Turning the tide in scaling renewables

Addressing the barriers and opportunities to accelerate the global energy transition

KPMG in Belgium

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Mike is passionate about taking action to solve the climate crisis, particularly by accelerating the pace of innovation, scaling renewable energy deployment, and attracting increased capital to projects in developing markets.

His recently published work on behalf of KPMG focuses on sourcing renewable energy through PPAs to speed companies' decarbonization plans and the importance of prioritizing a just and equitable energy transition.

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He led the work on scaling renewables in the UK as Director General for Energy in the UK Government between 2008-15, which has resulted in the share of electricity coming from renewables in the GB market rising from 5 percent in 2007 to over 40 percent today. Since joining KPMG, he has advised leading renewable and energy companies on the Energy Transition. The Queen awarded him a CB in 2014 for his work on energy and climate change issues. He is a Fellow of the Energy Institute (FEI) and on the Markets Advisory Council of the Electricity System Operator (ESO).

Introduction

Achieving the ambition of the Paris Agreement depends on dramatically and rapidly scaling the deployment of renewable energy. In a report about credible pathways to achieving this goal released in 2023, the International Energy Agency (IEA) concluded that renewable energy capacity additions must triple from 2022 levels by 2030.[1] In short, that means installing over 1,200 gigawatts annually by the end of the decade. To put that number in context, consider that the total electricity generation capacity in the United States (US) from all fuel types at the end of 2022 was 1,200 gigawatts.[2] The focus on enhancing renewable capacity is pivotal, not only for meeting climate targets but also for complementing the existing energy mix, where traditional energy sources continue to play a significant role in ensuring stability and reliability in energy supply.

[1] International Energy Agency (IEA), "Credible pathways to 1.5 C: Four pillars for action in the 2020s," 2023

[2] US Energy Information Administration (EIA), "Electricity explained: Electricity generation, capacity, and sales in the United States," 2023

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It's a daunting task. It's even more daunting to consider that a similarly robust pace of renewable deployment would need to continue through 2050. The International Renewable Energy Agency (IRENA) forecasts that to reach net-zero emissions by 2050, annual energy-related carbon dioxide emissions need to plummet by 37 gigatons annually compared to 2022 levels.[3] For context, in 2022, global emissions from transportation, including aviation and all passenger and cargo cars, trucks, and boats, totaled eight gigatons.[4]

The primary vehicle for achieving ambitious climate goals is elevating the share of renewables in the global energy mix from its current level of 14 percent to 77 percent by mid-century.[5]

How well positioned is the global renewable energy industry to deliver on the speed and scale of growth needed to power 77 percent of the world by 2050? The blunt reality is that the renewable energy industry and its many supporters are far from reaching the scale necessary to achieve this goal.

This sobering truth is often overlooked because there is a warranted celebration of the remarkable progress renewables like wind and solar and supporting technologies like energy storage have made over the past decade. Renewables have improved their performance, scaled up production and, most critically, slashed their costs beyond what many believed was possible.

The blunt reality is that the renewable energy industry and its many supporters are far from reaching the scale necessary to achieve this goal.

Why is renewable energy so difficult to scale?

[3] International Renewable Energy Agency (IRENA), "World Energy Transitions Outlook 2023: 1.5 C Pathway," 2023
[4] International Energy Agency (IEA), "Tracking Clean Energy Progress 2023," 2023
[5] International Renewable Energy Agency (IEA), "World Energy Transitions Outlook 2023: 1.5 C Pathway," 2023

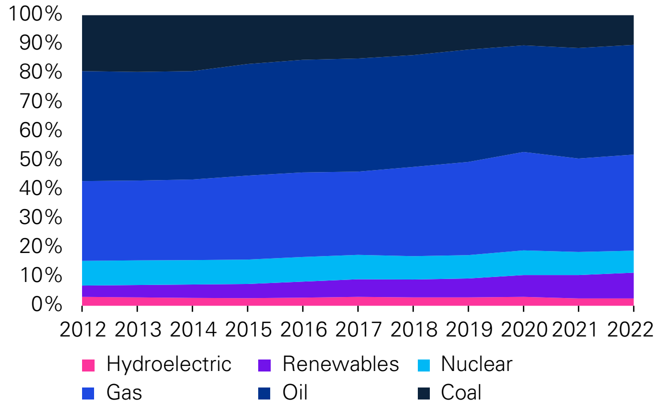
Success and failure

The successes of the renewable energy industry are real. And with the help of supportive policies, renewables routinely notch up record annual growth.[6] But it's also true that renewables can simultaneously succeed beyond anyone's imagination while still failing dramatically to deliver on the promise of a sustainable future. Indeed, while growing rapidly, renewables still account for a tiny sliver of the overall global energy mix, with significant disparities across markets.

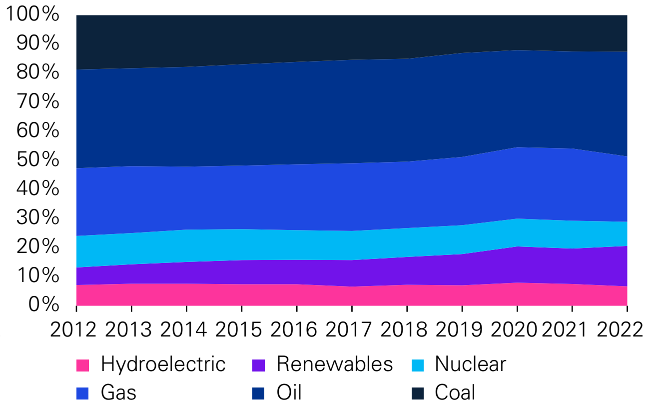
Examining the current pace of renewable deployment reveals significant opportunities for growth. According to IRENA, the world added a record 295 gigawatts of renewable capacity in 2022, an increase of nearly 10 percent over 2021.[7] In the summer of 2023, the IEA forecast that global renewable capacity additions would reach 440 gigawatts for the year and could increase to 550 gigawatts in 2024.[8]

This is impressive growth, yet the shortfall could be more manageable. IEA's bullish projections for 2024 are still 650 gigawatts short of what needs to be added each year by 2030 to limit warming as set out in the Paris Agreement. Acknowledging how much more wind, solar, and energy storage must be built quickly should be enough to spark a sense of urgency across all renewable energy stakeholders. Aligning urgency with strategic measures can help sustain the growth of renewable deployments.

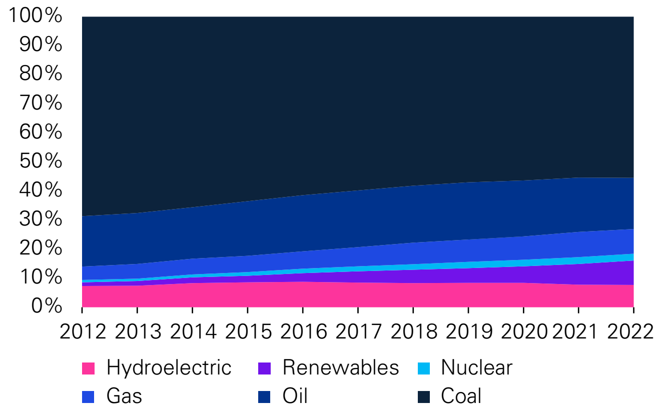
US primary energy shares by fuel



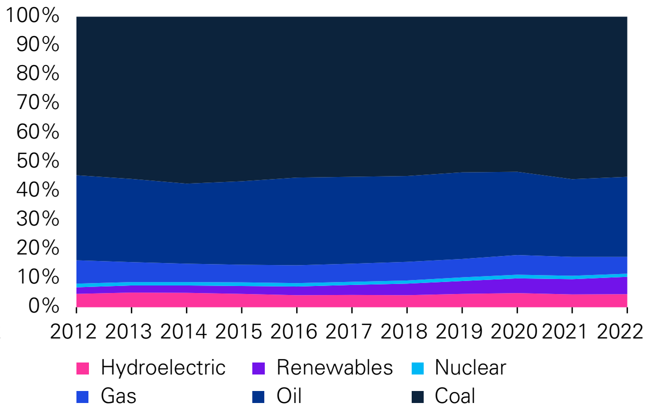
EU primary energy shares by fuel



China primary energy shares by fuel



India primary energy shares by fuel



[6] International Renewable Energy Agency (IRENA), "Record Growth in Renewables Achieved Despite Energy Crisis," 2023
[7] International Renewable Energy Agency (IRENA), "Record Growth in Renewables Achieved Despite Energy Crisis," 2023
[8] International Energy Agency (IEA), "Renewable Energy Market Update: Outlook for 2023 and 2024," 2023

The barriers that will likely define the renewable era

The starting point for effective action is accurately diagnosing the primary challenges preventing a dramatic renewable energy scale-up. Some of these barriers to scale are well-known, like inadequate grid infrastructure, insufficient energy storage and grid flexibility, and delays caused by inefficient permitting and planning processes.

Other challenges need to be better understood, which means that effective strategies and resources to overcome them are lacking. These include obstacles posed by nature and biodiversity concerns, the growing emphasis on social license to build new renewable energy developments, and challenges accessing the financing necessary to fund renewable energy projects.

As a starting point to catalyze action, KPMG professionals recommend an accurate diagnosis of the primary challenges preventing renewable deployment at pace and at scale.

This report aims to highlight the challenges to deploying renewables at the pace necessary to achieve global targets by raising awareness about these challenges and proposing recommendations for overcoming them. As part of the report's development, KPMG surveyed organizations to confirm the need to diagnose barriers to renewables and help identify the most significant challenges to scaling renewables.

Input was received from over 100 survey respondents, including renewable developers, investors, utilities, and other stakeholders from across the globe. Over 80 percent agreed or strongly agreed that significantly accelerating renewable deployments is the most pressing issue requiring attention to meet the Paris Agreement's targets. At the same time, 84 percent reported that current market challenges are causing substantial delays and, in some cases, even the abandonment of renewable energy projects.

This report provides insights about real-world challenges and solutions from KPMG firms' clients, services, and revenues directly engaged with developing, financing, constructing, and interconnecting projects. We also provide an analysis of global policies that are changing the game for renewables, bolstering energy efficiency, and expanding end-use electrification.

The Inflation Reduction Act (IRA) in the US and the European Union's (EU) Green New Deal are notable policies in their respective regions. These policies, with their implications, are being analyzed as countries progress and refine their Nationally Determined Contributions (NDCs) under the Paris Agreement. By considering the findings in this report, organizations can better tailor their approaches towards renewables and emissions.

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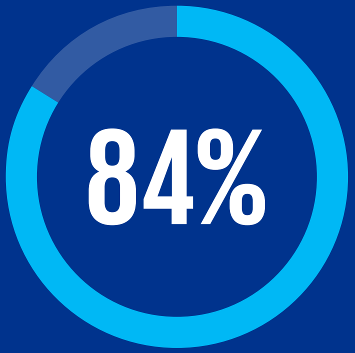

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Barrier 01 Market structures

The flexibility needed to support a significant buildout of intermittent renewable generation is supported by only some current market structures and rules. Many power markets were designed to incentivize conventional power generation, like coal and natural gas, rather than flexible low-carbon resources like energy storage that can fill the gaps when wind and solar generation is low. Market designs in some regions, like the UK, are considering evolution to accommodate the growth of renewables by exploring emissions limits in capacity markets. Other measures, like more significant use of demand-side response measures, stronger carbon price signals, and incentives for long-duration storage, can help speed the transition to renewables.

Barrier 02 Access to capital

Funding the energy transition requires an enormous amount of capital. The International Renewable Energy Agency (IRENA) estimates that cumulative global investments required to achieve the Paris Agreement's climate targets are USD 5 trillion annually over 30 years.[7] High-interest rates and supply chain inflation recently have made attracting investments in some renewable projects and companies more difficult. In contrast, other renewable companies and projects have ample access to capital. Steps necessary to ensure adequate supplies of capital are available to support the scaling of renewables include increasingly integrating renewables with firm power and traded propositions to scaling floating offshore wind to drive down the levelized cost of capital.

Barrier 03 Investment in grid infrastructure

A grid capable of providing reliable electricity while integrating massive additions of intermittent renewable generation will differ from the grid societies have depended on for over a century. A renewables-dominated grid demands flexibility and intelligence to continuously balance supply and demand and maximize power system efficiency and utilization. Grid investments that enable rapid integration of renewables should facilitate the demand-side flexibility electricity customers can provide. They should also advance innovative technologies like artificial intelligence (AI) and machine learning and seek to maximize the myriad of expected benefits energy storage can deliver to a distributed grid with large amounts of renewables.

Barrier 04 Planning and permitting

The energy transition is arguably the world's most ambitious and complex development project. The problem is that it takes far too long to build renewable energy projects and the supporting infrastructure they depend on. For example, a report by the National Academies of Sciences, Engineering, and Medicine in the US calculated that it takes about a decade to move from identifying the need for transmission infrastructure to lines transporting clean electrons.[8] Accelerating necessary permitting and planning approvals requires ensuring that officials responsible for making decisions have sufficient knowledge of renewables and their impacts and that developers provide community benefits that are tangible and clear. Designating geographic areas where renewable planning and permitting are streamlined can be an effective accelerator. Planning and permitting practices that lead to robust deployments of renewables can serve as models for renewable developers and regulators who seek to move faster.

Barrier 05

Accelerating storage solutions

The importance of energy storage in accelerating the deployment of renewables is evident. Because the sun doesn't always shine and the wind doesn't always blow, energy storage is needed to help fill the gaps and keep reliable electricity flowing. To play that important role, energy storage must achieve scale, and storage technologies must provide electricity and other grid services for longer durations. Just as important, energy storage needs to be financially viable. This can be accomplished through long-term contracts that ensure predictable revenue streams that attract financing, state-backed capacity payments, income guarantees, grid codes and ancillary service rules that incentivize storage.

Barrier 06

Supply chain issues

The COVID-19 pandemic laid bare the challenges to scaling renewables that arise when supply chains are disrupted. Higher prices and lack of access to equipment and necessary skills have delayed or canceled many planned projects. Therefore, ensuring resilient and reliable supply chains is one of the foundations of scaling renewables quickly. Solutions to ensure renewable projects have what they need to be developed include geographic diversity of suppliers — critical minerals and equipment manufacturing is currently concentrated in too few countries — but also low-cost financing to encourage additional manufacturing capacity, a skilled workforce, and supply chain traceability and transparency.

Barrier 07

Access to critical raw materials

Scaling renewables requires cost-competitive access to a vast volume of raw materials, like cobalt, nickel, graphite, copper, and lithium. The IEA estimates that mineral requirements for clean energy technologies will need to quadruple by 2040 to meet the Paris Agreement's targets.[9] To make this possible, a lot will have to happen, including expanding mining capacity and diversifying where critical raw materials are sourced. Other steps should also be pursued, including developing supply chains and business models that promote a circular economy, designing products to last longer and be recycled and reused, and innovating to build renewable products using more readily available materials.

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Nature and biodiversity

Earth's growing population depends on healthy ecosystems and biodiversity. Climate change is already accelerating habitat loss and the rate of species extinction.[10] But while nature and biodiversity depend on a stabilized climate, and, therefore, a rapid expansion of technologies such as renewables to limit temperature increases, we also must acknowledge the potential negative impacts of renewable development on nature and biodiversity and take steps to alleviate or avoid them. This can be accomplished by proactively enlisting the guidance of environmental experts in siting projects, leveraging technologies that mitigate impacts on habitat and species, and integrating nature and biodiversity considerations at the earliest possible stages in all renewable developments.

Barrier 09

Social license to operate

Renewables will be scaled more quickly if renewable developers establish a social license to operate. Developers need to secure licenses to operate in the form of permits and government approvals, but they will also need to license the level of acceptance of a project among communities, stakeholders, and the public. While renewable developers often view the community engagement necessary to establish a social license as a barrier, renewables will scale more rapidly and equitably when communities are engaged early as project co-creators.

Barrier 10

Emerging markets

The world's ability to meet both the Paris Agreement's climate targets and individual net-zero commitments heavily relies on the rapid deployment of renewables in emerging markets. Without such accelerated deployment, the global community might find itself relying on fossil fuels for longer than anticipated, given the imperatives of energy security and affordability.

According to the Global Energy Alliance for People and Planet (GEAPP), if emerging economies remain reliant on fossil fuels and developed economies hit their net-zero goals by 2050, the world will be on course to warm by 2.5 degrees Celsius.[11] Catalyzing investments in emerging markets is critical to accelerating renewable development and providing millions of people with life-transforming access to energy. This can be accomplished by facilitating private investment through innovative financing instruments, expanding the role of multilateral development banks, and working with local partners able to mitigate project risks. Emerging markets can also help by establishing clear renewable targets in their Paris Agreement Nationally Determined Contributions (NDCs) and developing policies and regulations that support their goals.

Renewable developers will need to act decisively to overcome these barriers. In this report, we provided detailed insights on each of these pressures and share potential ways organizations can take action. The importance of collaboration is common across many of these recommendations. It is an imperative that will determine the success of the energy transition, which represents a fundamental reordering of how companies, governments, regulators, communities, and individuals interact.

The importance of collaboration across sectors, including industry, academia, and government, is becoming increasingly evident. Such collaborations may involve understanding policies, promoting research, and working towards shared standards. The energy transition is a sprawl of interconnected challenges and opportunities that look different to different stakeholders. Only by collaborating and partnering can renewables reach the scale the world needs. Building those partnerships should start now.

The past few years' events have erased doubts about the need for the renewable energy industry to mature quickly. While it's true that the energy sector is rapidly transforming, three imperatives will remain unchanged. All stakeholders within the energy industry should work together towards ensuring energy security, affordability, and sustainability in the societies they serve. Even as sustainability and decarbonization become more important, citizens are unwilling to sacrifice affordability and security. Until renewable sources can satisfy more energy demand, existing fossil fuel energy sources will continue to play a more critical role in the energy mix.

This was apparent in the aftermath of Russia's invasion of Ukraine, which led to some nations increasing consumption of coal and other fossil fuels to keep the lights on. However, scaling up to meet the Paris Climate Accord ambitions will require much more significant and concerted action on several action theatres, including setting appropriate policy by various countries and enabling implementation, easing barriers to project development, creating enabling transmission infrastructure, aligning supply chains, scaling up finance availability (including for higher risk locations and technologies) and also ramping up human resource capabilities across the ever-expanding clean energy value chain.

It doesn't have to play out this way. There are opportunities for renewables to offer affordable, secure, and decarbonized energy, but their scale and maturity fall short today. We have already seen how consistently renewables can defy even the most optimistic growth expectations. The IEA recently reiterated that a pathway to achieve the ambitions in the Paris Agreement remains viable, albeit narrow.[9] The pathway is feasible due to the ongoing record growth of clean energy.

According to the IEA, achieving the targets necessitates tripling global renewable capacity by 2030. At KPMG, we understand the dynamic nature of the renewable energy industry. This report is an embodiment of our dedication to helping organizations navigate the ever-evolving renewable market landscape.

The barriers identified in this report are not always uniformly challenging to all renewable technologies. For example, access to capital is an acute barrier to offshore wind projects and somewhat less so for solar and onshore wind. Advances in energy storage, however, are less significant to offshore wind projects than for solar and onshore wind. Specific barriers, like supply chain issues, are equally vexing to solar, onshore and offshore wind, and bioenergy.

Grasping the scale of the challenges and identifying solutions to overcome them is an important start. Many respondents of the KPMG survey hold this view. While they recognize the steps required to scale renewables to address global climate goals, only 36 percent are optimistic that renewable energy generation will surpass that of fossil fuels by 2050.

