TRANSFORMING THE POWER SYSTEM IN ENERGY-POOR COUNTRIES

Connecting human opportunity with climate action

Global Energy Alliance for People and Planet (GEAPP)

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Foreword

As world leaders gather in Glasgow, Scotland for the 26th United Nations Climate Change Conference (COP26), the fate of the world—or at least the world as we know it—feels in the balance. Each of us believes humanity can meet this moment. But to do so, we must reimagine the future, and the ways we can shape it.

For decades, humanity has struggled to reduce carbon emissions while at the same time creating the jobs that boost human development. The choices were bleak. Humanity could reduce emissions by forcing generations of people in developing economies to pursue limited opportunities with limited power (unlike their counterparts in wealthy economies, who have contributed most to climate change). Or humanity could speed up a climate crisis driven by enormous growth in emissions from developing economies. Until now, the world has chosen to muddle through, looking for marginal improvements and hoping for technological advances.

But muddling through is no longer an option. Climate change is bearing down on humanity. Without dramatic changes, it will grow beyond all hope of control. Today, 81 energy-poor developing countries, home to nearly half the world's population, have collectively contributed only 8 percent of the CO_2 emissions since the industrial revolution. These are the emissions driving warming today. In comparison, wealthy countries have contributed 60 percent of emissions.

Wealthy and large emerging economies now have the capability to dramatically reduce their emissions in line with their promises. But if the 81 energy-poor countries are left behind by the energy transition, their annual contribution to global emissions could grow from a quarter in 2020 to more than three quarters by 2050. Without a new global approach to supporting energy transition in these countries, this trajectory will make it impossible to avert the worst of climate change.

But, as this report and others from The Rockefeller Foundation and its partners make clear, a new path—a new future—is available. For the first time in history, the technology exists to reliably and affordably empower those with little or no access to electricity, while creating jobs at a massive scale and offsetting the need for new coal plants.

This is the moment the world has been waiting for.

By taking bold actions today, these 81 economies could avert 38 billion tons of emissions. These same initiatives would also end energy poverty and enable millions of good jobs, creating an on-ramp to opportunity in the 21st century. Focusing on renewable energy in the decade ahead will also set these economies on a climate-friendly development pathway. This will open the door for further decarbonization of transport, buildings, industrial processes and agricultural activities.

To realize this opportunity at COP26 and beyond, we must come together around a new approach. Many national governments in wealthier nations have not yet lived up to their climate finance pledges to support this transition in poorer and more vulnerable countries. Fortunately, new partnerships, like The Global Energy Alliance for People and Planet (GEAPP) that we are introducing in Glasgow, can help chart a path forward.

While the carbon savings and benefits for humanity are enormous, the barriers named in the following pages are challenging to navigate. Beyond resources, achieving this agenda requires dedicated attention, political and financial focus and expert advice. It also calls for a spirit of trust and collaboration between governments, private sector actors, and philanthropies to succeed.

During COP26 and beyond, humanity can take the steps to make the energy transition a reality—with partnerships like The Global Energy Alliance for People and Planet (GEAPP) leading the way. If we do so, billions of people will be able to connect to the renewable electricity they need to participate in the modern economy and care for their loved ones. Millions more will gain access to good jobs that improve not only their own lives but also their communities, countries, and the world. And humanity will have a chance to stop the climate crisis before it is too late.

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Acknowledgments

This report is an effort of The Global Energy Alliance for People and Planet (GEAPP), with external contributions. Its preparation was led by Dr. Joseph Curtin with contributions by a team at The Rockefeller Foundation, including John Gans, Eric Gay, Robin Bristow, Ashley Chang, Joseph Peralta, Clare Boland Ross, Eileen O'Connor, and Liz Yee; oversight provided by Ashvin Dayal. Additional input and feedback was provided by colleagues at IKEA Foundation. Neil King provided editorial input. Catalyst Off-Grid Advisors contributed predictive modelling, case studies and editorial feedback. Design by AHOY Studios.

Executive Summary

The world has long been at loggerheads over how to move forward most aggressively to combat global energy poverty while also avoiding a looming climate crisis. It is vital that we find a sustainable path to bring clean and reliable power to over three billion people whose lives are diminished by insufficient power access. It is equally vital that we take urgent steps to reduce carbon emissions and wean the world off fossil fuels.

The one mission need not be at the expense of the other. We can and must do both.

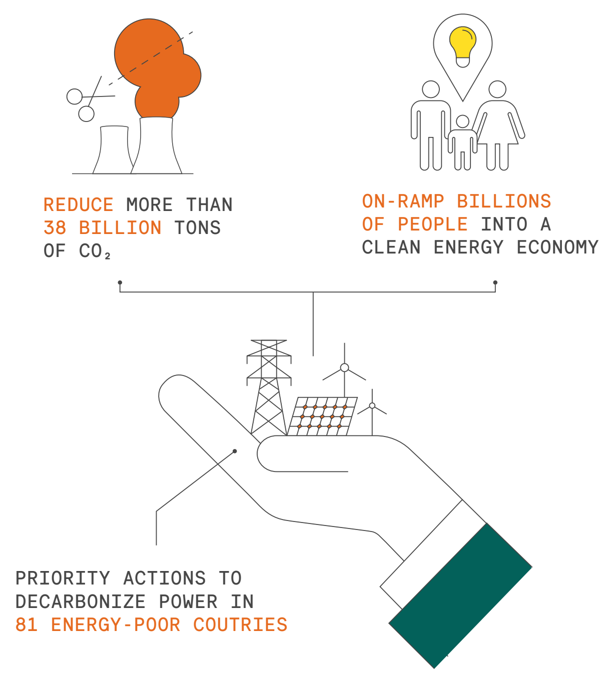
The gathering of world leaders at COP26 presents a unique opportunity to address these twin energy challenges. Given proper focus, commitment, and resources, and collaboration between countries, we can promote the well-being of humanity while tackling the climate crisis. We can increase our clean energy output and bring power to those who need it most desperately, while also reducing harmful emissions. The two aims need not be in conflict.

By 2030, the cost of renewables will undercut fossil fuels almost everywhere. These transformed power-system dynamics present a new opportunity to rethink and revolutionize how we generate and distribute electric power while boosting economic growth and global prosperity.

In this report, we highlight the central importance of galvanizing climate action in the 81 energy-poor countries that are home to nearly half the world's population. Situated firmly within a climate justice framework, we identify new opportunities for collaborative action between countries to achieve a near-term clean power transition in these countries.

We are already seeing real results in this transformation in terms of new jobs, economic savings, competitiveness, and market opportunities. But too many people are being left behind.

We lay out the essential steps to begin bridging this gap in this report. Priority actions in the power sector that we identify could reduce 38 billion of tons of CO_2, while on-ramping billions of people into the clean energy economy.



Time for a new development model

In our September report, *Transforming a Billion Lives*, we illustrated how transition to a clean power future should no longer be seen as a costly imposition on low-income countries. The widespread proliferation of clean and distributed power technologies can instead become an engine of economic transformation that drives countries toward equitable progress.

Galvanizing the necessary investment has the potential to create millions of power sector jobs. Hundreds of millions of additional downstream jobs could be created across the electric mobility, heavy industry, agriculture, enterprise, health and education sectors, *if* this power supply can be harnessed for new productive applications. No other global initiative has the potential to deliver such a sweeping and lasting impact.

Energy-poor countries are central for climate protection

The 81 energy-poor countries have collectively contributed only 8 percent of the CO_2 to the atmosphere that is driving warming today, compared to 60 percent for OECD countries. They are also by far the most vulnerable to climate impact such as rising sea levels and extreme weather, and they have the lowest level of resources to invest in protecting their populations.

Their pledges of action have therefore been conditional on receiving international support in the form of concessional finance, technology transfer and capacity building. But the support requested far exceeds pledges from rich countries, and fossil fuel use continues to grow rapidly.

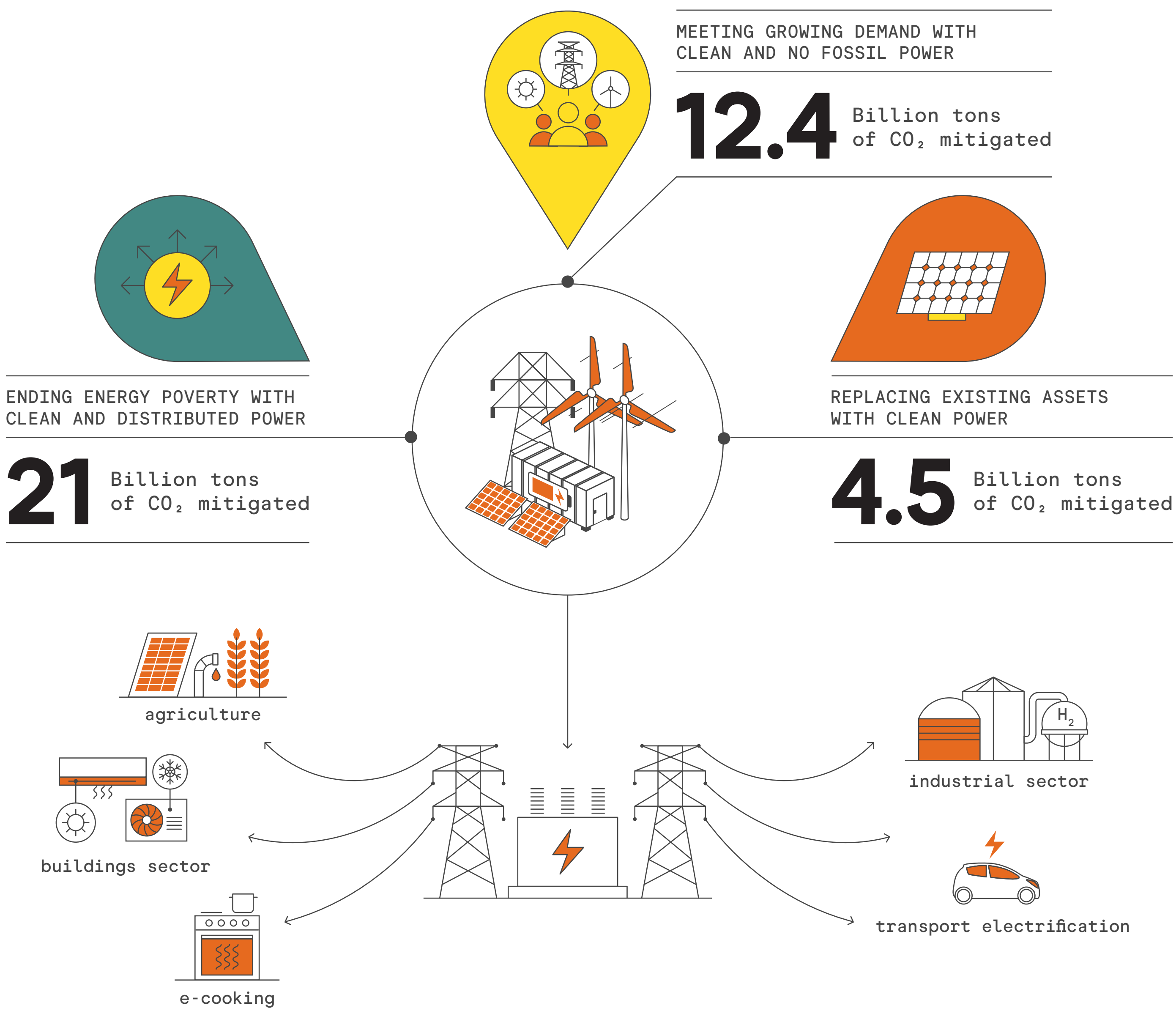
Yet, these countries are now essential to a safe climate future. If the world decarbonizes without them, our *Energy-Poor Left Behind* transition scenario illustrates that this group's share of global emissions could grow from a quarter today to more than three quarters by 2050. Without a radical rethink, and a globally collaborative approach to address this reality—even assuming rapid decarbonization from all middle and high-income countries—the 1.5-degree Celsius pathway and even the 2-degree pathway will fast drift beyond reach. To avoid this outcome an energy transiton in these countries must be more proactively supported.

Focusing on power generation

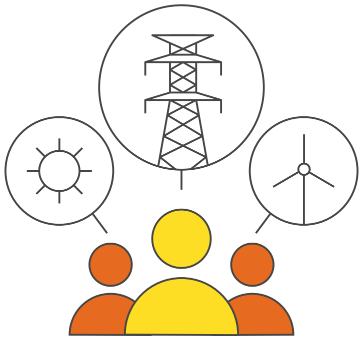
The immediate focus must be on clean power in the decade ahead. The power sector is responsible for 2.3 billion tons of annual CO_2 today in these 81 countries, but this vastly underrepresents its importance. On business-as-usual trends, power sectors emissions are set to increase rapidly over the coming decade. Deploying sufficient fossil fuel generation to end energy poverty would push emissions even higher.

Considering the needs of ending energy poverty and addressing climate action together, we estimate that priority actions taken could deliver 38 billion tons of CO_2 savings in the power sector alone, while on-ramping billions of people into the modern economy and enabling hundreds of millions of jobs.

But this is not the full story. Together the buildings, transport, agriculture and industrial sectors in energy-poor countries are responsible for another 9 billion tons of CO_2 per annum. The new clean power generated from the above actions can be an engine of transformation, unlocking decarbonization across the entire economy through the electrification of cars, busses and two-wheelers, e-cooking and electrification of industrial and agricultural processes.



Our modelling results suggest that near-term actions in these three areas would be transformational, but they may not be sufficient to set these 81 countries on a net-zero pathway. Further measures would be required in decades ahead to build on the momentum created.

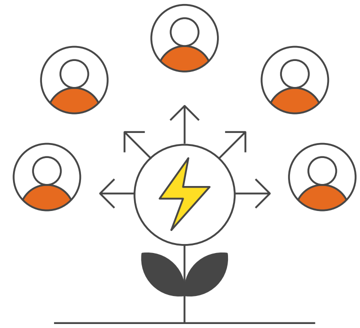


Meeting growing power demand with clean energy

The first opportunity is to meet the projected increase in demand for power with clean power, thus alleviating the need for new coal plants. This would save 12.4 billion tons CO_2.

