# Financing 3xRenewables by 2030

## Mapping global capital needs

Global Renewables Alliance

# Acknowledgements

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| **CoC** | Cost of Capital |
| **CSP** | Concentrated solar power |
| **BNEF** | BloombergNEF |
| **EMDEs** | Emerging Markets and Developing Economies |
| **FID** | Financial Investment Decision |
| **FiTs** | Feed-in-Tariffs |
| **GRA** | Global Renewables Alliance |
| **GST** | Global Stocktake |
| **GW** | Giga Watts |
| **IEA** | International Energy Agency |
| **IFIs** | International Finance Institutions |
| **IRENA** | International Renewable Energy Agency |
| **MDBs** | Multilateral Development Banks |
| **NDCs** | Nationally Determined Contributions |
| **ODA** | Overseas Development Assistance |
| **PPAs** | Power Purchase Agreements |
| **PTCs** | Production Tax Credits |
| **WACC** | Weighted-Average Cost of Capital |

Photo: GWEC

# Key findings

**Tripling renewable power capacity by 2030 – the global goal endorsed by 133 countries at COP28 under the UAE Global Stocktake's 3xRenewables pledge - will require investments of around USD 8.6 trillion between 2024 and 2030. Achieving this global goal is essential to keeping the Paris Agreement goals within reach.**

To meet the 3xRenewables goal, project developers will need to mobilise around USD 2.4 trillion in equity (28%) and USD 6.2 trillion in debt (72%) over the six-year period from 2024 to 2030. This implies that annual financing flows to renewable power must reach USD 1.44 trillion per year every year to 2030, compared to the record USD 0.62 trillion invested in 2024.

Investment needs to 2030 vary by renewable energy technology. While investment in solar PV is broadly on track, wind power investment needs to accelerate. Investment in 2024 at around USD 134 billion represented less than a quarter of what the annual level required between 2025 and 2030 (inclusive). Currently, investment flows for bioenergy for power, geothermal, hydropower, marine and solar thermal also remains well below the levels needed to deliver the 3xRenewables target. Regional and country differences are equally pronounced. Over two-thirds (USD 5.9 trillion) of the total financing required to achieve the 3xRenewables goal must flow to emerging market and developing economies (EMDEs) by 2030, underscoring the central role of these countries in the global energy transition. Unfortunately, EMDEs are still not receiving the investment required to achieve the tripling goal. In 2024, investment flows to EMDEs (excluding China) amounted to only 17% of the average levels needed through 2030, representing just a slight improvement from 2023. Compounding the challenge, the cost of capital (CoC) for renewable projects in most EMDEs remains two to five times higher than in Advanced Economies, placing a significant burden on electricity consumers in EMDEs in these countries.

In addition, recent trends in Overseas Development Assistance (ODA) raise further concern. Many EMDEs depend on public funding to enable essential infrastructure investment, yet ODA funding fell by 9% in real terms in 2024 (OECD), with concessional financing for climate mitigation also falling. While IRENA reported record global investment in renewable power of USD 624 billion in 2024 (IRENA, et al., 2025), critical challenges remain. Ensuring that financing flows to all regions and countries in a timely manner and at the necessary scale will be essential to delivering the 3xRenewables goal by 2030.

This briefing paper aims to contribute to global action on financing the tripling of renewable energy capacity by 2030 by quantifying the USD 8.6 trillion needed and identifying what is required to unlock debt and equity finance across markets. About 72% of this investment must come as debt (USD 6.2 trillion) and 28% as equity (USD 2.4 trillion). Understanding this split is essential, as debt and equity face different risks and incentives—helping target the actions governments, investors, and the private sector must take to overcome financing barriers and scale renewable investment at the necessary pace and cost.

Increasing financing of renewable power to the needed level is challenging, but achievable. That is why the Global Renewables Alliance (GRA) has identified financing as one of the key policy areas required to meet the 3xRenewables goal[1].

Addressing this financing challenge will require action in four key areas:

## Provide investor certainty

Ensuring stable regulatory, institutional and market frameworks for renewable power between 2025 and 2030 is essential to give investors the confidence to develop the pipeline of bankable projects needed to achieve the 3xRenewables goal and thereby faciiltate the needed global finance flow between 2025 and 2030.

## Direct funds to EMDEs

Investment in EMDE's (excluding China) must increase five-fold from their 2024 level each year to 2030. Yet, prospects for scaling up investment in these markets has shown little improvement since COP28. Without significant progress in unlocking capital to EMDEs, the benefits of a just energy transition risk being undermined, and the 3Renewables goal put out of reach.

## Enable project bankability and lower the cost of capital

Renewable power projects are long-lived assets that benefit from long-term revenue visibility and predictable policy environments. However, EMDEs continue to face disproportionately high costs of capital (both debt and equity), further compounded by supply chain disruptions and price inflation that have strained macroeconomic stability. Aligning perceived with actual project risks, de-risking investment, and reducing country and exchange rate risk premiums will be crucial, with donors, IFIs and MDBs playing a central role.

## Address the imbalance of financing by technology

While solar PV deployment and investment are broadly on track to meet the 3xRenewables goal, financing for bioenergy, concentrated solar power (CSP), geothermal, hydropower, marine, and onshore and offshore wind power remains off track. Accelerating investment across all renewable power technologies is essential, not only to achieve the 3xRenewables target but also to ensure a balanced technology mix capable of delivering the required generation (TWh) by 2030.

[1] The others being supply chains, permitting, grids and corporate sourcing, as part of the GRA Policy Agenda

Addressing these four interrelated challenges is essential to ensure that finance flows at the necessary scale and cost to the countries and technologies needed to achieve the 3xRenewables goal.

Moving beyond headline financing numbers is essential to tailoring solutions to regional and national contexts, especially in EMDEs. A more targeted discussion is needed on where investments should flow within these economies, and how different technologies can play distinct roles in different markets to effectively scale-up finance flows.

It is equally important to understand where the funds will come from. Project developers, utilities, independent power producers, etc. do not turn to a single 'finance' market; instead, they seek debt and equity from a diverse range of institutions, each with its own criteria and risk appetite.

Scaling up financing flows, particularly to EMDEs, reducing the cost of capital and ensuring investment reaches all renewable power technologies are pivotal to keeping the Paris Agreement goals within reach. Renewable power and energy efficiency together account for roughly four-fifths of the solutions that can be deployed at the scale and speed needed to bend the global emissions curve by 2030.

The declining cost of renewable power, combined with its broader benefits, including lower health and climate costs, enhanced energy security, reduced exposure to volatile fossil fuel prices, and increased job creation and local value, represents a significant opportunity for both people and the planet. Mobilising finance at scale is essential to unlock this potential.

Photo: Holyoke Dam, USA by American Public Power Association / Unsplash

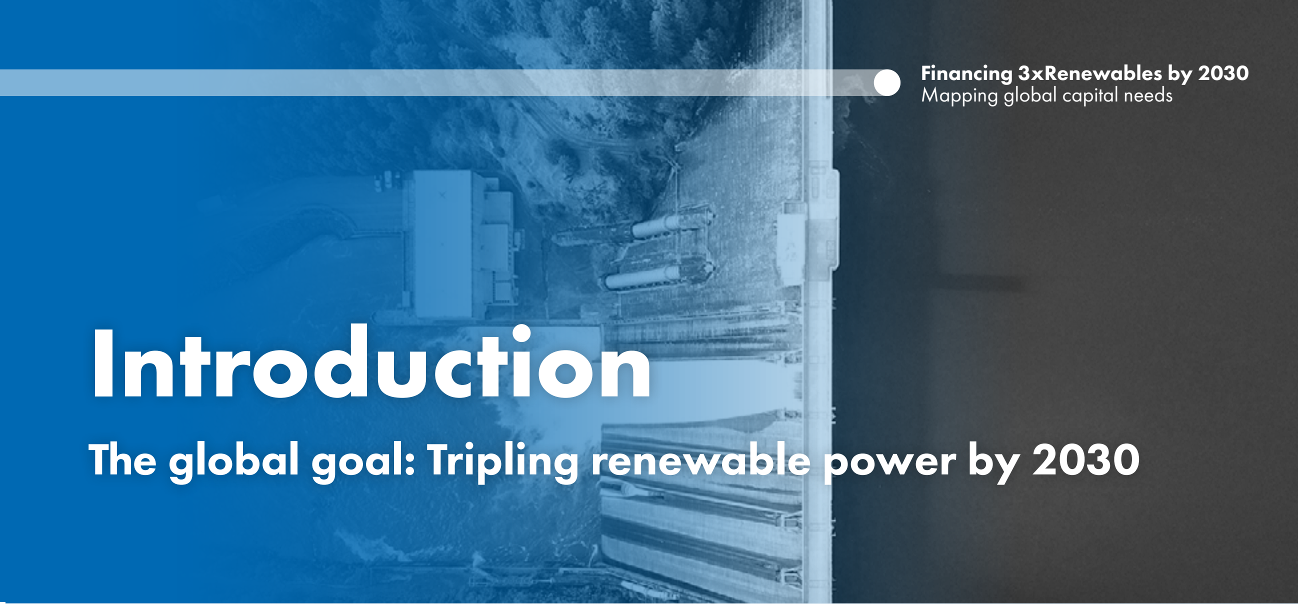


Photo: Detroit Dam, USA by Dan Meyers / Unsplash

# Introduction

## The global goal: Tripling renewable power by 2030

**In 2023, the historic agreement at COP28 saw the countries of the world agree, as part of the Global Stocktake Goals, to triple renewable power capacity[2] and double the rate of energy efficiency improvements by 2030, alongside a transition away from fossil fuels.**

This goal reflects the reality of the ongoing seismic shift in the energy sector. As the costs of renewable power have fallen in recent years, notably for solar and wind technologies (IRENA, 2024a), renewable power and electrification have become the least-cost pathway to achieving the Paris Agreement goals to avoid dangerous, unjust and costly impacts of climate change.

The GST goal is to triple total installed renewable power capacity from 3,382 GW in 2022 to 11 174 GW in 2030. This would be consistent (including the energy efficiency goal) of keeping the world on track to achieve IRENA's 1.5°C Scenario for 2050 (COP28, IRENA and GRA, 2023).

Renewables continue gathering momentum. In 2024, renewable energy set another record, as new capacity additions reached 582 GW (IRENA, 2025b). After the dramatic increase in new solar PV capacity additions in 2023, new solar PV again led with 27% growth in 2024, reaching 453 GW. However, even if the tripling goal is clearly achievable, headwinds exist for renewable technologies, excluding solar PV.

Yet despite this important progress the world is not on track to deliver the capacity additions needed to reach the tripling goal. In 2024, the world needed to add 1 044 GW, but fell 462 GW short. As a result, renewable capacity must now expand even faster, at 1 122 GW each year from 2025 on.

The situation remains dynamic, but the world appears likely to miss the tripling goal consistent with a 1.5°C Scenario by between 0.9 TW and 2.3 TW by 2030 (IRENA, 2024b; BNEF 2024; and IRENA, 2025b).

