which are both consistent with the Paris Agreement and avoid unsustainable levels of CDR deployment. For more details see Climate Analytics (2023).

These 24 pathways provide data on 1.5ºC compatible renewable capacity deployment at the level of ten major 'macro-regions' or geographical grouping of countries with common characteristics.[1]

We aggregate this together to provide data on renewables deployment in six major world regions: the OECD, Asia, Latin America and the Caribbean, Eurasia, the Middle East and North Africa (MENA), and Sub-Saharan Africa. This regional breakdown is shown in Figure 1.[2]

[1] These are North America, Latin America, Europe, Eurasia, China, India, Other Asia, Pacific OECD, Middle East and North Africa and Sub-Saharan Africa.
[2] The OECD region is not an exact mapping to OECD member states, as some OECD countries are included in other regions in the models. In particular, Mexico, Colombia, Chile and Costa Rica are included in the Latin America and Caribbean macro-region, and South Korea is included in the Asia macro-region. These countries represented 7% of the OECD's renewable capacity as of 2022.

Regional breakdown used in the analysis

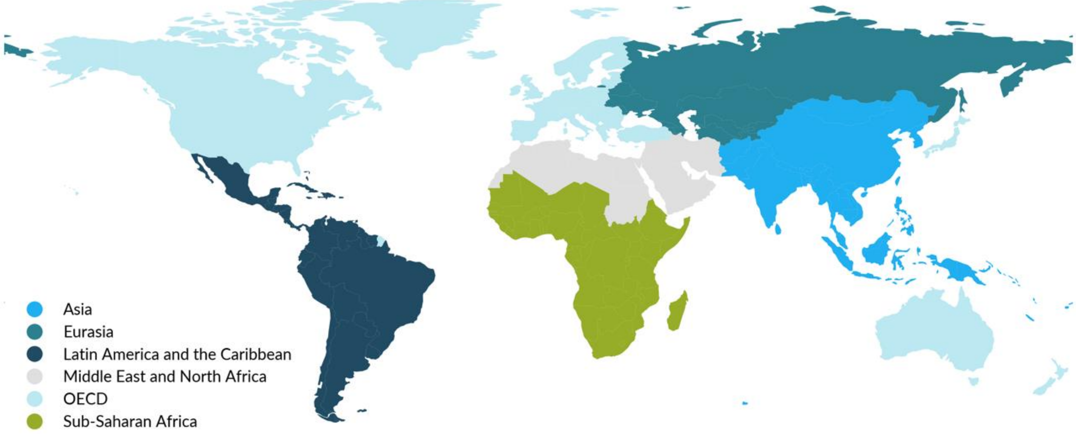

Figure 1: This report splits the world into six major world regions: the OECD, Asia, Latin America and the Caribbean, Eurasia, the Middle East and North Africa (MENA), and Sub-Saharan Africa.

Each pathway has a specific renewables capacity deployment trajectory for each region that aligns with 1.5ºC. This provides a diversity of perspectives on the energy transition in each region.

In this report, we calculate the median renewables deployment in each region across all 24 pathways. We use this as the 1.5ºC compatible benchmark for renewables deployment at the regional level, which we then compare with projected capacity additions based on current policies and targets (see Annex for more details).

We estimate the investment requirements for the transition using a mix of top-down and bottom-up approaches, which bring together multiple lines of evidence (see Annex for more information). These investment estimates incorporate projected cost declines that will occur as renewables deployment ramps up (NewClimate Institute and Climate Analytics 2023), as well as the cost of deploying the grids and storage infrastructure required to support renewables deployment.

Importantly, these 1.5ºC compatible pathways also assume strong progress is made on energy efficiency improvements. This is essential, as tripling renewable capacity without controlling energy demand could lead to large, wasteful energy system in which large amounts of renewables exist *alongside* large amounts of fossil fuel demand. It is the combination of tripling renewables and doubling energy efficiency that will lead to a fossil fuel phase-out.

The rest of this report focuses on a regional breakdown of the renewables rollout, which occurs alongside strong energy efficiency improvements in the pathways. Without this, the pace of renewables deployment would need to be even higher to ensure fossil fuels are displaced from the energy system.

The global picture

Renewable capacity needs to more than triple by 2030 to limit warming to 1.5ºC. In the median of the 24 selected pathways, total renewable capacity reaches 11.5 TW in 2030 (Figure 2). This requires another 8.1 TW of renewable capacity to be added between 2022 and 2030.

COP28 did not explicitly define the base year against which a tripling would be measured. Establishing a base year is essential to ensuring a shared understanding of the pace of change needed. 2022 is the most appropriate choice, for the following reasons:

- Both the IEA and IRENA used 2022 as the base year when concluding that renewable capacity needs to triple by 2030 to over 11 TW.
- 2022 was the latest year for which capacity data was available during the COP28 negotiations.
- In some drafts of the COP28 decision text, 2022 was referenced as the base year, even if this was not eventually included in the final outcome.

Estimates of renewable capacity in 2022 vary between 3.4 TW (IRENA 2023a) and 3.6 TW (IEA 2023c). According to our analysis, renewable capacity would need to increase between 3.2 and 3.4 times from 2022–2030 to be 1.5°C compatible. It is therefore important to recognise that while the political goal of tripling can help drive ambition, it is a floor, not a ceiling. We will need to do more than triple capacity by the end of the decade to align with the Paris Agreement.

These IPCC-assessed pathways suggest that the tripling goal should be interpreted as increasing renewable capacity 3.2–3.4 times relative to 2022 levels (depending on which capacity data is used in 2022), to reach 11.5 TW by 2030. This, alongside doubling energy efficiency improvements, would push down fossil fuel demand and help accelerate a fossil phase-out. Simultaneously, governments need to adapt power markets and incentive structures to enable a fast and efficient phase-out of fossil fuels.

Our capacity benchmark is slightly higher than the values provided by the IEA (11 TW) and IRENA (11.2 TW). The differences with the IEA can largely be explained by reduced reliance on nuclear and biomass in these scenarios, and the faster power sector decarbonisation required by the IPCC's 1.5ºC compatible scenarios (Climate Analytics 2023). The differences with IRENA are slightly smaller but could arise from similar factors.

Achieving 11.5 TW of installed renewable capacity by 2030 is within reach but will require accelerated efforts. In 2023, just over 500 GW of renewable capacity was installed – up 50% on 2022 installations (IEA 2024). Under current forecasts from the IEA, renewable capacity is set to grow around 2.5-fold by 2030, reaching around 9 TW of capacity.[3]