Barrier intensity across renewable energy technologies

Barrier	Critical scaling required by 2030		Prioritize technology development and ecosystem creation for the next wave of technology		Future resources: Concentrating on driving innovation
	Solar	**Wind**	**Offshore wind**	**Bioenergy**	**Geothermal**
Barrier 1: Planning and permitting	High	High	High	Medium	High
Barrier 2: Investment in grid infrastructure	High	High	High	Medium	High
Barrier 3: Critical minerals	Medium	Medium	Medium	Low	Low
Barrier 4: Storage solutions	High	High	Medium	Medium	Low
Barrier 5: Social license to operate	Medium	Medium	Medium	Low	Low
Barrier 6: Nature and Biodiversity	Medium	Medium	Medium	High	High
Barrier 7: Supply chain issues	High	High	High	High	Medium
Barrier 8: Access to capital	Medium	Medium	High	Medium	High
Barrier 9: Emerging markets risks	Medium	Medium	High	Medium	High
Barrier 10: Market structures	Medium	Medium	High	Medium	High

Low Medium High

[9] International Energy Agency (IEA), "Net Zero Roadmap: A Global Pathway to Keep the 1.5 °C Goal in Reach," 2023

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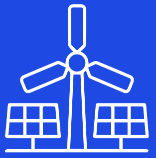
Market structures

On the morning of June 6, 2023, the wind did not blow across a section of the US stretching from North Dakota down to Texas. According to the independent system operator which runs the wholesale market in the US Midwest, the 32,000 megawatts of wind capacity installed across that region produced just 110 megawatts of electricity.[10]

Fortunately, grid operators were able to dispatch enough electricity to meet the demand of this increasingly wind-dependent region of the world. But those windless late spring hours also highlighted a structural challenge that must be addressed to scale renewables rapidly. Electricity markets around the globe were not designed with the energy transition in mind. Adapting these structures might be necessary to accommodate the increasing integration of renewables.

At first glance, it may seem as though the growth of renewables is moving along just fine. According to the Energy Institute's 2023 Statistical Review of World Energy, which was produced in collaboration with KPMG and Kearney, our extensive research showed 2022 saw record deployments of renewables worldwide, including double-digit growth in nearly every region of the globe. Globally, wind and solar accounted for a record 12 percent of power generation, with solar generation increasing 25 percent and wind rising 14 percent compared to 2021. This robust growth benefits the millions of consumers who now have access to cheaper renewable power. But digging a bit deeper reveals several significant challenges to the continued rapid scaling of renewables, many of them related to inadequate market structures.

As that windless early June morning in the US made clear, one is the risk to grid reliability as the influx of renewables accelerates. This is more than a technical challenge because of the intermittent nature of most renewables and the fact that societies increasingly rely on electricity to fuel transportation, heat and cool buildings, and power manufacturing. That rising dependence on electrification makes grid outages less and less tolerable, and if they increase, outages threaten the energy transition.



Globally, wind and solar accounted for a record 12 percent of power generation, with solar generation increasing

25 percent

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compared to 2021.

Markets aren't designed to reward flexibility

Many power markets were designed for conventional power generation, based on coal or gas, rather than intermittent renewables, like wind and solar. As more renewables have been built around the world, the job of filling the gaps when wind and solar produce little or no electricity has historically been handled by coal and natural gas power plants.

With the increasing emphasis on net-zero targets, the role of fossil fuels in maintaining grid reliability is a topic of discussion, especially in the power sector. For example, fossil fuel-powered peaker plants that ramp up quickly to meet demand when renewable generation wanes produce expensive energy and heavy emissions. According to a report by the NGO Clean Energy Group, peaker plants emit not only substantial amounts of carbon dioxide over a short period of operating time, but their emissions also include sulfur dioxide, nitrogen oxides, and fine particulate matter that can contribute to heart disease, asthma, and other illnesses.[11] In the US, peaker plants also tend to be located in disadvantaged communities, exacerbating the negative social impacts of their continued operation and underscoring the importance of a social license.[12]

The goal of market design is to balance the growth of renewables deployment with grid reliability, and its effectiveness can differ across regions. Seventy-five percent of renewable energy stakeholders surveyed said that market structures and design were a highly significant obstacle to scaling renewables.

[10] Flatland, "Wind Nearly Stopped Blowing Through Midwest Turbines in June," 2023
[11] Clean Energy and Strategen, "The Peaker Problem: An Overview of Peaker Power Plant Facts and Impacts in Boston, Philadelphia, and Detroit," 2022
[12] Clean Energy Group. "Phase out Peakers." Clean Energy Group, Clean Energy Group. 2021

We can consider incentivizing adding flexible capacity to deliver low-carbon or carbon-free power when it's cloudy and windless to help ensure grid reliability and scale renewables. This is not straightforward, but solutions do exist. The influx of intermittent renewable generation has resulted in such an oversupply of clean energy in European electricity markets that prices have sometimes fallen into negative territory.[13] Investments in flexible capacity are not attractive when prices are low or negative, and load factors are falling.

Reimagining how to use market forces to reward low-carbon flexibility

Historically, capacity payments, strategic reserves, and capacity markets have rewarded plants fueled by coal or gas. A transition to net zero would require innovative market designs that result in ample low-carbon flexible capacity.

Several capacity market designs aim to bolster the availability of low or low-carbon flexible capacity. These markets use different designs to encourage the construction of flexible generators. In the UK, for example, the grid operator, ESO, runs auctions to procure sufficient capacity to meet future peak demand.

In Germany, Sweden, and Finland, generators are kept in reserve to meet demand during emergencies, like extreme heat or cold or widespread outages. Greece and Italy provide capacity payments to generators to be available when demand peaks. The payments depend on the amount of capacity generators can supply at a price dictated by the system operator. In Chile, we have seen the full integration of capacity markets and low-

carbon support mechanisms into 'firm power auctions,' which have delivered cheap, reliable low-carbon power, drawing on the country's vast wind and solar resources.

One idea to drive that transition is introducing emissions limits to capacity markets. In early 2023, the UK government proposed introducing emissions limits into the capacity market in the future. Another idea is to set targets for deployments of low-carbon flexible generation and to subsidize new forms of low-carbon generation, like hydrogen.

A demand-side response can also help ensure the grid stays balanced when demand spikes and renewables are the dominant generation resource. But this will require more powerful market signals to encourage households, businesses, and industrial customers to reduce their consumption when the grid is strained. According to the IEA's Net Zero Scenario, 500 gigawatts of demand response need to be added to markets by 2030.[14]

Fixing the broken interconnection process

Another step grid and market operators can take to assure grid reliability and propel far greater renewable deployment simultaneously is to reform interconnection processes to diversify generation supplies and spread risk. Looking at the numbers, there seem to be areas in the interconnection process that could be improved.

[13] PV Magazine, "New episodes of negative or zero prices in European electricity markets," 2023
[14] International Energy Agency (IEA), "Tracking Clean Energy Progress 2023," 2023

In the US, the Lawrence Berkeley National Lab reported that interconnection backlogs grew by 40 percent in 2022, totaling 1,350 gigawatts of generation and 680 gigawatts of storage. This translates into years-long wait times for the new generation to connect to the grid.[15] Grid connection delays are also commonplace in Australia.[16]

This delay also produces unhelpful and unintended consequences. For example, generation and storage project developers often submit interconnection applications for far more projects than they could realistically complete because they want to increase the likelihood of securing enough precious interconnection agreements. The volume of unviable phantom projects slows the lengthy interconnection process further.

Without significant change, interconnection queues in the US may increase because of the feverish development triggered by IRA incentives. Utilities in charge of interconnection are in an unenviable spot. They must balance and navigate a surge of EV interconnection requests and increases in customer-owned distributed energy resource (DER) ownership. DERs can reduce demand and revenues at a time when new investments are needed to reinforce the grid for increasing numbers of EVs and additional electrification.

Initiatives from around the globe provide ideas about how interconnection times can be slashed. For example, a connect and manage philosophy has helped speed renewable grid connections in the UK and Germany. In this approach, interconnection studies are limited to the infrastructure upgrades needed to connect a generation asset to the grid physically. Because studies that examine power delivery take place later, renewables can connect to the grid faster if they are willing to accept the higher risk of grid congestion and curtailment. After adopting the approach in the UK in 2011, interconnection times were reduced by 17 percent.[17]

This was not a quick and sustainable fix for UK interconnection woes, given that grid connections for renewables remain excessively long.[18] Indeed, the UK is now moving to a new approach of 'Invest and Connect' to address continuing delays. In Germany, connect and manage is part of a more comprehensive interconnection process that has allowed renewables to connect to the grid in as little as one or two years.[19] Germany also requires renewable developers to secure planning and siting approvals before they apply for interconnection and mandates that renewables be prioritized in the interconnection process.[20]

Generation and storage project developers often submit interconnection applications for far more projects than they could realistically complete because they want to increase the likelihood of securing enough precious interconnection agreements.

Market structures need to be informed by the latest commercial insights from renewable developers. Companies need to engage proactively with policymakers, supported by robust evidence, to help deliver market designs that accelerate the deployment of renewables while striving to ensure the security of supply and minimizing costs to consumers.

Simon Virley, CB FEI
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[15] Lawrence Berkeley National Laboratory (LBNL), "Queued Up: Characteristics of Power Plants Seeking Transmission Interconnection As of the End of 2022," 2023
[16] Financial Review, "Slash grid delays to get the energy transition back on track," 2023
[17] Office of Gas and Electricity Markets (OFGEM), "Monitoring the 'Connect and Manage' Electricity Grid Access Regime," 2013
[18] The Guardian, "'Lack of vision': UK green energy projects in limbo as grid struggles to keep pace," 2023
[19] BloombergNEF, "Germany's Grid Holds Up Against Renewables Influx So Far," 2023
[20] Energy Policy, "The Grid Access of Energy Communities: A Comparison of Power Grid Governance in France and Germany," 2022

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Our recommendations

Though the problem of slow and backed-up interconnection queues is notably acute in the US, it is an issue that utilities and renewable developers grapple with around the world. But there are also promising reforms and advances worldwide that can provide guidance and inspiration to accelerate deployments of renewables. Recommendations include:

1. **Introducing emissions limits into capacity markets.**
This can help drive the low-carbon flexibility of a power system with a large percentage of renewable needs. Rather than continued reliance on unabated gas, which is inconsistent with a net-zero power system, emissions limits encourage gas plus carbon capture utilization and storage (CCUS) and hydrogen power generation. The UK has proposed introducing carbon emissions limits in the capacity market.[21]

2. **Greater use of demand-side response.**
Demand-side response can potentially reduce peak demand, lowering consumer costs and reducing greenhouse gas emissions. PJM, America's largest grid operator, has implemented measures to leverage the value of demand-side response.[22]

3. **Utilize firm power markets.**
The deployment of renewables plus storage is encouraged when auctions are run for firm, reliable, and low-carbon power. This approach is a feature of Chile's electricity markets.[23]

4. **Greater interconnection.**
The EU has set a target of at least 15 percent of its generation from interconnection. This helps provide greater resilience and diversity of supply in cases of disruption in any single country.[24]

5. **Pursue grid access and connection reform.**
Access to the power grid remains a significant barrier to the rapid deployment of renewables. Reforming regulations to speed grid access is needed and is happening in places like Germany.[25]

6. **Stronger carbon price signals.**
Stronger carbon price signals will encourage the deployment of low-carbon flexibility rather than unabated fossil fuels. The EU and California have embraced this approach with their emissions trading schemes.[26]

7. **Introduce incentives for long-duration storage.**
The UK recently proposed a regime to stimulate investments in long-duration storage, including hydrogen storage, like those used for interconnectors. This will be essential to help complement the growth of intermittent renewables.[27]

[21] Department for Business, Energy & Industrial Strategy, "Carbon Emissions Limits in the Capacity Market Guidance," 2022
[22] PJM Demand Side Response Operations, "2022 Distributed Energy Resources (DER) that participate in PJM Markets as Demand Response," 2023
[23] Energy Strategy Reviews, " Chile's electricity markets: Four decades on from their original design," 2022
[24] European Commission: Energy, Climate Change, Environment, "Electricity interconnection targets," 2023 energy.ec.europa.eu/topics/infrastructure/electricity-interconnection-targets_en, Accessed 4 Oct. 2023
[25] Reuters, "German regulator identifies 5,000 km to aid green power switch," 2023
[26] European Commission: Climate Action, "EU Emissions Trading System (EU ETS)," 2023, climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets_en, Accessed 23 Oct. 2023
[27] Department for Energy Security & Net Zero, "Hydrogen transport and storage infrastructure: minded to positions," 2023

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Access to capital

Scaling up the deployment of renewables requires an enormous amount of investment. IRENA recently released a report outlining a pathway to limit the rise in average global temperatures to achieve the ambition of the Paris Agreement.[28] IRENA estimates that the required cumulative global investment to accomplish this goal is USD 150 trillion. This equates to an average of USD 5 trillion annually over 30 years. The total global gross domestic product (GDP) in 2022 was just over USD 100 trillion.[29]

It's important to note that renewable investments can take several forms. The most common include:

- Equity investments via capital markets into renewable developers, known as strategic, and directly into renewable assets, known as yieldcos.
- Private equity capital from institutions and funds investing directly into renewable companies and assets.
- Bank and institutional investments into renewable assets using debt instruments.
- Major renewable developers also raise capital by issuing bonds.

2022 was a record year for renewables investments; IRENA estimates that wind, solar, and other clean energy projects attracted about USD 1.5 trillion. According to the IEA, 2023 is set to be another record year for clean energy investments, with over USD 1.7 trillion expected.[30] The IEA also forecasts that investments in solar projects will surpass those for oil production for the first time in 2023.

Such significant year-on-year record investment figures are not a surprise. The renewable industry is driving a wide range of new deal volumes across the energy transition space. A few examples include:

- Projects focused on flexible energy generation that can ensure grid systems are adapted to variable demand needs.
- Increasing interest in hydrogen as a power source and across its supply chain, from production to distribution, storage, and other industry applications.
- Technology development is needed to explore alternative renewable sources.
- Wider services and supply chains linked to the expanding renewable industry.

Despite that success, the gap between the necessary investments to adequately scale renewables and the money deployed is vast. At a time when wind, solar, and other clean energy developers need access to unprecedented amounts of capital, there are daunting challenges that need to be overcome to accelerate the pace and scale of the energy transition.

Challenges to renewable financing

The transition to renewable energy requires an enormous amount of capital. Upgrading the grid to integrate more renewables, investing in buildings to be more energy efficient, and electrifying transport can only happen when ample supplies of capital are available.

In the past, capital-intensive renewables benefitted from low-interest rates, which kept the cost of capital relatively low. But over the past few years, interest rate hikes have significantly raised the cost of capital for renewable projects. For example, the International Monetary Fund (IMF) recently reported that central bankers in advanced economies have increased interest rates by an average of 400 basis points since late 2021; in emerging economies, the average interest rate hike has been 650 basis points.[31]

The aggressive interest rate increases across the world have been to counteract increasing inflation. In the EU, for example, the IMF reports that the inflation rate in 2021 was 2.9 percent. By 2022, the inflation rate rose to over 9 percent and fell to 6.5 percent in October 2023.[32]

The transition to renewable energy requires an enormous amount of capital. Upgrading the grid to integrate more renewables, investing in buildings to be more energy efficient, and electrifying transport can only happen when ample supplies of capital are available.

[28] International Renewable Energy Agency (IRENA), "World Energy Transitions Outlook 2023, Volume 1," 2023
[29] World Bank, "World Development Indicators database," 2023, databank.worldbank.org/source/world-development-indicators, Accessed 3 Oct. 2023
[30] World Energy Investment 2023, International Energy Agency (IEA), May 2023
[31] International Monetary Fund (IMF), "Higher-for-Longer Interest Rate Environment is Squeezing More Borrowers," 2023
[32] International Monetary Fund (IMF), "Inflation rate, average consumer prices: Annual percent change," 2023, imf.org/external/datamapper/PCPIPCH@WEO/OEMDC/ADVEC/WEOWORLD Accessed 10 Oct. 2023

High inflation has influenced the cost dynamics of renewable energy projects. For example, steel, the primary material used in utility-scale solar and onshore wind projects, rose 160 percent in the US and 270 percent in Europe between the beginning of 2020 and the high point of commodity prices in 2022.[33]

Similar increases in copper, polysilicon, aluminum, and other commodities essential to renewables have also risen and contributed to commodities and transportation costs accounting for an estimated 30 to 35 percent of the capital costs of utility-scale wind and solar projects — which is twice as much as 2020.[34] Corporate power purchase agreements (PPA) reflected these increased costs. For example, even after inflation rates began to subside in early 2023, PPA prices in North America increased by over 6 percent compared to 2022 in the first quarter of 2023.[35]

High wholesale energy prices in 2021 and 2022 also benefitted renewable projects by driving higher valuations and reducing or eliminating the need for government subsidies. But in recent months, as inflation and interest rates have risen, wholesale energy prices have decreased, putting even more pressure on the economics of renewable projects. For example, international power prices peaked in August 2022 at between USD c.420-600 per megawatt-hour and have since declined steadily.

This mix of high-interest rates, inflation, and declining power prices has had real-world impacts on the valuation of renewable developers. For example, the average pipeline value of the biggest renewable European developers decreased from USD c.660k per megawatt in September 2022 to USD c.295k in September 2023. Additionally, these same companies' average enterprise value/EBITDA declined from 13.75X in September 2022 to 12.75X in September 2023. These myriad factors help explain why 48 percent of renewable energy stakeholders surveyed said access to capital was a highly significant obstacle to scaling renewables.

Steps to expand access to capital

Although renewables as an underlying infrastructure investment is challenged, a lot of capital is focused on the areas that spin out of renewables, like supply chains, energy services, and technology-oriented energy businesses. It is a different, more capital growth-oriented investment proposition in many areas. In many ways, it is more capital-light and seeking solutions to the technical and commercial challenges of net zero. This is the space where impact and energy transition funds are focusing now.

While there are challenges in renewables financing, the industry has demonstrated resilience. For example, there continues to be strong demand for renewable projects in many regions of the world. Several regions globally, such as the Middle East, have displayed a strong commitment to the energy transition.

In addition, several East Asian strategics and financials are seeking to expand their capacity to serve their booming domestic markets by pursuing mergers and acquisitions (M&A) in Europe across renewable platforms and infrastructure providers. Another example in this space is the strategic partnership announced in December 2020 between Octopus

Actions stakeholders can take to provide the investments renewables need to scale quickly:

1. Integrate with firm power and traded propositions to drive more value from electrons
2. Focus on scaling floating offshore wind
3. Open more markets for renewables such as hydrogen, e-methanol and ammonia
4. Plan strategically on grid connection
5. Support policies and procedures to streamline permitting
6. Provide specific supply chain support.

[33] International Energy Agency (IEA), "Will solar PV and wind costs finally begin to fall again in 2023 and 2024?" 2023
[34] International Energy Agency (IEA), "Will solar PV and wind costs finally begin to fall again in 2023 and 2024?" 2023
[35] Utility Dive, "Renewable energy PPA prices continue to rise despite Inflation Reduction Act relief: LevelTen," 2023

Energy and Tokyo Gas to penetrate the Japanese renewable market,[36] which was further supported by the recent licensing of Octopus' platform in October 2023.[37] Likewise, Octopus Energy invested in solar-focused Yotsuya Capital in April 2023, aimed at supporting Japan's transition to renewable energy.[38]

Many renewable strategics have ample cash supplies and are pursuing value opportunities, while renewable funds and financial institutions alike are making significant investments.

Market dynamics suggest that energy price trends may influence access to capital for renewables. However, relying solely on increasing energy prices is not a viable solution to adequately address the climate crisis. For organizations that are exploring the renewable sector, we've identified a few strategies that have been effective in securing investments to scale operations quickly.

Our recommendations

- Renewables need to integrate more with firm power and traded propositions to drive more value from electrons.
    - Developers must conceptualize projects by taking the wider green economy into account, including supply chain integration.
- Governments are unlikely to return to untargeted subsidies and instead should focus on specific areas where there are obvious market failures, including:
    - Scaling floating offshore wind so the levelized cost of capital comes down.
    - Targeted support to opening more markets for renewables, including specific green hydrogen for the grid, e-methanol, and ammonia, which creates greater commercial optionality for renewables.
    - Strategic planning on grid connection to reduce delays.

As an M&A advisor, the last 18 months have been perhaps the toughest to date to mobilize appetite, marry up buyer and seller expectations, and get deals done.

Developers are playing their part to drive capital back. Integrated solutions across different technologies and assets combining growing trading sophistication drives much more value from green electrons. Alignment and partnerships with major energy users and hard to abate sectors enable longer term investment decisions together. Combining these approaches provides a big opportunity to decouple renewables, at least operationally, from largely unconnected commodity cycles and geo-political environment; and towards the true value of reliable low carbon energy on a mass scale.