Carbon savings from this action are highly cost effective: renewables are commercially viable in many geographies, but their deployment is slower than needed almost everywhere.

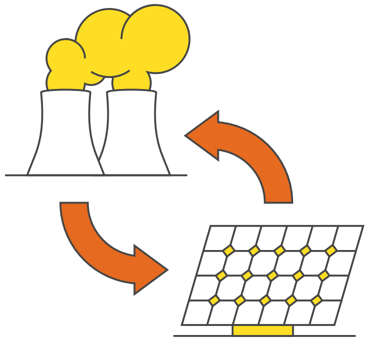
External actors must provide long-term, embedded in-country support paired with local expertise to overcome barriers to clean power deployment. For example, grids need to be upgraded so they can integrate more variable renewable resources, and governments need to implement complex renewables procurement processes to deliver new clean generation. Innovative approaches to managing residual risks for private investors are also needed in many markets.



Ending energy poverty with clean and distributed power

Rapidly deploying grid-based and distributed renewable power assets to set the world on a pathway to end energy poverty would save another 21 billion tons of CO_2, compared to a counter factual where this need is met by fossil fuels. We estimate that distributed renewables alone could account for a third of total carbon savings. Our provisional research indicates a higher cost of carbon for this action area, but that investment brings unique co-benefits for vulnerable communities in terms of job creation and lives improved.

Distributed renewable projects can also be nimbly and rapidly deployed and are often the most cost-effective option in areas where the grid has yet to arrive, or where it is unreliable. For these technologies to achieve their full deployment potential will require carefully designed and implemented integrated electrification planning frameworks. Efforts will be needed to spur reduced capital costs for clean power components, so that they come into line with the norm in advanced economies, while subsidies will need to be scaled up and more coherently deployed. The development of a market for energy poverty-aligned carbon credits could provide another important impetus.



Replacing existing assets with clean power

The final opportunity is to decommission existing coal-powered plants. If 10 average-sized coal plants are retired early each year, and replaced with clean power plants, more than 4.5 billion tons of CO_2 could be saved.

Coal plants that already exist in these 81 countries will contribute 62 billion tons of CO_2 over their lifetimes, which is more than total global emission in 2020. Early retirement of a sub-set of these plants, in close collaboration with national authorities, has the potential to save money for bill payers and to create a more certain environment for investors in renewables. It is crucial, however, to ensure that clean, reliable power is provided to replace the generation deficit, and that support is provided to ensure a just transition for impacted communities.

Even though strong economic headwinds affect coal power economics, many are insulated from competitive pressures by the terms of long-term power purchase agreements that result in payments for power that is not needed. Our provisional research suggests that decommissioning offers cost-effective carbon savings, although the absence of pilot projects to draw upon means this there is high uncertainty. A huge scale-up in the levels of concessional capital provided by rich countries is required to finance early retirements, while the development of carbon markets could unlock another new source of capital.

Conclusion

At COP26, we can offer all countries a compelling and positive reason to cooperate with global efforts to keep the world on a climate-safe pathway, thereby transforming the politics and practice of climate action, and opening opportunities for billions of people.

The world must come together to provide a concrete, finance-ready pathway for economies to accomplish near-term power sector transitions, focused on ending energy poverty with distributed renewables, funding alternatives to new coal, and replacing loss-making coal plants with clean energy. While the carbon savings and human benefits are enormous, the barriers are challenging to navigate. Dedicated effort, attention, political and financial focus, new resources, access to expertise and a spirit of trust and collaboration between countries are needed to achieve success.

Introduction

In development circles, it is often correctly pointed out that energy-poor countries—a cohort that includes the lowest-income countries in the world—have minimal responsibility for causing the climate crisis. Many conclude that this cohort have little or no moral imperative to act. They point to the enormous opportunities that opened up for the 1.2 billion people who gained access to electricity since 2000, even if 70 percent of new power came from centralized fossil fuels,[1] mostly coal.

Up to this point in history, the trade-off between development and climate action has created tension between those who prioritized ending energy poverty, often in low-income countries and emerging markets, and those who prioritized climate action, often advanced economies.

At this moment, the world is at a crossroads and this logic is being turned on its head. Over the past decade technological and market progress has driven the shift to an entirely new economic model. These breakthroughs have already made renewable energies commercial for new power generation in more than two-thirds of the world. By 2030, the cost of renewables will undercut fossil fuels almost everywhere.[2] Utility-scale renewable and distributed energy technologies that are already mature can supply the overwhelming majority of new power required by 2050, while investments in transmission and distribution systems and system integration technologies can allow for the optimal balancing and deployment of these generation assets.[3]

These transformed power system economics present a new opportunity to promote the well-being of humanity while tackling the climate crisis. But current economic and political thinking is inadequate for capturing the full potential of this shift.

In our September 2021 report *Transforming a Billion Lives* we suggested that energy transition in developing economies should no longer be seen as a costly imposition, but rather as an engine of economic transformation. In it we illustrated with case studies and predictive economic modelling that harnessing the full potential of clean and distributed renewables to end energy poverty for over 3 billion people could have a truly transformational impact.

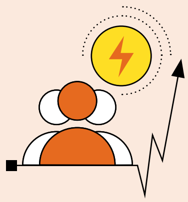
Galvanizing the necessary investment has the potential to create millions of direct jobs. If the new clean power supply can be harnessed for productive uses in new applications, hundreds of millions of additional downstream jobs could be created across the electric mobility, heavy industry, agriculture, enterprise, health and education sectors (see text box, page 12). We concluded that no other global initiative had the potential to deliver such a sweeping and lasting impact.

In this report, we focus on the importance this same agenda–power system transition in energy-poor countries–for climate protection. We begin with a climate justice framing, underlining the minimal historic contribution and heightened climate vulnerability of the 81 countries that suffer from energy poverty, before exploring the implications of business-as usual-emissions development pathway in these countries. Our findings suggest that, contrary to common perception, we cannot meet global climate targets without near-term power system decarbonization in these countries.

On this basis we explore the potential to galvanizing targeted support to ensure growing power demand comes from clean sources. Achieving success is an enormous challenge. It requires overcoming a series of intractable barriers, each demanding collaborative action and medium-term focus and attention. But the potential benefits are enormous. 38 billion tons of CO_2 emissions can be saved. The widespread availability of clean power will open the door to the wider decarbonization of the buildings, transport and industrial sector in the decades ahead. Most importantly, billions of people can sustainably on-ramp to the modern economy.

SUMMARY

Transforming a Billion Lives



Achieving success across energy-poor countries in Asia and Africa would require a several-fold increase in investment, reaching $130 billion per annum over the coming decade. However:

It would result in **25 million new jobs created globally in the power sector itself,** which is more than 30 times the number of jobs that would be created by a comparable investment in fossil fuels.

More remarkably, we estimate that nearly **500 million additional new jobs** can be enabled in an array of downstream applications that could harness this new, clean power: across electric mobility; heavy industry; agriculture, enterprises of various sizes, health, education etc.

Furthermore, **hundreds of millions of existing jobs would be improved:** they would become less time-consuming, less drudgerous and more productive by the availability of clean, reliable power.

It is important to acknowledge that energy transition will also result in jobs lost. For example, the IEA estimates that 5 million jobs could be lost in high-carbon industries across the world by 2030 with rapid decarbonization.[4] These jobs losses will be acutely concentrated geographically, often creating a strong countervailing impediment to transition. Success requires managing these complex dynamics within a just transition framework, where negative impacts on employment are carefully managed and counter-balanced with investments towards job-creating renewables.

This report was a starting point for considering the enormous economic potential of the clean power shift we anticipate over the coming decade.


HERBALIFE
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Billions of people remain cut off from economic opportunity

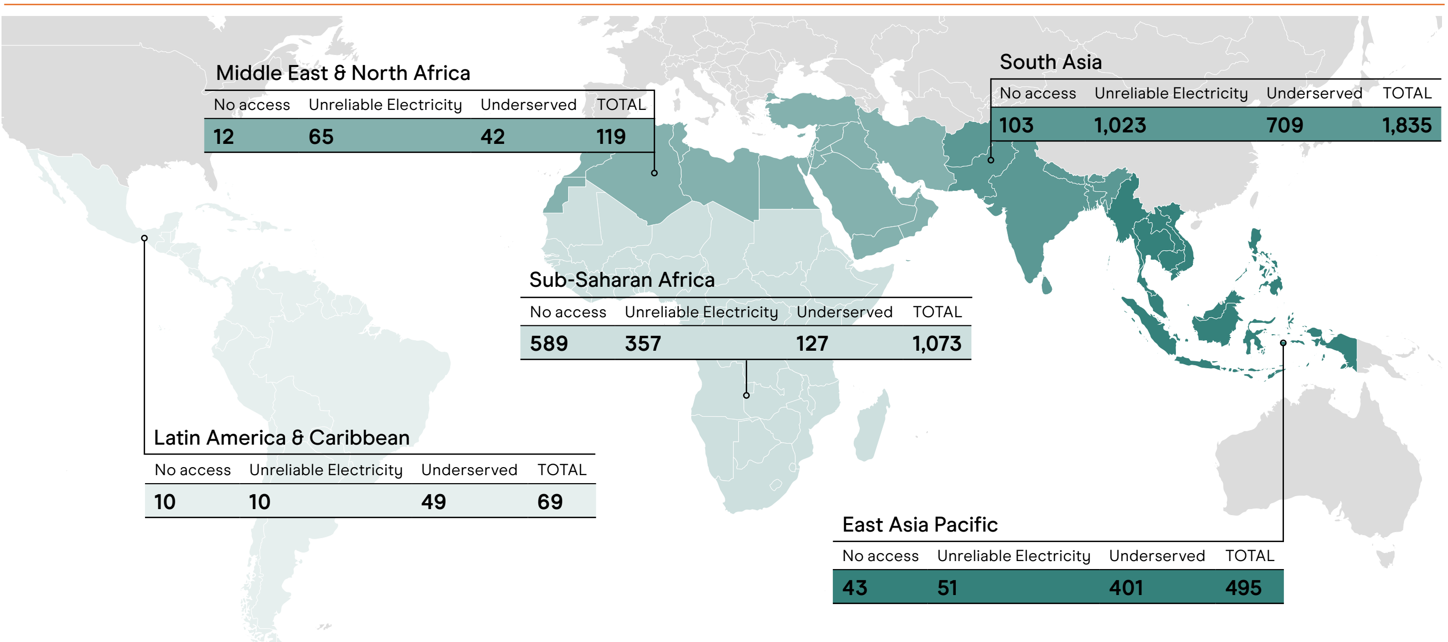
Access to power has become central and indispensable to modern life: nothing is more predictive of extreme poverty than lack of access to electricity, and nothing does more to alleviate poverty than providing that access. For many of the world's poor, the key impediment to their entry into a modern economy is the inability to plug into a reliable source of power.

For this reason, the U.N. Sustainable Development Goal 7 calls for *"access to affordable, reliable, sustainable and modern energy for all"*. Yet the principal indicator is the residential electrification rate of a minimum of 50 kilowatt-hours (kWh) per capita per year. This level of consumption is in no way sufficient to sustain economic development and to open the doors of economic opportunity to the citizens of energy-poor countries. For a country to reach lower middle-income status requires a Modern Energy Minimum (MEM) of about 1,000 kilowatt hours per annum to be achieved.[5]

Using this threshold as a proxy for energy poverty, we estimate that approximately 3.6 billion people live in energy poverty across 81 countries: 75 of these countries have not reached a MEM and another 6 have grids that are so unreliable that they constitute an impediment to development.[6]

This 3.6 billion people can be broken into three subsets. The most deprived group are the 757 million people that have no electricity whatsoever, almost 609 million of whom live in Sub-Saharan Africa. An additional 1.5 billion people have unreliable or unstable access (and are also energy-poor), while approximately 1.3 billion people have a reliable connection but their level of power consumption remains a sever impediment to progress.[7]