Renewable capacity needs to more than triple by 2030 to limit warming to 1.5°C

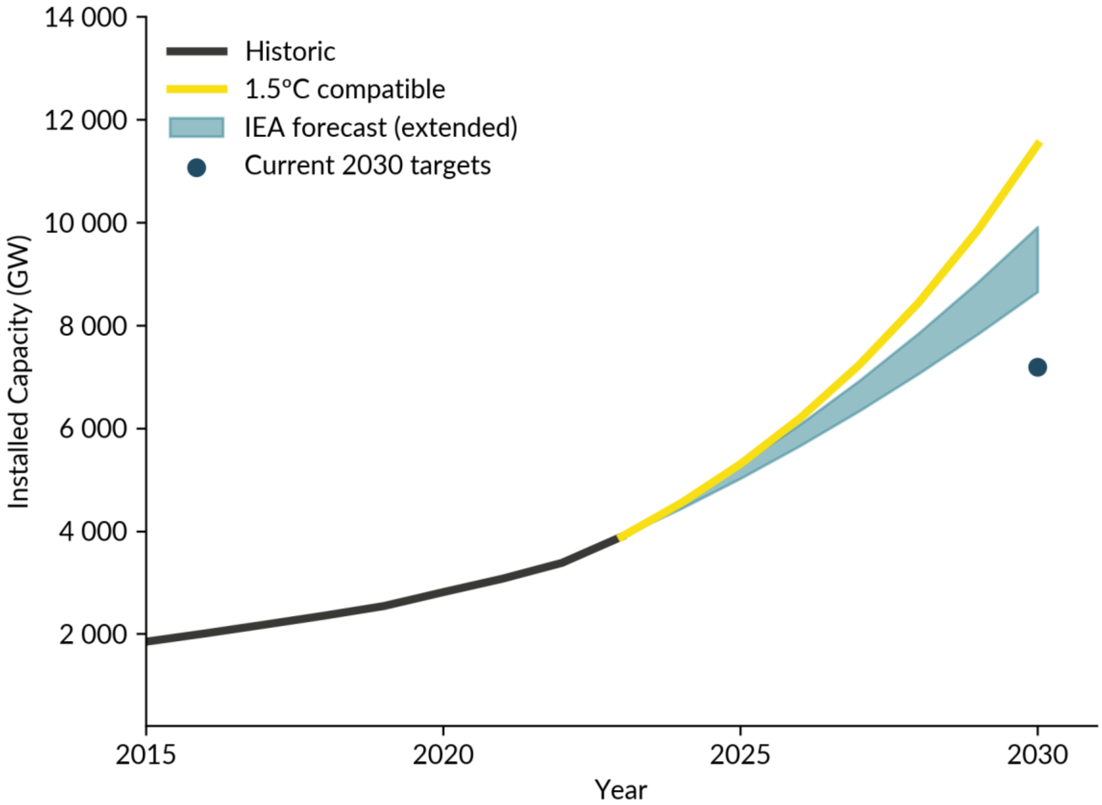

Figure 2: This figure shows how fast renewable capacity needs to scale for 1.5ºC, compared to the capacity forecast under current policies and market conditions, and the capacity that would be reached under current 2030 targets. Historical data is provided from IRENA (IRENA 2023a). The capacity forecasts are taken from the IEA, which provides data out to 2028 on renewable capacity additions (IEA 2024), which we extend to 2030. Estimates of the capacity installed under current renewable targets is taken from analysis by Ember (Ember 2023).

There is a gap of 2.2 TW between current forecasts and the 1.5ºC compatible benchmark. However, as the pace of renewable deployment continues to accelerate, this gap could quite feasibly be closed by 2030. This would require renewables to grow 70% faster over 2022–2030 than they did over the last eight years.

[3] The IEA provides forecasts for renewable capacity out to 2028 under a 'main' and 'accelerated' case. We extend these to 2030, assuming that renewable capacity additions will grow linearly from 2028–2030 along the 2023–2028 trendline. See the Annex for more details.

This would achieve a key Paris-compatible milestone and be one of the most important actions for keeping 1.5ºC within reach. To at least triple renewables would require an acceleration beyond current targets, which correspond to a doubling of global capacity to 7.3 TW in 2030 – far off being 1.5ºC compatible (Ember 2023).

These targets do not account for the acceleration in renewable deployment that has occurred in recent years and are below the levels that the IEA thinks could be achieved even with current policies and market trends. Governments should provide new targets which push for even greater ambition aligned with the 1.5°C warming limit, include them as part of their next Nationally Determined Contributions (NDCs), and advance the policies and finance needed to achieve them.

To align with 1.5ºC, renewable installation rates need to reach above 1500 GW/yr by 2030 (Figure 3).

Renewable capacity additions need to reach over 1500 GW per year by 2030

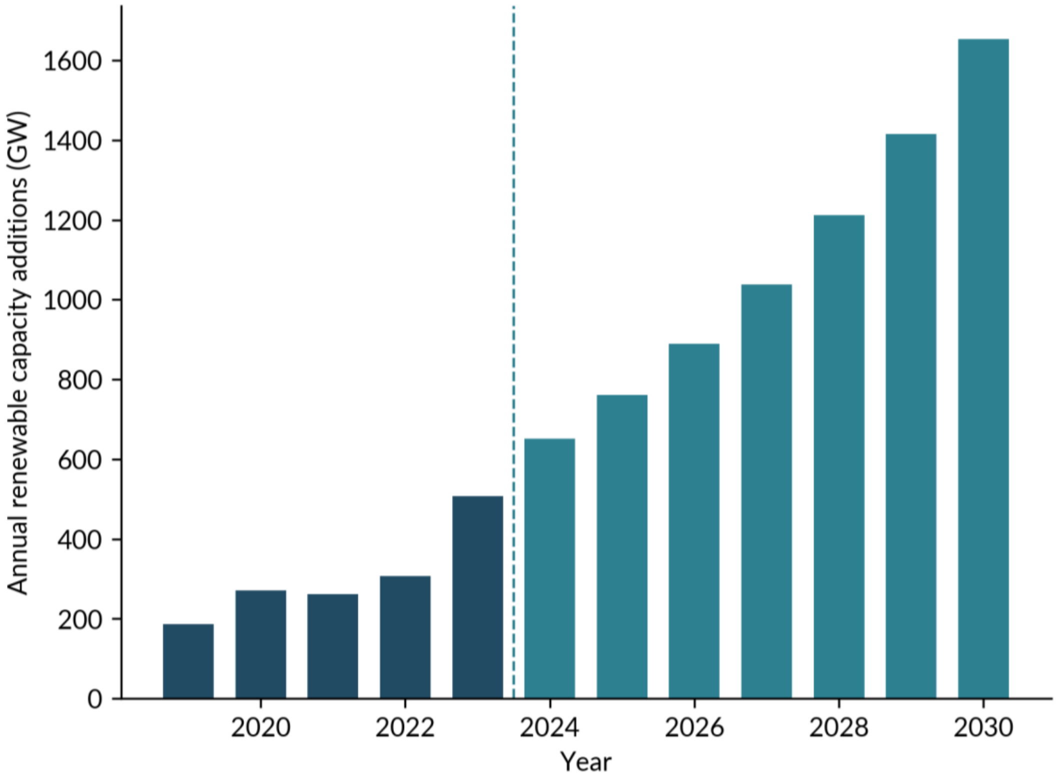

Figure 3: This figure shows the renewable capacity additions needed for 1.5ºC compared to historical capacity additions.

Wind and solar are key to achieving this growth, as they represent over 90% of the capacity that needs to be added over the decade in sustainable, 1.5°C compatible pathways. In such scenarios, wind and solar capacity grows closer to five-fold by 2030, towards 10 TW of installed capacity in 2030.

A breakdown of the global goal

Regional renewables benchmarks

The shape of the global energy transition is clear – turbocharged renewables deployment (particularly wind and solar) displacing fossil fuels in the energy system this decade.

A regional breakdown of 1.5ºC compatible renewables deployment

	Renewable capacity in 2030 (GW)	Capacity additions needed over 2023–2030 (GW)	Renewable capacity in 2030 (relative to 2022)	Renewable capacity growth from 2014–2022
Sub-Saharan Africa	300	260	x 6.6	x 1.9
Middle East and North Africa	500	460	x 11.8	x 1.8
Latin America	730	420	x 2.3	x 1.6
Eurasia	340	240	x 3.6	x 1.2
Asia	5350	3850	x 3.6	x 2.7
OECD	4290	2910	x 3.1	x 1.7
World[4]	***11510***	***8130***	***x 3.4***	***x 2.0***

Table 1: This table shows the regional renewables deployment required by 2030 in 1.5ºC compatible pathways. By 2030, 11.5 TW of renewable capacity needs to be installed.

[4] We calculate global renewable capacity as the sum of the median 1.5ºC compatible capacity in each region. This differs very slightly from the capacity calculated by taking the global data directly and calculating a median (which would give renewable capacity of 11,470 GW in 2030).