Adrian Scholtz
Partner and UK Head of Renewables
KPMG in the UK

[36] Octopus Energy Group, "Octopus Energy Group Enters Asia with landmark partnership with Tokyo Gas," 2020
[37] Octopus Energy Group, "Konnichiwa Kraken! Tech platform licensed by Tokyo Gas to manage 3 million Japanese homes," 2023
[38] Octopus Energy Group, "Octopus Energy kicks off Asian renewables push with first Japanese solar deal," 2023

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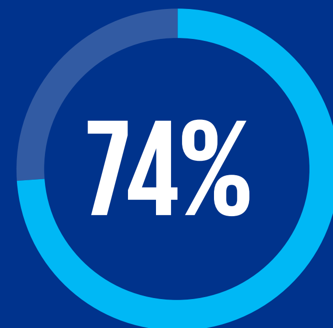
Investment in grid infrastructure

Several years ago, the National Academy of Sciences in the US released a list of what it considered the top engineering achievements of the 20th century. At the very top, above the Internet, automobiles, and spacecraft, was electricity.[39]

The accolade was a recognition of the marvel that is the electric grid; people and businesses assume that the electricity needed to switch their lights on or to power their operations will be there. And it almost always is. But the grid emerging as the engine for today's modern, net-zero world will little resemble the power system of the 20th century, which relied on large, fossil fuel power plants sending electricity long distances in one direction to homes and businesses.

Instead, a truly net-zero grid will need to integrate large amounts of intermittent renewable generation. It will also be far more decentralized than before, with customer-owned distributed energy resources (DERs) like rooftop solar and battery storage often located where power is consumed. DERs enable an "energy democracy," where local communities have an unprecedented say in how energy is generated and distributed. This is true in any community where individuals can leverage DERs to make decisions about energy production and consumption. But it is especially true in developing nations where grid power doesn't reach many communities and DERs can play a transformative role in energy access. The rise of DERs could represent a movement towards a more democratized energy landscape.

According to a survey of renewable energy professionals,



said a lack of new grid investments is a barrier to scaling renewables.

This renewables-dominated, decentralized grid will also be highly digitized, enabling the use of machine learning, artificial intelligence (AI), and the Internet of Things (IoT) to balance supply and demand, identify grid infrastructure that needs to be fixed before causing an outage, and optimize the overall efficiency and reliability of the power system. Advances in grid technologies are essential to drive momentum in the trend toward decarbonized electrification. But they aren't happening quickly enough. According to a survey of renewable energy professionals, 74 percent said a lack of new grid investments is a barrier to scaling renewables.

[39] The National Academy of Engineering, "A Century of Innovation: Twenty Engineering Achievements That Transformed Our Lives," 2003

What should grid investments accomplish?

A decarbonized, decentralized, and digitized grid can be every bit the marvel its 20th-century predecessor was. However it will benefit from smart and strategic policies and regulations to incentivize transformative grid investments. To realize that potential, policies, rules, and investments in grid infrastructure can be designed to achieve these four outcomes:

Enable renewable energy integration

The IEA Net-Zero Roadmap has clarified that limiting average global temperatures in line with the Paris Agreement depends on tripling renewable energy capacity by 2030.[40] Accelerating the integration of unprecedented volumes of intermittent wind and solar generation requires a grid with enormous flexibility and intelligence to balance supply and demand consistently by routing excess energy to where it is needed most. This ability to efficiently manage supply and demand bolsters grid utilization while enhancing system reliability. This becomes increasingly important as more transportation, building heating and cooling, and industrial uses depend on electricity.

Support distributed energy resources

The energy transition depends in part on millions of individuals and companies across the globe continuing to purchase rooftop solar panels, energy storage, and other DERs. In the US alone, the DER market is forecast to double between 2022 and 2027.[41] While adding so many DERs near where electricity is consumed has many benefits — such as eliminating energy losses from transmitting and distributing electricity long distances and making communities more energy independent — it also comes with challenges. Unlike traditional power plants, for example, DERs introduce bi-directional power flows, which, if unmanaged, can result in grid voltage and frequency issues that threaten grid equipment and trigger outages.

Facilitate energy storage

Energy storage technologies can provide much of the flexibility that a grid with significant amounts of intermittent renewable energy demands. While energy storage technologies themselves can be improved, investments and policies can be geared to prepare the grid and incentivize additions of this important source of flexibility. With enough energy storage — including short-duration and seasonal storage technologies — the grid can become a platform for storing excess renewable energy for peak demand and to support greater electrification.

Enable digitalization

An onslaught of sensors, smart meters, and data analytics capabilities is already transforming the grid. According to the IEA, the number of smart meters deployed worldwide surpassed one billion in 2022.[42] Leveraging digital tools to collect and analyze data can make the grid more efficient, reliable, and secure. Policies and investments can support an increasingly digitalized grid while ensuring a robust defense against the growing threat of cyberattacks.

[40] International Energy Agency (IEA), "Tripling renewable power capacity by 2030 is vital to keep the 1.5 C goal within reach," 2023
[41] Wood Mackenzie, "Transformation in the US distributed energy resource market," 2023
[42] International Energy Agency (IEA), "Unleashing the benefits of data for energy systems," 2023

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Challenges to grid infrastructure investments, but signs of change

Because the grid has operated in essentially the same manner for well over a century, the policies, rules, and paradigms guiding investments have not needed to evolve, and because electricity is so fundamental to the functioning of global societies, the risk of change can feel acute.

As the energy sector evolves, reconsidering regulatory barriers may better support grid infrastructure investments and the broader incorporation of renewables. Around the world, there are encouraging steps in this direction, including:

- The Federal Energy Regulatory Commission (FERC) in the US has implemented a series of regulations to incentivize the development of a more modern and resilient grid infrastructure. FERC Order 841, for example, requires regional transmission organizations (RTOs) and independent system operators (ISOs) to establish rules for energy storage systems to participate in wholesale energy markets.[43] Separately, FERC Order 2222 requires RTOs and ISOs to develop rules allowing aggregations of DERs to participate in wholesale markets for energy and grid services.[44]
- The Connecting Europe Facility (CEF) established by the EU provides funding for cross-border infrastructure projects. The CEF awards grants and loans to support smart grids, energy storage, and interconnections between national energy systems — creating a new level of interregional connection that can link excess supplies of renewables to demand rather than curtailing carbon-free generation.[45]

To support the transport of so much clean energy, we need both a large-scale transmission system and more modern power networks, with the capacity to integrate the growing volume of renewable sources. These increasingly modern and digitalized networks can help guarantee the reliability, efficiency, and flexibility of electrical systems. These new, more complex, more technological and innovative networks require an adaptation in the design and structures of markets.

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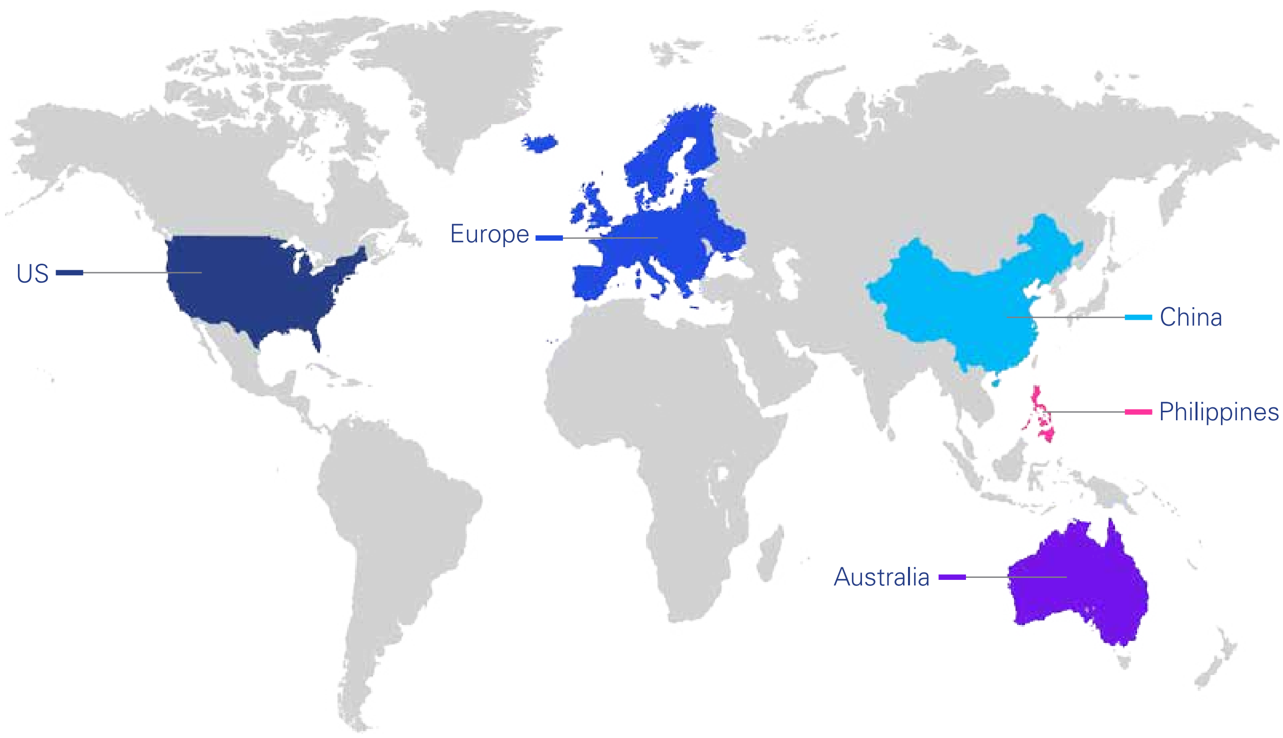
Global Leader, Power & Utilities, KPMG International



[43] Federal Energy Regulatory Commission (FERC), "Order No. 841," 2018
[44] Federal Energy Regulatory Commission (FERC), "FERC Order No. 2222: Fact Sheet," 2020
[45] Connecting Europe Facility (CEF), "About Connecting Europe Facility," European Commission, 2022, cinea.ec.euopra.eu. Accessed 12 Oct. 2023.

- The Australian Energy Regulator (AER) has implemented a regulatory framework that incentivizes electricity distribution companies to invest in grid improvements. The framework incentivizes companies that deliver services efficiently, reduce grid costs, and impose penalties for those not meeting performance targets.
- Similarly, the Philippines' Energy Regulatory Commission (ERC) has embraced a performance-based regulation (PBR) framework that incentivizes electricity distribution companies to improve the quality and reliability of their services. The PBR framework sets performance targets for distribution companies and provides financial incentives for those that meet or exceed their targets.
- China has enacted a broad suite of reforms designed to reach peak emissions by 2030 and carbon neutrality by 2060. According to an analysis by KPMG China, that nation has made significant progress in developing smart grid technology to enhance demand side management (DSM) and energy efficiency.[46] This has included creating a database power system that connects power supply information to grid, load, and energy storage data. Transmission and distribution infrastructure investments have improved renewable energy delivery across regions and provinces. Investments in smart grids are vital to achieving China's goal of reducing energy consumption by nearly 14 percent per unit of GDP by 2025.

How to drive necessary grid investments: Foster collaboration and innovation

A common complaint among grid operators is that regulatory constraints prevent them from making proactive investments that could accelerate decarbonization. For example, grid operators in the US often can't get the approval needed to upgrade substations and other grid infrastructure required to support electric vehicle (EV) charging. This is true even when the operator knows that a large fleet of EVs is scheduled to arrive in the next few years.

Regulatory frameworks can play a role in the growth of renewables and other energy transition technologies by considering incentives that encourage renewable development and the technologies and grid infrastructure needed to integrate them. This can be done to ensure the grid's safety, reliability, and security while promoting competition and innovation. Work can also be accomplished in tandem with urban planners and city officials. Cities produce 60 percent of the world's greenhouse gas emissions.[47] Integrating urban and grid planning can be a powerful force for achieving urban net-zero targets. This type of Local Area Energy Planning (LAEP) can benefit from leadership by local governing bodies. This could enhance accountability and avoid perceptions of conflict of interest if grid companies lead them.

A holistic and forward-looking development process that doesn't lose sight of the decarbonization goal is recommended.

Regulatory frameworks can play a role in the growth of renewables and other energy transition technologies by considering incentives that encourage renewable development and the technologies and grid infrastructure needed to integrate them.

[46] KPMG China, "Smarter Grids: Powering Decarbonisation Through Technology Investment," 2023
[47] United Nations, Climate Action, "Generating Power," 2023

Principles to guide grid investment rules, policies and regulatory activities

The following principles can guide grid investment rules, policies, and regulatory activities:

1. **Commit to collaboration.**
Grid operators can work collaboratively with other stakeholders in the energy system, including energy producers, regulators, consumers, and policymakers, to create an energy system able to scale renewables rapidly. This can include weighing the different interdependencies and regions of the energy system to plan impactful grid investments and rules that efficiently integrate renewables and account for their variability and intermittency. By providing funding, establishing regulations, and implementing performance-based frameworks, regulators play a crucial role in encouraging energy companies to invest in grid infrastructure to support the transition to a low-carbon energy system.

2. **Foster innovation and new technologies.**
With the deployment of smart grid technology, energy storage systems, sensors, and flexible transmission and distribution networks, the modernization of grid infrastructure is underway. Grid operators and regulators can gear their work to encourage the deployment of technologies supporting renewable integration and grid reliability, including vehicle-to-grid technology and the large-scale buildout of public and residential EV charging stations. Grid operators and regulators can also tap the potential of behavioral psychology to predict energy consumption patterns better. This can result in proactive grid investments that enable greater renewable energy consumption. Innovation often goes hand in hand with regulatory evolution, which is already happening in some nations. For example, innovation enablement in the UK includes Electricity North West's CLASS (Customer Load Active System Services) initiative, which deploys voltage controllers in substations to manage peak electricity demand.

3. **Enlist customers in flexible demand response.**
Energy consumers have a direct role in driving decarbonization and ensuring grid reliability. The growing numbers of DER owners have earned the name "prosumers" for their ability to act as both mini power plants and traditional energy consumers. Planners can consider leveraging the role of demand response and demand flexibility to accelerate the adoption of renewables. This includes understanding how consumers can contribute to balancing electricity supply and demand in real-time and designing grid infrastructure to support demand response programs. It also means finding innovative ways to ensure that people who don't own their own homes or live in multi-family housing have opportunities to participate and benefit from demand response and the proliferation of DERs.

4. **Double down on energy efficiency.**
It can be easy to overlook the value of energy efficiency in supporting renewables integration and grid reliability. This is a mistake. Grid operators and regulators have an opportunity to incentivize the potential for energy efficiency improvements in buildings, appliances, and industrial processes and design infrastructure to support energy-efficient technologies better.

5. **Embrace education.**
The emergence of prosumers has expanded individuals' awareness of how much energy they use and how it is produced. However, a decentralized and decarbonized energy system requires that energy literacy become the norm rather than the exception. When people understand how energy is produced and distributed, they can voice their preference for renewables to utilities, regulators, and policymakers. It could become a standard component in school curricula to advance energy literacy. While some energy literacy initiatives exist, there's room for a more comprehensive approach. For example, the Electric Power Research Institute (EPRI) developed a curriculum and activities to teach US high school students about basic energy and electricity concepts, different generation types, and how to decide about energy portfolios. Similar courses have been offered in other countries, including Nigeria, but much more could be done to improve energy literacy.[48] The uptake of EVs presents an educational opportunity because it changes how the public engages with energy.

[48] Electric Power Research Institute (EPRI), "Elevating Energy Literacy in Nigeria," 2023

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Planning and permitting

As the world seeks to address climate change, a transition to an energy system primarily powered by renewables has become pivotal. Across the world, however, the planning and permitting processes required to build wind, solar, energy storage, transmission, and other projects essential to deep decarbonization should be moving faster.

For example, in the US, one analysis found that it takes an average of four years to permit, site, and develop a utility-scale wind or solar power plant.[49] A report by the National Academies of Sciences, Engineering, and Medicine in the US calculated that it takes about a decade to move from identifying the need for transmission infrastructure to lines transporting clean electrons.[50]

The pace of planning and permitting is no faster in other countries. In Croatia, Sweden, and many other nations, it can take over ten years to complete the development of an onshore wind farm. Offshore wind projects are even more time-consuming. For example, in the United Kingdom (UK), it takes an average of 12 years to plan, permit, and develop an ocean-based wind power plant.[51] This challenging reality helps explain why nearly half of the renewable energy industry professionals surveyed by KPMG International said that planning and permitting bottlenecks are significant obstacles to scaling renewables. Another 30 percent said they are a moderate obstacle.

Speedier approvals that still encourage public input

Shortening the time needed to move projects through mandatory approval processes is seen by industry leaders as an essential step towards scaling renewables sufficiently to meet 2030 greenhouse gas emissions reduction targets and, eventually, a net-zero world. But in any reform to existing planning and permitting processes, acknowledging and respecting citizens and communities' role in the approval process is critical.

Speedy approvals that don't consider local communities' input are not the best way to foster enduring support for the energy transition. Stakeholders should consider maintaining the transparency and due diligence of existing planning and permitting processes. But the processes can be reimagined to align with the pressing societal goal of building a net-zero economy. There is a balance to be struck. While avenues for local community involvement can be preserved, KPMG professionals can also recognize that the rapid deployment of renewable energy is an overriding public interest.

Diagnosing the problem

Effective planning and permitting reforms are essential to identify and rectify current inefficiencies. Though jurisdictions worldwide vary and have strengths and weaknesses, several common deficiencies exist, resulting in most survey respondents feeling neutral or uncertain about the effectiveness of current governmental policies. One challenge observed is the need for a clearer long-term strategy in policy and regulation that aligns with net-zero objectives. Establishing a paradigm in which the planning and permitting of renewable projects is viewed through the prism of advancing net-zero progress could accelerate approvals.

Another shortcoming is a need for more basic knowledge about the operation and impacts of renewable technologies among those responsible for planning and permitting approvals. This is problematic for many reasons. Already slow and rigid permission processes, for instance, can be delayed even more when those responsible for guiding discussions, evaluating feedback, and ultimately making decisions must first educate themselves about the basics of renewables.

Finally, many existing planning and permitting mechanisms don't include tools and incentives to mitigate public and stakeholder opposition to proposed projects. Whether the opposition is well-intentioned or self-serving, the results are legal challenges and procedural delays that slow or halt often worthwhile and necessary projects.

Planning and permitting issues are being increasingly recognized as bottlenecks to renewables deployment across jurisdictions and addressed in recent policies such as REPowerEU. From speaking with a wide range of influential stakeholders, KPMG professionals have found that several key planning and permitting improvement areas are common across jurisdictions, most notably adequate resourcing of statutory bodies, strong strategic direction in policy, streamlined and simplified planning procedures, increased collaboration, and clear prioritization of renewable energy projects.

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KPMG in Ireland

[49] Worley, Princeton University, and Andlinger Center for Energy + the Environment, "From ambition to reality: Weaving the threads of net-zero delivery," 2021
[50] The National Academies of Sciences Engineering Medicine, "Accelerating Decarbonization of the US Energy System," 2021
[51] Energy Transitions Commission, "Streamlining planning and permitting to accelerate wind and solar deployment," 2023

Three common deficiencies in planning and permitting reform:

Lack of long-term direction
in policy and regulation

Lack of basic knowledge
about the operation and impacts of renewable technologies

Lack of tools and incentives
to mitigate public and stakeholder opposition to proposed projects

Building on hopeful momentum

There is a growing awareness and action about the need to reform renewables planning and permitting. For example, in the aftermath of Russia's 2022 invasion of Ukraine, the European Union (EU) committed to accelerating renewable energy deployments to decrease dependency on imported gas, enhance energy security, and accelerate progress towards the EU's 2050 net-zero target.[52]

RePowerEU is the continent-wide set of energy-related actions responding to Russia's invasion and the energy crisis it spawned. Spearheaded by the European Commission (EC), REPowerEU includes specific recommendations to simplify and speed up the complex and time-consuming permitting processes that prevent projects from being built quickly.[53]

Among REPowerEU's recommendations are for planning and permitting bodies to recognize that renewable energy is an overriding public interest. This recognition would help address the current imbalance that allows renewable projects to stall when priority is given to other societal interests. Another REPowerEU proposal would establish dedicated go-to areas for renewable development with short and straightforward permitting processes and a cap on the time allowed to debate permitting decisions.