What is concerning is that national goals in some cases are below the likely market reality for growth. Ember analysis of national renewable energy targets for 2030 show they are just 2% higher – at 7.4 TW in 2030 – than prior to the COP28 announcement (EMBER, 2025). This is 3.7 TW lower than the tripling goal and between 1.5 and 2.5 TW less than market expectations from IRENA and BloombergNEF. The pace, scale and distribution of the transition must therefore change, and it needs to happen now. It must also urgently see the additions of wind, concentrating solar power, hydropower, geothermal and bioenergy rise to meet the goal as laid out by IRENA, GRA and the COP28 Presidency (COP28, IRENA and GRA, 2023) in support of the adoption of the 3xRenewables goal.

Ensuring finance flows to EMDEs will be crucial not only for meeting the 3xRenewables goal,

[2] Throughout this report 'the tripling goal' and '3xRenewables' are used interchangeably to represent the goal of tripling renewable power capacity, globally by 2030.

but also for ensuring that the benefits of the energy transition are equally shared globally, given that the geographic deployment of renewable power remains highly uneven. At the end of 2023, China, Europe and North America accounted for almost 85% of global, cumulative installed capacity; while Africa accounted for just 1.6% of the total (IRENA, et al., 2024).

The GRA has identified four key areas where action is needed to ensure the world delivers on the tripling goal, including:

**Financing:** Concerted action on ensuring the policy, regulatory and institutional arrangements are in place to ensure all actors are aligned on mobilising the finance necessary for the tripling goal.

**Supply chains:** Establish robust, secure, and resilient renewable energy supply chains. These serve as a critical foundation necessary to achieve the scale and speed required to reach the tripling renewables target by 2030.

Photo: American Public Power Association/ Unsplash

**Permitting:** Streamline planning and permitting processes to reduce time and cost constraints of renewable energy projects. Acceleration is urgently needed to triple renewables by 2030 – it still takes longer to permit a project in many markets and jurisdictions than it does to build one.

**Grids, flexibility and storage:** Increase much needed investment in new grid infrastructure and optimise the existing energy system to make it fit for an ever-higher share of renewables. Investment in power generation needs to go hand in hand with investment in transmission, distribution, flexibility and electricity storage infrastructure to triple renewables by 2030.

These four key action areas to deliver the 3xRenewables target can be used to inform how national energy planning can achieve the goals outlined at COP28, which need to be translated into new and updated Nationally Determined Contributions (NDCs).

Enhanced NDCs present an opportunity for nations to re-evaluate and align renewable ambitions with 1.5°C and the COP28 Global Stocktake (GST) and outline how they will leverage renewables to meet climate and economic goals. Countries that have not yet submitted updated NDCs should urgently step up to close the ambition gap highlighted in Ember's analysis.

GRA has outlined recommendations for countries to deliver specific, measurable and ambitious renewable energy targets within their NDCs (GRA, 2024). On the finance topic within NDCs, GRA recommends coordinating investment mechanisms to achieve greater progress. Governments should develop and publish NDC investment strategies that are integrated into sectoral and national plans, as well as policy and regulatory frameworks. These should present and promote quantified, bankable mitigation projects supported by robust investment mechanisms.

It is vital to increase renewable energy investment in terms of speed, scale, and distribution worldwide to reach the tripling target by 2030. A more nuanced discussion is needed on the sources of finance in different markets and how to mobilise greater public and private finance at lower costs in EMDEs. This report provides data and analysis on the likely call on financing from debt and equity, the cost of finance, and the impact this has on the challenges of raising finance, both debt and equity in different markets.

# Financing the 3xRenewables goal by 2030

The tripling goal requires global cumulative installed renewable power capacity to increase from 4 443 GW in 2024, to 11 174 GW in 2030 (Table 1) (COP28, IRENA and GRA, 2023).

In 2024, IRENA statistics show that the world added 582 GW of renewable power, up from 473 GW in 2023. In 2024, 106 GW onshore wind was added, 8.6 GW of offshore wind and 9 GW of hydropower; while bioenergy, geothermal and marine together added just 5.4 GW of capacity (IRENA, 2025). These are all significantly below what is needed to reach the 3xRenewables goal.

However, solar PV added 452 GW and is the only technology that is seeing its annual new capacity additions increase fast enough to ensure it is likely to meet its required contribution to the tripling goal by 2030.

This is welcome progress, yet 2024 additions still fell short of the pace required new capacity additions now need to average 1 122 GW per year, each and every year, from 2025 to 2030 inclusive. Just as importantly, while solar PV is likely to grow fast enough to meet its share of the 3xRenewables goal, it has the lowest capacity factor among the renewable technologies, meaning the shortfall in TWh generated could be larger than implied by any 'missing' GW of new capacity from other sources.

The corollary of missing the capacity targets, is that the flow of finance to renewable power projects is not growing fast enough. In 2024, a record USD 624 billion (bn) investment in new renewable power capacity was well short of IRENA's estimated needs of around USD 1 400 billion per year between 2025 and 2030, inclusive (Table 2).

**Table 1: The tripling renewable power generation capacity goal**

| CUMULATIVE CAPACITY | HISTORICAL (2024 GW) | PATHWAY TO 1.5C (2030 GW) |
|---|---|---|
| BIOENERGY | 151 | 308 |
| CSP | 8 | 124 |
| GEOTHERMAL | 15 | 63 |
| HYDRO (excl. pumped) | 1277 | 1465 |
| MARINE | 0 | 28 |
| SOLAR PV | 1859 | 6153 |
| WIND OFFSHORE | 83 | 413 |
| WIND ONSHORE | 1050 | 2620 |
| **TOTAL RE INSTALLED CAPACITY** | **4443** | **11174** |

Source: (IRENA, et al., 2025)

For geothermal, CSP and bioenergy; the annual investments in 2024 were around USD 23 billion, around one-tenth of the required annual investment each and every year to 2030 of USD 223 bn/year (Table 2). Investment flows to these technologies, particularly in EMDEs are far from sufficient to meet the 3xRenewables target and require urgent attention.

Investment in hydropower is similarly not on track, with USD 31 billion in 2024 compared to the annual average required of USD 127 bn/year to 2030.

The lack of investment in these technologies, which can provide firm, clean electricity; has implications for the amount of flexibility and grid investments needed in the period to 2030. If investment in these technologies - particularly hydropower, with signficant storage opportunities, which can help balance solar and wind generation and provide ancillary services – is not accelerated, investments in grids, storage and other flexibility sources need to be brought forward.

The situation for investment in onshore and offshore wind also needs to be addressed. In 2024, offshore wind investment fell 28% to USD 22 billion, roughly one-eighth of the average needed each year to 2030 of USD 184 bn/year. The investment situation for onshore wind is not quite as serious, but at USD 112 billion in 2024, was still only 30% of the average USD 365 bn/year required each year to 2030. There has been welcome news in 2025 for offshore wind, with investment in the first half of 2025 surging to USD 39 billion (BNEF, 2025), more than the investment over the entire year in 2024, as governments increasingly recognize the strong fundamentals of wind power. The other bright spot in the investment data is that solar PV growth is on track to deliver the required GW, with total investment in 2024 of USD 436 bn, already approaching the needed USD 511 bn/year through to 2030.

Unfortunately, this is not enough to bridge the gap opening up in investment of all the other renewable technologies (IRENA, 2024b; and BNEF, 2024; and IRENA, et al. 2025).

**Table 2: Investment for the 3xRenewables power generation capacity goal**

| CUMULATIVE CAPACITY | HISTORICAL (2024 GW) | PATHWAY TO 1.5C (2030 GW) |
|---|---|---|
| BIOENERGY | 19 | 106 |
| CSP | 2 | 78 |
| GEOTHERMAL | 1 | 39 |
| HYDRO (excl. pumped) | 31 | 127 |
| MARINE | 0 | 29 |
| SOLAR PV | 436 | 511 |
| WIND OFFSHORE | 22 | 184 |
| WIND ONSHORE | 112 | 365 |
| **TOTAL RE INSTALLED CAPACITY** | **624** | **1439** |

Source: (IRENA, et al., 2025)

Photo: Larderello Geothermal Power Plant near Toscana, Italy from 1913 by Fusun Tut / Unsplash

# Diving deeper: Where will the finance come from?

## Global finance required to achieve the global 3xRenewables goal by 2030

**Headline investment figures are vital to convey the scale and urgency of the challenge, but understanding the type of financing required is equally important. Distinguishing between debt and equity allows for a more meaningful discussion of the different risk profiles and incentives across technologies, regions, and funding sources. This perspective helps tailor solutions and clarify the roles of governments, investors, and project developers in unlocking and scaling renewable energy finance. By deepening this understanding, stakeholders can better align efforts to mobilize the volume of capital needed to achieve the 3xRenewables goal.**

To complement the global debate on financing renewables, GRA intends for this analysis beyond the headline numbers to allow a more focused debate on:

- Where do renewable energy investments need to flow? Particularly within EMDEs and smaller states.
- Which technologies are likely to be deployed and how will technology choice differ between markets?
- Where will the funds come from? Project developers, utilities, independent power producers, etc. do not go to a single 'finance' market; rather, they approach a range of institutions for debt and equity. These actors have very different criteria when providing funds.
- How will the share of debt and equity vary by market and technology? What impact will this have on the costs of capital?
- Taking the investment needs analysis deeper, allows for a more action-orientated discussion of where and how the necessary funds can be sourced.

It also enables a more meaningful discussion of the different risk profiles by technology, region, country and funding source.

This can help stimulate discussion between key stakeholders – governments, project developers and the financial community – about what is needed to unlock the volume of funds needed to meet the 3xRenewables goal. This is vitally important if the world is to deliver the step-change in investment needed over the six years 2025 to 2030, inclusive.