But it is important to understand how renewable capacity should be distributed across the world’s regions so that we can better track progress against this global goal and identify where investments need to flow.

Table 1 shows how global renewables deployment is broken down across the six regions investigated. In 1.5°C aligned pathways, most of the renewable capacity installed this decade is in Asia and the OECD; these two regions are responsible for over 80% of the capacity additions out to 2030 (6.8 TW of the 8.1 TW required). But the largest relative scale-ups take place in Africa and the Middle East.

Renewable capacity additions are driven by two main factors. First, renewables are needed to push fossil fuels out of the power sector and clean up electricity. The OECD and Asia have the largest existing fossil fleets, representing 35% and 46% of global fossil fuel capacity in 2022 respectively. This is perhaps unsurprisingly almost exactly the same as the share of global renewable capacity additions that each region represents in this analysis (36% and 47% respectively). Accordingly, both regions see higher levels of investment in renewables as a result of the large amounts of fossil fuels they need to displace.

The OECD has to phase out fossil fuels fastest, phasing out coal by 2030 and fossil gas by 2035 (Climate Action Tracker 2023). This requires displacing 4500 TWh of fossil-based generation in the OECD between 2020 and 2030 with a combination of renewables, storage, energy efficiency and other demand management measures.

Secondly, renewables are needed to meet electricity demand growth caused by population and/or GDP growth as well as the structural increases in demand due to the electrification of end-use sectors. Here the greatest absolute increase in demand occurs in Asia, further driving high renewables deployment and investments.

As Asia has the largest demand growth and the second largest level of fossil fuel retirements needed by 2030, it sees the largest overall capacity additions. Of the 8.1 TW installed over the decade, almost half is installed in Asia. The OECD has the second largest level of total additions, with 36% of all renewable capacity additions over the decade, due to the particularly rapid phase-out of fossil fuels needed by 2030.

In other regions, there is either less fossil fuel generation that needs to be displaced or lower levels of absolute demand growth, which together lead to lower overall levels of capacity installations. For example, Sub-Saharan Africa has the greatest level of electricity demand growth in relative terms, with demand doubling over the decade. However, as the region represented only <2% of global electricity demand in 2021, even doubling demand does not lead to a very large absolute increase in generation (an additional 650 TWh), and hence renewable capacity installations are lower. The region also has very limited fossil fuel capacity (~60 GW) in need of retirement by 2040 (Climate Action Tracker 2023).

When we look at the growth needed in relative, rather than absolute terms, then the picture is different. Here regions with relatively higher existing renewables capacity as of 2022 (Latin America and the OECD), scale up renewable capacity slower than the global average.

Meanwhile regions with low existing renewables capacity (MENA and Sub-Saharan Africa) see scale-up rates above the global average. The highest relative scale-up rates are seen in MENA (twelve-fold) and Sub-Saharan Africa (seven-fold). This would require international investment and support, with Sub-Saharan Africa in particular urgently needing finance for a renewable-driven transition.

While the existing renewables capacity in Asia is relatively large (45% of the global total in 2022), the very strong additions needed out to 2030 to both displace coal and fossil gas from the power system and meet electricity demand increases mean that the region still scales at above the global average, with renewable capacity growing 3.7-fold by 2030.

The renewables benchmark provided for Sub-Saharan Africa is compatible with universal electricity access on the continent. Even greater capacity additions could enable countries in Sub-Saharan Africa to capitalise on the region's potential to develop green industry. It is clear that barriers to financing renewables in Africa need to be overcome. If Africa were to miss out on the renewables revolution, not only would this negatively impact energy access and economic development, it would lead to increased dependency on fossil fuels. Both outcomes can and should be avoided.

Over the eight years leading up to 2022, the world managed to double its renewable capacity from around 1.7 TW to 3.4 TW, with particularly rapid growth seen in Asia. While all other regions achieved more or less a doubling during this time, it is important to note that some were starting from a much smaller base (e.g. MENA and Sub-Saharan Africa), explaining the need for a much stronger scale-up in the future. To achieve the 3.4-fold growth required globally from 2022 to 2030, deployment needs to be accelerated in all regions.

What about after 2030?

The 2020s are the critical decade for limiting warming to 1.5ºC. However, the need for action will not stop in 2030. Renewables deployment will continue to accelerate into the 2030s, on the road to clean electricity by 2040 and net zero CO_2 emissions by 2050.

This report focuses on 2030 as a key milestone. However, as countries begin to develop 2035 targets in the next round of NDCs, the focus is beginning to shift to 2035. To limit warming to 1.5°C, global renewable capacity must reach around 17.5 TW by 2035 – up five-fold from 2022 levels. Tripling is just the beginning.

Table 2 shows how this capacity brakes down across regions. While this report focuses on the tripling by 2030 target, this table aims to inform the ambition of 2035 NDCs and longer-term renewables targets at the national and regional level.

Renewable capacity needed by 2035 to limit warming to 1.5°C

	Renewable capacity in 2035 (GW)	Capacity additions needed over 2023-2035 (GW)	Renewable capacity in 2035 (relative to 2022)
Sub-Saharan Africa	600	550	x 13.0
Middle East and North Africa	1020	970	x 23.9
Latin America	1030	720	x 3.3
Eurasia	610	510	x 6.4
Asia	8200	6700	x 5.5
OECD	6020	4640	x 4.4
World	***17470***	***14090***	***x 5.2***

Table 2: This table shows the regional renewables deployment required by 2035 in 1.5°C compatible pathways. By 2035, 17.5 TW of renewable capacity needs to be installed.

Are we on track to triple renewable capacity by 2030?

Figure 4 shows how much renewable capacity is required at a regional level to limit warming to 1.5°C and compares this with the renewable capacity that could be expected by 2030 based on IEA forecasts. To compare with the targets that governments have put in place, we also indicate the aggregate impact of current renewable targets in a region. Due to data constraints, this is only currently possible for the OECD, Asia and Latin America.[5]

Despite accelerating growth in renewables across the world, Asia is the only region that could be considered on track to triple renewables in line with 1.5ºC. Where we have sufficient information on renewables targets, it is clear that these fall far below 1.5ºC compatibility. In Asia, renewable capacity could reach 5-5.7 TW by 2030 under current policies and measures, which at the upper end would align with 1.5ºC.

This is largely driven by the rate of renewables deployment in China and India, where forecasts show particularly strong growth in renewables under current policies. In China, renewables are on track to grow 3.5–3.9 fold from 2022-2030, while in India they are forecast to grow 2.9-3.5 fold.

In the rest of Asia, growth rates are generally lower, with renewable capacity set to grow 2.5-3.1 fold by 2030 relative to 2022 levels. This would not be sufficient to align with 1.5ºC. However, as India and China represent 90% of total renewable capacity in the region, their strong growth rates dominate and pull the whole region up towards the 1.5ºC compatible benchmark.

While Asia has the strongest renewables growth rates out of the regions, it also has the largest pipeline for fossil fuel power plants. Almost half of the global gas-fired power plant pipeline is in Asia, along with almost 90% of the global coal-fired pipeline (Global Energy Monitor 2022, 2023). This vast building spree of fossil fuel infrastructure is in direct tension with the global commitment to triple renewables.

Continuing to invest in fossil fuels in the context of such a rapid scale up of more affordable and secure renewable power risks slowing the energy transition and the associated climate impacts, or large-scale asset stranding. With Asia's forecast strong growth in renewables capacity, new fossil fuel plants are not needed to meet electricity demand growth and should be avoided.

[5] This is defined as where the countries with target data gathered represent over 80% of the regional renewable capacity in 2022. In the case of Sub-Saharan Africa, MENA and Eurasia, the data gathered does not yet have sufficient regional coverage to allow us to calculate an overall capacity target for the region. This could be updated as more countries are added to the Ember Renewable Target Tracker (Ember 2023). See Annex for more details.