Total population experiencing energy poverty by region



Middle East & North Africa

No access	Unreliable Electricity	Underserved	TOTAL
12	65	42	119

South Asia

No access	Unreliable Electricity	Underserved	TOTAL
103	1,023	709	1,835

Sub-Saharan Africa

No access	Unreliable Electricity	Underserved	TOTAL
589	357	127	1,073

Latin America & Caribbean

No access	Unreliable Electricity	Underserved	TOTAL
10	10	49	69

East Asia Pacific

No access	Unreliable Electricity	Underserved	TOTAL
43	51	401	495

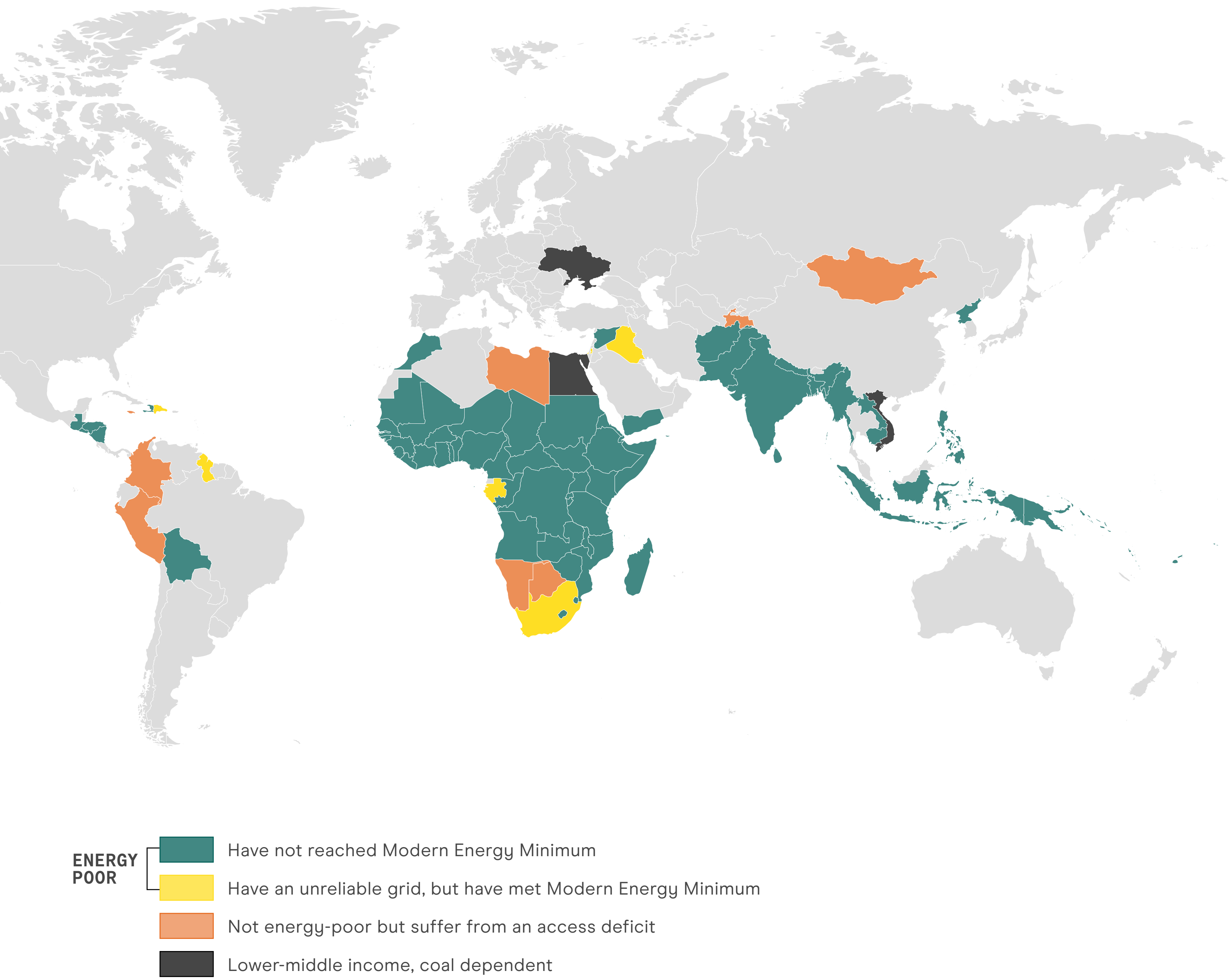
Total

No access	Unreliable Electricity	Underserved	TOTAL
757	1,507	1,328	3,591

It is important to point out that the MEM is a relatively imprecise approach for identifying those who live in energy poverty: it does not account for disparities in access within countries, which are often enormous. For example, eight additional countries that we do not categorize as energy-poor (they have met the MEM and have a reliable grid) have a portion of their population with no access to electricity whatsoever.

Finally, when considering the overlap between development and climate change, three additional lower-middle income countries are worth highlighting: Vietnam, Ukraine, and Egypt. These countries have surpassed the MEM threshold, have reliable grids and all citizens have access to power. However, they are highly dependent on existing and/or planned coal plants for economic development.

Countries experiencing some form of energy poverty (2021)



Energy-poor countries have low responsibility for climate change

When considering the issue of energy transition for the world's energy-poor countries,[8] it is important to begin with a climate justice framework. According to the Mary Robinson Foundation for Climate Justice, this means safeguarding the rights of the most vulnerable people and sharing the burdens and benefits of climate change and its impacts equitably and fairly.[9]

When considering climate justice, it is useful to divide countries into three very broad categories:

Low responsibility countries: this is the cohort of 81 "energy-poor" countries, many of whom continue to suffer from an energy deficit, and whose per capita power consumption is below 1,000kWh.[10]

Medium responsibility countries: this is a large and diverse group of some 70 countries, which merits further disaggregation:

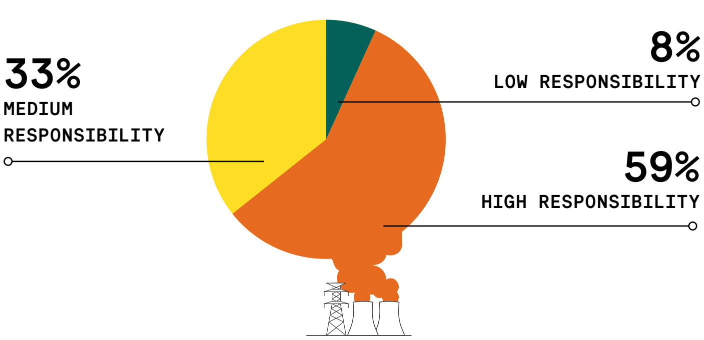
Medium-high: large emerging economies like China, Brazil, Argentina, Russia, Saudi Arabia, and Malaysia, which have achieved a significant level of economic development and whose power consumption on a per capita basis is above 2,500 kWh.

Medium-low: countries such as Thailand, Vietnam, Egypt, Algeria, Tunisia, Serbia, Armenia, Moldova, Colombia, and Mexico whose power use is between 1,000 kWh and 2500 kWh, indicating that they no longer suffer from energy poverty, but whose level of economic development and power use remain modest.

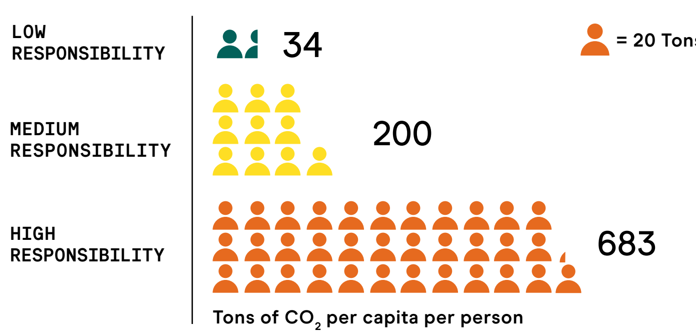
High responsibility countries: this includes all developed (or OECD) countries who were, by and large, the earliest industrializers and who have achieved a high level of power use per capita and are considered advanced economies.

When considering total historic contribution to CO_2 concentrations in the atmosphere,[11] which are driving warming and contributing to current extreme weather events today, the low-responsibility countries have only contributed 8 percent of the total. The whole of Africa is responsible for under 3 percent. By contrast, the high-responsibility group has contributed nearly 60 percent of total atmospheric CO_2.[12] When taking current population into account, low-responsibility citizens are responsible for only 5 percent of the emissions in the atmosphere compared to high-responsibility citizens.

Total historic contribution by country grouping (%)

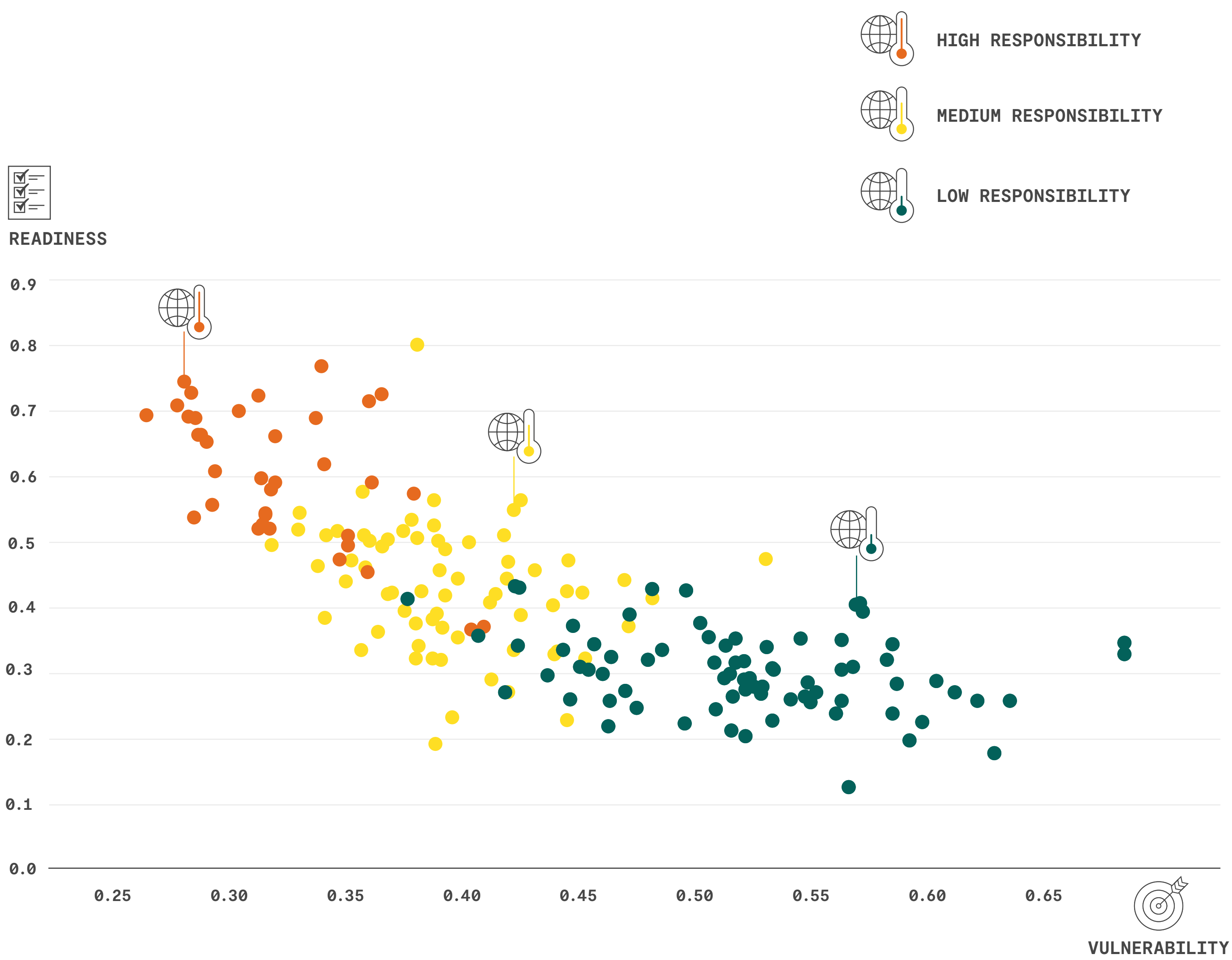


Total historic contribution by population and country group



Climate justice also necessitates consideration of vulnerability to climate impacts. The ND-GAIN Country Index summarizes a country's vulnerability to climate change in combination with its readiness to improve resilience. It illustrates that the energy-poor and low-responsibility countries tend to have the most to lose from a warming planet across six life-supporting sectors: food; water; health; ecosystem services; human habitat; and infrastructure. These countries also have the lowest readiness to respond, whereas the medium-responsibility and high-responsibility group tend to be more insulated from climate impacts and better positioned to adapt.

Vulnerability to climate impacts and readiness to respond by country grouping




HOTEL
ALL
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WELL
HIRA SONS
हीरा सन्स
READY MADE GARMENTS
A COMPLETE FAMILY SHOP
SUMMER & WINTER WEAR
ROOF
TOP
FREE
WI-FI

Avoiding the *Energy-Poor Left Behind* transition scenario

Even though energy-poor countries have low responsibility for climate change, energy transition for this group is essential for successful global action on climate change, from both a climate and development perspective.

This grouping is responsible for 24 percent of global emissions in 2020, which compares to nearly half of all emissions which come from medium-responsibility countries, and about 30 percent of global emissions which comes from the OECD grouping last year. However, when we consider how emissions contributions might evolve, even with rapid decarbonization in other countries, it becomes clear that business-as-usual growth for energy-poor countries is incompatible with a safe climate future.

It is widely accepted that the primary onus remains on developed economies to take immediate steps to reduce emissions due to their high levels of responsibility for the climate crisis. This is reflected in three ways. First, emissions from this cohort of countries peaked in 2007 and have declined by about 20 percent since then (including the dramatic fall in 2020 that resulted from the pandemic). Second, many countries in this cohort have taken on ambitious Nationally Determined Contributions (NDCs) to dramatically reduce emissions in the period to 2030 and thereafter. This includes the US commitment to achieve a reduction of its net emissions by 50-52 percent below 2005 levels by 2030,[13] the EU commitment to reduce emissions by at least 55 percent by 2030 compared to 1990,[14] Japan's pledge to reduce emissions 26 percent by 2030 compared to 2013,[15] and the UK's aim to reduce emissions by at least 68 percent by 2030 compared to 1990 levels.[16] Finally, all countries in this grouping have taken on net-zero commitments for 2050, apart from Australia (whose NDC is also an outlier and considered "highly insufficient").[17]

It is equally clear that the secondary onus falls on the medium-income and medium-responsibility countries, who, as a group, are now responsible for nearly half of global emissions. China alone is responsible for more than a quarter of global emissions.

Unlike the high-responsibility grouping, few countries in this cohort have taken on near-term commitments to reduce emissions. However, several of the larger emerging economies with medium-high responsibility such as China, Turkey, Russia, Brazil, Argentina, and Malaysia have committed to achieving net zero emissions, albeit China's commitment is for 2060. Furthermore, there is growing pressure for this cohort of countries to achieve a near-term peak in emissions, and there are signs that a peak in emissions may have already have been reached or is approaching for many of the biggest emitters in this group, including China, Mexico, Russia, and Brazil.[18] China, for example, has committed to "have CO_2 emissions peak before 2030" and the IEA predicts its CO_2 emissions could then decline in the period to 2030.

In the medium-low category, some country's emissions may have peaked (Georgia, Moldova) but for the most part countries like Thailand, Vietnam, Egypt, Algeria, Qatar, Ecuador, or Uruguay have considerable potential for development-driven emissions growth over the coming decade, which is reflected in their NDCs. In some cases, medium-low countries have made their mitigation pledges either partially or fully conditional on international support.[19]

Finally, when it comes to the low-responsibility and energy-poor group, many of these countries have taken on net-zero pledges, but none have committed to near-term emissions reductions. When it comes to NDCs, in keeping with the principles of equity in the Paris Agreement, all countries in this group have made their mitigation pledges conditional upon receiving international support (with the exception of Somalia).[20] Developed countries have so far failed to live up to their climate finance pledges to mobilize $100 billion per annum to support transition and adaptation in these countries.[21]

To illustrate the importance of low-responsibility countries from the perspective of climate protection, we developed an *Energy-Poor Left Behind* transition scenario, which is based on the considerations and developments outlined above. We assume a best-case scenario for high responsibility countries, wherein this group meets its 2030 and 2050 emissions pledges. Similarly, we assume a best-case scenario for the middle-income grouping, which achieves a peak in emissions between 2025 and 2030, and an increasingly steep decline thereafter.