IRENA, the IEA and BNEF all have estimates of the increase in capacity and investment needed to meet the 3XRenewables goal [3]. These are broadly aligned on the total renewable capacity needed in 2030, albeit with different starting values for 2022 and 2023. However, there is some divergence in the estimated investment needs, due to different shared of capacity additions by technology and underlying assumptions around the investment costs up to 2030. Figure 1 presents the two key, high-level metrics for the 3xRenewables goal as

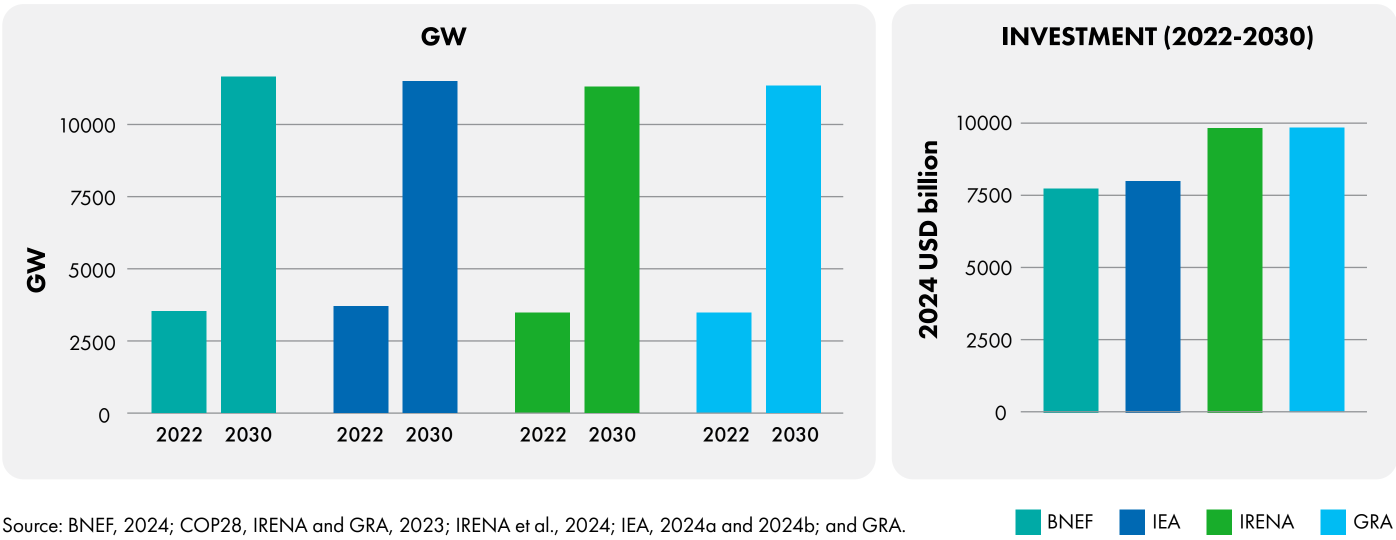
[3] It is worth noting, however, that IRENA and BNEF figures for solar PV capacity differ.

analysed by BNEF, GRA, IEA and IRENA. The estimates for the starting point of total installed renewable capacity in 2022 ranged from a low of 3 382 GW by IRENA, to a high of 3 680 GW by the IEA. BNEF was between these two estimates at 3 521 GW. The GRA capacity data is aligned with its joint work providing the analytical basis for the tripling goal conducted with the COP28 Presidency and IRENA (COP28, IRENA and GRA; 2023).

For 2030, BNEF, in its Net-Zero scenario, sees cumulative renewable power capacity reaching 11 622 GW by the end of 2030, while the IEA identifies it needs to reach around 11 500 GW, and IRENA/GRA estimates that capacity must reach 11 174 GW. This represents a difference of just 4% between IRENA/GRA and BNEF, significant, but not particularly large. However, there are more significant differences in the share of solar and the other renewable power technologies between IRENA/GRA and BNEF and IEA data.3 BNEF and the IEA both model a higher share of solar PV by 2030 than IRENA, which has a more balanced expansion, especially of wind, to help reduce integration costs.

In terms of the projected investment, IRENA estimates reaching 11.2 TW (adding 7.8 TW, which has been reduced to 6 731 GW needed after the additions in 2023 and 2024 are taken into account) will require investment of USD 9.8 trillion between 2023 and 2030 inclusive, while the IEA estimates it will require around USD 8 trillion (Figure 3) for their capacity additions.

**Figure 1: Comparison of BNEF, GRA, IEA and IRENA scenarios for renewable capacity and investment to meet the 3xRenewables goal**




Source: BNEF, 2024; COP28, IRENA and GRA, 2023; IRENA et al., 2024; IEA, 2024a and 2024b; and GRA.

BNEF estimates investment needs of USD 7.8 trillion between 2023 and 2030 inclusive, but with a higher share of PV in their capacity additions of 8.1 TW.

IRENA's investment numbers are influenced by the higher deployment of more capital-intensive hydropower, bioenergy, CSP, geothermal and marine energy than BNEF and IEA. For instance, IRENA projects 544 GW of these technologies, excluding hydropower, need to be added between 2023 and 2030 inclusive, while BNEF projects 71 GW of additions and the IEA 168 GW.

The GRA estimate is based on country and sub-region scenarios, but aligns closely with IRENA's GW deployment. GRA's investment is therefore around the same 11.2 TW estimated by IRENA for 2030, also requiring a total investment of USD 9.8 trillion[4].

[4] Although GRAs total align with IRENAs, there are small differences for each technology, resulting GRAs estimate of the new capacity additions needed being around 26 GW higher than IRENA's; a 0.4% difference.

The key challenge, irrespective of the scenario examined, is to ensure that the scale-up of financial flows to projects on the ground happen in a timely manner in order to ensure the 3xRenewables goal can be met by 2030. However, two critical aspects of this should be highlighted. Not only do investment flows have to almost double per year, but they need to be more equitably distributed between technologies and regions, as well.

EMDEs (excluding China, India and Brazil) are not seeing investments flow at the scale needed. Indeed, in 2023, 84% of investments went to China, the European Union and the United States falling to 83% in 2024 (IRENA, et al., 2025). Brazil and India accounted for just over 8% in 2024, while sub-Saharan Africa – home to almost 550 million people – saw just USD 5 billion in investment, around 0.8% of the global total (IRENA, et al., 2025).

Photo: GWEC

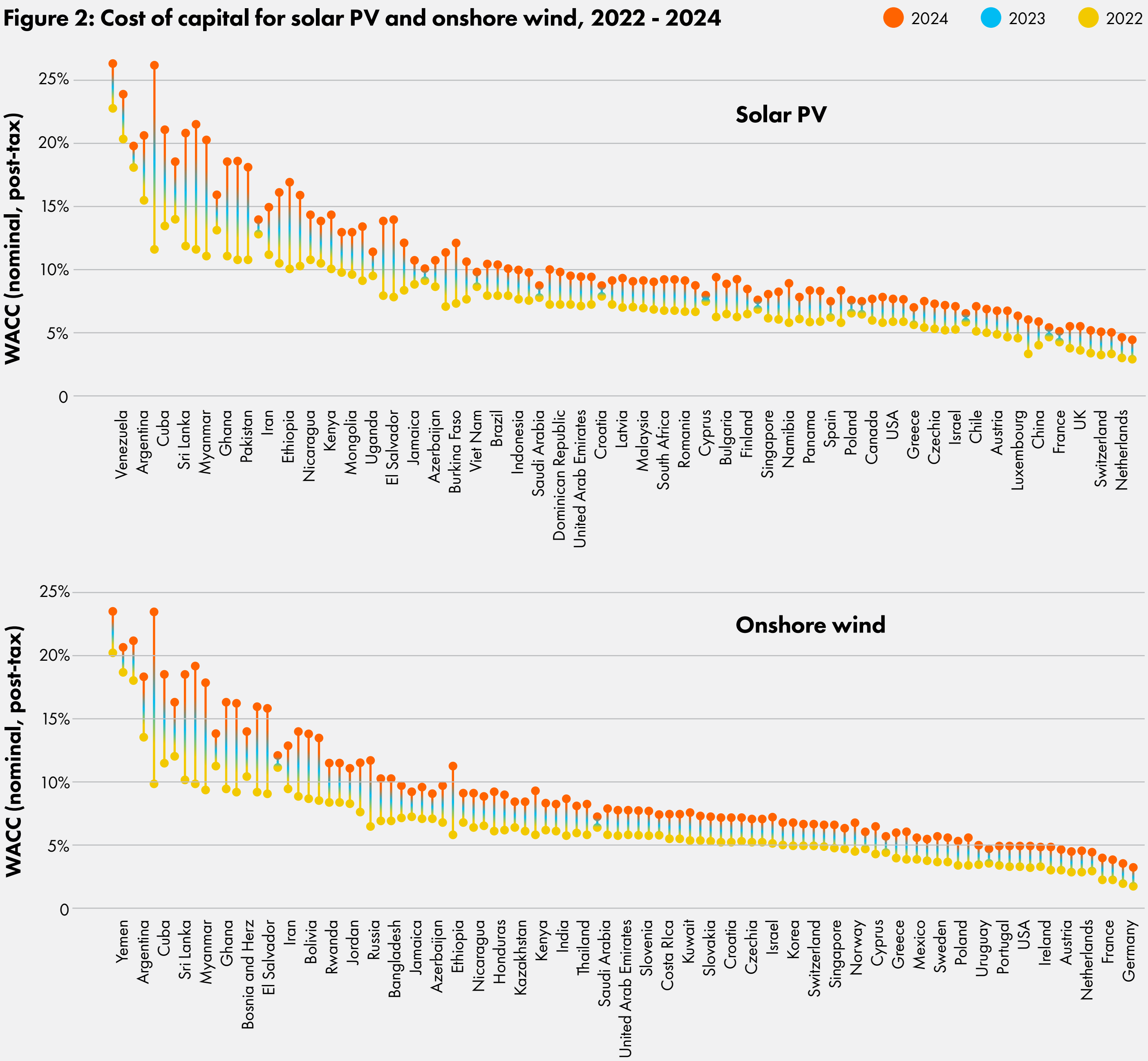
The second major challenge is that EMDEs typically often face a cost of capital - measured in the weighted-average cost of capital (WACC) – that is higher than in most advanced economies. This undermines project economics, often in already challenging business environments, and impedes citizens and economies in these countries from leading a clean energy transition at a reasonable cost. Smart policies and interventions to reduce the WACC for projects in many EMDEs will be crucial to delivering the 3xRenewables goal - and especially to achieving a just transition.

Material differences exist in the cost of capital (CoC) for renewable power projects across countries and technologies. The most significant variation comes from the country risk premium. However, there is no single value for the CoC within a market for a given technology. To give an example, IRENA survey data showed that for solar PV in Spain the CoC ranged from 36% below to 72% above the average (IRENA, 2023).

The cost of finance for renewable power projects (Figure 2) can be as much as two to five times higher than in most OECD countries (IRENA, 2023). Looking at the specific contribution of the cost of debt and equity, as well as the debt share is crucial to understanding as the determinants of the CoC vary significantly depending on market, regulatory and market rules, the developers size and experience, offtake arrangements and other project-specific factors.

The importance of the CoC has only increased, as the macroeconomic instability unleashed by Russia's aggression against Ukraine in 2022 has disproportionately affected the CoC in some EMDEs, leading to dramatic increases of 10% or more in some cases.

**Figure 2: Cost of capital for solar PV and onshore wind, 2022 - 2024**




Source: IRENA, 2023; IRENA, 2024b and EME Consulting.

## Financing needs by source to achieve the 3xRenewables goal by 2030

Based on IRENA's deployment needs for tripling renewables by 2030[5] and adjusted with country- and region-specific investment cost data, GRA's analysis estimates total investment needs of USD 8.6 trillion for the six years to 2030 (Figure 3), or around USD 1.4 trillion per year, compared to around USD 0.6 trillion in 2024. This is consistent with IRENA's analysis (IRENA, et al., 2025).