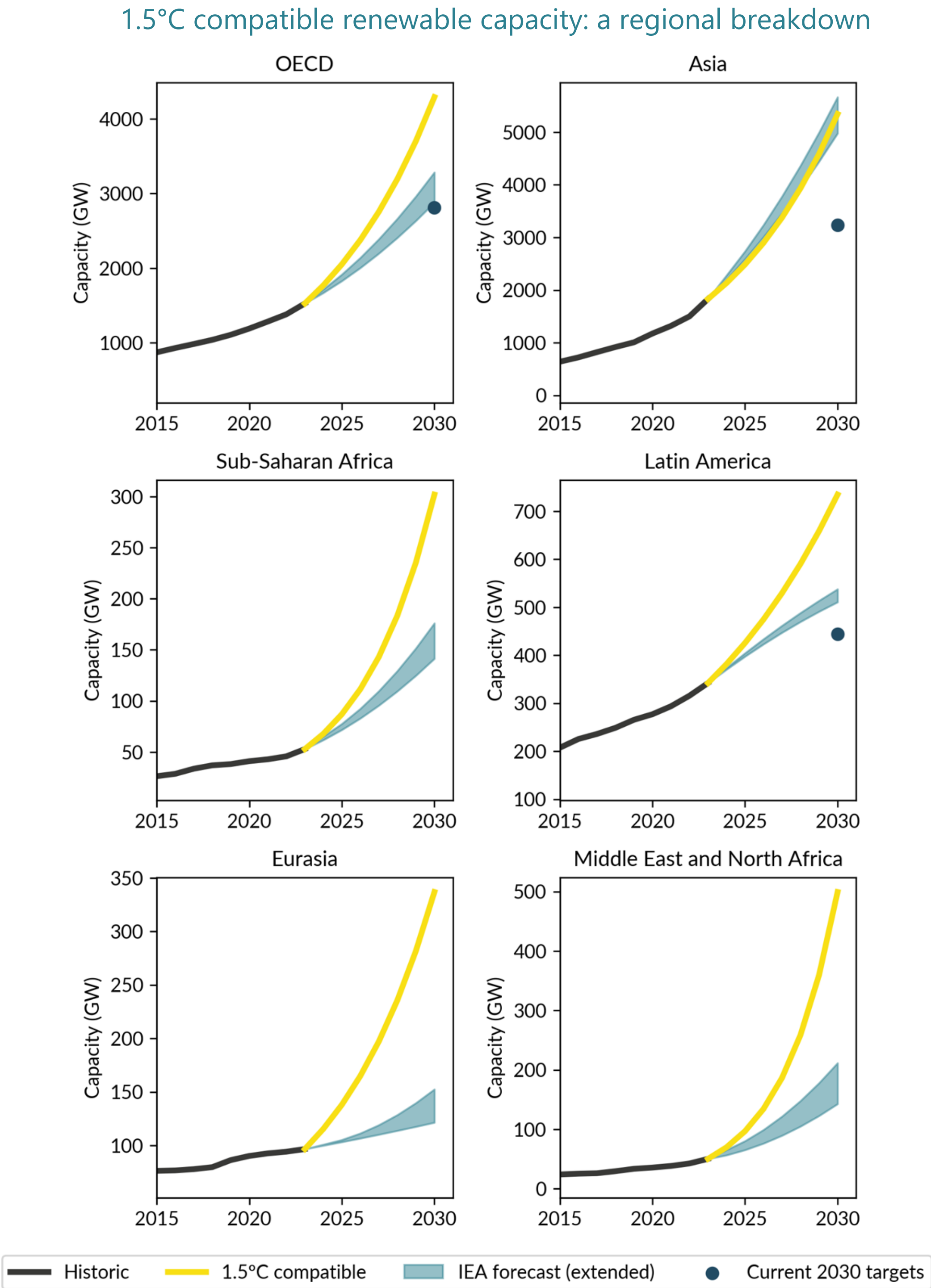

Figure 4: This figure shows how fast renewable capacity needs to scale for 1.5°C at the regional level, compared to the capacity forecast under current policies and market conditions, and the capacity that would be reached under current 2030 targets. Historical data is provided from IRENA (IRENA 2023a). The capacity forecasts are taken from the IEA, which provides data out to 2028 on renewable capacity additions (IEA 2024), which we extend to 2030. Estimates of the capacity installed under current renewable targets is taken from analysis by Ember (Ember 2023).

The largest relative gap between current trends and benchmarks is seen in MENA, but the absolute gap in the region is relatively small at 100–300 GW. The majority of the global capacity gap that needs to be closed by 2030 is found in the OECD, which is currently lagging behind the 1.5ºC compatible benchmark by around 1-1.4 TW.

Breakdown of the global capacity gap in renewables for 2030

	1.5°C compatible benchmark in 2030 (GW)	Capacity in 2030 based on current trends (GW)	Capacity gap (GW)
Sub-Saharan Africa	300	140–180	130–160
Middle East and North Africa	500	140–210	290–360
Latin America	730	510–530	200–220
Eurasia	340	120–150	180–220
Asia	5350	4980–5670	-320–370
OECD	4290	2880–3280	1010–1410
World	***11510***	***8650–9910***	**1600–2900**

Table 3: This table shows the gap between current forecasts and 1.5°C aligned capacity by 2030. This is 1600-2900 GW in 2030. Over half of the global gap could be closed through 1.5-aligned action in the OECD alone.

Globally, the gap between current forecasts and 1.5°C aligned capacity by 2030 is 1.6-2.9 TW in 2030 (central estimate ~2.2 TW); 50–63% of the global gap could be closed through 1.5-aligned action in the OECD alone (Table 3).

The benchmarks provided here are regional benchmarks – with work ongoing to provide national-level renewables capacity benchmarks (NewClimate Institute and Climate Analytics 2023). However, the current forecast growth in a region is a function of the policy ambition and market conditions in each of the underlying countries. These vary strongly within a region. Table 4 shows how the growth in renewables forecast for the region as a whole is broken down into the action of key underlying countries.

There are often clear 'laggards' and 'leaders' in the race to scale up renewables. In the case of the OECD, while no country is on track to triple renewable capacity relative to 2022 levels, the USA is leading the race as the Inflation Reduction Act takes effect. Meanwhile Japan is lagging behind, with renewable capacity set only to grow 50% over 2022-2030.

Forecast renewables growth under current policies compared to 1.5°C compatible benchmarks

	1.5°C growth needed over 2022-2030	**Growth forecast over 2022-2030 under current policies and market conditions**				
Sub-Saharan Africa	**x 6.6** (+260 GW)	**Regional average** x 3.5 (+110 GW)	**South Africa** x 6.4 (+55GW)	**Nigeria** x 6.2 (+12GW)	**Kenya** x 2.7 (+4.5GW)	**Ethiopia** x 2.4 (+7.9GW)
Middle East and North Africa	**x 11.8** (+460 GW)	**Regional average** x 4.2 (+130 GW)	**Saudi Arabia** x 92[6] (+40GW)	**UAE** x 7.5 (+23GW)	**Israel** x 3.6 (+12GW)	**Morocco** x 2.5 (+5.4GW)
Latin America	**x 2.3** (+420 GW)	**Regional average** x 1.7 (+210 GW)	**Chile** x 2.8 (+34GW)	**Brazil** x 1.8 (+140GW)	**Mexico** x 1.5 (+17GW)	**Argentina** x 1.5 (+7.8GW)
Eurasia	**x 3.6** (+240 GW)	**Regional average** x 1.5 (+43 GW)	**Ukraine** x 1.5 (+8GW)	**Russia** x 1.3 (+15GW)	***Lack of data for remaining countries in region***	
Asia	**x 3.6** (+3850 GW)	**Regional average** x 3.6 (+3820 GW)	**China** x 3.7 (+3100GW)	**India** x 3.4 (+390GW)	**Viet Nam** x 2.2 (+54GW)	**South Korea** x 1.8 (+24GW)
OECD	**x 3.1** (+2910 GW)	**Regional average** x 2.2 (+1700 GW)	**USA** x 2.6 (+570GW)	**EU27** x 2.2 (+700GW)	**Australia** x 2.2 (+58GW)	**Japan** x 1.5 (+65GW)

Table 4: This table compares the renewables scale-up needed for 1.5°C (provided in the first column) with the current forecast scale-up of renewables at a regional and country level. All scaling-up factors are given relative to 2022 levels. Renewable capacity growth forecasts are provided by the IEA (IEA 2024). The average scale up between the 'main' and 'accelerated' forecasts is shown here.