Drawing inspiration from both the allocation of drilling blocks in the oil and gas industry and the establishment of national parks, a compelling approach emerges. Governments often set aside specific blocks for drilling based on potential hydrocarbon reserves. In a similar vein, Renewable Energy Blocks (REBs) can be designated, highlighting areas with optimal renewable energy potential. These REBs, akin to national parks, protect and prioritize their inherent value, in this case, renewable resources. Just as drilling blocks expedite the oil and gas exploration process, REBs would streamline the planning, permitting, and development of renewable projects, addressing key barriers to scaling renewables.

In Texas, the heartland of America's oil and gas production, the introduction of REBs has been instrumental in sparking a significant upswing in wind and solar energy projects by streamlining and prioritizing permitting. The Netherlands and Denmark have also embraced a one-stop approach to permit and build new renewables quickly. At the same time, Germany recently passed a law that requires 1.7 percent of its land mass to be set aside for wind development by 2027 and 2 percent by 2032.[54]

In the UK, several recommendations to streamline permitting have been proposed to the nation's National Grid Electricity Operator (ESO), Office of Gas and Electricity Markets (Ofgem), and other government agencies. These include reforming the interconnection queue to prioritize the 330 gigawatts of renewables currently awaiting a grid connection to move forward. Another proposal would amend the UK's National Planning Policy Framework (NPPF) to allow onshore wind and solar projects that have garnered "sufficient" local support to move ahead.

[52] RePowerEU, "RePowerEU at a glance," European Commission, 2022, commission.europa.eu. Accessed 5 Oct. 2023.
[53] RePowerEU, "RePowerEU at a glance," European Commission, 2022, commission.europa.eu. Accessed 5 Oct. 2023.
[54] DW, "Germany's Scholz pledges rapid onshore wind power expansion," 2023

Three principles to improve planning: Collaboration, simplicity, and prioritization

While examples of improved planning and permitting are encouraging, they remain the exception rather than the norm. As more nations and permitting jurisdictions consider reforms, their efforts can be guided and improved by these principles:

Promote collaboration towards achieving shared objectives. The world knows how to set clear and ambitious net-zero targets. Over 150 countries and hundreds of corporations intend to become carbon-neutral or powered by 100 percent renewable energy.[55, 56] Those responsible for planning and permitting approvals can communicate the clear connection between the rapid growth of renewables and the achievement of climate goals. They can also integrate the objective of quickly scaling renewables into their policy and regulatory activity through reduced complexity. Increased engagement between the clean energy industry and policymakers in formulating rules can also help. Collaboration between regulators, renewable developers, and communities benefits everyone.

Promote clarity and equip decision-makers with the necessary knowledge. It's no longer viable for knowledge about renewables to be scarce in the offices where permitting decisions are made. Devoting resources to hire knowledgeable staffers is worth the investment; the learning curve for inexperienced staff can be shortened by soliciting industry expertise. Any reform to permitting and planning processes can seek to make rules more streamlined, simplified, and repeatable. Designed properly, permitting and planning can be a tool to promote rather than inhibit the scaling of renewables. Technology can also play an important role in modeling and visualizing the potential impacts of renewable projects, which can help inform decisions.

Enhance the prioritization of renewable energy projects in planning and decision-making. Stakeholders can be vocal in their support of renewables. The subject of the debate can evolve from net-zero goals, and all stakeholders can seek consensus that accelerating renewables is the vehicle to reduce emissions rapidly.

New forms of incentive. Renewable projects present a range of advantages with potential societal impacts. But sometimes, those benefits need to be understood more personally to convince communities to support new projects. Planning and permitting can move faster when, for example, new wind and solar projects lower the energy bills of surrounding communities, and that benefit is clearly communicated to them. The benefits need to be obvious and well-understood by community members. Besides lower bills for those living near renewable projects, improved infrastructure like roads and schools can result from renewable development. Renewable companies can also consider offering training and the opportunity for high-quality careers to people in the communities where they work.

[55] Climate Group RE100, "RE100 Members," 2023, there100.org/re100-members. Accessed 15 Sept. 2023

[56] Net Zero Tracker, "Data Explorer," 2023, zerotracker.net, Accessed 26 Oct. 2023

Principles to improve planning and permitting

Work together towards a clear target

Ensure simplicity and give decision makers the expertise they need

Loudly **prioritize renewables**

Clearly **communicate** new forms of incentives

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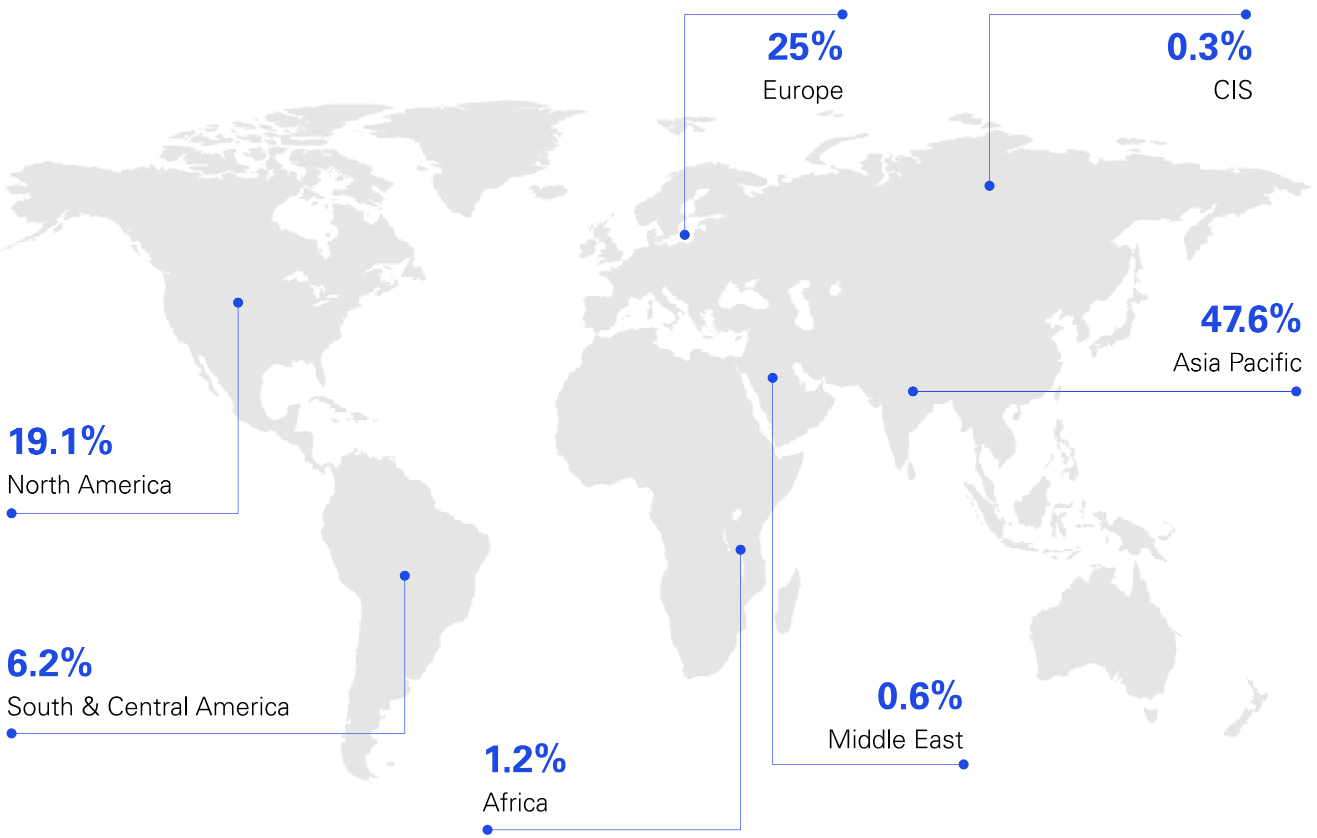
Accelerating storage solutions

For nine hours in May of 2023, Spain's electric grid ran entirely on renewable energy.[57] It wasn't the first time a large electricity market had been supplied by 100-percent renewable generation. In March of 2023, Brazil broke a record for renewable energy production when renewables represented 90 percent of all energy generated in the country. A year earlier, California briefly produced more renewable energy than the US state (and fourth-largest economy in the world) required.[58] Smaller nations like Portugal have also achieved the same feat for much longer periods of time.[59]

The reason these milestones attract headlines is because they are so rare. Over 60 percent of global electricity generation is produced with fossil fuels — an amount the IEA says will have to fall below 30 percent by 2030 for the world to reach net-zero carbon emissions.[60] However, tremendous advances in energy storage are necessary for deployments of renewable energy to reach the scale required to make periods of 100- percent renewable electricity production more the norm than the exception.

The reason energy storage is so vital to rapidly scaling renewables is obvious. Because wind and solar are intermittent and depend on favorable weather conditions, power grids with abundant renewables need resources to help meet demand when the sun is behind the clouds and the wind is calm. In the context of renewables, flexibility is the ability to immediately fill gaps in supply as wind and solar generation ebb and flow. Power grids with large amounts of renewables need the flexibility that energy storage can provide.

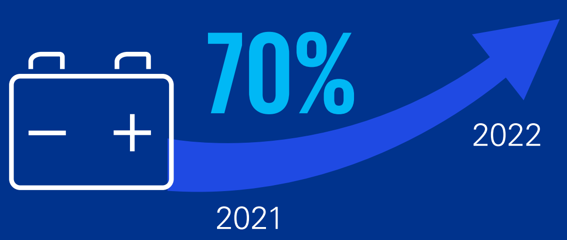
Renewables: Renewable power generation*



[57] El País, "The nine hours in which Spain made the 100% renewable dream a reality," 2023
[58] Bloomberg, "California Poised to Overtake Germany as World's No. 4 Economy," 2022
[59] The Guardian, "Portugal runs for four days straight on renewable energy alone," 2016
[60] Electricity Market Report 2023, International Energy Agency (IEA), February 2023

Without flexibility provided by energy storage, achieving higher levels of renewable integration becomes challenging. Power systems with large amounts of renewables also need to replace the grid balancing services, such as frequency and voltage regulation, that traditional generators have historically supplied to maintain grid reliability. Energy storage can enhance grid reliability by providing voltage stability, frequency regulation, and peaking capacity. Storage paired with renewables can also reduce the need to build additional grid infrastructure by lowering grid congestion and maximizing the use of existing capacity. This is possible because energy storage co-located with renewable generation has higher utilization potential than wind or solar generation alone.

According to Bloomberg New Energy Finance (BNEF), 2022 saw the installation of 16 gigawatts (GW)/35 gigawatt-hours (GWh) of energy storage capacity globally, an increase of nearly 70 percent from 2021.



Momentum builds for energy storage, but there is more to achieve

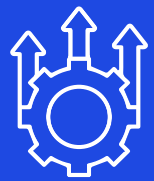
The past few years have seen significant deployments of energy storage. According to Bloomberg New Energy Finance (BNEF), 2022 saw the installation of 16 gigawatts (GW)/35 gigawatt-hours (GWh) of energy storage capacity globally, an increase of nearly 70 percent from 2021.[61]

The pace of deployment is accelerating quickly. In October 2022, BNEF projected that cumulative energy storage installations would reach 411 GW/1,194 GWh by the end of 2030.[62] However, six months later, that forecast had to be revised upward to 508 GW/1,432 GWh.[63] Myriad drivers are propelling the growth of energy storage, which today is predominantly provided by pumped hydropower and growing amounts of lithium-ion battery storage.

One driver of storage growth is the ability to provide the necessary flexibility to balance grids with increasing amounts of renewables. Another is the opportunity for energy storage owners to earn revenue by delivering grid services and participating in wholesale markets. Other uses spurring demand for storage include its application in microgrids, co-location with renewables to optimize valuable grid connections, and uninterrupted backup power supply at commercial and industrial facilities.

However, the current growth rate of energy storage might not match the anticipated rise in renewable energy capacity. Grid-scale battery storage, for example, must grow 35-fold by 2030 to be on course for net zero by 2050, according to the IEA. By the IEA's estimates, grid-scale battery storage alone must reach 970 GW by 2030, nearly double what BNEF projects for all energy storage capacity by then.[64]

Energy storage challenges extend beyond the need to expand capacity massively. Energy storage must



Drivers of the growth in energy storage:

1. Flexibility to balance grids with increasing amounts of renewable energy
2. Opportunity to earn revenue from grid services and wholesale markets
3. Application in microgrids
4. Optimization of valuable grid connections
5. Uninterrupted backup power supply at C&I facilities

[61] Bloomberg New Energy Finance (BNEF), "1H Energy Storage Market Outlook," 2023
[62] BNEF, "Global Energy Storage Market to Grow 15-Fold by 2030," 2022
[63] BNEF, "1H Energy Storage Market Outlook," 2023
[64] International Energy Agency (IEA), "Tracking Clean Energy Progress 2023," 2023

also deliver electricity and other services to the grid for increasingly long durations. Currently, utility-scale batteries have durations ranging between two and 10 hours, with the vast majority at the bottom end of that range.[65] Storage solutions capable of providing extended or seasonal durations will be needed for times of the year, like in winter when solar production is low and during times when wind is insufficient to produce much energy. Eventually, seasonal storage solutions could replace short-duration storage, but both need substantial development and improvement. These longer-duration storage options will likely require different technologies, including hydrogen storage

Financial viability is the first of many challenges to solve

Energy storage deployments will only accelerate to the level a renewables-dominated grid requires when projects are financially attractive to investors and developers. That is not currently the case because most energy storage projects lack sufficient contracted revenue to facilitate access to financing. Current power market designs, which are heavily dependent on fossil fuels, have resulted in a lack of revenue certainty for other energy solutions like renewables. This is a challenge for all energy storage technologies but is a particular problem for large-scale technologies like pumped hydro that take a long time to build.

Other challenges preventing rapid energy storage deployments include:

- **Supply chain constraints**. The demand for the critical minerals necessary to produce energy storage is unprecedented and growing, thanks in large part to competition from the producers of EV batteries. Pressures on mining, processing, and cell manufacturing can be expected to increase and are likely to slow project delivery times and put upward pressure on prices. While most apparent for battery energy storage, other types of energy storage are not immune. For example, pumped hydro needs significant engineering expertise and skilled construction labor to build projects. Their geographic concentration also threatens access to minerals in relatively few countries and exposure to geopolitical risks. There are also challenges to converting gas storage to hydrogen storage that must be overcome.
- **Grid access**. Energy storage can play a significant role in supporting a rapid scaling of renewables only if it can connect to the grid. But the wait times and costs of getting more energy storage on the grid are growing, especially in the US. For example, a report by the Lawrence Berkeley National Laboratory (LBNL) found that transmission queues in the US had about 670 GW of storage projects awaiting connection.[66] The US Department of Energy (DOE) has also found that long delays translate into ballooning project costs.[67]
- **Talent shortage**. It's not difficult to find news articles and analyses lamenting the shortage of skilled workers in the solar and wind industries.[68, 69] This coverage has triggered action to begin closing the gap. Energy storage faces an equally wide gap between the supply of skilled employees and growing demand, yet policymakers and other stakeholders have not prioritized adequately staffing the industry.

Energy storage deployments will only accelerate to the level a renewables-dominated grid requires when projects are financially attractive to investors and developers.

Challenges preventing rapid energy storage deployment:

1. Supply chain constraints
2. Grid access
3. Talent shortage

[65] National Renewable Energy Laboratory (NREL), "Annual Technology Baseline," 2023
[66] Lawrence Berkeley National Laboratory (LBNL), "Grid connection requests grow by 40% in 2022 as clean energy surges, despite backlogs and uncertainty," 2023
[67] US Department of Energy's Office of Energy Efficiency & Renewable Energy, "Tackling High Costs and Long Delays for Clean Energy Interconnection," 2023
[68] The Washington Post, "The next labor secretary will face a big shortage of clean-energy workers," 2023
[69] S&P Global, "Skills shortage imperils global energy transition," 2022

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Innovative market design can enhance energy storage feasibility

A key immediate step to enhance energy storage capacity is ensuring long-term revenue predictability for potential investors. Market dynamics and power system needs vary considerably around the globe, meaning no single solution applies everywhere. And it's vital for any proposed changes to encourage investment that doesn't distort the rest of the market.

Stakeholders can achieve multiple objectives at once through well-designed policies on energy storage. Thoughtful policies can unlock the benefits of energy storage by catalyzing private sector investment and minimizing the need for subsidies.

Decision-makers can harness the power of appropriately designed market signals that reward the unique system benefits that energy storage can provide. One example is the recently implemented suite of frequency response products in the UK. These are dominated by battery storage because market requirements demand rapid, sometimes sub-second response times and build on the revenue streams already available to battery developers and owners.

Additional innovative market design can include strategies such as:

Long-term system operator contracts. These provide storage assets with a predictable revenue stream over a longer period, which makes it easier to attract financing to fund storage development. For example, the UK's Short-Term Operating Reserve (STOR) allows for fixed-price contracts of up to two years and has been widely utilized by pumped hydro projects.

State-backed capacity payments that compensate storage assets just for being available benefit newer or less established storage technologies because they mitigate the risk that the assets will be underutilized in other markets. These payments can go a long way towards making projects financially viable and encouraging the deployment of larger projects. And the development of large projects helps to drive economies of scale and subsequent technology cost reductions, which speeds deployment.

Income guarantees. Cap and floor contracts are excellent examples of income guarantees that have successfully enabled private sector investment in higher-risk energy infrastructure. This contract structure guarantees long-term minimum and maximum revenues for new projects, providing revenue certainty to mitigate against volatile energy prices. This has been highly successful at bringing forward investment in interconnectors in the UK and is currently proposed as the mechanism for bringing forward large-scale, long-duration storage such as pumped-hydro.

Contracts for difference. These agreements guarantee a fixed payment for each megawatt-hour of power output. Allocated via auction, the guarantee ensures that storage asset owners receive a top-up payment if market prices fall below the contracted rate. This protects them against low prices and improves investor confidence.

State equity/grant funding. State funding can alleviate the initial capital outlay required for energy storage projects and encourage private investment by reducing risk. An excellent example of this approach is the US IRA, which provides up to 30 percent tax credits to support energy storage projects.

Incentivize grid services. Grid codes and ancillary service rules can be formulated to incentivize the selection of the low-carbon flexibility energy storage provides over fossil fuel-based balancing services. Smart market design can also ensure storage assets can participate in a broad range of wholesale market and grid services, including:

- **Transmission**: Ensure wholesale markets, ancillary services, and capacity schemes are accessible to various storage technologies.
- **Distribution**: Ensure constraint management and voltage support schemes are accessible and attractive to storage assets.
- **Behind-the-meter**: Innovative tariffs can incentivize the use of storage to minimize customer exposure to high prices and enable aggregating storage assets into Virtual Power Plants (VPPs) that provide grid services.

There is an increasing demand for not only higher renewables penetration and products such as round the clock power but also for flexible and schedulable green energy. Hence, storage has become the key ingredient on which climate ambitions around the world closely depend. The key would be to leverage all technologies available whether this is batteries, pumped hydro, hydrogen and other innovative technologies to meet varied requirements. While renewables are cheaper than fossil fuels in most parts of the world, adding storage can affect economic adversely today. Hence, the key imperative is to massively focus on bringing down costs through scale, partnerships, supply chain transformation as well as revenue optimization through value stacking enabled by smart market design and commercial frameworks.

Anvesha Thakker
Partner & National Lead — Clean Energy
KPMG in India

Government-industry collaboration and investment to tackle storage challenges

There are other immediate steps that stakeholders should pursue to help scale storage deployment. Approaches to eliminate barriers preventing a rapid increase in energy storage capacity include:

Prioritize speedy grid connection. It might be beneficial for authorities to consider revising approval processes to facilitate quicker connection of storage facilities. Current processes slow project progress and disincentivize new projects.

Invest in tackling supply chain constraints. Governments and industry should invest in broadening the supply chain, reducing dependency on single regions or suppliers, and limiting exposure to geopolitical risk. Favorable policies such as grants, tax breaks or low-interest financing can help incentivize a build-out of local supply chain capabilities.