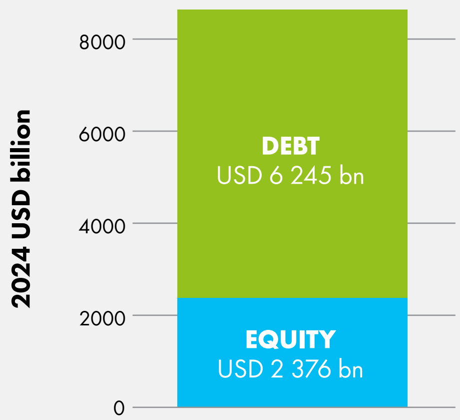
The processes and challenges facing the financing of renewable power projects vary significantly depending on the location of the project, the regulatory and institutional arrangements, government policies in the electricity sector, financing institutions' familiarity with renewable power in individual markets, offtake risks and opportunities, and the experience of the project developer; to name just the most important.

[5] From this point on in the report, 2024 is the base year. Investment figures presented as "to 2030" or "2024 to 2030," whether total or annual averages, refer to the investment needs for the six years remaining to 2030.

For each project, the financing is therefore a multi-faceted decision space where the goal is to get an acceptable risk-reward profile for lenders of debt and providers of equity to allow the developer to take a financial investment decision (FID).

The criteria examined by debt and equity providers have common elements, but they also have very different requirements. Understanding the magnitude of the investment needs that will come from debt and equity by technology and market can therefore help to focus the policy development and actions of all stakeholders on what is needed to scale-up financial flows to meet the 3xRenewables goal.

**Figure 3: Debt and equity need to reach the tripling goal, 2024-2030**




Source: COP28, IRENA and GRA, 2023; IRENA, et al, 2025; and EME Consulting

Of the total of USD 8.6 trillion required between 2024 and 2030, GRA estimates that USD 6.2 trillion (72%) will come from debt markets and USD 2.4 trillion (38%) from equity providers (Figure 5). This is based on data for the debt-to-equity ratio of renewable power projects from a database of around 4 000 projects globally (EME Consulting, 2025).

This database of debt-to-equity ratios[6] is used to estimate representative ratios by technology for each country and region for which projections consistent with the 3xRenewables goal could be found. Combining the country/region-specific debt-to-equity ratios by technology with the investment needs by technology, then yields the split between debt and equity in each market by technology.

This data on debt-to-equity ratios is, of course, historic and the future is likely to differ given changing macroeconomic conditions, support policies, international donor activities, etc. Trying to analyse these potential changes is beyond the scope of this report. The results should be viewed with this uncertainty in mind. Figure 4 presents the results for the 36 countries (see Methodology Annex for the full list) covered in the analysis, as well as four sub-regional groupings. Given these countries cover most investment needs, the remainder is grouped under 'Rest of World'.

China is expected to dominate the deployment of renewable power to 2030, and it is therefore projected to require the largest debt and equity financing, at USD 1 577 and USD 533 billion respectively between 2024 and 2030.

The United States will be the next largest market in terms of investment if the 3xRenewables goal is achieved, with USD 809 billion in debt and USD 415 billion in equity invested between 2024 and 2030. The United States remains the next largest market, even after the recent legislative changes. The United States will see a higher share of equity relative to debt than in China, given the influence of production and investment tax credits in driving deployment, at least in part of the observed period. These incentivise higher equity shares to unlock the full value of the tax credits, although this will change with the recent policy reset in the United States that is phasing out the tax credits for wind and solar.

Of the USD 8 621 billion global investment needed, USD 3 346 trillion (USD 558 bn/year) is needed for **wind power**, to deliver the additional 1 570 GW of onshore and 330 GW of offshore wind that needs to be built in the period 2024 to 2030 (Figure 5). This is 39% of the total financing required, with 71% of that estimated to be debt.

[6] Debt-to-equity ratios in this report are percentages of the total financing needs. For example, a project with total investment need of USD 200 billion that raised a total of USD 150 billion in debt, would have a debt-to-equity ratio of 75% (150 divided by 200). This is common practice but is unfortunate in that it is not actually a ratio of the debt to equity, rather a percentage of the share of debt in the total.

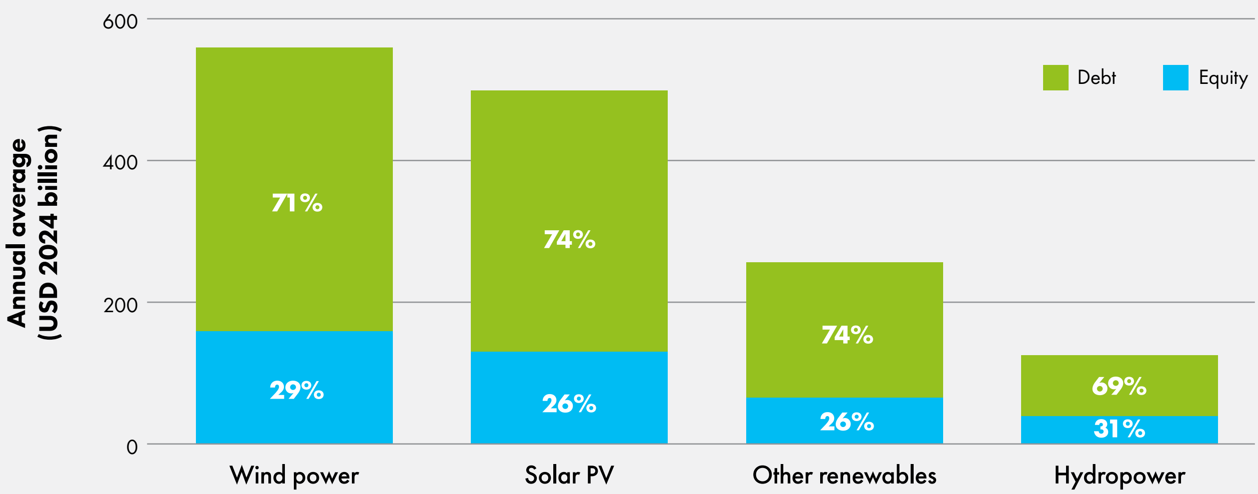
Photo: Bolero PV Project, Chile by Antonio Garcia / Unsplash

Investments in **small and utility-scale solar PV** will need to total USD 2 993 billion, 35% of the total, for an average of USD 499 bn/year over the period 2024 to 2030, as an additional 4 294 GW needs to be completed over this period to meet the tripling of renewables by 2030. This would require roughly 74% debt financing (USD 368 bn/year) globally, with significant variation by market. The continuing sizeable contribution of rooftop solar PV in deployment means that the challenges of financing solar PV can be more diverse than for purely utility-scale technologies. Ensuring that funds flow to residential, commercial and industrial installations 'behind-the-meter', as well as utility-scale projects requires carefully designed support policies.

**Hydropower** accounts for USD 747 billion (USD 124 bn/year) in financing if the additional 200 GW of new hydropower capacity in the period to 2030 that is required for the 3xRenewables goal is to be financed. With hydropower capital costs remaining higher in the last ten years (IRENA, 2024a), there remains some uncertainty around how much investment will be needed to deliver the 200 GW of new capacity. EMDEs are expected to account for 94% of the hydropower investment to 2030, debt financing averages just 69% for the 200 GW of new capacity, resulting in a higher WACC for hydropower in the 3xRenewables goal. Policies that increase debt shares for hydropower projects in EMDEs at lower interest rates would materially reduce the delivered cost of hydropower to EMDEs.

**Bioenergy for power, CSP, geothermal and marine** together account for 18% of the total investment needs for renewable power expansion in the remaining six years to 2030, amounting to USD 1 535 billion (USD 256 bn/year) for around 350 GW of new capacity that is estimated to be financed, on average, with 74% debt.

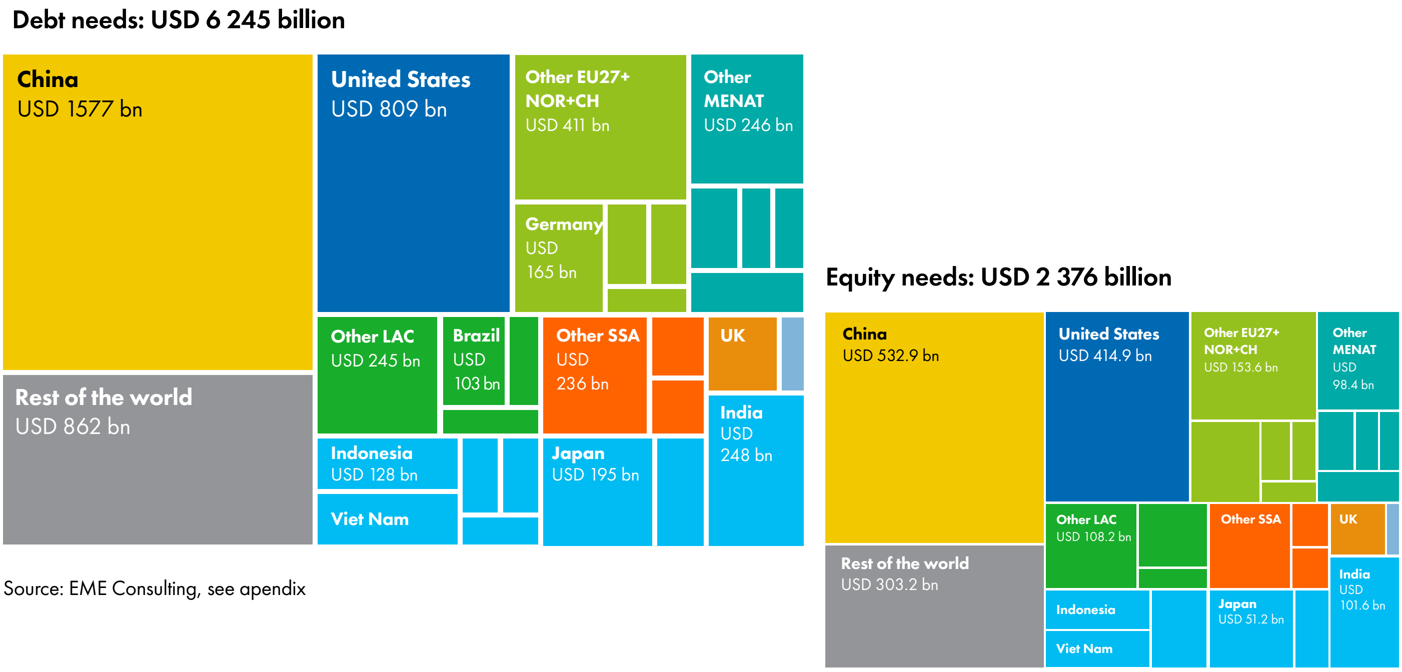
**Figure 4: GRA annual average investment needs by renewable energy technology for the 3xRenewables goal, 2024-2030**




Note: 'Other renewables' includes bioenergy, concentrating solar power, geothermal and marine power.

Source: IRENA, 2023; IRENA, 2024b; IRENA, et al., 2025; and EME Consulting

**Figure 5: Debt and equity needs by country/region to reach the tripling goal, 2024-2030**




Source: EME Consulting, see apendix

**Wind power** represents the largest investment opportunity, between 2024 and 2030. Annual average investment in onshore and offshore wind will need to average around USD 103 bn/year in Europe, including the United Kingdom (Figure 6). Debt-to-equity ratios typically range from 70% to 80%, varying by country depending on policy settings and financing conditions, as well as by the share of offshore wind in the buildout, given on average the higher risk compared with onshore projects.