Similarly in Asia, while India and China are surging ahead in renewables deployment, much of the rest of the region is growing more slowly. Saudi Arabia's growth rate seems impressive – but in 2022, renewable capacity in Saudi Arabia was less than 1 GW. Growing to 41 GW by 2030 is to be welcomed, but still represents a very small amount of installed capacity.

[6] Saudi Arabia's very high relative growth rate is because it is starting from a very low base. In 2022 it had installed less than 1 GW of renewable capacity. While the absolute growth of 40 GW is still the largest in the region, total renewable capacity in 2030 remains very low at 41 GW.

In Latin America, Chile is leading the way, with renewable capacity set to almost triple over 2022-2030. However, other countries in the region are currently forecast to less than double renewable capacity over the decade and need to upscale policy support and implementation to accelerate renewables deployment.

Despite positive signals and the agreement at COP28 to triple renewable capacity, it is clear that many countries would need to do far more to play their part in achieving the global goal. There is a real risk that countries hide behind a global goal and rely on others to do the heavy lifting in the race to renewables. Developing the monitoring and tracking frameworks to hold countries accountable to their commitments will be essential in delivering this pledge.

In some cases (the OECD), the effort required to align with 1.5ºC can and should be provided by internal resources. However, in other cases (Africa and parts of Asia), there will need to be international support to ensure that countries with lower capacity to transition are still able to benefit from the renewables revolution. This should include financial support to drive renewables deployment. The next section provides an estimate of the investment needs required to support the transition in each region.

Investments needed for the renewables revolution

Global investments in grids and renewables

Installing an additional 8 TW of renewables over 2023-2030 to take capacity to 11.5 TW in 2030 is achievable and would be the single biggest step that the world could take to align with 1.5ºC. Central to this is upscaling investment in renewables, and crucially, in the grid infrastructure required to accommodate renewables.

In the median 1.5ºC compatible pathway assessed here, $15.5 trillion[7] is invested in renewables deployment and grid expansion between 2020 and 2030. So far this decade (2020-23), $3.6 trillion has been invested globally in renewables, grids and storage.

This means that around $12 trillion of investment is still needed between 2024–2030, or roughly $2 trillion per year.

[7] All currency data is reported in 2022 US dollars

In comparison, in 2023 investment into renewables and grids reached around $1 trillion (IEA 2023b). While this is up 30% from 2020 levels, it's only half the estimated average annual amount required over the period 2024-2030 (Figure 5).

Currently, the world is forecast to invest around $6.6 trillion in renewables and grids over the rest of the decade, falling short of the investment needed by around $5 trillion (IEA 2023b). However, the world is also forecast to invest around $6 trillion in fossil fuels under current policies, the vast majority of this into extracting new fossil fuels – which is incompatible with 1.5ºC (IEA 2023c). **Shifting this investment to renewables and grids could fully close the investment gap and put the sector on a 1.5ºC aligned transition.**

Historical investment into clean electricity compared with 1.5°C compatible investments

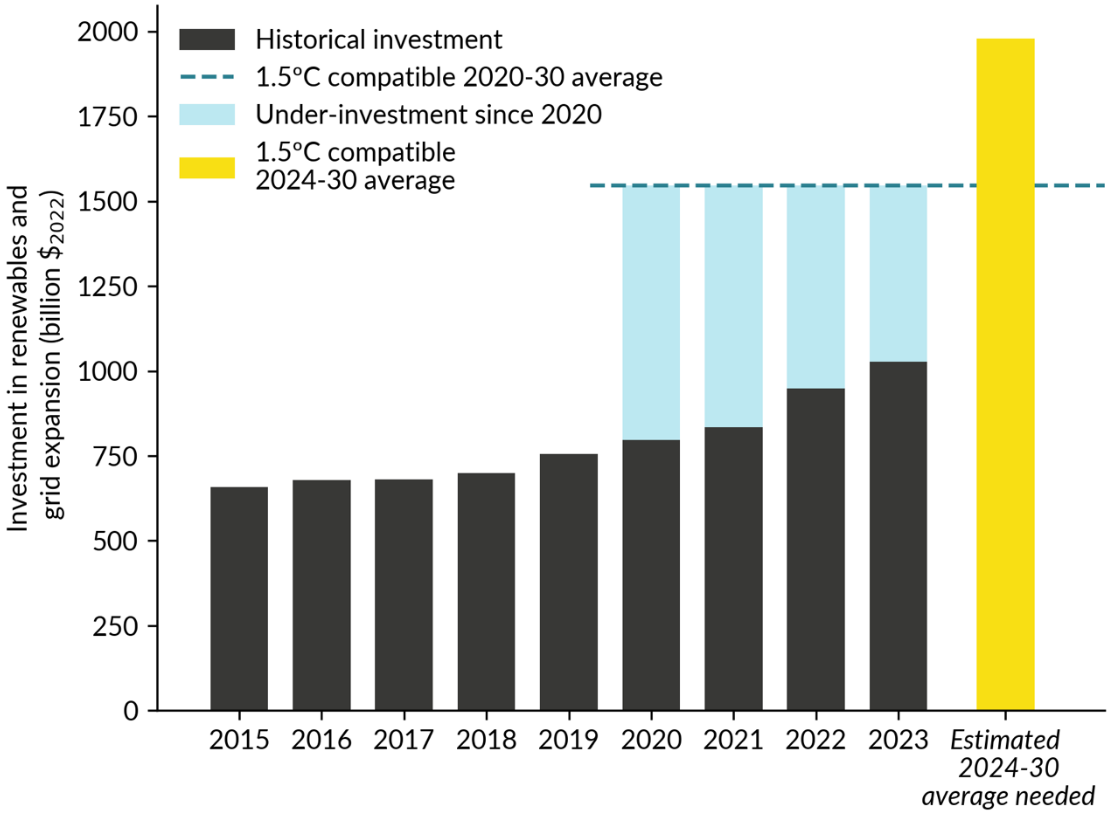

Figure 5: This figure compares historical investment into renewables and grid expansion at the global level with the level needed from 2024 onwards to limit warming to 1.5ºC. Historical data is provided from the IEA (IEA 2023b), with the 2020-30 average calculated from the assessed 1.5ºC compatible pathways. The 2024-30 average is calculated by subtracting the historical data on investment over 2020-23 from decadal total from the 1.5ºC compatible pathways.

As investment will also be needed for energy efficiency, end-use electrification, green hydrogen and more, additional investment will need to be mobilised. Shifting fossil fuel investment is not enough. However, redirecting the vast sums of money still being ploughed into fossil infrastructure is a good place to start in aligning investments with the 1.5ºC limit.