Collaborate to close the talent gap. Energy storage companies can proactively engage with academic institutions to develop programs focused on energy storage. These programs can provide the skills and education students need to install energy storage systems and pursue research to improve the performance of storage technologies. Government education campaigns highlighting the importance of energy storage in a decarbonized energy system can raise awareness and encourage students and workers to pursue a career in the industry.

Provide resources to advance storage technologies. Consideration could be given to the potential benefits of increased research and development (R&D) funding in reducing the costs of storage technologies. R&D can improve existing storage options' performance and drive the innovation necessary for new technologies to emerge.

Steps government and industry can take to scale storage deployment:

Prioritizing speedy grid connection

Investing to tackle supply chain constraints

Collaborating to close the talent gap

Providing **resources** to advance storage technologies

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Supply chain issues

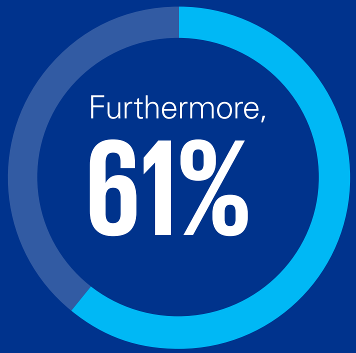
The connection between resilient supply chains and renewable energy deployment came into sharp focus during the COVID-19 pandemic. Ready-to-build renewable energy projects stopped when COVID-19 lockdowns led clean energy manufacturing facilities to stop or slow production.

In the US, the Solar Energy Industries Association (SEIA) calculated that one-third of solar capacity scheduled to be completed in the fourth quarter of 2021 was delayed due to transportation backlogs and lack of equipment. SEIA also found that solar developers canceled 5 percent and delayed nearly 10 percent of the projects they had planned for 2022 and 2023.[70]

More recently, supply chain problems have been a primary cause of delays in offshore wind projects. In August of 2023, for example, the developer of large offshore wind projects off the eastern coast of the US cited supply chain issues in announcing delays of three projects and the potential slowdown of more.[71] Challenges are evident beyond the US as well. The Global Wind Energy Council (GWEC) recently downgraded its near-term offshore wind forecast for North America and Europe by 17 percent, partly because of supply chain challenges.[72] Furthermore, 61 percent of renewable energy industry stakeholders surveyed by KPMG International cited supply chain risks as a significant obstacle to scaling renewables.

A lack of equipment needed to develop projects isn't the only negative impact of snarled supply chains. Prices also rise when supply chains aren't functioning correctly. LevelTen Energy tracks renewable power purchase agreement (PPA) prices in Europe and North America. Throughout the pandemic, LevelTen's PPA Index rose steadily before moderating recently.[73] The main reason: Between 2020 and 2022, prices of solar cells and modules increased by over 40 percent, mainly due to a six-fold rise in polysilicon prices and other supply chain problems.

Optimizing supply chain processes may play a significant role in scaling renewables to reach the world's targets rapidly. The IEA projects that global renewable power capacity must exceed 10,000 gigawatts to achieve net-zero carbon dioxide emissions by 2050.[74] Under that scenario, the world must add between 800 and 900 gigawatts of solar and wind each year, a significant increase from the nearly 300 gigawatts installed in 2022. Broken and disrupted supply chains threaten to put that pace of deployment out of reach.



of renewable energy industry stakeholders surveyed by KPMG International cited supply chain risks as a significant obstacle to scaling renewables.

[70] Solar Energy Industries Association (SEIA" and Wood Mackenzie, "US Solar Market Insight," 2022
[71] Reuters, "Cost crunch prompts mass rethink of US offshore wind contracts," 2023
[72] Global Wind Energy Council, "Global Offshore Wind Report 2023," 2023
[73] LevelTen Energy, "LevelTen's PPA Price Index Q2," 2023
[74] International Energy Agency (IEA), "Net Zero by 2050: A Roadmap for the Global Energy Sector," 2021

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The risks of a geographically concentrated supply chain

It would be a mistake to believe the challenge of building reliable supply chains is limited to the unique disruptions spawned by a global pandemic. While the demand for renewables is growing globally, the raw materials and manufacturing capacity needed to produce solar panels, wind turbines, energy storage, and other clean energy components are concentrated in a few countries.

The geographic concentration of global renewable supply chains carries significant risks	
Solar Energy	• China produces most of the silicon used to make solar panels.[75] Polysilicon manufacturing is spearheaded by just ten companies, seven based in China.[76] • In 2020, floods forced the closure of the Chinese factory of Tongwei, the world's largest polysilicon producer, resulting in a sharp rise in global polysilicon and solar module prices.[77]
Wind Energy	• China produces about 60 percent of the world's wind blades.[78] • The wind industry relies on commodities like steel, copper, and aluminum, all of which have experienced high price volatility due to COVID-19 and Russia's invasion of Ukraine.[79]
Batteries	• Battery storage production depends on reliable access to minerals like nickel, lithium, cobalt, manganese, and graphite, the supplies of which are in a handful of countries, such as Australia, China, Chile, and the Democratic Republic of Congo.[80]

Even with significant increases in production capacity across the world by 2030, China is forecast to continue to dominate solar, wind, and battery manufacturing. The US, India, and the EU all have ambitious plans to grow their renewable supply chains.

When the materials and production capacity for renewable technologies are in a few countries, the availability of low-priced shipping to transport goods around the globe becomes paramount. Recent experience demonstrates this can't be taken for granted, given the significant increase in shipping costs during and after COVID-19. Dramatic increases in prices for international shipping in recent years contributed to a large uptick in the cost of all renewable energy components.[81]

[75] Statista Research Services, "Major countries in silicon production worldwide in 2022," 2023
[76] PV Magazine, "Tongwei led global polysilicon capacity in 2022, says Bernreuter Research," 2023
[77] PV Magazine, "Tongwei led global polysilicon capacity in 2022, says Bernreuter Research," 2023
[78] Nikkei Asia, "Chinese manufacturers dominate wind power, taking 60% of global market," 2023
[79] Journal of Economic and Financial Sciences, "Metal price behavior during recent crises: COVID-19 and the Russia-Ukraine conflict," 2023
[80] Statista Research Services, " Major countries in worldwide lithium mine production in 2022," 2023
[81] International Monetary Fund (IMF), "How Soaring Shipping Costs Raise Prices Around the World," 2022

Auxiliary equipment and social impact challenges

Encouraging progress has been made to expand the production of renewable energy technologies to meet rising demand. For example, announced capacity additions can expand polysilicon production by three-and-a-half times and double the manufacturing of solar cells and modules.[82]

These announcements have yet to become reality, of course, but a less-recognized challenge that could derail the rapid expansion of renewables is insufficient production of the other components that go into making clean energy equipment. Solar panels, for example, need high-quality glass and gels and must eventually be installed on mounting systems on roofs, in the ground and, increasingly, floating on the water. The manufacturing capacity of this often overlooked but essential auxiliary equipment has not kept up with the pace of demand, leading to predictable results. A shortage of solar-grade glass in 2020 resulted in price hikes of 70 percent, raising the price of panels.[83]

Supply chain risks also include the social impacts that result from the extraction of critical minerals vital to the energy transition. For example, the 2022 *book Cobalt Red* detailed child labor and what many observers have described as "modern slavery" in mining the cobalt needed for lithium-ion batteries used in EVs and energy storage.[84] A Natural Resources Defense Council (NRDC) report found that lithium mining in Chile threatens access to precious water resources for Indigenous communities.[85]

A higher standard and legislative mandates

Renewable energy supply chains are held to higher human rights and environmental protection standards than the fossil fuel industry. Media stories and reports from advocacy groups about ecological degradation and human rights abuses in the renewable energy supply chain can have a negative reputational impact that can slow clean energy deployments.

Besides simply being the right thing to do, several other drivers can spur the renewable energy industry to proactively tackle the challenges of building an equitable, sustainable, and high-capacity supply chain. Earlier this year, for example, the European Union's (EU) Corporate Sustainability Reporting Directive (CSRD) went into effect. The CSRD requires about 50,000 companies to report information about the environmental impacts of their operations, including supply chain, human rights, diversity, and other social metrics.[86] The EU also recently rolled out a new Battery Directive aimed at addressing human rights and lowering the environmental impact of the production of batteries.[87]

Developed and developing nations are prioritizing ensuring reliable, clean energy supply chains. This can often translate into government investments in domestic manufacturing or preferential treatment of imports from countries viewed as allies. The domestic and global demand for renewable products will be determined by a mix of factors, including issues like human rights and environmental impact, as well as strategic and geopolitical concerns.

Concentrated supply chains expose the global ambitions on clean energy to deep vulnerabilities which can have far reaching consequences to climate targets. Addressing this through diversifying supply chains is not only an imperative but also presents an attractive opportunity for equitable growth. Global energy transition is set to evolve to a USD 4.5 trillion annual opportunity by 2050 which will likely require countries strong in manufacturing and with a supply of skills to step up, collaborate globally and innovate to emerge as credible alternate supply chain hubs for clean energy.

Anvesha Thakker
Partner & National Lead — Clean Energy
KPMG in India

[82] International Energy Agency (IEA), "Renewables 2022: Analysis and Forecast to 2027," 2023
[83] Bloomberg, "Glass Shortage Threatens Solar Panels Needed for Climate Fix," 2020
[84] St. Martin's Press, "Cobalt Red: How the Blood of the Congo Powers Our Lives," 2022
[85] Natural Resources Defense Council (NRDC), "Lithium Mining Is Leaving Chile's Indigenous Communities High and Dry (Literally)," 2022
[86] European Commission Business, Economy, Euro, "Corporate sustainability reporting," 2023
[87] European Commission: Energy, Climate Change, Environment, "Batteries," 2023

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Recommendations to overcome supply chain issues

Diversity, technology improvements, and transparency can overcome challenges

The renewable energy industry has an opportunity to think expansively and act decisively to overcome supply chain challenges proactively. KPMG professionals' recommendations include:

1. **Diversify, diversify, diversify.**
Reliance on a few countries to produce renewable equipment threatens the large-scale deployment of clean energy the world needs. Today, there are only 15 gigawatts of solar module capacity outside China.[88] Policies seek to bring production capacity closer to demand. But much more can be done to scale and diversify manufacturing. Some nations have considered mobilizing low-cost financing to aid manufacturing capacity in specific developing regions.[89] A focus on producing necessary auxiliary equipment can accompany capacity expansions of solar, wind, and battery storage technologies. Individual nations can also take advantage of inherent advantages they hold across specific parts of the supply chain.

2. **Avoid technology obsolescence.**
It is the nature of rapid technology innovation that the equipment in renewable energy manufacturing facilities becomes outdated quickly. Factories that lack digitalization, automation, and other advances are at a distinct disadvantage against competitors and can't drive the cost improvements that encourage rapid renewable adoption. In some sectors, financial instruments are being considered to help manufacturers address technology obsolescence challenges, paired with capacity-building efforts. Alternate materials research and development (R&D) and initiatives to improve the development of low-cost manufacturing facilities that promise faster paybacks can also spur capacity expansion.

3. **Ensure a skilled workforce.**
In 2022, the global renewable energy industry employed nearly 13 million people. By 2030, the number of people with jobs in renewables could reach 38 million.[90] In some nations, a large percentage of the jobs are in manufacturing. For example, 1.6 million of the 2.7 million jobs in China's solar industry are in the production of products like polysilicon and solar cells and modules. Today, a gap exists between the demand for workers needed to manufacture and install renewables and the available talent pool. This makes attracting and retaining workers more expensive, making renewables pricier. To help ensure an ample and skilled workforce, nations can do more to support technical training courses, apprenticeships, and other educational resources. These efforts must also emphasize gender and social inclusion to foster diversity in thinking, approach, and an inclusive and just energy transition.

4. **Commitment to transparency.**
Traceability and transparency are vital to avoiding supply chain-related environmental and human rights abuses. Also significant is the more widespread adoption of sustainable production, including greater use of renewable energy to power manufacturing and a greater embrace of circular economy practices to reduce waste. Already, some new global legislation requires companies to be able to trace the supply of the finished equipment used for renewable projects back to individual mine sites. Some renewable companies work directly with mining suppliers to obtain and document assurances that their environmental and social practices meet legal standards. This also addresses customer concerns and increases demand for clean energy products. Adherence to reporting requirements like those developed by TNFD, the Task Force on Climate-Related Financial Disclosures (TFCD), and the International Sustainability Standards Board (ISSB) can also build consumer and investor confidence.

KPMG recommendations to proactively overcome supply chain challenges:

1. Diversify, diversify, diversify
2. Avoid technology obsolescence
3. Ensure a skilled workforce
4. Commit to transparency

[88] Renewable Energy World, "New tool showcases solar manufacturing outside of China," 2022
[89] World Economic Forum, "These developing countries are leading the way on renewable energy," 2022
[90] International Renewable Energy Agency (IRENA), "Renewable Energy and Jobs Annual Review 2022," 2022

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Critical raw materials

It seems counterintuitive, but tripling the scale of renewable deployments depends on the success of one of the world's most extractive industries: mining. An extensive analysis found that the volume of solar panels, wind turbines, energy storage systems, and other clean energy technologies that need to be rapidly manufactured and installed demands an unprecedented supply of raw materials, like copper, lithium, cobalt, nickel, and graphite.

They are indispensable to a low-carbon economy, and as a result, demand for them is estimated to increase four-fold by 2040. Demand for the raw materials needed to manufacture clean energy technologies is soaring. The IEA recently reported that the market for the materials required for the energy transition doubled over the past five years, and investments in critical mineral development increased by 30 percent in 2022 alone.[91]

We do not, however, have the current capacity to meet this demand and must scale up production, explore alternative supply chains and look at ways they can stay in life for longer.

For example, the quantity of copper required to replace the global fleet of 1.4 billion internal combustion vehicles with EVs far outstrips the total amount ever produced. The availability of other metals and materials is equally dire, particularly within the short timeframe in which many renewable projects need to be completed.

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30%

in 2022 alone.

One of the encouraging points about sourcing the supply of critical minerals is that, by and large, we know where they exist around the planet. Global skills and techniques are also largely available to extract them. The difficulty is in the global collaboration of effort needed to bring them to market in an affordable manner. Increasingly, we see governments establish funds with the express purpose of accelerating developments.

Trevor Hart
Global Mining Leader,
KPMG International

[91] International Energy Agency (IEA), "Critical Minerals Market Review 2023," 2023

The complex landscape of raw material acquisition

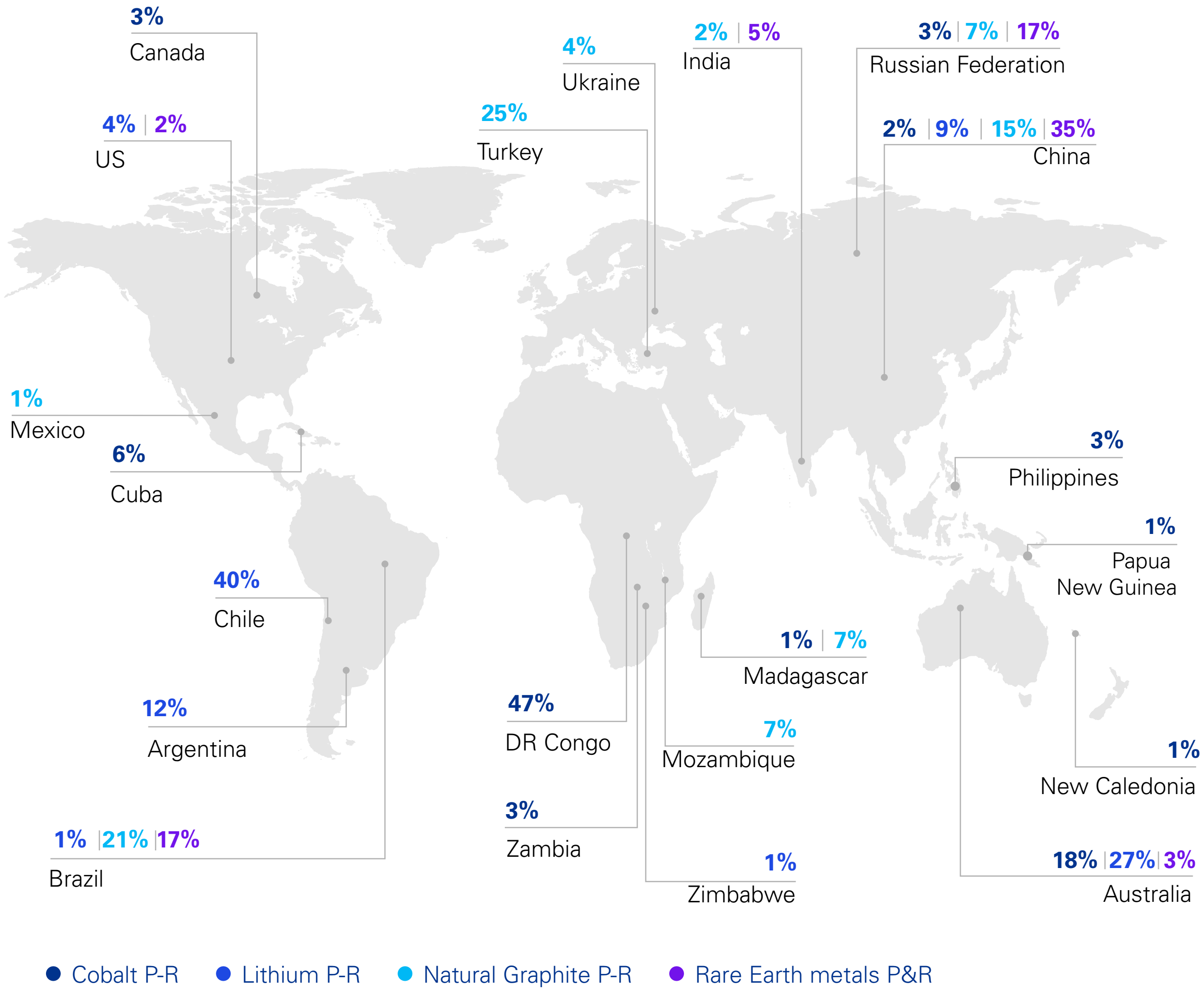
Available quantities of raw materials and the capacity of mining companies to extract them are not the only challenges. Geopolitical and supply chain risks also abound.

Australia, Chile, China, the Democratic Republic of Congo, and South Africa all hold dominant positions in mining materials like lithium, copper, graphite, nickel, platinum, iridium, and rare earth minerals.[92] China dominates the EV battery supply chain and, to a lesser extent, the production of solar panels.[93] A few countries have the bulk of critical materials and the processing capacity to transform them into clean energy products.

Supply chain challenges may arise when a few nations predominantly control raw materials and processing capacity. Trade disputes like the tariffs imposed on solar panels, conflicts like Russia's invasion of Ukraine, and the increasing frequency of extreme weather events can all reduce or cut off supplies of the materials and products needed to adequately scale renewables.