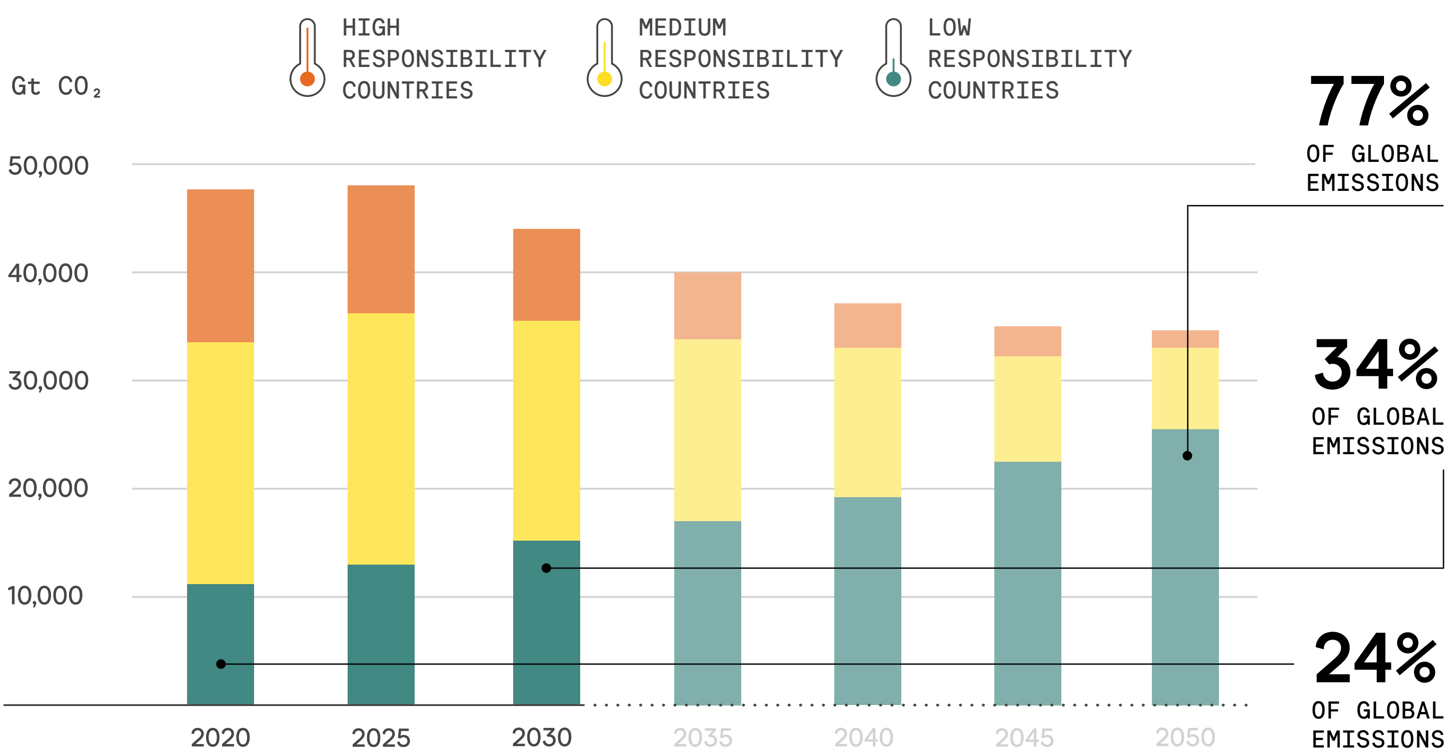
However, in this scenario energy-poor countries continue to depend on fossil fuels for their economic development because of a lack of technical and financial resources, and low levels of technology transfer. Emissions continue to grow in line with business-as-usual trends over the past decade in the period to 2030 and beyond to 2050 (see appendix for assumptions underpinning this scenario).

In this scenario, whereby all high- and medium-responsibility countries take immediate and persistent action to address the climate problem but technology transfer, financial or capacity building support does not flow to energy-poor countries, the low-responsibility cohort could account for more than a third of global emissions (34 percent) by 2030 and up to 77 percent of the total by 2050.

Business-as-usual growth in emissions for the low responsibility grouping might be considered a worst-case scenario. However, it should be pointed out that per capita annual emissions would likely be under 5 tCO_2e for this group by 2050 in this scenario, which is below per capita emissions in China today, and only about one quarter of current per capita emissions in the US.

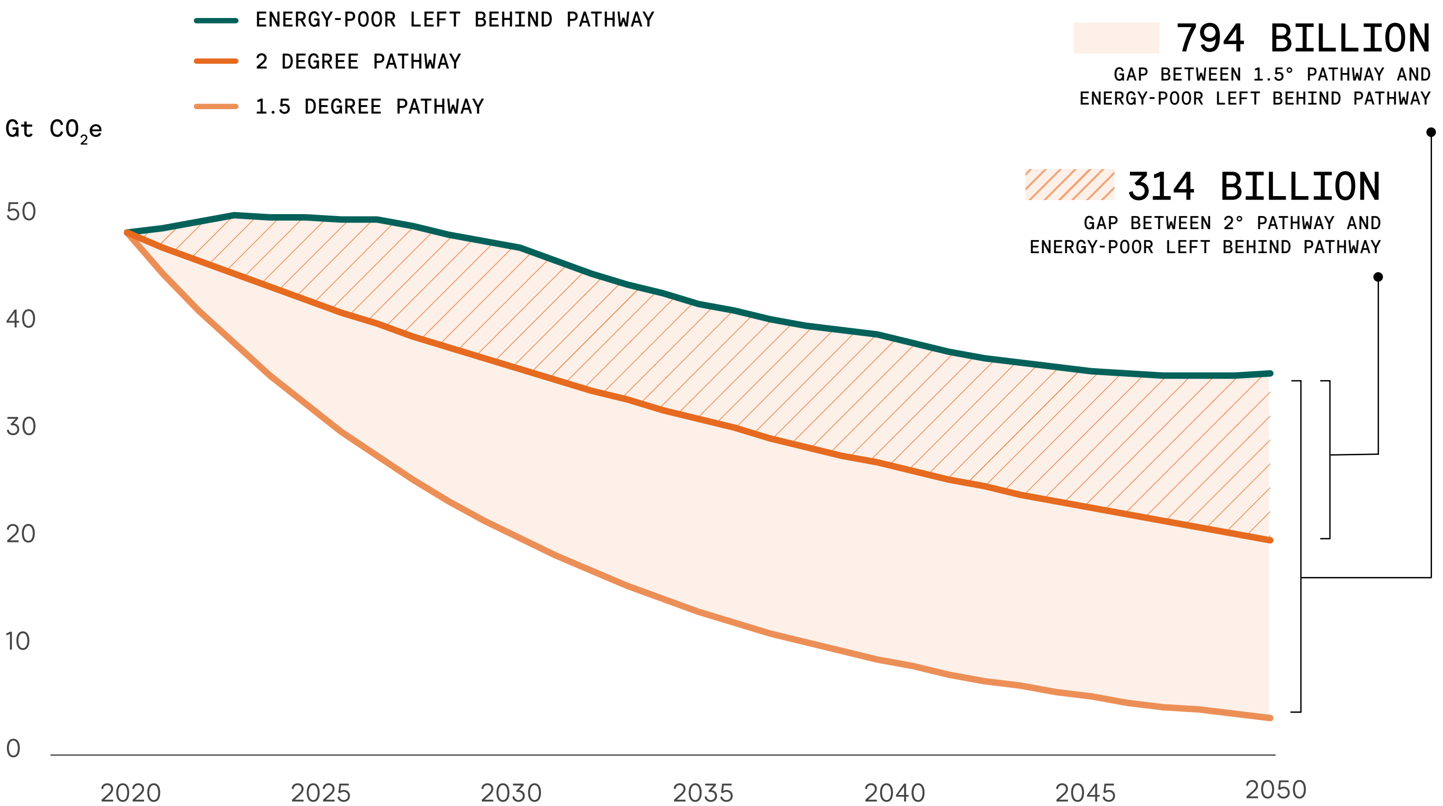
This is not a prediction, but an illustrative scenario which demonstrates that decarbonization from the energy-poor countries is a necessary condition for a safe climate future.

Global emissions in *Energy-Poor Left Behind* transition scenario



To achieve the 1.5-degree Celsius target, a 7.6 percent reduction in global emissions is required every year between now and 2050. The required cut for the 2-degree Celsius target is 2.7 percent per year.[22] In the above Energy-Poor Left Behind transition scenario, where the transition needs of energy-poor countries are ignored, by 2050 global emissions would exceed the 1.5-degree Celsius pathway by 794 billion tons CO_2-eq and the 2-degree Celsius pathway by 314 billion tons CO_2-eq.

The *Energy-Poor Left Behind* transition scenario compared to the 1.5 and 2-degree Celsius target



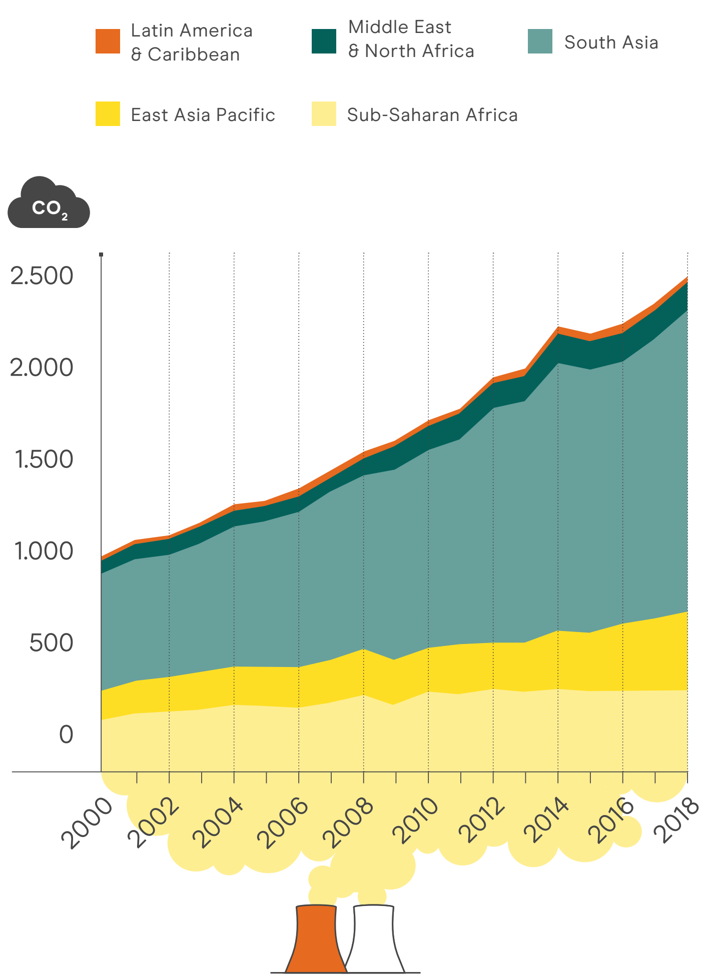
The power system is the engine of rapid decarbonization

Avoiding the *Energy-Poor Left Behind* transition scenario requires a concerted global effort over the coming decade. The primary effort must immediately focus on the power sector for three reasons.

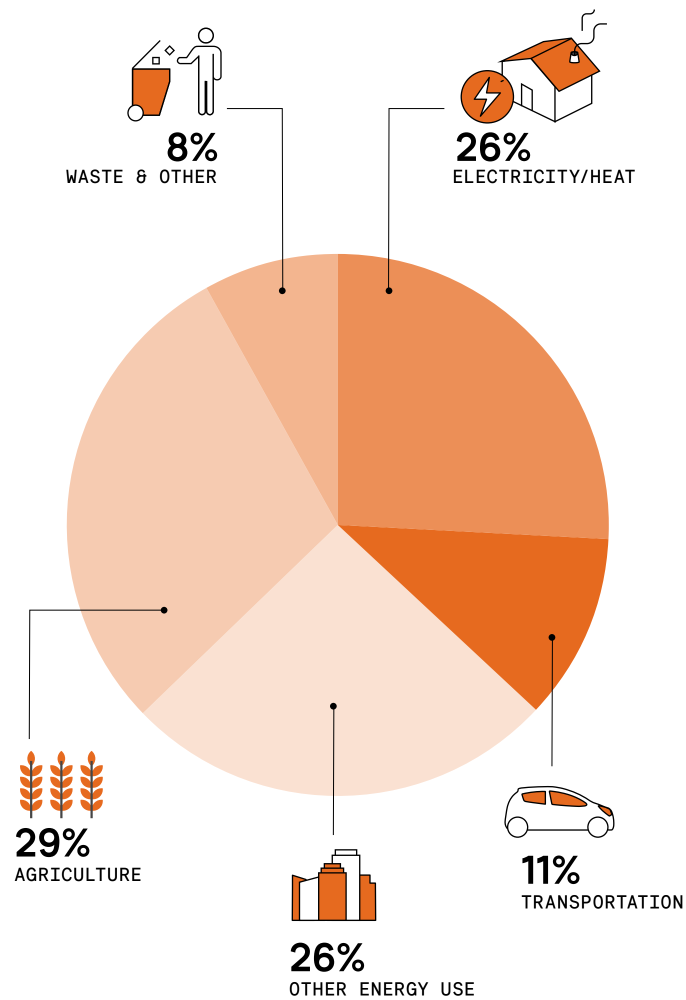
First, power sector decarbonization technologies are commercially available or close to commercial viability in many markets compared to low-carbon solutions in other major polluting sectors such as transport, buildings, industry and agriculture.[23]

Second, although CO_2 emissions from power systems in energy-poor countries are responsible for about a quarter of total emissions (of nearly 11 billion tons of CO_2e) from energy-poor countries in 2018, this contribution will continue to grow on business-as-usual trends. Growth in emissions would be ever more rapid in a scenario consistent with bringing sufficient power to the 3.6 billion people living in energy poverty today using fossil fuels.

Power sector CO_2 emissions growth by region for energy-poor countries (2000-2018)



Sectoral GHG emissions from energy-poor countries (2018)



The **third** reason to focus on the power sector is that the economy of the 21st century will increasingly be empowered by clean power generated from renewables. Power sector decarbonization is therefore a crucial starting point and a necessary pre-condition for the decarbonization of the transport, building and heavy industry sectors.