Of this $12 trillion investment, around $8 trillion is directly for installing renewables (particularly wind and solar), while $4 trillion is for investment in the transmission, distribution and storage infrastructure needed to accompany the renewables rollout. That means that **around a third of the total investment required is for grids** – highlighting their key role in the energy transition. Investments in energy efficiency will also be critical, but these are not assessed here.

A regional breakdown of investments in renewables and grids

The $12 trillion global investment figure can be broken down into the different regions. The 1.5ºC compatible pathways provide investment totals for the 2020-30 period. This can be converted to a 2024-30 figure by subtracting the investment already mobilised in 2020-23. Historical data is available for Latin America and the Caribbean, Eurasia and the OECD and estimates are used for Sub-Saharan Africa, MENA and Asia.[8] Estimated values are subject to higher uncertainty, but still provide a clear signal of the level of investment required over the decade.

Table 5 breaks down the total investment that takes place over the 2020s into the different regions, and also provides estimates of the investments that would be needed from 2024 onwards. The regional breakdown largely follows that of capacity deployment, with over 80% of the total investment taking place in Asia and the OECD.

This distribution of investment is strongly driven by the distribution of capacity additions across regions, which relates to the need to phase out fossil fuels from the power sector (greatest in the OECD) and meet electricity demand growth (greatest in Asia). There are regional differences in the upfront cost of renewables that come into play: for example, the capital cost, or CAPEX, of solar PV is greater in the OECD than in

[8] The IEA does not provide data for Sub-Saharan Africa and the MENA region, but for Africa and the Middle East. We infer Sub-Saharan Africa and MENA data by assuming that energy system investment as a share of GDP has been constant across the regions. A similar approach is used to estimate Asia investment data from the Asia-Pacific data provided by the IEA. Where available, historical data suggests this approach is valid (IRENA 2022). See Annex for more details.

most other regions of the world due in part to higher labour costs for installation, and hence this also increases investment estimates in the OECD compared to most regions.

Regional investment requirements for a 1.5°C aligned renewables transition

	1.5°C compatible investments over 2020-2030 (billion $)	**1.5°C compatible investments over 2024-2030 (billion $)**
Sub-Saharan Africa	690	**630**
Middle East and North Africa	810	**710**
Latin America	1140	**920**
Eurasia	600	**560**
Asia	5900	**4500**
OECD	6300	**4600**

Table 5: This table shows the total regional investment in renewables and grid expansion that occur in the 2020s in 1.5°C compatible pathways, and estimates the investments required from 2024 onwards.

Figure 6 shows recent clean investment flows in the power sector for each of the six regions, and how this compares to the 1.5°C compatible benchmark. It highlights that investment is falling behind what is needed for 1.5°C in all six regions.

All regions need to increase investment in clean electricity to limit warming to 1.5°C

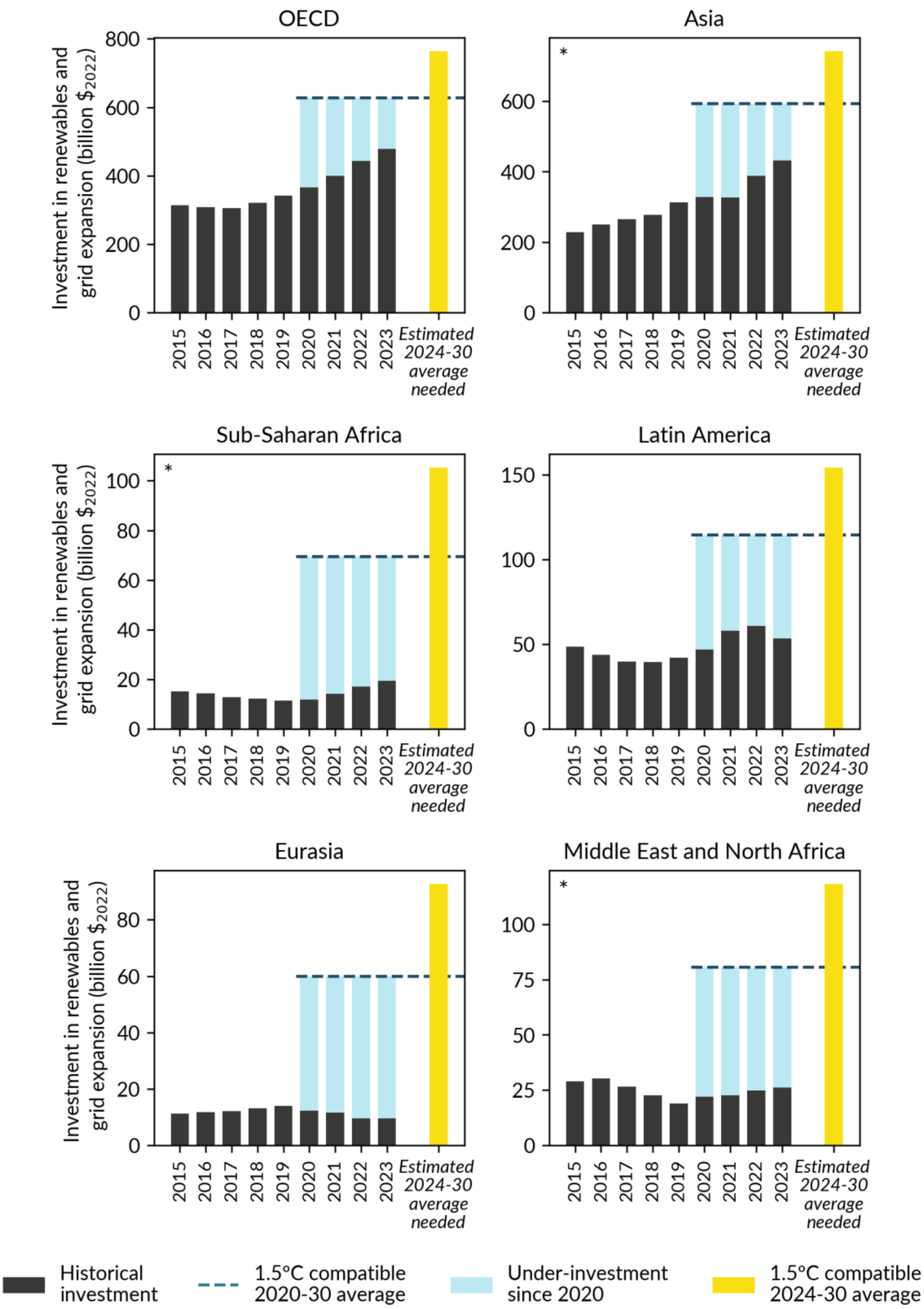

Figure 6: This figure compares historical investment into renewables and grid expansion at the regional level with the level needed from 2024 onwards to limit warming to 1.5°C. Historical data is provided from the IEA (IEA 2023b), with the 2020-30 average calculated from the assessed 1.5°C compatible pathways. The 2024-30 average is calculated by combining the decadal total from the 1.5°C compatible pathways with historical data on investment over 2020-23. * In Asia, Sub-Saharan Africa and MENA, the historical data is not directly available in the IEA dataset and so has been estimated by assuming investment into renewables and grids scales linearly with GDP.

Box 1: Investments in renewables and grid expansion in Sub-Saharan Africa

In line with a 1.5°C-aligned global tripling of renewables, just over $100 billion per year needs to be invested in Sub-Saharan Africa's renewables rollout and grid expansion. This sum will need to be provided, in part at least, by climate finance, which can also serve to mobilise private investment in the region.

This represents a massive increase from current investment levels, which were around $20 billion in 2023. At the same time, per capita investment in the transition remains low in Sub-Saharan Africa, reaching $125 per person by 2030. This is eight times smaller than in the OECD, where investment is close to $1000 per person. These lower investment figures are a direct result of the lower capacity additions over the decade in the pathways used for this analysis.