Other approaches beyond mining should also be explored to secure sufficient supplies of critical materials. For example, recycling existing materials for reuse holds long-term promise for expanding the volume needed to scale renewables adequately and reducing the greenhouse gas emissions produced by extracting virgin minerals. Unfortunately, the ability to recycle metals is limited to over 40 percent for aluminum and copper and as little as 0.5 percent for lithium.[94]

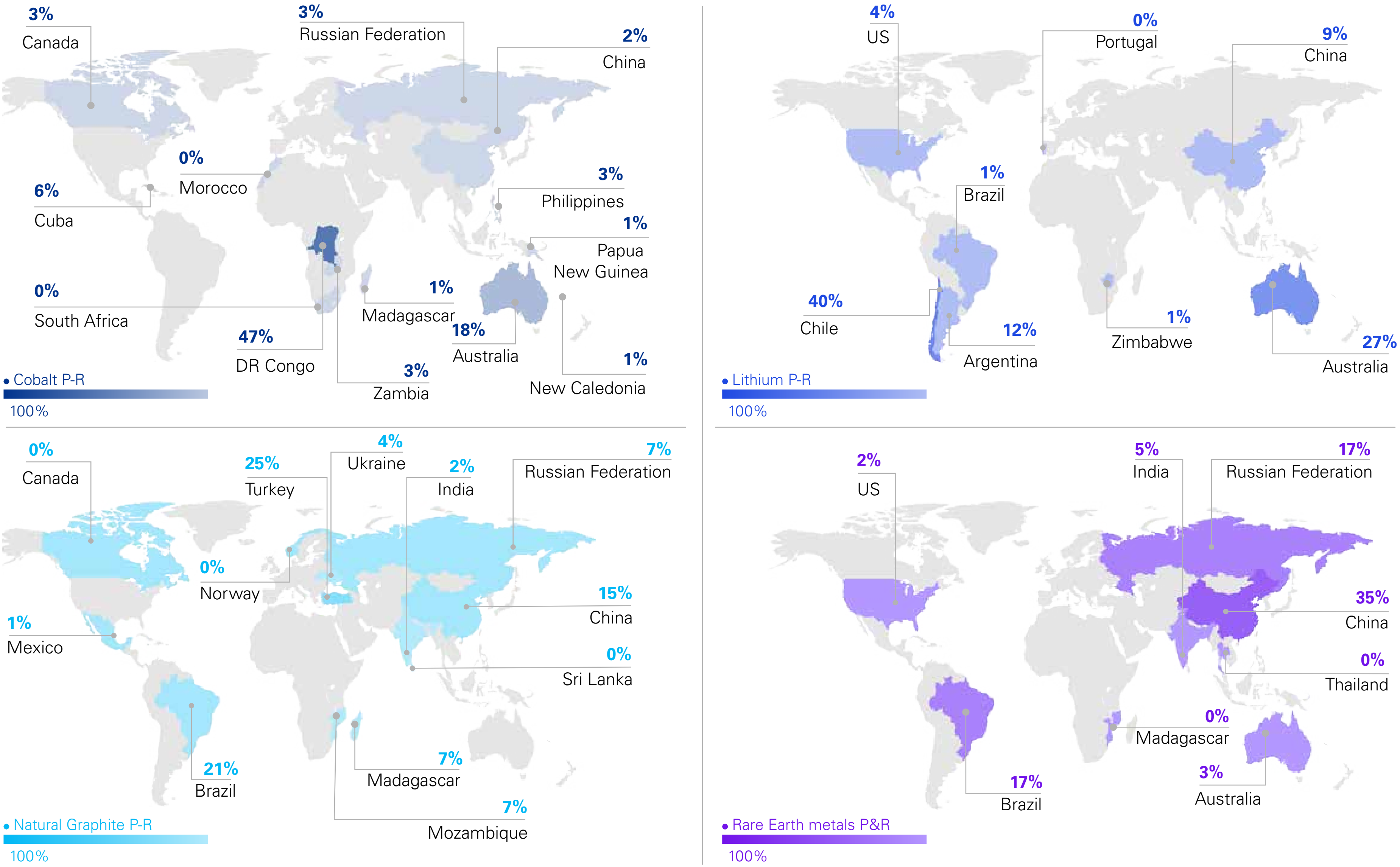
Global share of mineral production and reserves at end of 2022



Source: Energy Institute, in association with KPMG International and Kearney. "2023 Statistical Review of World Energy." 2023.

[92] International Renewable Energy Agency (IRENA), "Geopolitics of the Energy Transition: Critical Materials," 2023
[93] Rocky Mountain Institute (RMI), "The EV Battery Supply Chain Explained," 2023
[94] International Energy Agency (IEA), "End-of-life recycling rates for selected metals,"

Global share of mineral production and reserves at end of 2022



Note: 'Rest of the world' accounts for the remaining 10% of recorded reserves across other geographies.
Source: Energy Institute, in association with KPMG International and Kearney. "2023 Statistical Review of World Energy." 2023.

Mining companies are optimistic about supply but will likely be constrained by finite resources

Investments and new forms of collaboration are flowing into expanding mining capacity. For example, Canada has reserves of minerals needed in the energy transition, including cobalt, graphite, lithium, and nickel, and various strategies, including exploration, mining, and recycling, are being considered to optimize these reserves.[95] There's a growing emphasis on supporting research and improving the critical minerals supply chain.[96]

Nevertheless, companies that extract critical minerals from the ground acknowledge they are far from reliably delivering the materials needed to produce enough solar panels, wind turbines, and batteries.

KPMG International recently surveyed over 400 C-level executives representing various mining and metal production companies.[97] A managing director and chief executive officer of one Australian mining firm told KPMG that he expected that supplies of the dysprosium and terbium his company mines for use in EVs won't be sufficient in the short-term. "The expectation is widely acknowledged in the industry that there is going to be a shortfall in global supply into the early 2030s, though, and we'll be looking to meet some of that shortfall," he said.

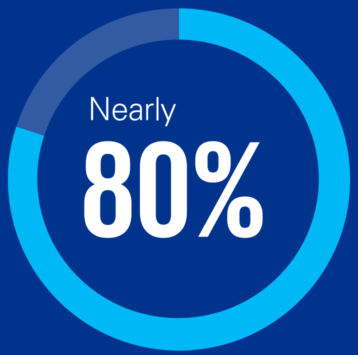
Over the longer term, however, the mining executives surveyed by KPMG are anything but downcast about their industry's ability to provide the raw materials needed to build a carbon-free world. Nearly 80 percent of executives reported high confidence that their industry can meet the increased demand for energy transition materials, while only 7 percent were not confident. That decreases when the question is limited to executives in the business of mining net-zero-specific materials, like lithium and copper. But by a ratio of 6-to-1, the mining executives surveyed by KPMG International were confident they could deliver.

One reason the industry has so much confidence in its ability to serve the needs of a quickly expanding renewables industry is because of technological innovations. Not only are mining companies leaning heavily on new technologies to reduce the carbon footprint of their operations, but they also view innovative technologies like artificial intelligence (AI), data analytics, 5G networks, and IoT as key to increasing mineral supplies over the next five years.

While the long-term optimism of mining industry leaders is encouraging, it should be tempered by the eventual limits of finite resources. This may not pose an immediate challenge in significantly scaling renewables. But eventually, innovation will need to overcome the reality of a limited supply of raw materials.

For example, according to KPMG International analysis, it would take nearly 10,000 years to produce the amount of lithium required to phase out fossil fuels at 2019 production levels. Similarly, daunting gaps between current production capacity and the critical metals needed to drive the energy transition exist for cobalt, graphite, nickel, and other metals. Unless this challenge is addressed quickly, it will impact commodity prices and delay the energy transition as EVs and renewable assets are built at scale.

KPMG International recently surveyed over 400 C-level executives representing various mining and metal production companies.



of executives reported high confidence that their industry can meet the increased demand for energy transition materials, while

[95] Government of Canada, "The Canadian Critical Minerals Strategy," 2022
[96] S&P Global, "Canada boosts critical minerals projects with latest investments," 2023
[97] KPMG. "2023 Global Mining and Metals Outlook," 2023. https://kpmg.com/xx/en/home/insights/2023/05/2023-global-mining-and-metals-outlook.html

There are already indications of looming material bottlenecks. In Australia, for example, EV companies are starting to invest in mining projects, especially those that include battery and electric motor components. This move towards vertical integration is being driven by a recognition that access to critical minerals is a risk to company growth.

Other challenges to the expanded production capacity of critical minerals include the amount of time required to approve projects and inconsistent government support for additional capacity. Increasing the production capacity for critical minerals faces hurdles such as time-intensive project approvals and differing levels of government incentives across countries.

For example, according to KPMG International analysis, it would take nearly 10,000 years to produce the amount of lithium required to phase out fossil fuels at 2019 production levels.

Sustainable approaches to help ensure the availability of raw materials to support the energy transition:

- Develop supply chains and business models a circular economy needs
- Design products to last longer and be recycled and reused
- Take advantage of existing circular economy frameworks and resources
- Invest in everything

A more sustainable approach to critical mineral production

Invest in a circular economy and new production

Beyond innovations and improvements in mining operations to increase production, other solutions can help ensure that the energy transition has the raw materials it requires. One is to move away from the traditional make-take-dispose model in which natural resources are turned into products that are used once and then thrown away. A more sustainable approach would include the following:

1. **Develop supply chains and business models a circular economy needs.**
The benefits of a circular economy are many. A more ambitious move towards circular economies where products are designed to be reused, recycled, and repurposed can reduce pressure on commodity prices and supplies while also generating revenue across supply chains that don't require new raw materials.

   For example, the US National Renewable Energy Laboratory (NREL) estimates that the total value of recyclable materials in solar panels will be approximately USD 15 billion by 2050. It's enough raw material to manufacture about 2 billion new solar modules or about 630 gigawatts of new capacity.[98] For this to be possible, entirely new supply chains and business models will need to emerge dedicated to profitably keeping limited natural resources and materials in circulation for as long as possible without producing further waste.

2. **Commit to Just Energy Transition Practices.**
Mining the resources needed for the energy transition is already having an impact on nature and biodiversity as well as the communities that live near mining operations (see nature and biodiversity, supply chain issues, and social license to operate chapters). Renewable energy companies can consider ensuring that their supplies of necessary resources won't harm communities — which are often Indigenous communities — the environment communities depend on or involve the use of child labor. It would be ideal for pledges to act in accordance with Just Energy Transition principles to be easily verifiable.

3. **Design products to last longer and be recycled and reused.**
Other ways to ease the demand for raw materials to support the energy transition include designing products to last longer and making it easy and affordable to repair and refurbish products to extend their productive lifetimes. Products can also be designed to make recycling and reuse their most valuable components less expensive. For instance, EV battery modules require a multi-step and labor-intensive disassembly and sorting process before recycling. A lack of standard sized EVs and stationary storage battery packs and modules also discourages recycling and reuse. A standardized battery module and pack size could simplify and incentivize recycling and reuse by allowing for greater automation and improved economics. EV battery recycling is in its infancy. The French government recently invested over USD 40 million to support an EV battery recycling effort aimed at yielding 50 tons annually of lithium, cobalt, manganese, nickel, and other metals from end-of-life batteries.[99]

[98] National Renewable Energy Laboratory (NREL), "Environmental and Circular Economy of Solar Energy in a Decarbonized US Grid," 2022
[99] Innovation News Network, MECAWARE secures €40m investment for EV battery recycling project, 2023

4. **Take advantage of existing circular economy frameworks and resources.**
EU,[100] the Organization for Economic Cooperation and Development (OECD),[101] and the Electric Power Research Institute (EPRI)[102] have all developed frameworks, plans, and metrics for enhancing circular economies. But ramping up circular models in areas like metal production will take decades and require more significant investment and global collaboration. It's work that is worth the effort and should take place alongside collaborative initiatives to support increased production of raw materials.

5. **Invest in everything.**
Supplying enough raw materials to spur a rapid buildout of renewables is not a choice between recycling and new production. It demands both. Accelerating progress in both domains is a challenge the renewable energy industry — and society at large — should no longer ignore.

[100] European Union (EU), "Circular economy action plan," 2020
[101] The Organisation for Economic Co-operation and Development (OECD), "The OECD Inventory of Circular Economy Indicators," 2021
[102] Electric Power Research Institute (EPRI), "A Framework for the Application of Global Circular Economy Principles for the Electric Power Industry," 2021

Barrier
08

Nature and biodiversity

Climate change has significant effects on nature and biodiversity. Warmer air and sea temperatures degrade vital ecosystems like coral reefs, force shifts where plants and animals can survive, and contribute to rapidly accelerating species extinction. Climate change also fuels extreme weather like droughts and wildfires that destroy forests and other critical habitat. As temperatures rise, research indicates that the impacts on nature and biodiversity could intensify. According to the United Nations (UN), an increase in average global temperatures of 1.5 degrees C will result in 4 percent of mammals losing half their habitat; a rise of 3 degrees C could lead to 41 percent losing half of their habitat.[103]

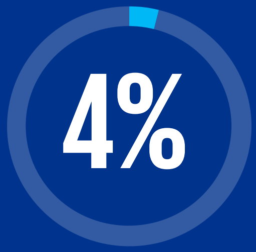
Scaling up renewables could help in mitigating some of the effects of climate change on the natural world, which is closely linked to human well-being and economic prosperity. While it's important to consider the deployment of renewables, it's also essential to acknowledge that clean energy development can sometimes negatively impact nature and biodiversity and even be counterproductive in limiting warming. For example, conserving and restoring forests, peatlands, and other natural resources that sequester carbon emissions could achieve one-third of the carbon emissions reductions needed in the next decade.[104] Clearing large tracts of forests and other climate-supporting ecosystems to build solar and wind power plants can harm nature and biodiversity while doing little to reduce greenhouse gas emissions.

A growing list of tools for renewable development in harmony with nature

Fortunately, there is a widespread acknowledgment of the importance of preserving biodiversity to tackle climate change and a growing menu of options for scaling renewables in ways that minimize the impact on the natural world. In December of 2022, 188 countries adopted the Kunming-Montreal Global Biodiversity Framework (GBF), which aims to protect 30 percent of the world's land, oceans, coastal areas, and inland waters.[105] Two of the framework's targets are especially relevant to renewables development, including a target around the importance of ensuring the integration of biodiversity's value into planning and development and a target that requests businesses to assess measures to monitor and disclose their biodiversity dependencies, impacts and risks and reduce their negative impact.[106] Nearly 60 percent of renewable energy stakeholders surveyed agreed that addressing clean energy projects' nature and biodiversity impacts is necessary to scale renewables.

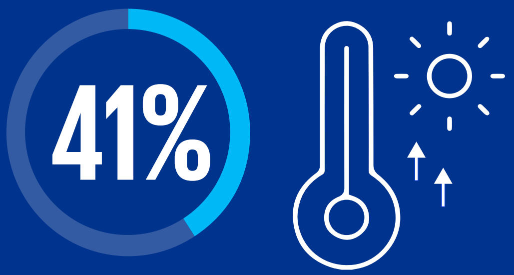
According to the United Nations (UN),

an increase in average global temperatures of **1.5 degrees C** will result in



of mammals losing half their habitat

a rise of **3 degrees C** could lead to



losing half of their habitat.

[103] United Nations, "Biodiversity — our strongest natural defense against climate change,"2022, un.org/en/climatechange/science/climate-issues/biodiversity, Accessed 20 Oct. 2023

[104] United Nations Environment Programme, "Nature for Climate Action," 2021

[105] Convention on Biological Diversity, "Nations Adopt Four Goals, 23 Targets for 2030 In Landmark UN Biodiversity Agreement," 2022

[106] Kunming-Montreal Global Biodiversity Framework, "2030 Targets (With Guidance Notes)," 2023

Various stakeholders, including renewable energy developers, can leverage insights and guidance from solutions being implemented around the world that demonstrate how renewables can scale in harmony with nature and biodiversity. For example:

Wind development in concert with migrating birds. Millions of birds journey to and from breeding grounds in Europe and Central Asia and their wintering homes in Africa each year. Their route takes the birds along the Red Sea and Rift Valley, an area that has attracted significant interest from wind energy developers. When wind turbines are constructed in the pathway of migrating birds, there is the potential for death and injury from collisions, displacement, and fragmentation of critical habitats. The Migratory Soaring Birds Project is a collaboration between the NGO BirdLife International, the Global Environment Facility (GEF), and the United Nations Development Programme (UNDP) that seeks to reduce the negative impacts on birds following this critical flyway due to not only wind development but also hunting, agriculture, and tourism.[107]

The project produced guidance for governments, wind developers, and other stakeholders about the importance of siting wind farms in locations that aren't along routes heavily trafficked by migrating birds. The project also developed guidance on the use of shutdown-on-demand, where turbines stop spinning when birds are either sighted on radar or cameras or during seasons and weather conditions when birds have been active in the past.[108]

Collaboration drives low-impact offshore wind development. Scaling offshore wind is a critical tool in combatting climate change. At the end of 2022, there were about 59 GW of operating wind capacity around the globe and an additional 427 GW in the development pipeline.[109]

The development of such a large volume of offshore wind has the potential to impact birds and marine ecosystems negatively. The desire to mitigate or eliminate harm to nature and biodiversity spawned the creation of the Offshore Coalition for Energy and Nature, or OCEaN. The group is made up of environmental NGOs, wind energy developers, and transmission systems operators (TSOs) and was established as a forum for sharing information and experience in planning and developing offshore wind in a manner that protects nature and biodiversity and identifies topics in need of additional research.[110] The group maintains a public database of research and best practices to promote nature-friendly offshore development. OCEaN also shares insights from members like the World Wildlife Fund (WWF), including WWF guidance on applying spatial planning — a science-based planning approach that considers all economic and ecological factors — in siting offshore wind.[111]

Innovation and wildlife-friendly design bolster solar and nature. Utility-scale solar projects require a lot of land. When developing large solar power plants necessitates clearing forestland or disrupting delicate ecosystems, the result can be harmful to nature and counterproductive in reducing greenhouse gas emissions. Smart siting of solar projects can maximize the climate benefits of solar while minimizing negative impacts on nature. In the United States, one environmental organization developed a framework with six principles to guide solar siting and design to reduce impacts on nature, including avoiding areas of high native biodiversity, preferencing the use of degraded lands, protecting water quality and avoiding erosion.[112]

of renewable energy stakeholders surveyed agreed that addressing clean energy projects' nature and biodiversity impacts is necessary to scale renewables.

[107] Global Environment Facility (GEF), "Good Practice Brief: Strengthening Regional Cooperation to Mainstream Migratory Soaring Birds Safeguards," 2022
[108] BirdLife International, "Review and guidance on use of "shutdown-on- demand" for wind turbines to conserve migratory soaring birds in the Rift Valley/Red Sea Flyway," 2023
[109] US Department of Energy, Office of Energy Efficiency & Renewable Energy, "Offshore Wind Market Report: 2023 Edition, U.S," 2023
[110] Offshore Coalition for Energy and Nature, "Who we are," https://offshore-coalition.eu/who-we-are Accessed 25 Sept. 2023
[111] World Wildlife Fund (WWF), "Ecosystem-based Maritime Spatial Planning in Europe and how to assess it," March 2021
[112] The Nature Conservancy, "Making Solar Wildlife-Friendly," 2023

The group also works closely with state regulators and solar developers to locate projects on lands that aren't critical to biodiversity.

There are an increasing number of examples of solar projects improving biodiversity. In Kentucky, for example, grazing sheep can cost-effectively manage vegetation around solar panels that would otherwise need to be mowed by utility workers or contractors. Besides being effective weed eaters, sheep following a sustainable grazing plan reduce water runoff and bolster soil health, which enhances biodiversity.[113] At the Frankfurt airport in Germany, a novel solar project design approach aims to eliminate negative biodiversity impacts. Developers mounted the panels vertically instead of horizontally or slightly tilted in relation to the ground. This was done intentionally to allow precipitation to reach vegetation on the ground.[114]

Steps to protect nature and scale renewables:

1. Prioritize nature and biodiversity at the beginning of projects
2. Publicly declare a commitment to nature and biodiversity

Nature and climate change are two of the biggest interlinked challenges that the planet faces. Renewables have a clear role to play in terms of limiting global temperatures and thereby tackling one of the key drivers of nature and biodiversity declines. Upfront planning to help ensure that nature and biodiversity considerations are properly built into new renewables projects, as well as focusing specifically on renewable technologies that offer win-win solutions for climate change and nature goals, are our two key recommendations for helping ensure that we meet both nature positive and net zero goals.

Sarah Nelson
Nature & Biodiversity Lead,
KPMG International

[113] Electric Power Research Institute (EPRI), "Solar Sheep," 2023
[114] PV Magazine, "Vertical PV to protect biodiversity at German airport, " 2022

Steps to protect nature and biodiversity and scale renewables

The natural world plays a crucial role, and a thoughtful energy transition can benefit both the environment and the people. However, deploying renewables in ways that protect nature and fully leverage its carbon-sequestering potential takes thoughtful planning and collaboration. As we have seen in this chapter, there is abundant knowledge and a growing list of tools to enable rapid renewable development and conservation to progress in harmony. To make the most of existing knowledge and resources, it's recommended to:

1. **Consider nature and biodiversity at the beginning of projects.**
   The optimal time to seek the input of nature and biodiversity experts is when solar and wind projects are in their infancy. Early collaboration can translate into site selection that reduces or eliminates negative impacts and positions a project to avoid time-consuming delays due to opposition from regulators or the public. Collaborating early with biodiversity and nature experts can also uncover opportunities for renewable projects to benefit the natural world.