This is most evident in the transport sector: battery prices have fallen dramatically and will continue to do so over the coming decade.[24] As a result, electric cars, busses, trucks and two-wheelers of various kinds are becoming mainstream and accessible, and this is increasingly the case beyond developed economies.[25] We estimate that electrification of transport including electric motorcycles, electric tuk-tuks/3-wheelers, electric boats, electric passenger vehicles, and electric bus rapid transit, as well as associated charging infrastructure, has the potential to create up to 14 million new jobs in energy-poor countries, of which 13.5 million would be "medium- or high-skilled" [26] (See Case Study 1).

In the buildings sector, the arrival of clean, reliable electricity also has the potential to be transformative for approximately 3 billion people that currently use biomass for cooking in energy-poor countries. This puts enormous pressure on ecosystems and contributes to increased CO_2 from severe deforestation, in addition to causing high levels of household air pollution, extensive daily drudgery to collect fuels and manage fires, and serious health impacts.[27] With falling global PV prices, recent advancements in battery technology and rising charcoal/fuelwood prices in severely deforested regions, the door is opening for solar electric cooking. Countries such as Zambia, Kenya and Tanzania offer the highest viability for an early transition.[28] Similarly electric heating and cooling solutions, such as heat pumps, can displace fossil fuels used to heat water and provide warmth.

Finally, the manufacturing and heavy industry sector in emerging economies is also ripe for decarbonization using clean energy. Of all the fuel that industrial companies use for energy, it is estimated that almost 50 percent could be replaced with electricity, using technologies available today.[29] Opportunities to adopt electric technology should only continue to expand as electricity prices fall and electric technologies improve. For example, green hydrogen produced from electrolysis of water using renewable energy is an opportunity that is increasingly in scope for developing countries.[30]

However, all of these opportunities for transition to a clean energy economy are dependent on the abundant availability of clean, reliable power.

CASE STUDY

01

Clean powered electric motorcycles in Rwanda

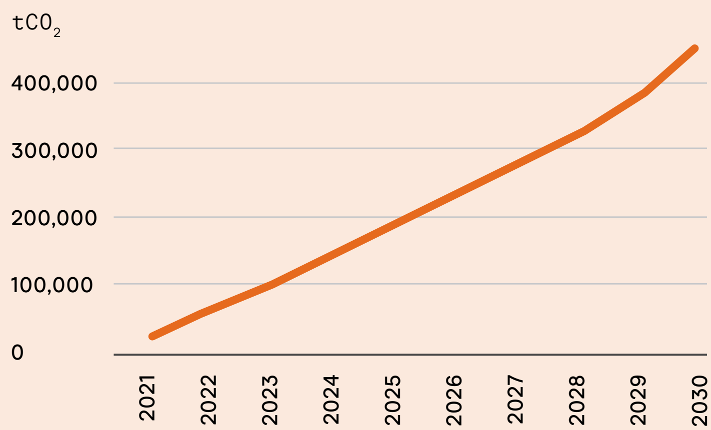
Rwanda is poised for a rapid transition to a sustainable transportation economy that could set an example for the region and the world. Currently, 11.5 percent of Rwanda's total greenhouse gas emissions are from the transportation sector. In the capital city of Kigali, 25 percent of air pollution is caused by motorcycles (more commonly known as "motos"). In response, Kigali announced plans to deploy charging stations at all fuel stations by 2050. Replacing traditional internal combustion motos with electric motorcycles (e-motos) can have a powerful impact on reducing CO_2 emissions, help accelerate further decarbonization of Rwanda's power sector, and save e-moto drivers hundreds of dollars each year.

A $36 million investment would enable e-moto battery swapping/charging infrastructure to power 75 percent of Rwanda's moto fleet in 2030. An additional $220 million would enable e-motos to be powered by grid-tied and standalone distributed renewable solutions via the buildout of 213 MW of generation capacity.

This fleet of over 250,000 e-motos would generate zero emissions if powered by clean generation sources, and could establish a powerful precedent to further decarbonize the country's transportation sector. A transition of this scale would avoid 2 million tons of CO_2 emissions by 2030 and reduce air pollution by nearly 20 percent.

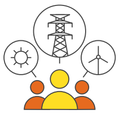
Ampersand, a Rwandan company that offers commercial electric motorcycles, illustrates the latent demand for the offering. It expects its e-moto fleet to be 500 strong by the end of 2021 and has a waiting list of 7,000 would-be buyers. Customers appreciate the lower cost and user experience compared to petrol-powered competitors thanks to a battery swapping model that makes charging quick and simple.

Annual CO_2 reductions from switch to clean powered e-motos

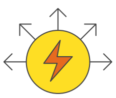


Setting energy-poor countries on a clean transition pathway

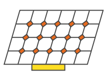
The graphic below illustrates the possible contribution of the power system to emissions in the period to 2030, divided as follows:



1. **CO_2 from business-as-usual approach to meeting growing demand for power across energy-poor countries**



2. **CO_2 from ending energy poverty with a reliance on fossil fuel technologies**

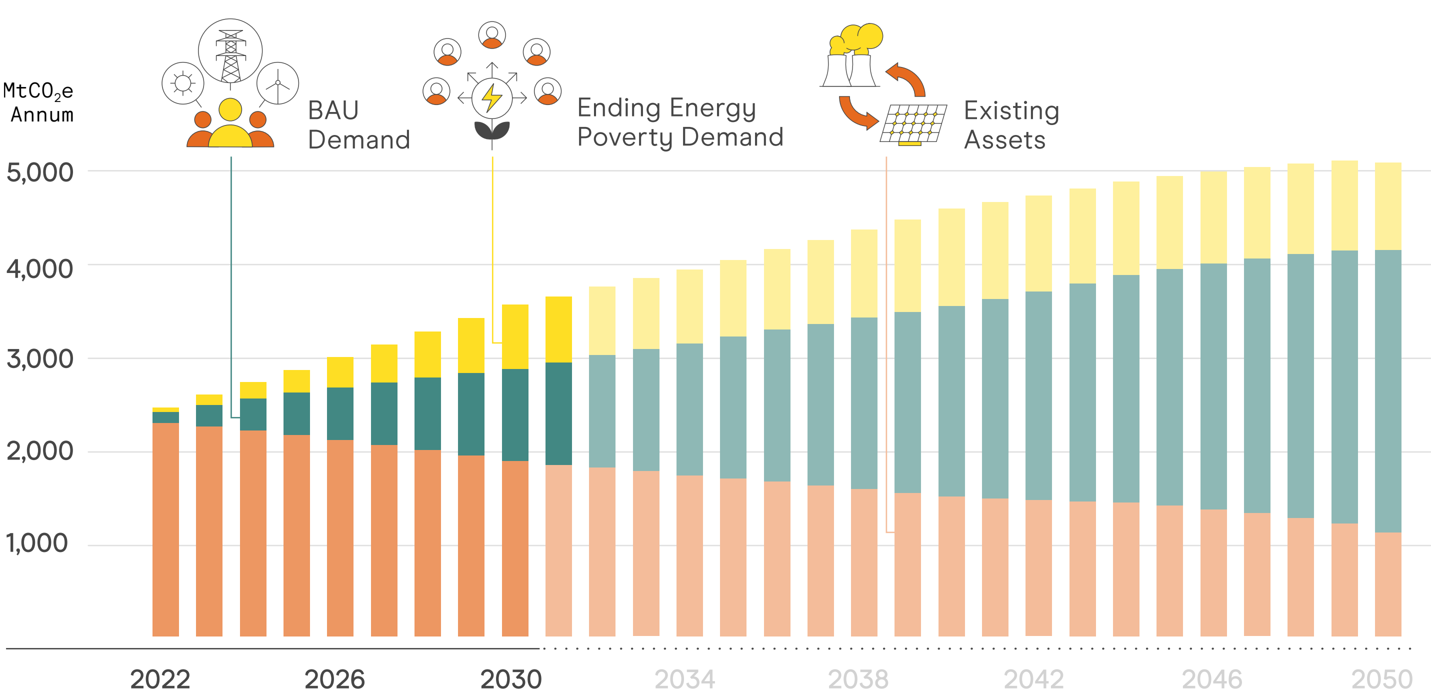


3. **CO_2 from already deployed power generating assets**

In this scenario, which is consistent with ending energy poverty, growing demand for power greatly outpaces the decarbonization of power supply. It is predicated on annual electricity demand growth of 5.5 percent, which leads to a near-quintupling of total demand by 2050. While trends become increasingly challenging to predict post-2030, even assuming a vastly reduced carbon intensity of electricity production, emissions could more than double by 2050. The cumulative carbon emissions from the power sector alone in this scenario could be 117 billion tons of CO_2 by 2050.

The coming decade is essential for disrupting this status quo and setting energy-poor countries on a clean power pathway. In each of the three wedges described above, all of which will make a substantial contribution to atmospheric CO_2 emissions in the decade ahead, there are near-term opportunities to travel down a different development pathway. In all cases, capitalizing on these opportunities will be dependent on overcoming enormously challenging barriers to progress (below), which in turn require the rapid scale-up and widespread availability of financial, technical and capacity building support.

Emissions from existing assets, business as usual growth for power and additional growth to end energy poverty



The three opportunities are as follows:

01
Meeting growing demand with clean power

There is an opportunity to meet a growing share of increased demand with clean, reliable power, which would alleviate the need for the deployment of new coal plants to meet growing demand, beginning in 2022.[31]

→ *Achieving "no new coal" this decade would yield 9.4 billion tons of CO_2 mitigation.*

02
Ending energy poverty with clean and distributed power

There is an opportunity to rapidly deploy clean, and distributed power assets to set the world on track to meet the needs of the 3.6 billion people who suffer from some form of energy poverty.[32] This would displace the need for fossil fuel grid power and diesel generation in off-grid or unreliable grid areas.

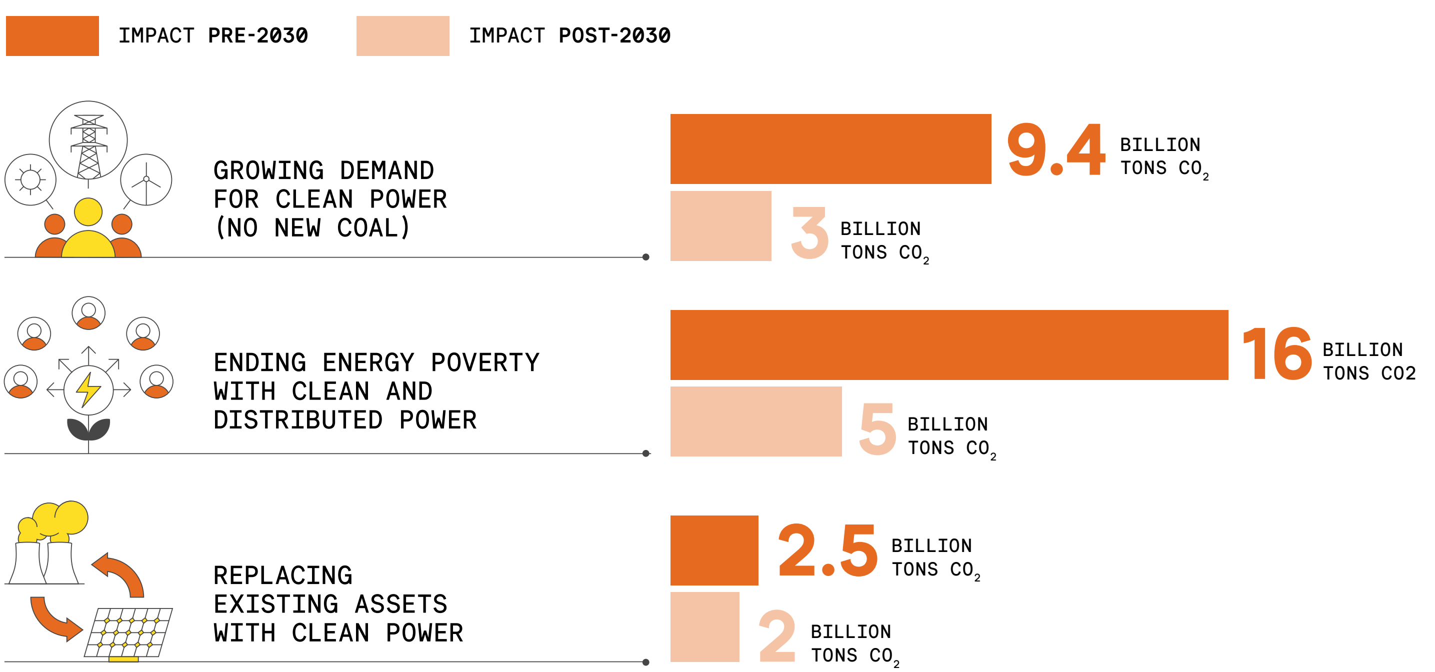
→ *Clean power deployment this decade consistent with achieving this objective would yield 16 billion tons of CO_2 savings*

03
Replacing existing assets with clean power

Providing clean, reliable power to replace the power currently provided by a sub-set of coal plants would enable the early retirement of these assets.