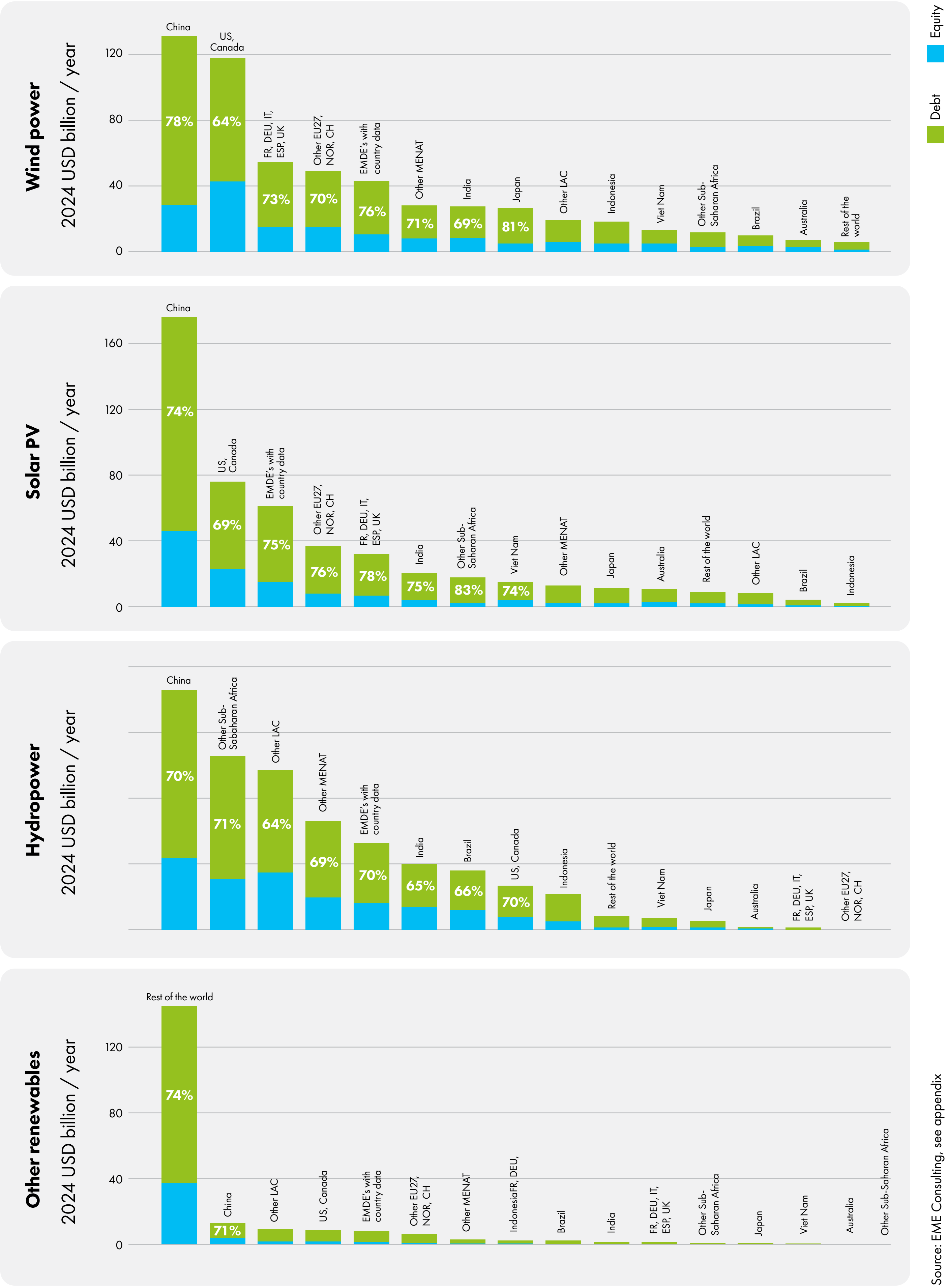
The United States, requires higher equity-gearing to take advantage of the Production Tax Credits (PTC) and Investment Tax Credits that have historically supported deployment, lowering the debt-to-equity ratio to 64%. This tendency is reinforced by the increasing share of offshore wind in new capacity additions towards 2030. The impact of the recent policy to phase out the ITC and PTC for solar and wind on debt-to-equity ratios for the six years from 2024 to 2030 is not yet clear, but may increase debt shares by 2-3% for the whole period.[7]

EMDEs see a wider variation in debt-to-equity ratios than Advanced Economies. This is not surprising, given their much wider variation in economic development and local financial market maturity and depth. Debt-to-equity needs for wind power deployment in the 3xRenewables goal are estimated to vary from a low of 58% to as high as 88% depending on the country.

Overall, Advanced Economies could account for 46% of the overall investment in wind, 44% of the estimated debt and 50% of the equity. EMDEs[8], excluding China, may account for 31% of the wind investment needed for the 3xRenewables goals, the same percentage for the global total of debt for wind power and 32% of the equity needed. China is estimated to account for 23% of the wind power investments between 2024 and 2030, and 18% of the global equity needs for wind power and 25% of the debt.

[7] Much depends on the extent of the rush to take advantage of the tax credits before expiration, the rules needed to qualify for those credits and the order of magnitude of the market slowdown, if material, post-tax credits.
[8] Note: 'EMDEs with country data' include Algeria, Argentina, Brunei Darussalam, Cambodia, Chile, Colombia, Egypt, Lao PDR, Libya, Malaysia, Mauritania, Mexico, Morocco, Myanmar, Nigeria, Philippines, Saudi Arabia, Singapore, South Africa, Thailand, Tunisia and Turkiye.

**Figure 6: Annual average debt and equity needs by country/region and technology, 2024-2030**




Source: EME Consulting, see appendix

The distribution of **solar PV** deployment is different than for wind power. China is by far the largest market, with estimated investment needs of USD 1 053 billion over the six years to 2030 (USD 175 bn/year). China is estimated to fund this investment with 74% debt and 26% equity.

Advanced Economies face higher average unit investment costs, but deployment is more concentrated in EMDEs than is the case for wind power. As a result, Advanced Economies account for 34% of the estimated total investment needs in solar PV, with total funds of USD 788 billion over the period 2024-2030 (USD 169 bn/year). The United States is again the second largest market for the investment needs, but at USD 75 bn/year, is investing 43% per year on average of what China may require.

Annual average investment in solar PV in Europe (including the United Kingdom), is estimated to average around USD 70 bn/year, with debt-to-equity needs of between 73% and 80%, with an average for France, Germany, Italy, Spain and the United Kingdom of 78% and 76% in the rest of Europe. However, there is significant variation in financing conditions between countries in Europe, notably between Western and Central Europe, compared to the East (IRENA, 2023 and Roth, et al., 2023).

EMDEs excluding China are estimated to need investment of USD 928 billion in the period 2024-2030 (USD 155 bn/year for seven years) to meet the 3xRenewables goal for solar PV. It is estimated that 75% of this investment will come from debt and 25% from equity.

The 24 EMDE countries where GRA was able to estimate investment needs from country-level energy transition scenarios account for 20% of total solar PV investments and two-thirds (USD 580 bn) of the investment in solar by all EMDEs, excluding China. These 24 countries are estimated to need USD 97 bn/year in the period 2024 to 2030.

Sub-Saharan Africa will rely heavily on low-cost solar PV to meet the growing electricity needs of its population, with an estimated USD 35 bn/year needed in the six years to 2030, with 78% of this being debt. This higher debt ratio than in some Advanced Economies is somewhat counter-intuitive. However, it reflects the fact that in many countries in the region the role of public finance and international donors is high, given the higher risk profiles and the difficulty, or indeed impossibility, of using domestic capital to fund projects.

As in many other low-income EMDEs, the ability of Sub-Saharan Africa to meet its goals for solar PV will be heavily dependent on the availability and cost of international public finance to leverage private capital at reasonable cost in order to accelerate deployment.

Investment in **hydropower** to reach the 3xRenewables goal is estimated to need to average USD 124 bn/year between 2024 and 2030. Almost all this investment (94%) is expected to occur in EMDEs, with China accounting for 24% and all other EMDEs for 71% of the global total.

After China, the largest investment is estimated to occur in Sub-Saharan Africa (17% of the total), which still has significant untapped economic potential. Annual average investments each year to 2030 are estimated to be USD 21 bn/year, with 71% of the funds needing to be raised in the form of debt.

Other major individual markets for hydropower deployment are Brazil, Indonesia and India. Brazil is estimated to require USD 7 bn/year in the period to 2030 (USD 44 billion in total), comprising two-thirds debt and one-third equity. India and Indonesia are estimated to need investment of USD 8 bn/year and USD 4 bn/year respectively, with debt making up 65% of investment in hydropower in India and 73% in Indonesia.

Investment in **bioenergy for power, CSP, geothermal and marine power technologies** between 2024 and 2030 is estimated to need to increase to USD 256 bn/year to deliver the 3xRenewables goal.

However, the country-specific scenarios where data is available for the 36 countries in the GRA analysis envisage much lower deployment of these technologies than IRENA's deployment, at the same time as in 2024 actual deployment is failing to accelerate. This suggests that 'other renewables' are going to struggle to meet the required rate of deployment without urgent corrective action. This represents a significant risk to the delivery of the 3xRenewables goal, but more worryingly, will ensure proportionately more TWh's are missing than GW's, given their higher capacity factors (on average) than solar PV, in particular, and wind power. At the same time, it also represents a risk for the scaling of solar PV and wind power, as these technologies are typically firm resources that can reduce solar and wind power integration costs.

The disconnect between the required deployment of these technologies is evident in Figure 8, where in order to align with the deployment of these technologies in the IRENA scenario, deployment has become a remainder that is captured in the 'Rest of World' region.

## Renewable power investment in EMDEs

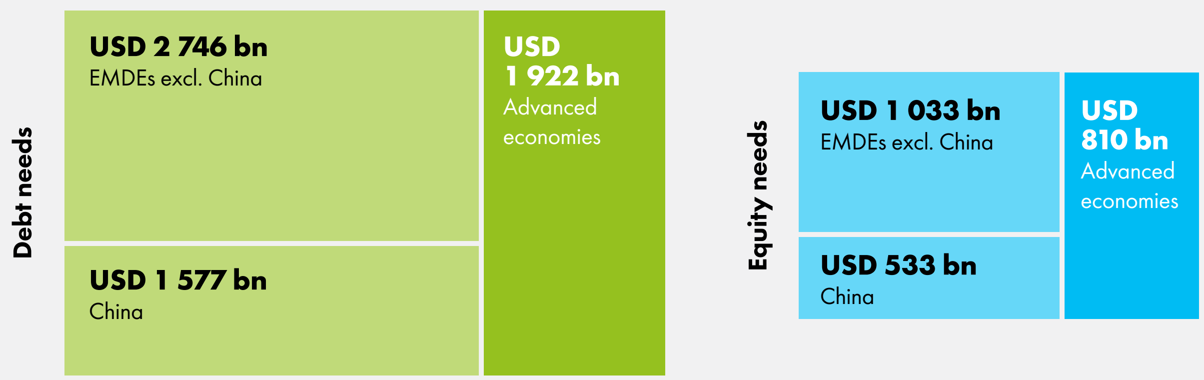
Just over two-thirds – USD 5 895 billion – of the total financing needs for the 3xRenewables goal needs to flow to EMDEs over the period to 2030 (Figure 7). EMDEs (excluding China) need to account for 43% (USD 3 786 bn) of the total investment needs to 2030. This represents a significant challenge, as just 17% of global investment in renewables went to EMDEs, excluding China, in 2024 (IRENA, et al., 2025).