While Africa would add 260 GW of new renewables by 2030 in the 1.5ºC compatible scenarios, the OECD adds 2900 GW of new renewables over the same period. This is due to two reasons. First, the fossil phase-out needs in Sub-Saharan Africa are much less than the OECD. Sub-Saharan Africa had 60 GW of fossil capacity in 2022, which needs to be retired by 2040, while the OECD had almost 1500 GW installed, all of which needs to be retired by 2035. Secondly, projected electricity demand in the region is lower overall. While the relative growth rate is greatest in Sub-Saharan Africa, by 2030 total electricity demand in the region is still only around 1 MWh per person – whereas it is close to 10 MWh per person in the OECD.

This analysis is based on a set of scenarios that achieve a level of electricity demand in Sub-Saharan Africa consistent with the IEA's Sustainable Africa Scenario (IEA 2022), which was designed to achieve Africa's energy-related development goals, including universal access to modern energy services by 2030. The benchmarks are therefore compatible with achieving universal access to electricity by 2030. However, they still assume a far lower level of energy demand per capita by 2030 than in other regions.

This imbalance in energy consumption in the scenarios lessens by 2050, but still remains, even out to 2100 (Hickel and Slamersak 2022). This highlights the highly unequal nature of current global energy consumption, and the level to which this inequity persists in most 1.5ºC compatible scenarios. In the longer-term, strong reductions in energy demand in wealthier countries, and renewed focus on providing decent living standards to all (Kikstra *et al* 2021) could result per capita energy demand and investment requirements starting to converge.

Global 1.5°C compatible scenarios should better represent the potential for energy demand to converge across regions, which would enable policymakers to map out a more equitable global energy transition. That said, the scenarios do make progress towards reducing energy inequality by 2030 and remain a useful roadmap for the renewables transition.

While power sector investment is growing strongly in Asia and the OECD (up 89% and 53% since 2015 respectively), in the other regions there is a less clear signal. In Eurasia, Latin America and the Caribbean and MENA, investment trends over the last eight years have been broadly flat. This is alarming; without a marked increase in investment, these regions will be unable to contribute sufficiently to the tripling goal and will fail to reap the full benefits of the renewables revolution.

In Sub-Saharan Africa, investment has been growing since 2020, but in 2023 still only reached around ~$20 billion. The region requires investment of at least $70 billion per year into renewables and grids over the 2020s as a whole. The historical underinvestment in the energy transition in Sub-Saharan Africa means that the average investment needed between 2024 and 2030 is closer to $100 billion per year. The need for such a vast increase in investment highlights the risk the region faces in falling behind in the transition to renewables due to a lack of finance. See Box 1 for a further discussion of the investment needs in Sub-Saharan Africa.

It would be neither fair nor practicable to assume that this $100 billion should come entirely from within the region – the majority of it should come from external sources, whether climate finance or foreign direct investment. As the cost of capital in Africa is often two to three times that of advanced economies, mobilising private finance can be very challenging (IEA 2023a). Here, climate finance can play a key role in mobilising investment.

Climate finance can help de-risk projects and bring in private finance. The IEA estimates that $28 billion in concessional finance could mobilise $90 billion in private investment in Africa (IEA 2023a). Therefore, the first step in mobilising increased investment in Africa should be a renewed commitment to climate finance, as well as addressing barriers in the global financial system which restrict finance flows to the continent.

Conclusions

In this report we show that, to limit warming to 1.5°C in a sustainable manner, renewable capacity needs to grow to around 11.5 TW, up 3.2–3.4-fold from 2022 levels. This shows that the goal agreed at COP28 to triple global renewable capacity is broadly aligned with 1.5°C, although it should be seen as a floor, not a ceiling.

We provide a regional breakdown of 1.5°C compatible renewables deployment, and also provide an estimate of the investments into renewables and grid expansion needed to support the rollout.

We find that **Asia and the OECD are key to the global transition,** with more than 80% of new renewables installed in these regions. However, the largest relative growth in capacity comes in MENA and Sub-Saharan Africa, where renewable capacity needs to grow 7–12 times relative to 2022 levels. And, while there is some variation in the growth required, **in all regions renewable capacity must at least double relative to 2022 levels**. All countries need to demonstrate their commitment to the global goal by taking action to substantially accelerate renewables deployment, including as they revisit and strengthen their 2030 NDCs, and develop new NDCs for 2035.

The world is not yet on track for a 1.5°C-compatible tripling of renewables, but could close the gap with further policies, measures and investment. **There is a global gap of around 2 TW in 2030** between renewable capacity forecast under current policies and market conditions, and what is needed for 1.5°C. This gap exists in almost all regions, although Asia could align with 1.5°C at the higher end of the forecast (with growth driven by China and India).

The largest area for improvement is in the OECD, which could close up to 60% of the global renewables gap by aligning its power sector transition with 1.5°C. Recent policy developments such as the Inflation Reduction Act in the USA and RePowerEU in the EU27 are providing much needed incentives and support for renewables deployment in the OECD, and their successful implementation will be crucial.

Underlying the renewables gap is an investment gap. **The world needs to invest around $2 trillion per year into renewables and grids from 2024 onwards. However, in 2023, global investments in renewables and grid expansion only reached ~$1 trillion.** Mobilising more investment will be essential. Importantly, this investment needs to be distributed across the world, with adequate support to ensure that every region can benefit from the renewables revolution.

Access to finance will be key to ensuring developing countries in Africa and elsewhere are able to upgrade their grids and install the renewables necessary to align with 1.5ºC. With current investment requirements in Sub-Saharan Africa around a fifth of the level required for 1.5ºC, there is an urgent need to upscale financial flows to support an equitable transition to a renewable future for all. Sub-Saharan Africa will need around $100 billion investment per year out to 2030 to support a seven-fold growth in renewable capacity.

This report has focused on the need to triple renewable capacity by 2030 in line with the science to help limit warming to 1.5ºC. However, by 2030 a range of other key measures will be needed. Central to this is a fossil phase-out. In the 1.5ºC compatible pathways assessed, fossil fuel production and use falls almost 40% by 2030 relative to 2020 (Climate Analytics 2023). While momentum grows around tripling renewables, we need to see commensurate ambition on phasing out fossil fuels.

2023 showed that renewables are ready to power the energy transition. Wind and solar saw explosive deployment across the world (IEA 2024) and were the cheapest source of new electricity in 96% of the world. More than tripling renewable capacity is within reach, but will not happen by accident. Further policy development and investment mobilisation can close the gap, and with it, help keep 1.5ºC alive.

References

Byers E, Krey V, Kriegler E, Riahi K, Roberto S, Jarmo K, Robin L, Zebedee N, Marit S, Chris S, Wijst K-I van der, Franck L, Joana P-P, Yamina S, Anders S, Harald W, Cornelia A, Elina B, Claire L, Eduardo M-C, Matthew G, Daniel H, Peter K, Giacomo M, Michaela W, Katherine C, Celine G, Tomoko H, Glen P, Julia S, Massimo T, Vuuren D von, Piers F, Jared L, Malte M, Joeri R, Bjorn S, Ragnhild S and Khourdajie A A 2022 AR6 Scenarios Database hosted by IIASA

Climate Action Tracker 2023 Paris-aligned benchmarks for the power sector Online: https://climateactiontracker.org/publications/paris-aligned-benchmarks-power-sector/

Climate Analytics 2023 2030 targets aligned to 1.5°C: evidence from the latest global pathways Online: https://climateanalytics.org/publications/2023/2030-targets-aligned-to-15c-evidence-from-the-latest-global-pathways/

Ember 2023 Tracking national ambition towards a global tripling of renewables *Ember* Online: https://ember-climate.org/insights/research/tracking-national-ambition-towards-a-global-tripling-of-renewables/