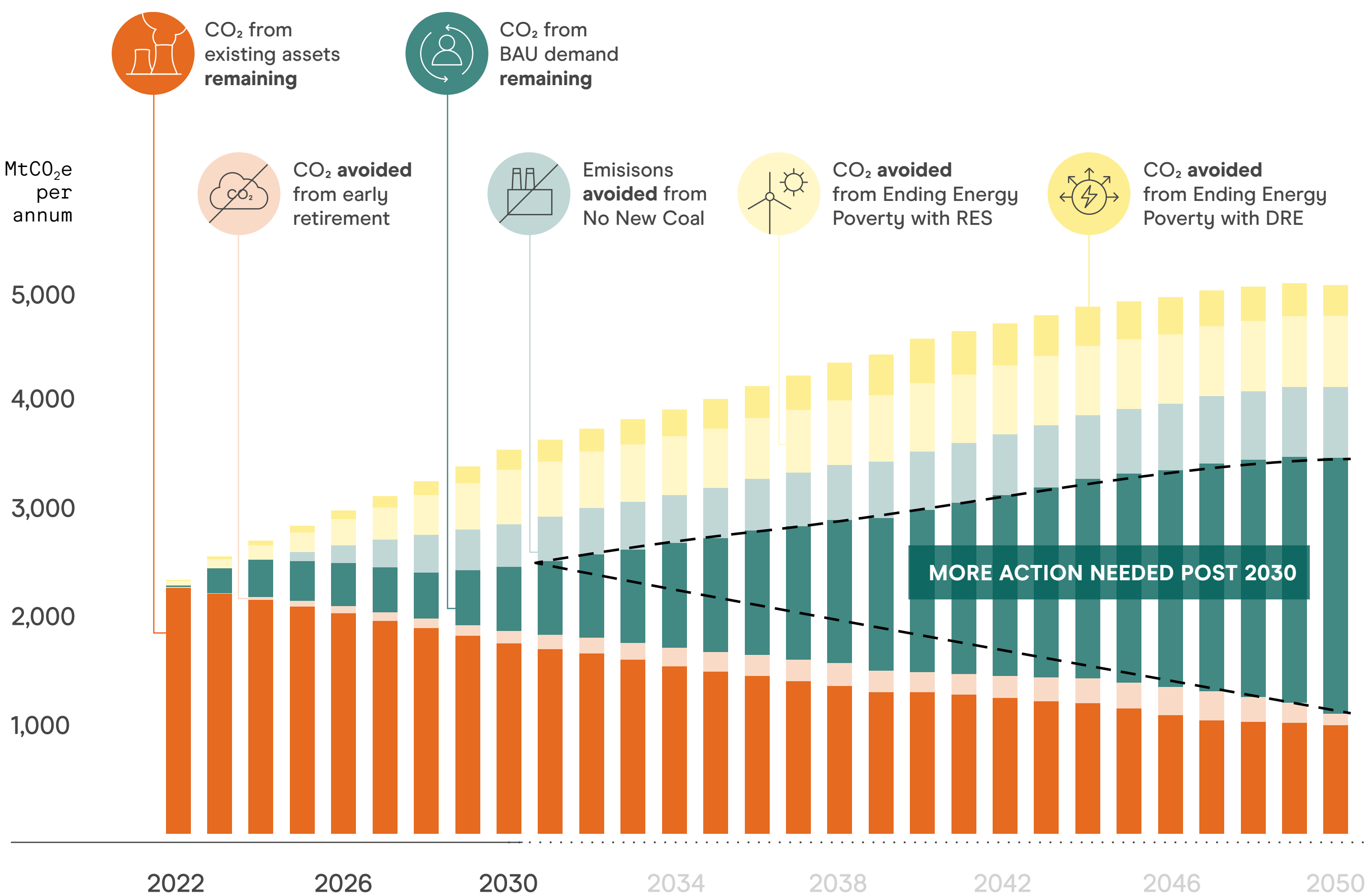
→ *Early retirement of 10 average sized coal plants per annum in the period to 2030 and replacing this generation with clean, reliable power would yield an additional 2.5 billion tons of CO_2 savings by 2030.*

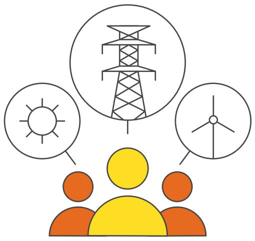
The carbon savings above reflect the lifetime impact of measures that can be taken between now and 2030. If these actions were continued after 2030, in other words: if no new coal plants were built after 2030; if ten coal plant were decommissioned early every year after 2030; and the world continued along a trajectory to end energy poverty with clean energy, another 10 billion tons of CO_2 savings would be achieved.



This full story is told in the chart below. The yellow, light green and light orange wedges illustrate the total carbon avoided (38 billion tons) by 2050 from all actions taken. We would emphasize the very high degree of uncertainty around how emissions from the power sector might evolve in the period beyond 2030. In this scenario, we assumed an aggressive rate of decline in the CO_2 intensity of power in business-as-usual, however, this is more than offset by increasing power demand. If this demand-side scenario were to unfold, it is clear that additional actions would be necessary in the post-2030 period to ensure that this new demand is met from clean assets, and not gas or other fossil fuels.

Total CO_2 savings from all actions taken 2022- 2050





Meeting growing demand with clean power

The most obvious near-term requirement is the displacement of fossil fuels with clean, reliable power to meet rapidly growing demand. When we look at the business-as-usual wedge, we can see that the majority of anticipated new emission will come from new coal plants announced, planned or permitted.

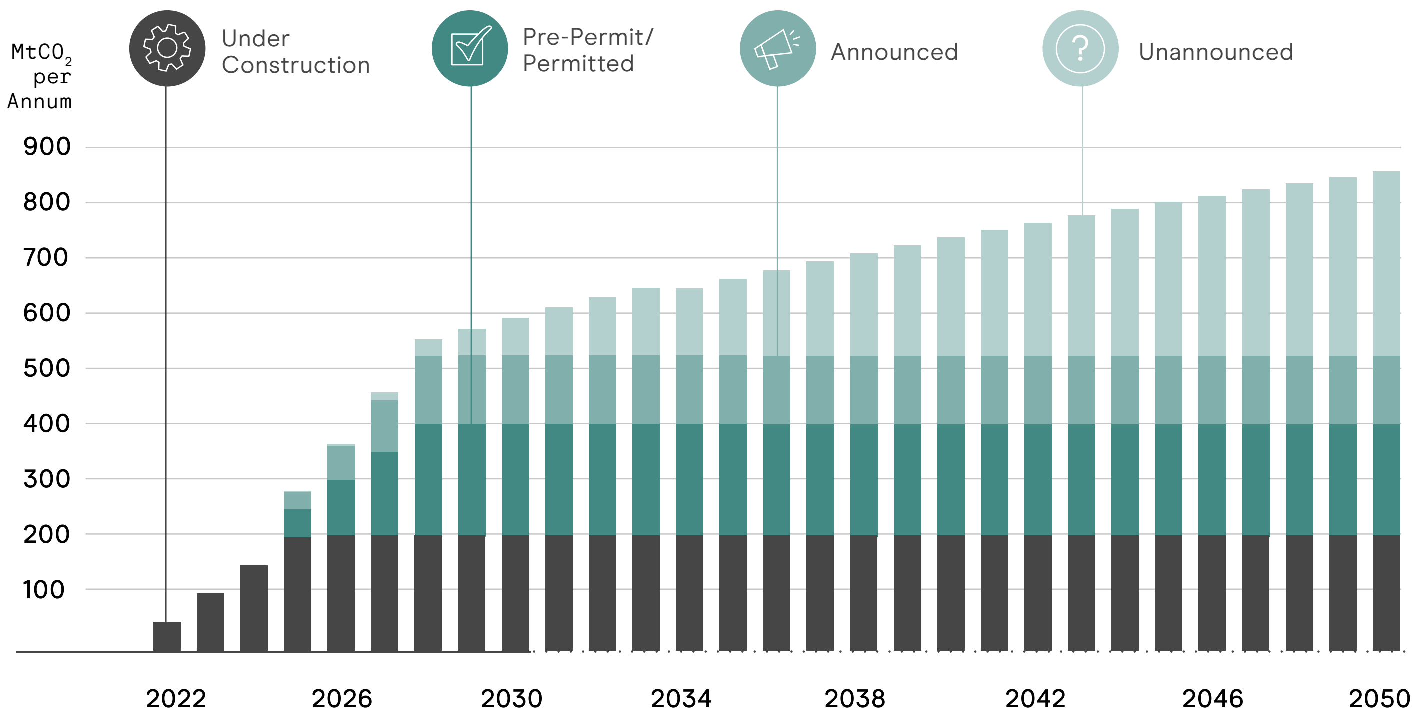
The economics of building new coal plants, which typically have an operational lifetime of 40 years, is questionable. There is a high probability that many of these assets could eventually end up stranded. Many of these coal plants are not required, will absorb scarce resources, and impede the transition to a clean power future.[33] Carbon Tracker has warned that 92 percent of these planned units will be uneconomic, even under business as usual, and up to $150 billion could be wasted.[34] We see huge potential for the world to act together to ensure that these new coal plants are not required because the deployment of clean power becomes the obvious first choice.

Provisional analysis undertaken for The Global Energy Alliance for People and Planet (GEAPP) indicates that building clean, reliable power provides cost-effective carbon savings. Clean power is often the most cost-effective choice in many contexts, yet the deployment of clean power assets is falling behind what is required almost everywhere, and this is particularly the case in energy-poor countries. The IEA's 2020 Sustainable Development Scenario estimated that a quadrupling of investment in solar in developing countries would be required to meet climate and energy poverty targets. This would require $500 billion dollars of investment capital by 2025.[35] In India, to take one example, a target to deploy 45GW of renewables per annum over the coming decade has been set, but so far is deploying about 7GW per annum.[36]

Renewables deployment is constrained by critical challenges no longer necessarily centered on the cost of the technologies themselves. An extensive literature points to a combination of technological, economic, institutional and political barriers which result in sub-optimal levels of investment in low-carbon technologies.[37] Meanwhile new demand for power is still being met by coal, in many cases due to status quo biases[38] and technology lock-in factors among power system planners.[39]

If these barriers could be addressed, the carbon mitigation benefits, which we estimate below, are potentially very significant. These arise from displacing coal plants that have been announced, are pre-permitted or permitted, and those we anticipate could be announced in the future based on an extrapolation of recent trends. We assume plants currently under construction cannot be displaced.

The CO_2 impact of displacing the coal pipeline with clean power



External actors can provide long-term, embedded in-country expertise paired with local talent to overcome barriers to rapid deployment. Country-specific barriers that impede renewables from achieving their full deployment potential that could be addressed by such support are categorized below.

BARRIER

01 Technical constraints associated with integrating increasing levels of variable renewables

Renewable sources such as wind and solar generally increase the uncertainty associated with power system operations. At higher levels of penetration of variable renewables there is a greater need for system operations and physical infrastructure to evolve to efficiently integrate these resources. In Sub-Saharan Africa, for example, the World Bank estimates that three out of four countries have a grid that cannot accommodate a solar PV penetration of more than 5–10 percent.[40] Effective strategies have been deployed to manage variable renewables in many geographies, including power forecasting, energy storage, balanced area coordination over larger geographies, moving to shorter intervals for scheduling and dispatching, enabling wind and solar plants to provide ancillary services, updates to grid codes and/or power purchase agreements, and implementing demand response programs.[41]

Identifying and implementing the correct mix of these strategies can be particular onerous in developing economies, requiring as they do accurate data, modelling staff capacity, software tool availability and rigorous stakeholder engagement, as well as the availability of capital to invest in priority transmission and distribution needs and other grid improvements. This can place an enormous burden in contexts where human and financial resources in regulatory commissions, Energy Ministries, and power system operators are constrained. Patient, long-term embedded support working with local experts and officials can support the development and implementation of a country-specific approach.

BARRIER

02 Designing and implementing an effective RES procurement schemes

The benefits of designing and implementing an effective renewables procurement scheme to attract private investment capital are potentially enormous. However, implementing such a procurement scheme is a resource and time-consuming undertaking. It requires the development of a long-term and coherent strategy and a stepwise approach to identifying and removing barriers. This generally includes, *inter alia:* least-cost resource planning, including on-grid, off-grid and T&D system needs; identification of RES targets and priority systems investments needs; evaluation of legal framework, skills gaps, financial, and political-economy constraints and limitations; assessing and maximizing socio-economic benefits of deployment on jobs, gender and inclusion; designing and implementing bidding schemes; and select independent power producers.

According to the World Bank, few energy-poor countries have completed the necessary downstream work to mount a sustainable solar program. In Sub-Saharan Africa, for example, it found that 90 percent of the countries had not met these conditions, even if in most countries there is a strong willingness to develop such programs.[42] Deep and patient technical support paired with local expertise is required to assist countries to address these hurdles.

BARRIER

03 Addressing perceived investment risks

Addressing technical constraints and rolling out high quality renewable procurement frameworks will address many of the risks that turn off investors. However, not all investor risks are addressable through these measures. The most prevalent risks from a private investment perspective include off-taker risk, FX risk and breach of contract.[44] There is a role for global collaboration to address these residual unmitigated risks, some of which can be managed through availability of insurance products of various kinds.

CASE STUDY

02

Vietnam's power sector at an inflection point–coal vs. renewables?

Vietnam's recent and rapid scale-up of renewables is generating important lessons that are relevant to other jurisdictions worldwide, particularly those with a heavy reliance on coal. To spur the development of solar power in Vietnam, and in line with its Power Development Plan, the government launched two rounds of solar feed in tariffs (FITs) over the July 2019-December 2020 period. The FITs targeted both rooftop solar (whereby surplus production would be purchased by the utility, EVN) and ground mount and floating (with all generation purchased at the FIT price), with remarkable results.

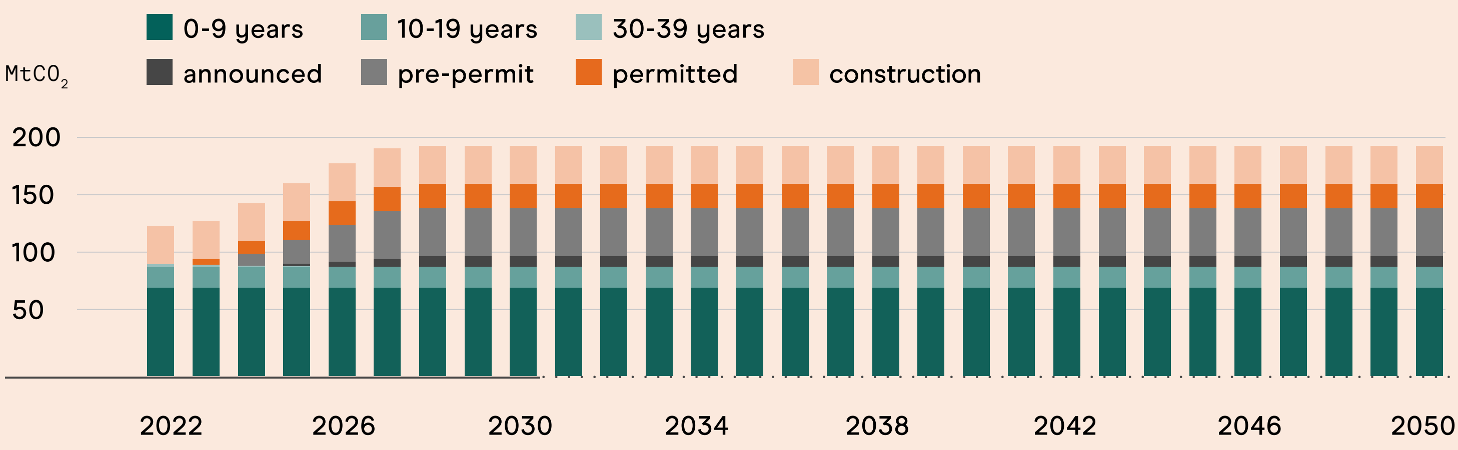
Solar capacity now totals 16.5 GW, representing 24 percent of Vietnam's generation fleet. Sources of financing for FIT projects varied, with the small rooftop market dominated by local investors, and larger projects a mix of local and international investors and developers.