An estimated USD 4 323 billion (69%) of the total debt, will need to be raised for EMDEs domestically and internationally and the remaining 31% of total debt needs (USD 1 922 bn) in Advanced Economies (Figure 9).

China will require USD 1 577 billion in debt, accounting for 36% of the debt needs in EMDEs and 25% of the total global debt needs. This implies annual debt raising for renewable power projects in EMDEs, excluding China, needs to increase from the USD 85-95 billion for projects commissioned in 2024 to average 458 bn/year in the six years to 2030 and USD 263 bn/year in China.

On the equity side, EMDEs will need around USD 1 566 billion over the period to 2030, or around two-thirds of the global total equity investment requirements, with Advanced Economies needing to raise USD 810 billion

**Figure 7: Total annual average investment by major country group**

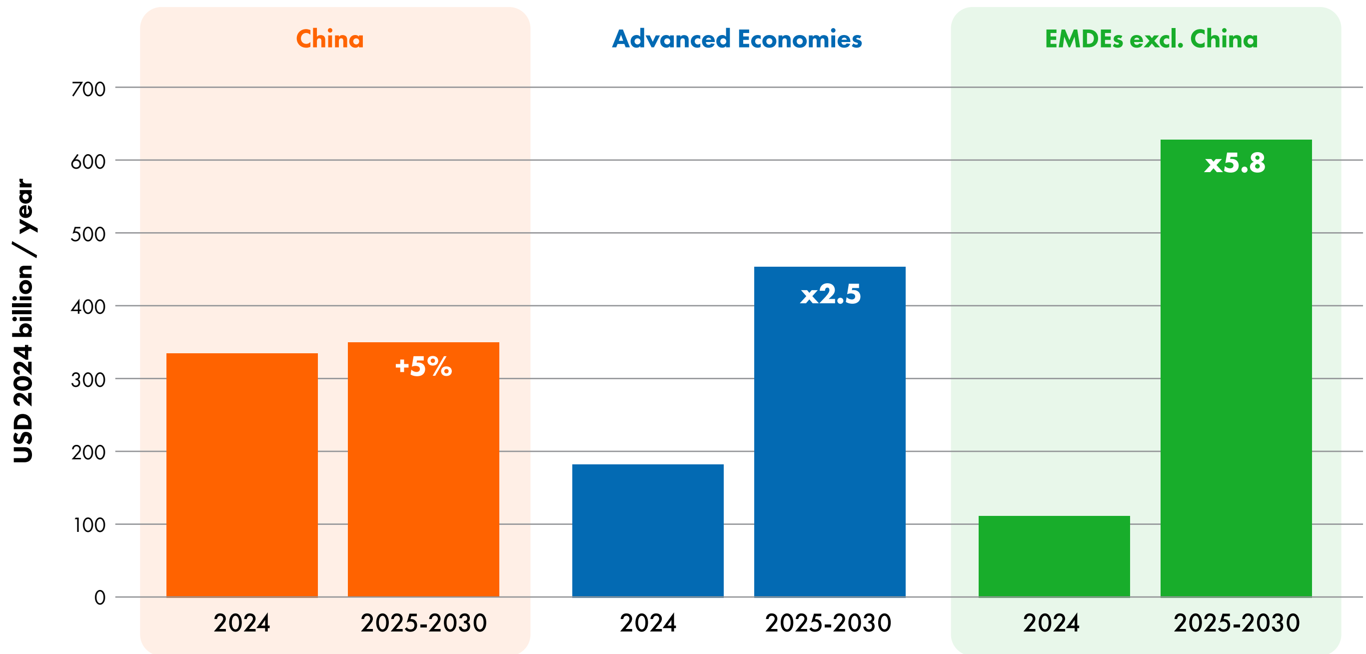



Source: COP28, IRENA and GRA, 2023; IRENA, et al., 2025; and EME Consulting in equity over six years to 2030. EMDEs, excluding China, would need to ramp up their access to equity finance from an estimated USD 25-30 billion for projects commissioned in 2024, to average USD 172 bn/year each year in the six years to 2030. China will need to find USD 89 bn/year in equity and Advanced Economies USD 135 bn/year over the same period.

The challenge facing stakeholders in unlocking the investment needs for EMDEs, excluding China, to be able to meet the 3xRenewables goal is put into stark contrast in Figure 8.

Investment funds for renewable power projects will need to increase almost sixfold from USD 109 billion in 2024, to an average of USD 630bn/year each year from 2024-2030.

**Figure 8: Total annual average investment by major country group**




Source: COP28, IRENA and GRA, 2023; IRENA, et al., 2025; and EME Consulting

Of the EMDEs with country-level data in the analysis, India requires the largest annual investment (excluding China) at 58 bn/year each year to 2030. The country with the next largest annual investment need is Vietnam, at USD 32 bn/year; followed by Indonesia at USD 29 bn/year.

Perhaps the real challenge lies somewhat hidden in Figure 9, the scale-up of financing flows to 22 small and medium-sized countries that have renewable deployment scenarios and are crucial to achieving the 3xRenewables goal but require strong scaling up. For instance, Tunisia needs investment flows each year to 2030 to average USD 3.2 bn/year a twenty-sevenfold increase over what occurred in 2024, Malaysia needs to increase investment flows thirty-onefold to USD 5.6 bn/year and the Philippines six-fold to USD 9.7 bn/year. Unlocking these financial flows to EMDEs will require significant efforts by policy makers, donors and international financial institutions (MDBs and IFIs). Many EMDEs economies have been badly hit by the macroeconomic instability caused by COVID 19-related supply chain issues, followed by the inflation unleashed by Russia's aggression in Ukraine.

This has, in many cases, reduced significantly the potential of governments to contribute to the financing of key infrastructure projects, which was already beforehand not adequate in many EMDEs (IMF, 2022). At the same time, it has also resulted in the CoC for renewable projects to increase, in some cases disproportionately

(Figure 2). With inadequate sources of domestic public funds and MDBs and IFIs also constrained in the amount of public finance they can provide, the role of the private sector in bridging the gap is crucial. However, the risk profiles of many of these EMDEs mean renewable projects in these countries are less commercially attractive to investors.

For instance, in 2024 almost three-quarters of all EMDEs had sovereign risk ratings that categorised the investment environment as 'highly speculative' (a B+ credit rating) or worse (WEF, 2024).

The goal is to increase both the volume and affordability of financing—whether debt or equity. Unlocking financial flows to many EMDEs will require a comprehensive set of actions across energy and climate policy, regulation, financial market rules, and investment policy:

- It will require additional efforts by MDBs and IFIs to increase public finance flows to those countries facing the greatest challenges, as well as using these scarce public funds to leverage greater private sector financial resources via innovative financial instruments and guarantees.
- Understanding the debt and equity needs by country can help with the targeting of instruments to achieve the greatest effect, aside from 'sovereign' or 'country' risk. The largest risk premiums often stem from currency exchange risk, or domestic market risks, which are often related to the policy and regulatory environment, as well as more specifically, off-taker risks (BNEF, 2023 and IRENA, 2023).
- Ongoing efforts to assist EMDEs to make renewable power project investment more attractive must occur to increase the pipeline of high-quality, investible projects. This can be achieved by, for example, reducing domestic barriers or risk adders, such as planning and permitting complexity/ uncertainty, uncertainty around grid connection rules or queues, offtake risks, etc.
- Overarching all this, governments should strive to create, to the extent possible, secure and predictable policy and regulatory environments that give project proponents and financing institutions the confidence to invest.

Figure 9 helps to put the discussion in the preceding paragraphs in context by looking at the scale-up of finance flows to meet the 3xRenewables goal compared to country risks and GDP per capita.

The lefthand side of Figure 9 plots the investment needs by country (area of the circles) against both the sovereign risk ratings from S&P and GDP per capita.

While Advanced Economies and China generally have the highest credit ratings, many EMDEs have much lower credit ratings, and the risk premium they command on debt and equity in these markets is significant (Figure 4).

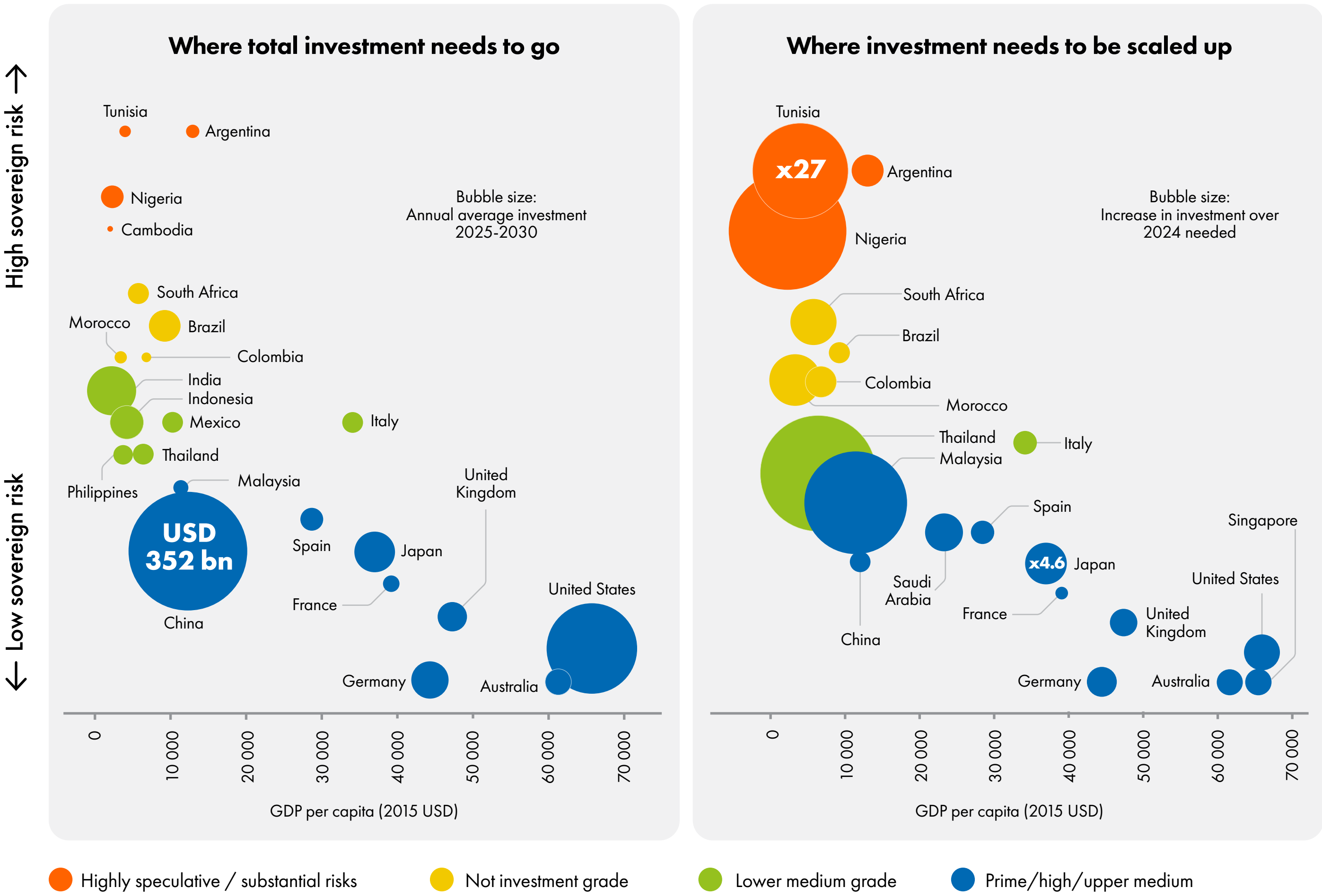
Countries such as Brazil, India, Indonesia, Nigeria and South Africa will be large markets for investment if the 3xRenewables goal is to be met, but they often face challenges in terms of directing public funds to support renewables deployment. Many EMDEs already face high debt service burdens which are a drain on public finances and limit borrowing. For instance, servicing their debt burdens required 24% of Brazil's and Egypt's budgets in 2022, 23% of India's, 13% of Indonesia's, 14% of South Africa's and 15% of the Philippines (World Bank, 2025).