   Being proactive about biodiversity and nature can also position renewable developers to navigate calls for greater disclosure. At a global level, the Taskforce on Nature-related Financial Disclosures (TNFD) includes governments and businesses recognizing that nature must be a factor in financial and business decisions. TNFD is developing a framework for companies and organizations to report on nature-related risks and impacts and identify opportunities to drive nature-positive outcomes.[115]

2. **Organizations could consider making their commitment to nature and biodiversity known.**
   Limiting or eliminating negative impacts on nature and biodiversity should be central to how renewable companies do business. Publicly announcing the protection of nature as an objective and quantifying what that means holds companies accountable for their progress and allows successful companies to differentiate from competitors. This is already happening. The Spanish renewable energy developer Iberdrola committed that all its future projects will have a net-positive effect on biodiversity by 2030 and entered a strategic alliance with BirdLife to inform its decisions better.[116]

[115] Taskforce on Nature-related Financial Disclosures (TNFD), "The TNFD Nature-related Risk and Opportunity and Disclosure Framework beta v0.4," 2023
[116] Carbon Pulse, "Iberdrola commits to net positive impact on nature by 2030," 2022

Barrier
09

Social license to operate

While many experts and studies laud the environmental, health, and financial benefits of scaling renewable energy, few dig deeper into the socio-cultural impacts. Overlooking or dismissing impacts on land, a community's traditional way of life, and the sense of powerlessness that some feel when they have no say about the clean energy projects built near their homes and businesses may slow the vital pace and scale of renewable development and negatively impact human rights.

To enable clean energy to be built at the pace required, building a social license to operate (SLO) by proactively engaging communities is critical to ensure they receive their fair share of benefits and have the agency to mitigate or eliminate the negative impacts of renewable development. To do that, a SLO ensures a process that maximizes opportunities for all people, particularly the most vulnerable, and minimizes the negative impacts as we evolve towards a low-carbon, circular, ecologically sustainable, and equitable economy. Notably, the opportunities and impacts of the energy transition must be distributed fairly to everyone.

This is not always a straightforward task. Risks, impacts, and opportunities exist on all sides of the energy transition. For example, communities where generations of citizens have worked in coal mines, will be understandably anxious when mines close and developers seek to build renewables. But there are also opportunities for employment and sustainable development that can be enhanced when renewable projects proceed with community support.

Often, people who feel their culture, economic livelihoods, local ecosystems, identities, and way of life are threatened by renewable energy projects will push back. Pushback can be fierce when communities do not have opportunities to meaningfully co-create what a sustainable future will look like. This is especially true when they perceive that projects are being imposed on them by outsiders. New wind, solar, transmission, and other clean energy projects are encountering fierce opposition, resulting in delays or outright cancellations. In the US, researchers from the Massachusetts Institute of Technology (MIT) tracked significant public opposition to renewable projects. They found nearly 300 stalled or stopped in the US between 2008 and 2021.[117]

Community engagement is often viewed as a barrier to renewable energy projects and a source of project risk. However, a SLO promises that the proactive and meaningful community engagement it drives is an opportunity to realize project benefits, enhance the overall value of renewables, and mitigate risks to those impacted. The Just Energy Transition can also be seen in a larger context: one addresses questions about who ultimately pays for projects — taxpayers or energy consumers — and the even larger distributional question about how nations should balance the costs of the energy transition.

At all levels, this is challenging work. It's especially challenging on the local level when renewable developments change a community's sense of identity. Unraveling old identities to make room for new ones is work that requires patience and empathy. This can seem like an unnecessary indulgence, given the pace and scale of renewable deployment needed. However, committing to a Just Energy Transition is both the ethically correct approach and a business imperative to accelerate deployment to the level required to reach net-zero targets.

In the US, researchers from the Massachusetts Institute of Technology (MIT) tracked significant public opposition to renewable projects. They found nearly

300 stalled or stopped

in the US between **2008 and 2021.**

[117] Energy Policy, "Sources of opposition to renewable energy projects in the United States," 2022

Laying the groundwork: Principles of a social license to operate

A social license to operate can be framed around two critical objectives: Mitigating or avoiding any adverse effects of the shift to a decarbonized energy system and working to make sure the benefits of the energy transition are maximized and equitably distributed.

To successfully navigate the social risks and opportunities of the energy transition, it helps to understand that they exist throughout the entire lifecycle of all projects — from procurement of equipment to initial planning and development to construction through operations and end-of-life. There are opportunities to build trust and engagement in each of these phases. Still, there are also risks of missteps that can harden opposition and potentially increase the risk of harm to individuals and communities.

For example, the procurement phase of renewable energy technologies includes potential social impacts from the extraction of minerals. This could include the use of child labor to mine cobalt and impact the rights of Indigenous communities from the extraction of lithium located in their traditional territory. Impacts can also occur in the processing, transporting, and manufacturing of renewable technologies, including allegations of using slave labor in producing solar panels. The key to identifying and addressing social risks and impacts is also to understand how intertwined environmental and social impacts are.

The planning phase of projects can also cause or contribute to impacts. To avoid and mitigate these, engaging with communities to listen and gain a deeper understanding of their priorities, attitudes, and past experiences with energy is crucial. These can be complicated to untangle. The environmental justice movement was born from the understanding that traditionally underserved communities have had to endure most of the negative consequences of fossil fuel development. The US IRA created an Environmental Justice and Climate Justice Program to ensure, as one of its goals, that underserved communities receive their fair share of the benefits of the energy transition.[118]

This initial project planning phase can uncover views that can be barriers or catalysts for scaling up renewables. For example, communities that have long relied on fossil fuel extraction and generation as a source of employment and revenue may worry about the impact of renewables on livelihoods and services provided to communities.

Even when the developers and owners of renewable projects proactively solicit community input and collaboration early, there are rarely simple solutions to these worries. Renewable energy projects create the bulk of their jobs during the construction phase and offer far fewer employment opportunities once operational, especially compared to mining. By contrast, communities that have borne the brunt of pollution-related health problems resulting from fossil fuel extraction may be eager advocates to enlist to build support and move projects forward quickly.

A social license to operate can be framed around two critical objectives:

1. Mitigating or avoiding any adverse effects of the shift to a decarbonized energy system.
2. Working to make sure the benefits of the energy transition are maximized and equitably distributed.

[118] US Environmental Protection Agency (EPA), "Inflation Reduction Act Environmental Justice and Climate Justice Program," epa.gov/inflation-reduction-act/inflation-reduction-act-environmental-and-climate-justice-program Accessed 10 Sept. 2023

The imperative of early community engagement: Lessons from across the globe

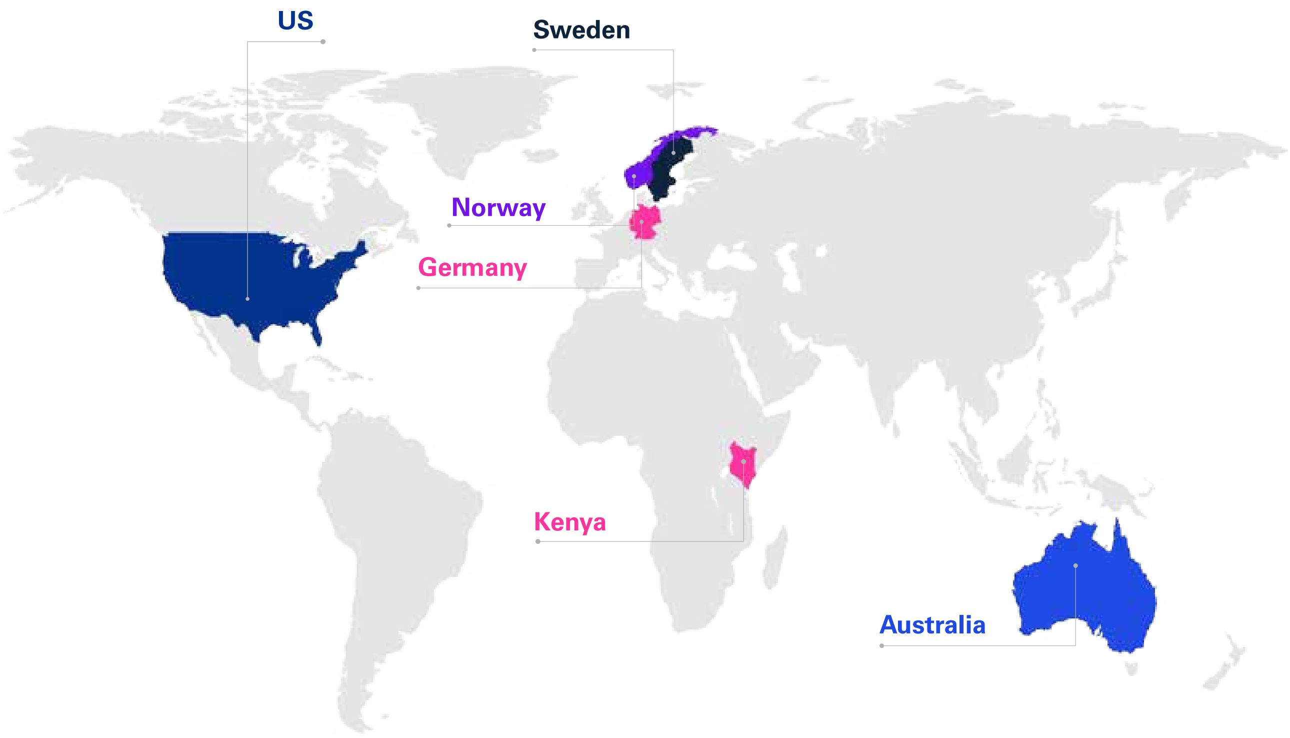
Pre-project outreach and engagement with Indigenous populations have been particularly inadequate. Australia is home to a large percentage of the critical minerals needed for the energy transition, and most of the reserves are located on First Nations lands.

In the US, Native American tribal lands represent 6.5 percent of the entire country's utility-scale renewable potential. In their analysis of common opposition sources to renewable projects, MIT's researchers said that a failure to respect tribal rights, particularly around self-determination, was a top reason native communities pushed back against proposed renewable developments.[119]

Developers who have failed to engage Indigenous communities and seek free, prior, and informed consent (FPIC) have run into problems across the globe. For example, the High Court in Kenya recently nullified land title deals for the Lake Turkana Wind Power project. The court ruled that the land was acquired without proper consultation or compensation of Indigenous community members.[120]

The Norwegian government apologized to the Indigenous Sami people for the development of wind farms on reindeer pastures, which threatened both the economic well-being and culture and identity of the Sami. The government called the wind development a "human rights violation."[121] According to the Business & Human Rights Resource Centre (BHRRC), there were over 200 allegations of abuse against renewable energy companies in the past decade, and a significant number were from Indigenous communities.[122]

Conflict and delay are not inevitable. To understand how to work collaboratively with communities, consider the successful example of Morbach, Germany, where renewable energy projects were welcomed. Once the site of a military base and munitions dump, the community southwest of Frankfurt worked with government officials and renewable energy developers to build solar, wind, and other clean energy projects that routinely attract executives, policymakers, and even tourists interested in lessons about adopting more renewables. What made the renewable development in Morbach so successful is that its details were co-created with the community, which found democratic ways to fund and execute projects.



[119] National Renewable Energy Laboratory (NREL), "Techno-Economic Renewable Energy Potential on Tribal Lands," 2018
[120] Reuters, "Why solar and wind developers ignore indigenous land claims at their peril," 2023
[121] Reuters, "Norway wind farms at heart of Sami protest violate human rights, minister says," 2023
[122] Business & Human Rights Resource Centre (BHRC), "Renewable Energy & Human Rights Benchmark," 2021

In Sweden, ten women established a co-operative, Qvinnovindar, with the aim of supporting renewable energy and providing opportunities to rural women. Since its launch in 2007, Qvinnovidnar has grown to 80 members and invested over USD 1.5 million in wind projects. Though individual co-op members invest differing amounts, each has an equal vote in how the company is run.

The primary lesson from both successful and struggling renewable projects is that community engagement at the earliest point possible dramatically improves the chances that communities will become advocates rather than opponents.

Embracing innovation and encouraging a healthy climate is essential for the well-being of all

There is a growing menu of tools to integrate community priorities into project designs without slowing down or diminishing the generation potential of renewable projects. For example, a common rationale for opposing renewable projects in rural communities is the belief that they will negatively impact agricultural production or, in some cases, mar the cultural aesthetics of traditional farming communities.

Many solar developers use sheep to control vegetation underneath elevated ground-mounted solar arrays. With proper grazing techniques, the sheep can improve soil quality and maintain the agricultural legacy some communities care about.[123]

Another key to identifying and addressing social risks and impacts is understanding how intertwined environmental and social impacts are. The United Nations recently confirmed that a clean, healthy, and sustainable environment is a human right and emphasized the connection between human rights and the environment.

Deliberations about new renewable energy projects can't lose sight of the impact of climate change that renewable energy seeks to ultimately address — including extreme weather and biodiversity loss — are human rights issues. Leveraging unique expertise, KPMG Banarra, Human Rights & Social Impact, collaborated with the Responsible Investment Association Australasia to create a guide for institutional investors. This guide enables an innovative approach to assessing climate risks through the lens of human rights, thereby offering invaluable insights for the social license to operate strategy.

The primary lesson from both successful and struggling renewable projects is that community engagement at the earliest point possible dramatically improves the chances that communities will become advocates rather than opponents.

[123] Electric Power Research Institute (EPRI), "Solar Sheep," 2023

A social license to operate requires early engagement and clear community benefits

Some of the principles outlined in the guide are applicable to social license-to-operate discussions. Perhaps none is more important than considering renewable energy projects using a balanced view that accounts for current climate-related human rights risks and the risks faced by children today and those who are yet to be born.

Different renewable energy stakeholders have varying responsibilities to help build a social license to operate. The following principles should guide the work of everyone seeking to rapidly scale renewables:

- **Ensure benefits are shared**. It's hardly surprising that communities protest when they see all the benefits of renewable energy projects reaped by non-community members and all the impacts borne by locals. This includes a commitment to distributive justice, which is the concept of equitably distributing the benefits of a renewable project.
- **Proactively manage expectations**. Many communities, particularly those home to mines and other fossil fuel power plants, expect new renewable energy development to create many jobs. While it's true that significant numbers of workers are needed to develop wind and solar plants, permanent jobs are far lower than in a mine. Communities that lose oil and gas jobs often aren't in locations where renewables will require a meaningful number of new workers. These expectations need to be managed early, and renewable developers and owners should work collaboratively with communities to expand educational and employment opportunities as much as possible.
- **Facilitate community engagement**. Developers should allow the participation and representation of people with different perspectives at each stage of a renewable project's development and construction. For example, beyond community involvement and throughout development, operations, and end-of-life, communities need a voice in reviewing project milestones and identifying metrics to measure and respond to unintended negative community impacts. In other words, the supply of clean energy can't be the only success metric.
- **Make community partnership the goal**. Negotiating agreements with local communities can ensure local buy-in and support and remove significant barriers to progress. A best practice is to co-design a project with communities to provide maximum benefits and minimum impacts.

Proposed actions

Key stakeholders	Action
Developers	• Engage early with affected communities, including consultation on the design of projects • Engage early with Indigenous communities to operationalize free, prior and informed consent (FPIC) • Embrace an expansive view of community benefits • Mitigate supply chain risks
Government	• Guide companies on expectations for engagement and consultation • Coordinate across sectors for community engagement in renewable energy zones • Facilitate the uplift of community capability and capacity

Finance (providers/lenders)	• Incorporate risk-to-people considerations into the financing of transition projects
	   ◦ Incorporate social due diligence into lending criteria
	   ◦ Incorporate social criteria in developer credit risk ratings
	• Monitor social impacts in funded projects

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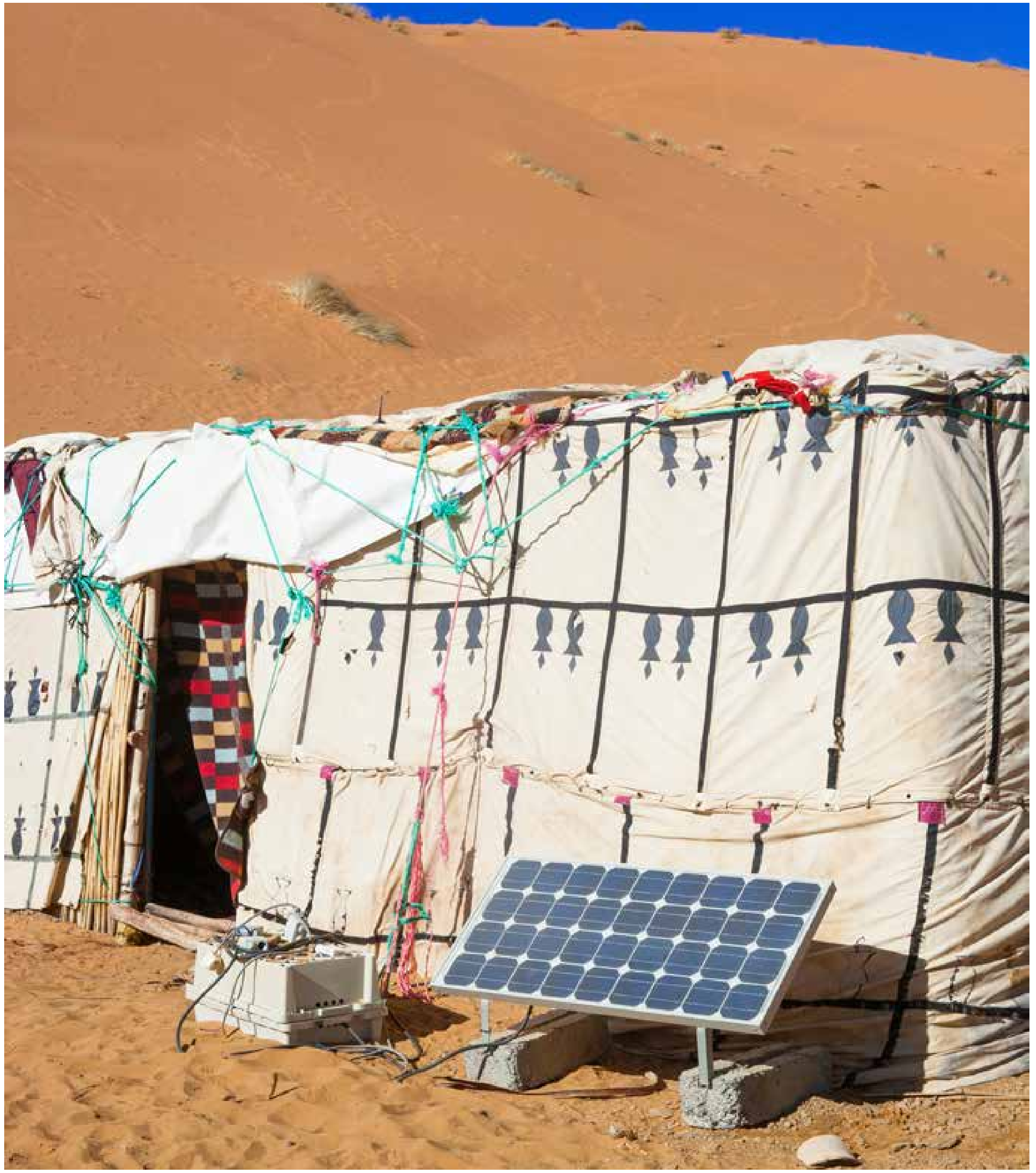
Emerging markets



The global aim to address climate targets hinges on the adoption of renewables in emerging markets. Consider this: According to the Global Energy Alliance for People and Planet (GEAPP), if all the world's developed economies reach their net-zero goals by 2050, while emerging economies continue to rely on fossil fuels, three-quarters of all emissions will come from emerging nations. In that scenario, the world will be on course to warm by 2.5 degrees Celsius.[124]

The IEA's recent World Energy Outlook 2023 not only emphasized the centrality of emerging markets in the energy transition but also subtly hinted at the repercussions of delayed action. A delayed transition could imply an extended reliance on fossil fuels, affecting both global climate targets and net-zero aspirations. "The urgent challenge is to increase the pace of new clean energy projects, especially in many emerging and developing economies outside China."[125] Put simply, a dramatic growth in renewables could be beneficial for emerging countries and the entire world.