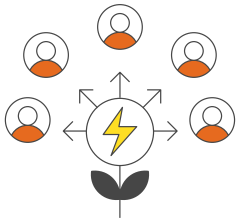
However, Vietnam's power sector remains heavily dependent on coal. 20.9 GW is currently operational, representing 37 percent of Vietnam's installed capacity. This fleet is relatively young, with 58 percent of those assets operating for less than 10 years. Vietnam also has 43 coal plants totaling 19 GWs under development, and an additional 8.6 GW that is already under construction. If this were to materialize on schedule, it would be responsible for 2.7 billion tons of CO_2 emissions over the expected plant lifetimes.

Vietnam's power sector is at a crossroads. Its latest draft Power Development Plan 8 (PDP 8) calls for total solar capacity to be capped at 18 GW. PDP 8 calls for 37 GW of coal capacity to be online by 2030, though there are questions as to how this will be financed.[43] Seizing the momentum created by the successful FIT initiative could help to spur significant additional investment into renewables, and crowd out a meaningful portion of its coal pipeline.

This push to decarbonize Vietnam's grid will necessitate a modernization of grid infrastructure for a renewables-intensive future mix. Significant investment capital needs to be mobilized for such a scale up, which in turn will require improvements to the commercial regime. Some of the most critical issues include investor protections around force majeure events, compensation in the event of curtailment, access to hard currency, and mitigation of off-taker creditworthiness risk.

Emissions from planned and existing coal plants by age





Ending energy poverty with clean energy

Approximately 2.2 billion people of the 3.6 billion that we estimate live in energy poverty have no electricity access or their access is unstable and unreliable. Using a grid-based approach to achieve the goal of ending energy poverty for this cohort presents challenges. Distributed renewable projects, by contrast, have several characteristics that make them a key infrastructure priority.

The first is cost-effectiveness: depending on location and population density, distributed renewables are often highly competitive with grid-based solutions. In fact, the World Bank estimates that off-grid solutions are the most economical solution for 490 million people.[45]

Distributed renewables projects can also be nimbly and rapidly deployed. Standardization in specifications and regulations has already accelerated project development timelines considerably. A typical 50 kilowatt-peak solar mini-grid serving a single village up to 3 kilometers in radius can now be installed in under two months. With more plug-and-play components, sophisticated procurement systems, and experienced contractors, project timelines are declining every year. For these reasons, distributed renewables quickly boost local economic activity, which is an important characteristic during an economic downturn.

They also can be right-sized at the outset and designed to grow along with demand, thanks to modular designs. DREs can target those at the margins, and can be designed in such a way that they can be connected with the grid once it arrives. Green power projects in general create almost three times as many jobs as fossil fuels projects, but distributed projects are particularly labor intensive, and open new opportunities for underserved communities.[46]

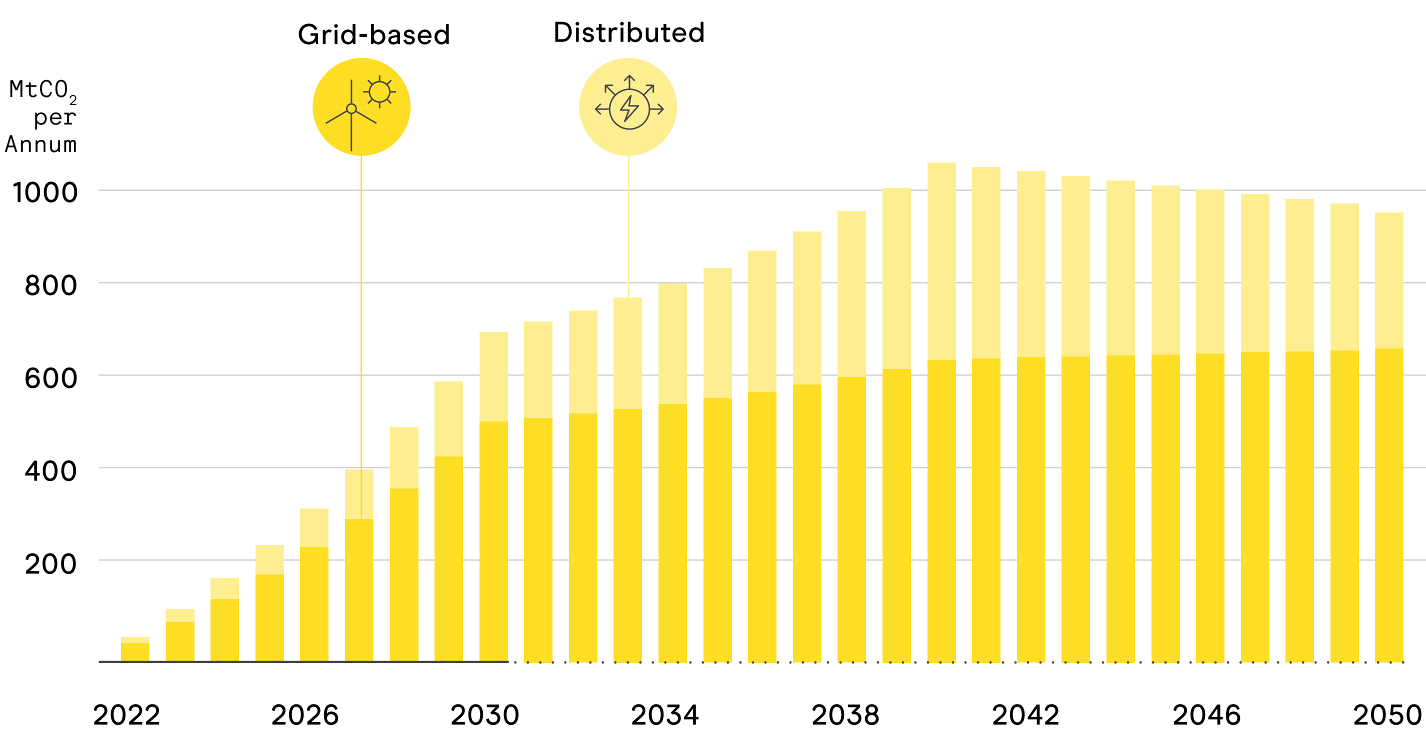
A second target market for distributed renewables is for those with unreliable grid access. Grid-based power would inevitably be used to meet the needs of this cohort in an ending energy poverty scenario, however, deploying distributed renewables to serve those with unreliable access is another promising solution. Distributed technologies can increase system-wide resilience and reliability in a number of ways. For

example, grid-tied distributed renewables can enhance grid reliability by circumventing transmission and distribution constraints. New projects also distribute the location, source and risk of failure across many smaller assets and offer centralized system operators important tools for voltage control and blackout prevention. Since distributed renewable projects are often developed at the edge of the distributions system, they can also defer or replace costly grid upgrades and investments.

Provisional analysis undertaken for GEAPP suggests that the investment costs and associated carbon costs of reducing emissions with these solutions could be higher. However, the co-benefits in terms of job creation, people empowerment and economic transformation are potentially enormous.

To estimate the emissions associated with ending energy poverty for the 3.6 billion people living in energy poverty, we modeled the amount of power required to put this cohort on a pathway to the MEM. For the most energy-poor grouping of countries, achieving the MEM by 2030 would require unrealistic annual growth rates. For this reason, we assumed the MEM was met by 2040 for this sub-cohort. We assumed that the share of demand met by the grid is directly proportional to the share of households connected to the grid today, but increases incrementally over time, with the remainder served by diesel-powered distributed assets. The counterfactual assumes that generation required to meet the MEM was met exclusively by utility-scale and distributed renewables, respectively. The total CO_2 savings associated with the clean power approach to ending energy poverty compared with the business-as-usual approach is 21 billion tons CO_2.

CO_2 savings associated with ending energy poverty with clean energy



Notwithstanding the enormous potential of distributed renewables to achieve widespread deployment and to make a major contribution to ending energy poverty, this asset class faces a number of barriers that must be addressed.

BARRIER

01

High component cost

The revolution in renewable pricing has yet to touch many African and Asian countries. This is particularly apparent for smaller-scale distributed energy resources. For example, mini-grid developers in sub-Saharan Africa pay between 2.5 and 3.8 times as much as the global average for lithium-ion batteries and over 20 percent more for photovoltaics, even before taxes and import fees that can increase costs by an additional 25 percent in many countries.[47] Achieving cost reductions would require a host of actions, including: standardizing component specifications to enable aggregated purchases and partnering with government-led rural electrification programs to increase access to low-cost technology for developers.

BARRIER

02

High cost of finance

The second factor is the cost of capital. Attracting investment in many markets is challenging because returns have long been modest and risks relatively high.[48] Mini-grid developers remain small and undercapitalized, lacking the balance sheets to start new projects. Mini-grids need to be treated like other infrastructure assets, leveraging a project financing approach to access long-term debt. Without scale and cost reductions, however, long-term financing will remain elusive.

BARRIER

03

Fragmented subsidy landscape

Subsidies are required for rural and last mile connections, regardless of whether electricity is provided via the main grid, mini-grids, or smaller off-grid solar systems. Governments, donors, and developers all recognize that distributed renewables are often the least-cost option to deliver universal electricity access, but small-scale projects lack access to the same concessional financing that supports central grid extension in rural areas.

A smarter use of subsidies is required to de-risk and catalyze a greater level of private investment. For example, a results-based financing approach that provides credit once a connection is made and verified to meet specific standards, or once the service has reliably been delivered for a period of time, can shift the focus towards outcomes and allow developers the flexibility to adapt and experiment to achieve delivery. The Universal Energy Fund is a multi-donor results-based financing facility that takes a coordinated funding approach for grid extension, mini-grids and solar home systems, but it needs to be scaled up.

BARRIER

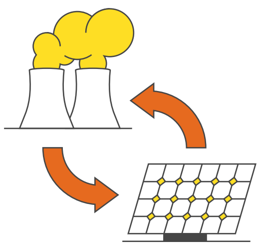
04

Carbon markets

Both voluntary and compliance carbon markets offer opportunities for renewable projects in developing countries. However, project types that have achieved commercial viability (e.g. grid-connected renewables) are generally no longer eligible for carbon credits on voluntary markets.

Carbon credit-generating projects increasingly need tangible co-benefits that can be measured and quantified under the framework of the 17 SDGs. Projects that target communities with unreliable or no access to electricity and contribute to alleviation of energy poverty, or SDG 7, are obvious candidates. Generally speaking, the more SDGs to which a project contributes, the higher the price of the carbon credits it can generate. Some carbon standards (such as the GS and VCS) have specific methods for certifying these contributions.[49]

However, the market for energy poverty-aligned carbon credits remains nascent and highly fragmented. There is an opportunity to define a specific energy poverty aligned carbon credit to support the deployment of distributed renewables in energy-poor contexts.



Replacing existing assets with clean power

The incumbent coal fleet in energy-poor countries will contribute 62 billion tons of lifetime CO_2 (53 Gt by 2050), which is more than total global emissions in 2020. Carbon Tracker and others[50] estimate that more than 60 percent of the world's coal plants are already generating more expensive electricity today than could be supplied by building new wind or solar plants. This figure will rise to 100 percent of plants in the world's major markets by 2030.[51] These findings are supported by IRENA analysis, which estimates that the levelized cost of electricity from renewables is undercutting the operating cost of coal plants in many contexts. The IRENA analysis found that 800 GW of existing coal-fired capacity has operating costs higher than new utility-scale solar PV and onshore wind, even when grid integration costs are considered, 193 GW of which was in India alone. Replacing these coal-fired plants would cut annual system costs by $32 billion per year and reduce annual CO_2 emissions by around 3 billion tons of CO_2.[52]

Early retirement of fossil fuel plants has the potential to create room for a more rapid energy transition. It can create a more certain and investable environment for new renewables deployment as demand and offtake counterparty incentives to absorb new capacity are increased. Conversely, strong deployment of distributed and grid-connected renewable will embolden countries to take more decisive action in phasing out

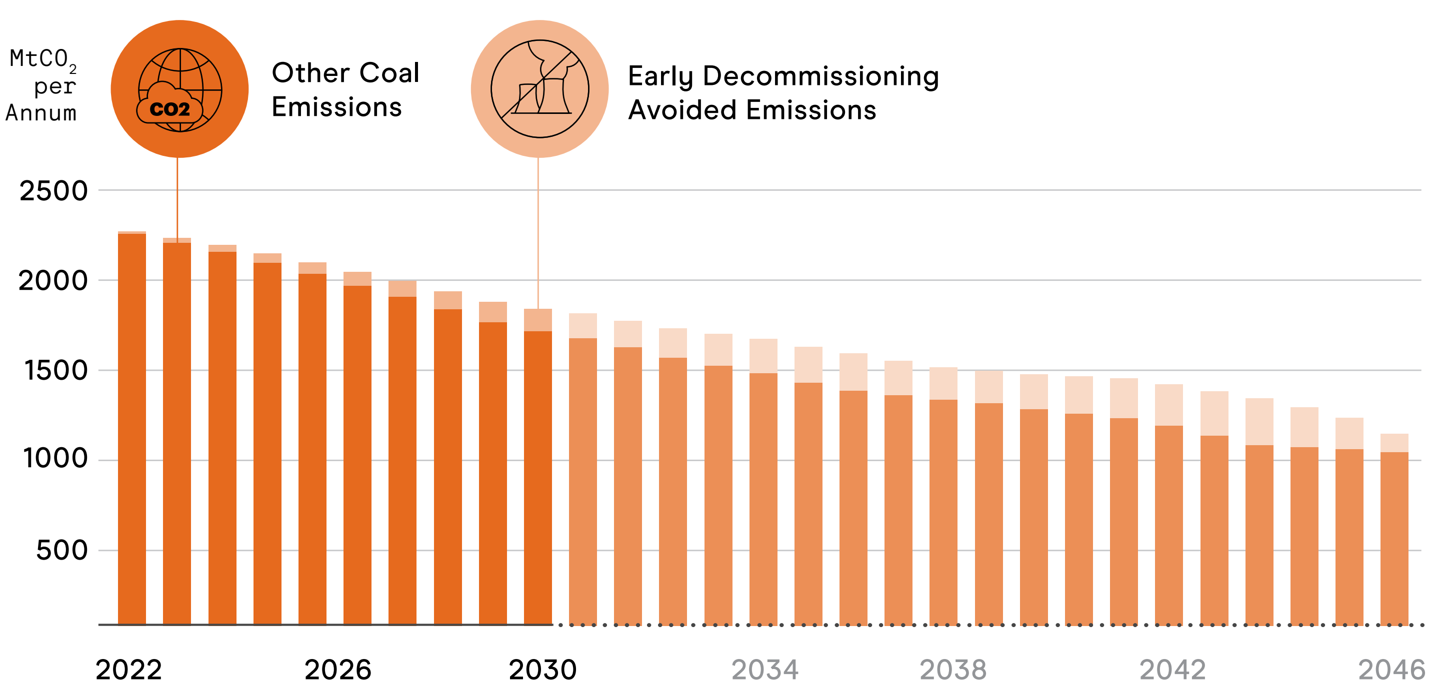
high-emitting fossil fuel plants and a virtuous circle of action can be created in this manner.