The righthand side of Figure 9 looks at this from a slightly different angle by showing which countries are required to see the largest relative increase in their renewable power project investment. The bubble size on the right-hand side shows the factor by which the average annual investment for renewables needs to increase compared to investment in 2023. For instance, in Germany, annual average investments in the period 2025-2030 need to be 1.7 times higher than in 2024.

When we compare the right-hand side to the left-hand side, it is readily apparent that those markets that require the largest scale-up are also the ones facing the most challenging circumstances when it comes to raising the volume of finance at a reasonable cost. It is therefore crucial to acknowledge that, while there are challenges to scaling up the funds needed in Advanced Economies, these can be addressed with advanced planning, a holistic energy transition plan, stakeholder engagement and political will. Ensuring a stable and supportive policy environment, along with continuously assessing the balance needed in the risk sharing between project developers and off takers (whether via government entities or directly with market participants), is key to overcoming these challenges and ensuring the volume of projects financed accelerates.

This is not the case in many EMDEs. Their poorer credit ratings can impose punitive risk premiums on debt and equity that make projects economically unviable, and/or significantly raise the cost of the energy transition in countries, with the least ability to pay and responsibility for climate change.

**Figure 9: Annual average investments by country for 3xRenewables goal compared to country risk and GDP per capita, 2024-2030**




Source: IRENA, et al., 2025 and EME Consulting, based on S&P, Moody's and the World Bank Development Indicators

Sovereign risk ratings are grouped using Moody's and S&Ps sovereign risk ratings: 'Prime/High/Upper medium' refers to all 'A' risk ratings, 'Lower medium grade' refers to all three B ratings (BBB- to BBB+ and Baa3 to Baa1), 'Not investment grade' to all double B ratings (BB- to BB+ and Ba3 to Ba1), 'Highly speculative to substantial risks' includes the single B ratings (B- to B+ and B3 to B1) and the double and triple C ratings (CC to CCC+ and Ca to Caa1).

Note: For the righthand side, the bubble size represents the annual average investment required for 2024-2030 divided by that country's estimated investment for 2024 (according to IRENA). Thus, in this chart for Germany, the annual average for 2024-2030 needs to be 1.4 times that of 2023.

# Policy recommendations

**Achieving the 3xRenewables goal will require a significant scale-up in financing for renewable power projects, particularly in EMDEs. While global capital is abundant, ensuring that renewable power projects are financed at sufficient scale and affordable cost of capital, will require concerted action across multiple fronts, including the need to:**

Repurpose select public capital flows and development financing toward renewable energy infrastructure and the broader clean energy transition. This is essential to ensure that EMDEs have access to sufficient public finance to meet the tripling goal.

Foster stronger collaboration between public and private sector actors to design innovative financing models tailored to the needs of underinvested countries. Instruments such as blended finance, green bonds, and risk mitigation mechanisms can help leverage limited public funds to achieve greater de-risking impact.

Deepen "trialogue" collaboration between industry, government and the financial community to co-develop context-specific financing and business models that address renewable energy investment gaps in underinvested countries.

Reduce the perceived risk premium for many EMDEs by reassessing actual EMDE country risks and adopting a more comprehensive definition of investment risk that accounts for environmental and social externalities. This would help align financial decision-making with broader public and societal goals.

Align countries' NDCs with the commitment to triple renewables by 2030. This requires updating renewable energy targets, planning, policies, and roadmaps to reflect the 3xRenewables ambition, while delivering clear, long-term investment signals.

Provide greater investor certainty through credible and coherent policy frameworks that address the complexity of the energy transition, from predictable support schemes for renewable power and de-risked cashflows, to anticipatory grid investments and enabling regulatory and market settings.

## Policy recommendations to increase the volume of finance and reduce the cost of capital

**Addressing the root causes of high financing costs in EMDEs requires improving both real and perceived risks. Reducing the key uncertainties that elevate project risk is essential, particularly through actions such as:**

Expanding public equity and first loss funding (including grants) at early-stage project development to strengthen the pipeline of bankable renewable projects and lower the cost of both debt and equity financing.

Integrating comprehensive electricity network planning to enable anticipatory investments that match the pace of renewable power growth. This will help reduce grid-connection delays, curtailment risks, and overall project uncertainty.

Providing revenue certainty for renewable power investors where competitive electricity markets do not yet deliver adequate price signals for decarbonisation, through mechanisms such as contracts for difference (CfDs), power purchase agreements (PPAs), or feed-in-tariffs (FiTs,)

Leveraging public funds to attract private finance through risk-reduction instruments such as guarantees, first-loss lending, concessional equity, grants, or currency hedging facilities. These measures can help de-risk projects, lower the overall cost of capital, and broaden the investor base to include more risk-averse investors such as pension funds.

# Policy recommendations to address debt and equity needs

**Policymakers must recognise that the risk-return dynamics for debt and equity differ significantly, and that these vary further across technologies, markets and types of financial institution.**

**To increase capital flows to renewable power projects at lower cost, policies should account for the diverse expectations and constraints faced by different investor groups: public (e.g., MDBs, DFIs, sovereign wealth funds) and private (e.g., banks, institutional investors, impact investors, pension funds, insurers, philanthropic foundations etc.), as well as by project developers. All work under unique risk-return expectations, liquidity requirements, and regulatory constraints.**

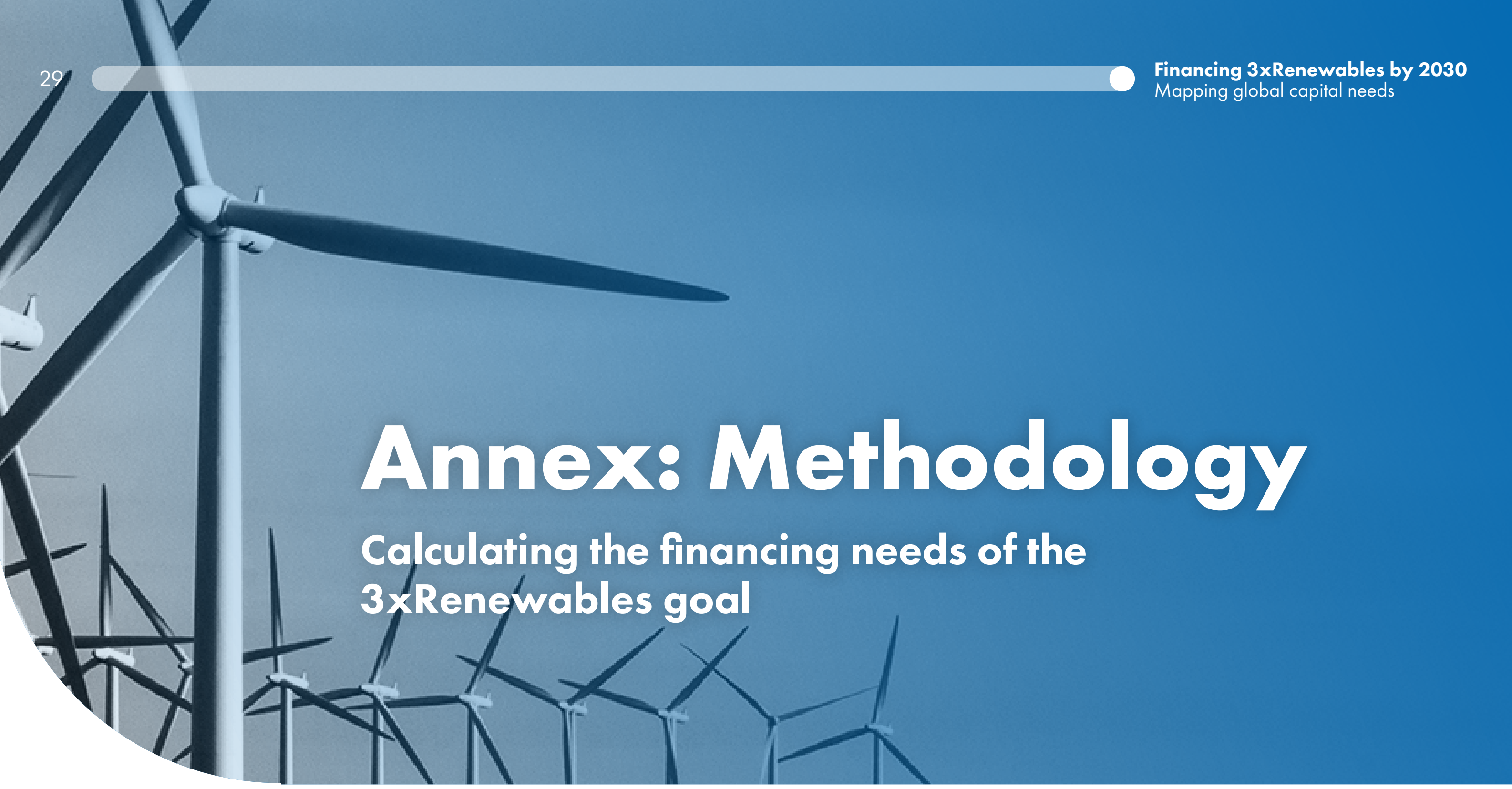
**This implies that policy makers should:**

Engage in a trialogue between industry, government, and the financial community at national or regional levels to identify specific barriers that constrain financing flows or increase cost.