Accelerating renewables across emerging markets is also an opportunity to dramatically expand access to low-carbon energy and economic opportunities for millions of people. This is especially important in emerging markets in Africa because populations are growing quickly, and the need for reliable energy to fuel economic growth is acute.

The energy transition in developed economies mainly describes a shift from fossil fuels to renewables. Yet, in many emerging economies, it's about moving from limited energy access to deriving economic, health, and educational benefits from consistent, clean energy supplies. Without accelerated deployment of renewables, these economies might default to fossil fuels for their immediate energy needs, given affordability and security concerns. The World Bank argues that access to energy is at the heart of development.

Accelerating renewables across emerging markets is also an opportunity to dramatically expand access to low-carbon energy and economic opportunities for millions of people.

According to the IEA, 770 million people around the globe lacked access to electricity in 2022.[126] The COVID-19 pandemic stalled and even reversed consistent progress in expanding electricity access. In Sub-Saharan Africa, for example, 600 million people lacked access to electricity in 2022, up from 580 million in 2019.[127] In many emerging markets, expanding access to electricity by extending the reach of the traditional power grid is prohibitively expensive.

While strategic grid extension remains a vital tool to expand access to electricity, the distributed nature of renewables can deliver the same benefits more cost-effectively and in a shorter period. Off-grid solutions, like mini-grids utilizing solar and energy storage and stand-alone home power systems, can drive industrialization and green growth in areas the grid doesn't reach. With mini-grids and other renewables-based solutions, businesses that depend on electricity don't face the risk that comes from frequent and long-lasting blackouts. Grid reliability and expansions can also be bolstered in emerging economies by focusing investments on renewables.

While the standard narrative is about the challenges of scaling renewables in emerging markets, many overlook that many of these markets harbor some of the richest renewables potential globally.[128] For example, Africa's ample and consistent sunshine means it has 60 percent of the world's best solar resources, according to the IEA.[129] Despite that potential, the continent only has around one percent of global installed solar capacity.

According to the IEA,
770 million
people around the globe lacked access to electricity in 2022.

[124] Global Energy Alliance for People and Planet, "Powering People and Planet 2022," 2022
[125] International Energy Agency (IEA), World Energy Outlooks 2023, 2023
[126] International Energy Agency (IEA), "Access to electricity," 2023, iea.org/reports/sdg7-data-and-projections/access-to-electricity, Accessed 6 Sept. 2023
[127] International Energy Agency (IEA), "Access to electricity," 2023, iea.org/reports/sdg7-data-and-projections/access-to-electricity, Accessed 6 Sept. 2023
[128] The World Bank, "Global Photovoltaic Power Potential By Country," 2020. The dataset is generated by Solargis (https://solargis.com) with funding provided by the Energy Sector Management Assistance Program (ESMAP).
[129] International Energy Agency (IEA), " Africa Energy Outlook 2022," 2022

Barriers to renewable deployment

There are many reasons renewables are not scaling in emerging markets as rapidly as the world needs. Inadequate investment is a significant enough barrier that demands special attention (see below). But there are a host of other challenges that need to be acknowledged and addressed, including:

The centrality of coal. Renewables have been growing quickly in recent years, but coal remains the primary source of electricity generation in many nations. According to the Energy Institute's 2023 Statistical Review of Energy, coal consumption increased to its highest level since 2014, driven largely by increases in India and China.[130] Coal's continuing dominance means it is entrenched in emerging nations' political and economic ecosystems — a significant contributor to gross domestic product (GDP), tax receipts, and employment in underprivileged communities. Coal ownership is often in the hands of wealthy and politically influential groups.

Reliance on central planning. Many emerging markets rely on central planning and a single buyer framework controlled by the state utility. It is beyond the capability of any single institution to collect, analyze, and act on all the information needed to reliably serve consumers with affordable and sustainable energy. Political risk, including corruption, also deters private investors in some emerging markets. Utilities and regulators could explore overhauling generation and grid regulations to create a more agile power system to meet changing consumer needs. In Indonesia, KPMG is working with the state utility to develop tenders for renewable developers who can secure corporate and private off-takers for the clean energy they generate. This allows the utility to confirm the demand for green energy and the willingness of customers to pay its incremental cost increase.

Lack of grid data and experience with renewables. Utilities in developed markets have long been exposed to the challenges of renewables' inherent intermittency. Many have developed a solid capability to manage grid intermittency and understand the data required to assess grid reliability and curtailment risks. Emerging markets have had far less renewable penetration and often lack the experience, knowledge, familiarity, comfort, and data to ensure the delivery of electricity reliably in a renewable-heavy grid.

Upfront renewables costs remain expensive. While solar and wind costs have declined significantly, their upfront costs can be high. Without low-cost capital, this can be a barrier to investment. For example, the cost of solar plus energy storage to replace a baseload coal plant would be more than double that of a coal-independent power producer tariff. To scale up renewables will require holistic combinations of wind, solar, storage, and other resources able to replace fossil fuels cost-effectively and reliably.

Much of future energy growth across the world will be in emerging markets and developing economies where energy demand is growing rapidly, outpacing that in advanced economies. The scale of capital required is massive. In the period 2026–2030, without considering China, the annual investment requirement for global net zero emissions by 2050 would be of the order of $1 tn per annum (~4X of 2022 levels) and just a shade below $2 tn per annum by 2050, far exceeding the deployments in advanced economies. Institutional mechanisms for such large capital flows into the EMDEs are currently absent. The high cost of capital and currency devaluation further compound the challenges. Unless these challenges are addressed proactively, there is an inherent risk of the EMDEs slowing down the transition trajectory and placing continued reliance on fossil fuels.

Anish De
Global Head for Energy, Natural, Resources & Chemicals,
KPMG International

[130] Energy Institute, "Energy system struggles in face of geopolitical and environmental crises," 2023

Renewable investments lag far behind the need

A lack of sufficient investment is the main reason renewables are not yet scaling rapidly enough to meet either the needs of people living in emerging markets or the world's climate targets. According to the International Monetary Fund (IMF), emerging and developing economies need to invest over USD 1 trillion annually in clean energy by 2030 to put the world on track to reach net-zero emissions by 2050. In 2020, total investments were less than USD 150 billion.[131] Additionally, the IMF projects that USD 140 billion to USD 300 billion in annual investments in adapting to the physical consequences of climate change by 2030 is also needed.[132]

Mobilizing the necessary capital to scale renewables and extend the many potential benefits of energy access means there is an opportunity to reduce a broad spectrum of risks, some of them real and others perceived. They include:

- Currency depreciation, exchange rate volatility, and capital controls.
- **Political risks, policy uncertainty, and economic uncertainty resulting from rapid policy changes that impact currency valuations or lead to changes to government programs designed to support renewables.**
- Off-taker risks due to the financial instability of some utilities in emerging markets. This increases the risk of nonpayment for power produced by renewables.
- Macroeconomic risks, including high inflation and debt constraints.
- Lack of transparency and overall difficulty of doing business.

These risks deter the investment needed to scale renewables at a level required to reach global net-zero targets. In Africa, for example, the cost of capital for energy projects was up to seven times higher than in Europe or North America in 2021. Forty-eight percent of renewable energy industry stakeholders surveyed by KPMG International cited emerging market risks as a moderately significant obstacle to scaling renewables. In comparison, 20 percent said it was a highly significant obstacle.

How to unlock investments needed to transform emerging market renewables

It's important to recognize the risks that deter emerging market renewables investors. It is also important to point out that there is a significant upside for investors who gain the experience and expertise to invest in emerging markets. For example, the OECD says that experienced investors can attain higher average returns in Africa than in other regions across the globe.[133]

Reforms, however, can focus on creating an environment where the incentives to invest in renewables surpass the risks. There are examples of nations where a combination of falling renewable electricity costs and ease of investment makes a difference — especially when reforms are supported by development finance institutions (DFIs) and multilateral development banks (MDBs). For example, in Zambia, the World Bank's Scaling Solar program has led to a record-low tariff of just over USD six cents per kilowatt-hour.[134]

[131] International Monetary Fund (IMF), "How to Scale Up Private Climate Finance in Emerging Economies," 2022
[132] International Monetary Fund (IMF), "How to Scale Up Private Climate Finance in Emerging Economies," 2022
[133] Organisation for Economic Cooperation and Development (OECD), "Africa's Development Dynamics 2023," 2023
[134] The World Bank, "Financial Solutions Brief, Zambia Scaling Solar," 2018. https://thedocs.worldbank.org/en/doc/208821518200595153-0100022018/original/BriefsGuaranteesZambiaScalingSolar.pdf Report produced by the World Bank, the International Finance Corporation, and the Multilateral Investment Guarantee Agency

The World Bank's Scaling Up To Phase Down program provides a roadmap to catalyze critical investments in all emerging markets. India's first Paris Agreement Nationally Determined Contribution (NDC) in 2016 included having 40 percent of installed electric power capacity come from non-fossil fuel sources by 2030. Since 2015, the World Bank has been providing loans and other financing to support the development of large solar power plants in the Indian state of Madhya Pradesh.

At the same time, the Indian government has introduced measures to promote renewables, such as incentives for electricity consumers to source more from renewables and modifications to tax structures related to coal power plants. These changes and World Bank financing supported the development of the 750-megawatt (MW) Rewa Solar Park, which attracted significant private investment and now produces electricity at a cost of just USD 4.4 cents per kilowatt-hour.[135]

Indonesia provides another example of an emerging market where the partnership accelerates renewable deployment. At the end of 2022, Indonesia only had around 300 MW of solar capacity.[136] But as part of the country's goal of achieving net-zero carbon emissions by 2060, the IEA and Indonesia's Ministry of Energy and Mineral Resources (MEMR) forecast that solar will need to make up between 50 and 60 percent of the country's installed electricity generation capacity by 2060.[137] The government aims to deploy 6.5 gigawatts of solar by 2025 and 45 gigawatts by 2050.[138]

As part of Indonesia's effort to accelerate renewable generation, KPMG serves as the lead financial advisor to PLN Indonesia Power (PLN IP), a state-owned utility PT PLN unit for the Proyek Hijaunesia 2023 project. The project includes a portfolio of 13 greenfield renewable projects totaling 1.2 gigawatts, including ground-mounted and floating solar, wind, and battery hybrid installations. Proyek Hijaunesia 2023 is developing partnerships with renewable energy developers with a track record of implementing large-scale projects to work with PLN IP to build renewables and provide equity. In addition, developers can bring corporate buyers to offtake the green energy produced to reduce the net effective tariff payment burden on the utility. KPMG and PLN IP also arranged a well-priced, stable debt facility as an offering to potential bidders.

[135] The World Bank, "Scaling Up To Phase Down," 2023. https://www.worldbank.org/en/topic/energy/publication/scaling-up-to-phase-down.
[136] Statista, "Solar energy capacity in Indonesia 2013-2022," 2023
[137] International Energy Agency (IEA), "An Energy Sector Roadmap to Net Zero Emissions in Indonesia," 2022
[138] PV Magazine, "Indonesian utility PLN seeks equity partners for large scale PV, wind projects," 2023

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A seven-step strategy to capitalize on emerging market opportunity

To capitalize on the vast opportunity in emerging markets, we must adopt a collaborative approach. A possible approach for stakeholders could be a seven-step strategy:

1. **Targeted reforms.**
Start with these three immediate actions: Streamline regulatory processes, offer tax incentives for green investments, and launch public awareness campaigns about renewable energy benefits.

2. **Facilitate increased private finance.**
Private sustainable finance in emerging markets and developing nations reached a record USD 250 billion in 2022. It must at least double by 2030. Achieving that will require innovative financing instruments, broadening the investor base, catalyzing the development of bankable investment projects, and expanding the involvement of MDBs and development finance institutions.

3. **Leverage local partners.**
Working with in-country investment partners and advisors can help navigate the uncertainties of investing in emerging markets.

4. **Enhance the role of MDBs.**
MDBs will play a critical role in providing the necessary financing required for climate action in emerging markets, given clean energy transition-related investment will be required to accelerate from current levels to around USD 4 trillion annually by 2030.[139]

5. **A clear vision and supportive policies.**
Policy signals play a critical role in attracting investments in renewables. According to the IEA, 40 African countries currently have renewable targets in their Paris Agreement NDCs. But only 25 have a stated policy to reach universal electrification.[140] To attract necessary investments and international support, nations can develop a clear renewables objective that is translated into supportive policies and regulations.

6. **Develop a strategy to manage stranded assets.**
Shutting down existing fossil fuel operations and declaring a write-off is not appealing to employees, owners, investors, or policymakers. Crafting win-win strategies to repurpose stranded assets for carbon capture and utilization and other purposes can go a long way toward accelerating the transition away from coal.

7. **Embrace the goal of shared prosperity.**
In much of the developed world, the energy transition is viewed as a vehicle for job creation and growth. Emerging markets must be supported in ways that deliver prosperity to as many communities and households as possible. One-sided trade will not be a sustainable long-term strategy. Fostering bilateral and multilateral cooperation and trade relationships should focus on bringing jobs and green economy development opportunities to emerging markets. Failing to do so will dampen renewable growth and encourage countries to consider onerous import barriers and local content requirements.

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[139] International Energy Agency (IEA), "World Energy Outlook 2021," 2021
[140] International Energy Agency (IEA), "Africa Energy Outlook 2022," 2022

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Conclusion

The barriers outlined in this report are significant and pose genuine challenges and risks to the critical progress of the energy transition. Taken together, these obstacles can appear insurmountable, as demonstrated by the 36 percent of KPMG survey respondents who are not very confident or not at all confident that renewables will replace fossil fuels by 2050. At KPMG, we draw a different conclusion. The intent of clearly outlining the complex barriers to scaling renewables is to provide businesses with a comprehensive understanding, enabling them to make informed decisions.

Over the past decade and beyond, the global community has learned not to underestimate the growth of renewables or the industry's ability to navigate around, over, or through difficult obstacles — from trade wars to an energy crisis to geopolitical conflict to a global pandemic. KPMG professionals believe the critical takeaway from this report is that now is the time for organizations to seek guidance in navigating the complexities of the energy transition and overcome the barriers that are preventing renewables from achieving their potential and driving economic value.

Fortunately, many in the renewable energy industry share KPMG professionals' clear-eyed realism about the barriers that must be overcome and confidence that they are temporary challenges. In the KPMG survey accompanying this report, 84 percent of respondents agreed or strongly agreed that current market challenges are delaying or canceling projects. Nevertheless, 36 percent have confidence that renewables will replace fossil fuels by 2050.

Nevertheless,

36%

have confidence that renewables will replace fossil fuels by 2050.

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As your organization shapes its future strategy, contemplate integrating these three principles, which can enhance outcomes and drive results.

Collaboration

A decarbonized world, by definition, is a departure from how people, communities, and societies have functioned for over a century. This means that new relationships and alliances must be forged to ensure, for example, that communities become advocates for the success of renewables because they are co-creators of the environmental and economic benefits they produce. Collaboration can also mean forging partnerships with schools and training programs to build the skilled workforce companies need to scale renewables or pursue projects in emerging markets with the help of local businesses.

Education

Those who work in the renewables industry can take for granted that the benefits of solar, wind, energy storage, and other clean energy technologies are self-evident. They are not. In taking action to break down the barriers to scaling renewables, consider embracing the role of educator. Education seeks to impart knowledge and foster comprehension. It requires empathy, an eagerness to hear and understand other points of view, and a commitment to the truth. This applies to building a social license to operate, navigating biodiversity concerns, and seeking capital for a project.

Innovation

The success of renewables so far is the result of the innovation of countless individuals across the globe. This innovation is rooted in creating and improving new technologies, business models, financing schemes, and public policies that birthed the energy transition. If anything, innovation is even more important now to surmount the barriers that prevent renewables from rising to a rapid scale. Innovation is essential in everything from the development of energy storage technologies able to deliver flexibility to renewables-dominated grids to accessing the critical minerals the energy transition needs. Going forward, we plan to examine the role that artificial intelligence can play in helping to mitigate the impact of at least some of the barriers identified in this report. An open and innovative mindset will reveal many of the answers needed to *Turn the Tide in Scaling Renewables.*

At KPMG, we are deeply committed to understanding the renewable energy landscape, identifying challenges, and providing solutions tailored to our clients' needs. Our vast experience in the energy transition space equips us to offer professional services that address specific hurdles and help promote business growth. If your organization is seeking guidance on navigating the energy transition, KPMG professionals are here to assist, helping to ensure that your strategies are not only effective but also commercially viable. Let us help you shape a sustainable future grounded in robust commercial principles and practices.

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Methodology

The survey data included in this report is based on the results of an anonymized online survey conducted by KPMG International in September and October of 2023. In total, 110 respondents from over 24 territories and countries across the globe answered questions about the need to accelerate renewable deployment, current market challenges, and policy effectiveness. The majority of respondents hold senior leadership positions at both public and privately held companies, including executive vice president, managing director, director, and senior vice president, as well as C-Suite titles. Survey respondents represent stakeholders across the renewable energy industry, including developers, utilities, investors, service providers, government, and the public sector. The technology focus of respondents covers a swath of renewables, ranging from solar, wind, and energy storage to hydropower, biomass, geothermal, and tidal energy.

Survey respondents are based in these nations: Australia, Bolivia, Brazil, Canada, Denmark, France, Germany, India, Indonesia, Ireland, Japan, Malaysia, Mexico, Nigeria, Norway, Peru, Rwanda, Singapore, South Africa, Turkey, Uganda, United Kingdom, United States and Venezuela.

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How we can help

In an evolving energy landscape marked by significant challenges and opportunities, KPMG professionals aim to be at the forefront as a leader to help provide insight, strategy, and actionable guidance. We understand the intricacies of the renewable energy sector and the necessity for businesses to adapt and thrive amidst these complexities.

Local knowledge, global experience

At KPMG, our strength lies in harmonizing local expertise with a vast global perspective. We understand the nuances of local markets, so we can tailor approaches that resonate with specific regional needs while drawing upon international best practices from our extensive operational footprint. This helps ensure that the advice provided is both locally relevant and global in scope, allowing organizations to navigate their unique challenges while staying on top of global trends.

A wide-range of services

An in-depth understanding of technical, financial, and regulatory aspects is necessary to navigate the renewable energy landscape. To provide services that capture the entire renewables ecosystem, KPMG leverages its expertise across Tax, Audit, Risk Consulting, Deal Advisory, and Management Consulting. We provide approaches that aim to reflect the multifaceted nature of renewable energy challenges and opportunities by striving to ensure close collaboration between our specialists in technologies, financing, supply chain optimization, and regulatory compliance.

Whether you're facing obstacles to scaling renewables or looking to explore emerging markets, our seasoned professionals can provide insights and strategies that align with your commercial objectives.

About the KPMG global energy transition practice

The energy transition stands as the defining challenge of our era. Every sector faces mounting pressure to power human progress in a way that is reliable and affordable but also, critically, more sustainable and equitable.

KPMG firms are here to help guide you through this increasingly complex landscape, enabling you to deliver on your ambitions for your business, people and the planet.

KPMG energy professionals include over 1,500 partners and staff in over 50 hubs around the world, working closely with institutions and companies to help them understand the ebb and flow of energy transition, identify growth opportunities and develop and execute their strategic plans.

Visit kpmg.com/energytransition

Acknowledgment

We could not have created this report without the support, knowledge and insights of colleagues around the world who contributed their time and energy to its planning, analysis, writing and production. Thank you to Andrew White, Terence McGovern, Jack Magill, Adrian Scholtz, Chiara Catgiu, Matt Colquhuon, Tracy Lane, Sharad Somani, Wen Bin Lim, Trevor Hart, James Colbert, Andy Symington, Cle-Anne Gabriel, Sarah Nelson, Carolin Leeshaa, Orlaith Delargy, Wout Steurs, James Delahunt, Anvesha Thakker, Marina Valls, Lyndie Dragomir, Nicole Duke, Erin Dodds, Evelio Robles Alejo, Maria Mallinos, Jeff Ho, Debashish Das, Sujay Mohapatra, Drishti Sikka, Jessica LoSchiavo, Mehma, Mayukh Chowdhury, Ozan Cakmak, Alex Choi, Samantha Dann, Rob Fisher, Michelle Pacey, Ben Twartz, Nichola Wee, Catherine White.

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Publication name: Turning the tide in scaling renewables | Publication number: 139134-G | Publication date: November 2023