Global Energy Monitor 2023 Boom and Bust Coal 2023

Global Energy Monitor 2022 Boom and Bust Gas 2022: Tracking the Global Gas Power Expansion Online: https://globalenergymonitor.org/report/boom-and-bust-gas-2022/

Grant N, Hawkes A, Napp T and Gambhir A 2021 Cost reductions in renewables can substantially erode the value of carbon capture and storage in mitigation pathways *One Earth* **4** 1588–601

IEA 2023a Financing Clean Energy in Africa – Analysis *IEA* Online: https://www.iea.org/reports/financing-clean-energy-in-africa

IEA 2024 Renewables 2023 – Analysis *IEA* Online: https://www.iea.org/reports/renewables-2023

IEA 2023b *World Energy Investment 2023* (Paris: IEA) Online: https://www.iea.org/reports/world-energy-investment-2023

IEA 2023c World Energy Outlook 2023 *IEA* Online: https://www.iea.org/reports/world-energy-outlook-2023

IRENA 2019a Future of Solar Photovoltaic Online: https://www.irena.org/publications/2019/Nov/Future-of-Solar-Photovoltaic

IRENA 2019b Future of wind Online: https://www.irena.org/publications/2019/Oct/Future-of-wind

IRENA 2023a Renewable capacity statistics 2023 Online: https://www.irena.org/Publications/2023/Mar/Renewable-capacity-statistics-2023

IRENA 2022 *Renewable Energy Market Analysis: Africa and its regions* (International Renewable Energy Agency and African Development Bank, Abu Dhabi and Abidjan) Online: www.afdb.org

IRENA 2023b Renewable Power Generation Costs in 2022 Online: https://www.irena.org/Publications/2023/Aug/Renewable-Power-Generation-Costs-in-2022

IRENA 2023c World Energy Transitions Outlook 2023: 1.5°C Pathway *International Renewable Energy Agency, Abu Dhabi*. **Volume 1**

NewClimate Institute and Climate Analytics 2023 Wind and solar benchmarks for a 1.5°C world *Climate Analytics* Online: https://climateanalytics.org/publications/wind-and-solar-benchmarks-for-a-1-5-c-world

Annex

Historical capacity and investment estimates

For historical capacity data we use data from IRENA (IRENA 2023a) to track capacity deployment up until 2022. We use the IEA's estimates of renewable capacity additions in 2023 to estimate renewable capacity in 2023 (IEA 2024). The IEA's data does not provide full regional coverage, with their report providing data for 86% of the OECD and 96% of Asia (by renewable capacity in 2022). We therefore scale the IEA's data for these regions, assuming that for countries where data has not been provided, deployment in 2023 was at the regional average rate.

For historical investments we take data from the IEA (IEA 2023b), which reports energy system investments at the regional level. The regional mapping provided by the IEA does not entirely map to the regions assessed in this report (data is provided for Africa and the Middle East separately, rather than Sub-Saharan Africa and the Middle East/North Africa, and for Asia-Pacific as a whole rather than Asia). Where this is the case, we infer the data at the regional resolution required by assuming the level of investment as a share of GDP is constant across a region, and thus energy system investment in a region scales linearly with GDP. This assumption appears valid from the historical data which is available. For example, over 2010-2020, 32% of renewables investment in Africa went to North Africa, which over the same period was 33% of the continent's total GDP (IRENA 2022).

Estimating renewables deployment under current policies / current targets

To estimate future capacity additions under current policies and market conditions, we use the latest IEA forecasts (IEA 2024). These forecast how renewable capacity could grow out to 2028, with a 'main' and an 'accelerated' case. We aggregate this data together to the macro-region level to estimate future capacity deployment for each of the six regions assessed. Where data is missing for a country in the macro-region, we assume that renewables will grow at the average rate of countries for which there is data.

The IEA provides forecasts out to 2028. We extend them to 2030. To do this, we fit a trendline to the 2023–2028 forecasts for capacity additions. This captures the accelerating nature of renewables deployment, as capacity additions continue to grow beyond 2028. This leads to overall renewables growing quadratically.

For some regions, we also show the renewable capacity which could be achieved by 2030 under current government targets. To do this we use data from Ember (2023). Ember's data gathers together the renewable targets of 57 countries and the EU bloc. These countries represent 93% of the world's renewable capacity today. However, the capacity coverage varies strongly at a regional level. While 99% of the OECD is covered in the dataset, only 23% of Sub-Saharan Africa is covered (South Africa only) and only 44% of the Middle East and North Africa (Morocco, Egypt, Israel, Saudi Arabia and the UAE).

For the OECD, Asia and Latin America, the countries included in Ember's data represent 99%, 96% and 82% of regional renewable capacity in 2022. For these regions, we infer a regional capacity target by assuming that the missing countries have the same ambition as the region as a whole (so the targets of the countries with existing data can be aggregated and then scaled by the capacity coverage). For the Middle East, Africa and Eurasia we do not calculate a regional capacity target, as the country coverage in Ember's dataset is not yet high enough to calculate this.

Calculating investment requirements

We calculate investment requirements for the transition using a mix of top-down and bottom-up approaches, which bring together multiple lines of evidence. We separate total investments into investments in wind and solar (WnS), investment in non-WnS renewables and nuclear, and investment in the infrastructure (grids and storage) required to support renewables deployment.

The models analysed provide data in five-year timesteps, with data provided for 2020, 2025 and 2030. We use this data to estimate investment needs over the 2020–2030 time period. Below we summarise how we estimate investment needs for each variable.

Investment in wind and solar

To estimate the investment required in wind and solar technologies, we take the capacity additions of wind and solar in each region and multiply this by capital cost estimates in the region.

Integrated Assessment Models (IAMs) have often been criticised for overestimating the cost of wind and solar, which could lead to an overestimate of the investment needs in the transition (Grant *et al* 2021). To avoid this, we use our own bottom-up assessment of wind and solar capacity costs. This uses a method developed for country-level wind and solar benchmarks (NewClimate Institute and Climate Analytics 2023), which broadly relies on IRENA data for both the current cost of wind and solar (IRENA 2023b) and their future evolution (IRENA 2019a, 2019b).

This method provides national level wind and solar costs for a range of countries for which IRENA reports cost data. We then aggregate these to provide regional cost data for the six regions investigated in this study. To do this we calculate weighted averages of the national cost data available for each region. Each national cost data point is weighted by the share of total wind/solar capacity in that country in 2022.

Having produced national capital cost data for wind and solar, we can then calculate the investments in wind and solar required in each region by multiplying capacity additions by capital costs.

Investments in other renewables and nuclear

To estimate investment requirements in non-WnS renewables and in nuclear, we take data directly from the IAMs. Not all models and scenarios report investment data. Where this is missing, we infer it based on the existing variables which are reported. We assume that investment in renewables/nuclear scales linearly with total renewable/nuclear capacity installed.

Investments in grids and storage

To estimate investment requirements in grids, we use multiple lines of evidence. The IEA and IRENA's net zero scenarios see average yearly investments into grids and storage of 600bn USD_{2022} and 575bn USD_{2022} respectively over the 2023–2030 period. Accounting for the annual investment in grids and storage from 2020–2022, of 320bn USD_{2022}, this gives total investment over 2020–2030 of 5100-5400bn USD, and an average annual investment over the decade of 510–540bn USD_{2022} per year. We use the average of this figure (523bn USD) as our global total for grid investment needs.

To provide a regional breakdown, we use the regional breakdown of grids and storage investment from the IAMs. (We do not use the IAM numbers directly, as the IAMs appear to overestimate investment needs in grids substantially, with the median pathway reporting annual investments of 790bn USD_{2022} over 2020–2030).

CLIMATE ANALYTICS

www.climateanalytics.org