Collaboratively assess risk ownership within this trialogue to determine which actors are best placed to address particular risk and where targeted action is most effective.

Promote scalable and replicable financing initiatives by ensuring that new coalitions, tools, and mechanisms can be adapted to across markets to achieve the pace of renewable deployment required to meet the 3xRenewables goal by 2030.

Deploy scarce public finance strategically to catalyse private investment in EMDEs. This includes using instruments such as catalytic capital, guarantees, and blended finance to extend debt tenors, enhance liquidity, and provide first-loss protection, aligning private sector incentives with the need for larger, lower-cost financing flows.



# Annex: Methodology

## Calculating the financing needs of the 3xRenewables goal

The starting point is the IRENA analysis for the capacity required to meet the goal, this global value for each technology comes from the joint report by IRENA, GRA, COP28 Presidency, COP29 Presidency, Ministry of Energy of the Republic of Azerbaijan, and Government of Brazil (IRENA, et al., 2024).In order to introduce greater regional and country detail, GRA has drawn on analysis from BNEF and IRENA that identifies either a 3XRenewables goal compatible growth path for a country or a region. Where these are unavailable, scenarios for a country/region that are consistent with the Paris Agreement goals are used, with a preference for IRENA analysis – which is available for North Africa and ASEAN countries. In the absence of data from BNEF or IRENA, energy transition scenarios that form part of government policy are used. Where these are not available targets for 2030 in an individual country are used.

Figure 10 presents an overview of the methodology for calculating the investment needs required to achieve the 3xRenewables goal by 2030.

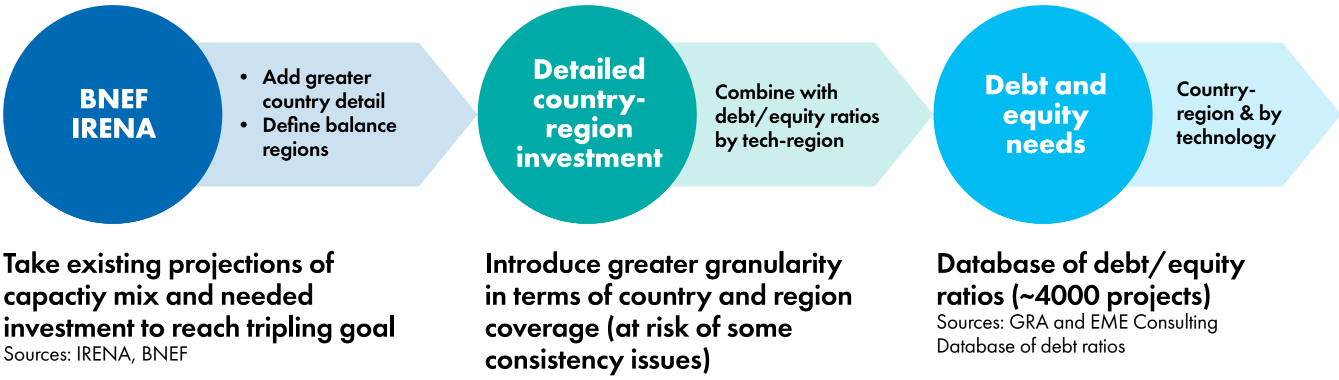
This yields deployment (in GW) for these countries/regions that is consistent with the 3xRenewables goal, or current national policy. Figure 11 details the 36 countries covered by national-level data. In addition, five regional sub-groupings exist to ensure the global total is consistent with the overall global deployment data.

The GRA analysis is consistent with the faster than expected solar PV deployment experienced since the 3XRenewables goal was adopted at COP28, although total deployment, at 11.2 TW of renewable capacity in 2030, which is consistent with IRENA's value for 2030.

As evident in Figure 6 in this briefing paper, the sum of individual country scenarios/plans for bioenergy for power, CSP, geothermal and marine power ('Other RE power' in Figure 6) and, market deployment; falls short of the IRENA levels. This is apparent in the 'Rest of the world' grouping having to accommodate almost all of the deployment needs.

The next step is to translate the GW of deployment data by country/region into total investment needs. To ensure consistency, where possible, the investment value of the deployment from the IRENA/BNEF or national sources is used. Where this is not available, GRA has estimated the total investment needs by drawing on IRENA data for the specific investment cost in USD/kW by country/region (IRENA, 2024a), while projecting forward to 2030 cost reductions based on IRENA learning rate data.

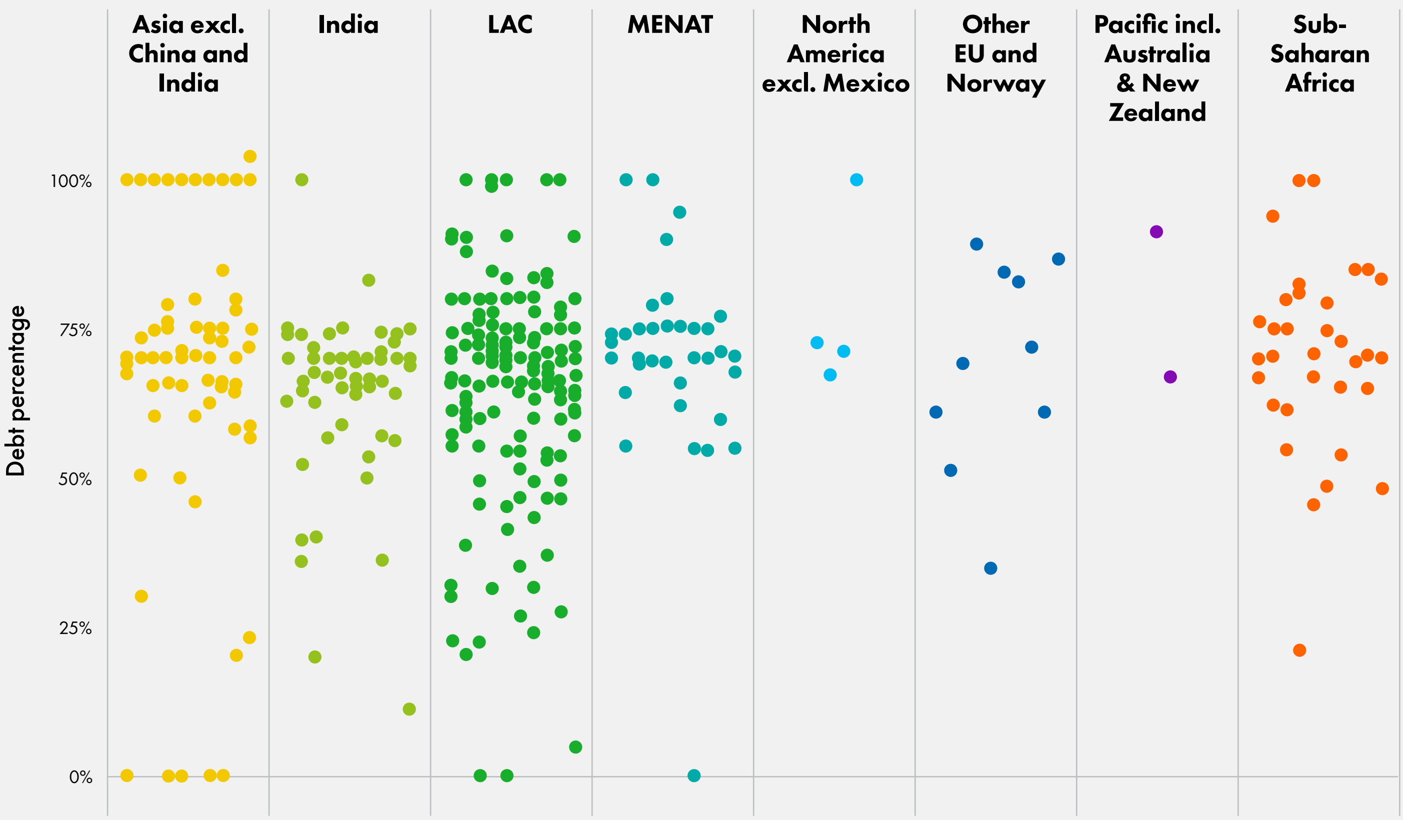
**Figure 10: Simplified methodology to calculate debt and equity needs for the 3xRenewables goal**




Source: EME Consulting Ltd.

The final step is to translate these total investment numbers by country/region and technology into the debt and equity requirements. To do this, GRA has used the EME Consulting Ltd propriety database on project level debt-to-equity ratios for renewable power projects, supplemented by new research to fill in some of the gaps in the EME Consulting Ltd database for the 36 countries examined in this analysis. Overall, the database currently contains project-level debt-to-equity ratios for around 4000 projects. As Figure 11 illustrates, it is worth noting that the use of country and regional averages for debt-to-equity percentages masks significant variation at the project level.

**Figure 11: Historical hydropower debt-to-equity ratios by country/region and project**




Source: EME Consulting Ltd.

The methodology used to calculate the debt-to-equity needs for the period 2024 to 2030, inclusive, provides results that are broadly consistent with the global and regional estimates of the total investment needs from BNEF, IEA and IRENA.

The results are robust for solar PV, wind power and hydropower, and align closely with IRENA for the remaining renewable power generation technologies – somewhat less so compared to BNEF and the IEA which have lower deployment levels for 2030 for 'Other RE power'.

Having said this, there are four caveats that should be kept in mind when using the analysis, specifically that:

- The country-level deployment needs are sometimes not sourced from IRENA or BNEF, so although they are typically consistent with government policy or official scenarios, there is no guarantee that they are internally consistent with the global deployment estimates (from IRENA) which are being used to identify the 'balance' items in the regional sub-groupings.
- The corollary of this is that converting capacity needs into investment needs using country/region specific investment costs in USD/kW may not be consistent, especially when the total investment value is not readily available from the national deployment source.
- The debt-to-equity ratio database is a large sample, but its coverage is not uniform and may not be statistically robust for every examined country. Additionally, where regional averages must be used due to a lack of data for a specific technology in a country, further uncertainty is introduced.
- Finally, it is of course possible that historical debt-to-equity ratios may not be appropriate for all the period out to 2030 for each country/technology pair if market conditions change

**Table 3: Country and regional grouping**

| COUNTRIES | | | | | |
|---|---|---|---|---|---|
| Algeria | Argentina | Australia | Brazil | Brunei Darussalam | Cambodia |
| Canada | Chile | China | Colombia | Egypt | France |
| Germany | India | Indonesia | Italy | Japan | Lao, PDR |
| Libya | Malaysia | Mauritania | Mexico | Morocco | Myanmar |
| Nigeria | Philippines | Saudi Arabia | Singapore | South Africa | Spain |
| Tunisia | Turkiye | United Kingdom | United States | Viet Nam | Thailand |
| **REGIONS** | | | | | |
| Other EU27 + Norway + Switzerland | | | | | |
| Other Latin America & Caribbean | | | | | |
| Other Middle East, North Africa, and Turkiye | | | | | |
| Other Sub-Saharan Africa | | | | | |
| Rest of the world | | | | | |

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