While this represents an enormous opportunity to improve power system functioning and galvanize a people-centered energy transition, it should be noted that there are dangers that need to be carefully managed. It is important to ensure that decommissioned coal plants would not result in a net power deficit that could adversely affect energy-poor populations. Efforts to repurpose existing coal plants therefore emerge as particularly attractive opportunity.[53] A transition period before any coal retirement would allow host nations sufficient time to manage the energy transition without increasing energy poverty, particularly with the availability of technical and financial assistance to ensure a just transition for affected workers, communities, and businesses.[54]

Provisional analysis by GEAPP suggests that coal decommissioning costs themselves could be relatively cost-effective in carbon terms. However, replacing the lost generation with equivalent clean and reliable power could increase the costs per ton of carbon saved, depending on the market and the appropriate technology. Further analysis is required to fully understand the economics and power system implications of an ambitious replacement trajectory. However, there is a high degree of uncertainty around these parameters given the absence of real-world coal decommissioning data to draw upon.

We estimate the CO_2 emissions that could be saved in the period to 2030 (and beyond in the period to 2050) from retiring and replacing ten average-sized coal plants per annum. This ambitious early retirement trajectory would only be possible if the power generated was replaced by clean and reliable generation. It is predicated on the widespread availability of concessional capital and commercial capital to finance decommissioning costs themselves, as well as replacement clean generation and storage.

CO_2 savings from early retirement of 10 coal plants per annum



Notwithstanding the strong economic headwinds that affect coal power in many geographies, there are several barriers that prevent coal plant retirement that would need to be addressed.

BARRIER

01
Long-term power purchase agreements

While early retirements of coal plants are accelerating in some geographies, 93 percent of plants worldwide are insulated from market competition by long-term contracts at generous tariffs.[55] Independent power producers are contracted to develop coal-fired power through long-term power agreements with a power purchaser (often a state-owned operator of the transmission and distribution network). These agreements often contain fixed payments for providing available capacity for a 20 to 25 year period, with capacity payments generally included, which are independent of the amount of electricity the power actually purchased.[56] These fixed payments may amount to more than half of the revenues that these power plant receive.[57] These market characteristics protect coal from market pressures that arise from lower plant utilization rates,[58] at least in the near-term, even if this often comes at the expense of end users in the form of higher bills.

An associated complicating factor is the young average age of the coal fleet in energy-poor countries. We estimate that the average age of a coal plant is a mere 11.5 years, suggesting a long operational lifetime ahead.

It is for this reason that innovative approaches to coal buyout support schemes are being developed. These types of financing instruments are garnering increased attention for policy makers, development finance institutions and even private investors.[59] Entities including the Asia Development Bank[60] and the Climate Investment Funds,[61] are developing coal finance instruments to encourage early retirements, and could announce pilot buy-out initiatives in the near future. These schemes require considerable quantities of concessional and grant capital if they are to be successful.

BARRIER

02
Absence of pilot retirement finance schemes

A key barrier to the development of early retirement support schemes is the absence of pilot schemes in developing economies to point to. There are, however, exemplar schemes to draw upon from developed countries. Several US utilities have developed financial incentives for the early retirement of coal.[62] Germany also implemented a successful early retirement scheme, with prices set by transparent market-based schemes. Compensation was lower than had been predicted ex ante.[63]

BARRIER

03
The political-economy importance of coal

The regional importance of coal from an employment and regional economic development perspective in countries such as India, Indonesia and South Africa is another complicating factor (as it is in Germany, Poland and the US and elsewhere). Deep country engagement with national political leaders and decision makers is required to ensure that early retirement schemes are nationally led and designed and implemented collaboratively.

BARRIER

04
The absence of well-developed carbon markets

Provisional analysis undertaken by GEAPP suggests that the early retirement of coal plants could offer a cheap option to abate carbon. However, the absence of carbon markets, either voluntary or mandatory (under the Paris Agreement), means that at the current time there are no off-takers for credits that would be generated from early retirement of coal plants. If carbon savings for early coal retirements could be certified and sold to off-takers, this could transform the economics of decommissioning and repurposing these assets.

CASE STUDY

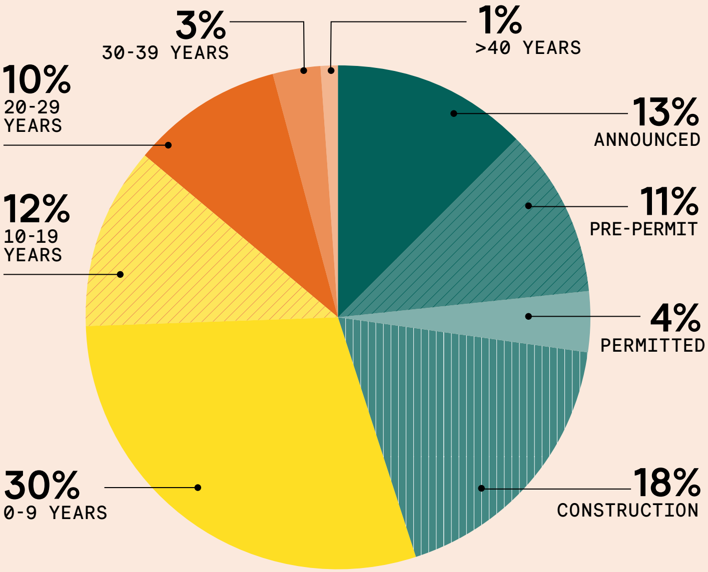
03

Scaling solar and storage to replace coal on Indonesia's grid

Rising living standards, urbanization and population growth are driving rapidly increasing demand for electricity in Indonesia. Tapping the country's massive solar potential could transform its generation mix.

Fossil fuels currently account for 89 percent of Indonesia electricity generation, while renewables currently account for 11.5 percent. The Indonesian government has a target to grow the renewables share to 23 percent of the primary energy mix by 2025. Indonesia's generation mix is dominated by young coal plants: of the 36 GW of coal capacity, more than half has been operational for less than 20 years. Another 30GW of *additional* capacity is in the pipeline. Through 2030, this fleet could cumulatively emit upwards of 2.6 billion tons of CO_2.

Indonesian planned and existing coal plants by age



Long-term power purchase agreements for these plants include "capacity payments" for power that may not necessarily be required. Further commitments to coal-fired power plants will require significant financial outlays and would saddle the national utility with even more of these long-term power purchase agreements, potentially including payments for more un-needed power from underutilized plants.[64]

However, the Indonesian government recently announced plans to replace 13.4 GW of old fossil fuel power plants (including 23 coal powered plants) with renewables, creating a window of opportunity to support Indonesia to decarbonize its power sector.

If solar power were to replace 30 percent of planned coal early retirements, we estimate that 38 million tons of CO_2 emissions could be avoided by 2030. This would require $6.8 billion of investment capital to support the deployment of 4.5 GW of solar and 9.1 GWh of storage.

Once financed, solar deploys quickly and could kick-start the greening of Indonesia's power sector. This could pave the way for other renewables to come online, further displacing Indonesia's emission intensive generation assets.

Conclusion: COP26 is unique moment in history to connect development and climate action

Up to this point in history, there has been a tension between those who prioritized ending energy poverty, often in low-income countries and emerging markets, and those who prioritized climate action, often advanced economies. In the past, this was underpinned by a very real trade-off, because action to end energy poverty required the deployment of fossil fuel technologies.

This stand-off has contributed to inaction, which was still evident in the lead-up to COP26. Many low-income countries proposed conditional NDCs, meaning that their energy transition is dependent on receiving international support in the form of finance, technology transfer and capacity building from developed countries. But the support requested far exceeds funding pledges from rich countries.

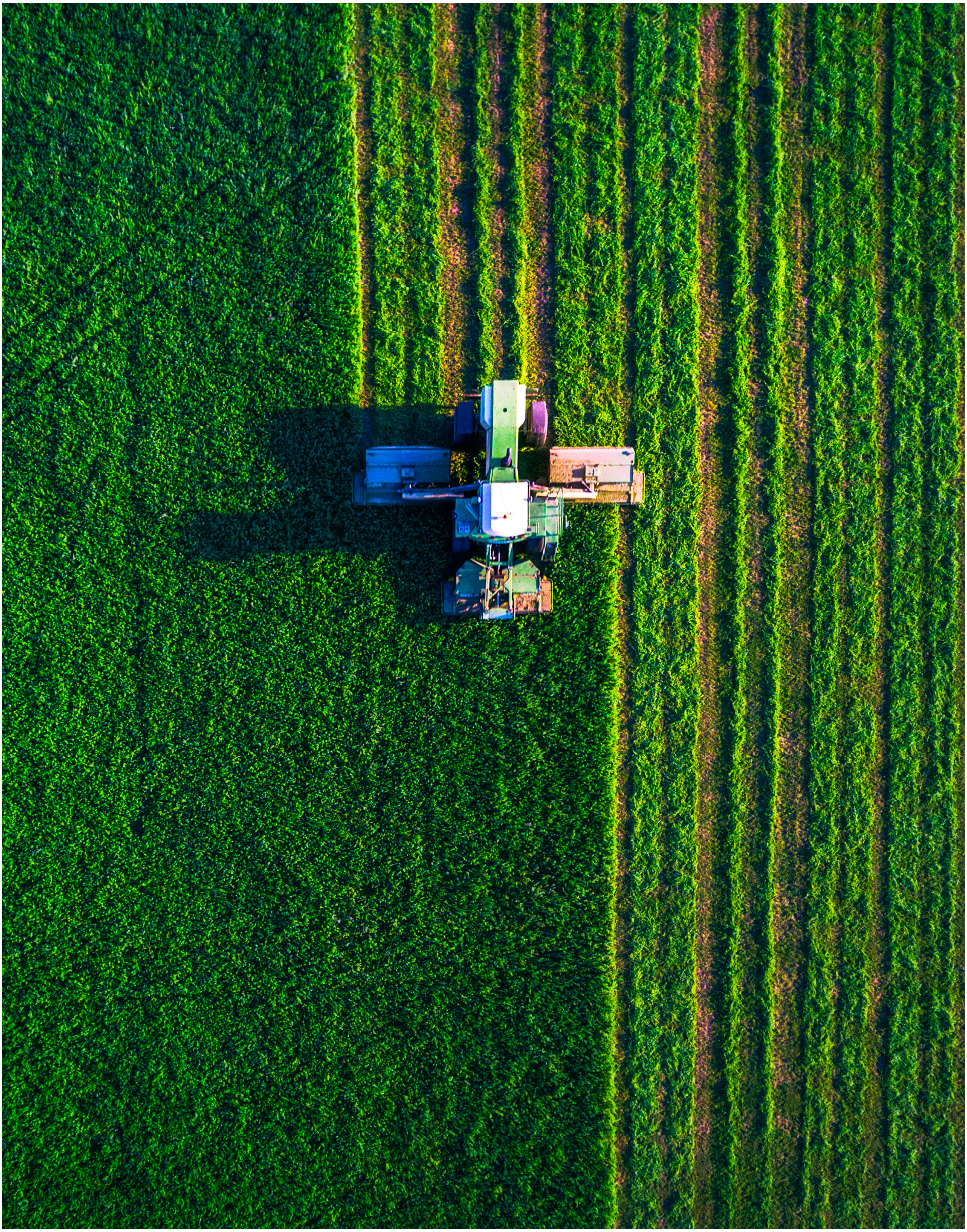
In our previous report, *Transforming a Billion Lives*, we pointed to an the opportunity for the world to move beyond this impasse. In it we illustrated how the widespread proliferation of increasingly cost-effective clean power technologies can be an engine of economic transformation that opens the door of opportunity for billions of people.

In this report, we highlight the need for collective action among developed and developing economies to make this a reality. Although developing countries are the least responsible and most vulnerable to climate impacts, our *Energy-Poor Left Behind* transition scenario illustrates that they are now essential for a global solution. If a swift transition from a business-as-usual development pathway cannot be supported, a safe climate future will drift out of reach for the world in the decade ahead.

COP26 is a key moment and a unique opportunity to initiate a new movement dedicated to addressing energy poverty and climate action together, and in so-doing to break the impasse between developed and developing economies.

It is clear that the power system must be the priority focus. By mobilizing new and additional capital and technical support to transform power systems in energy-poor countries, we can transform the politics of climate action, while opening up new opportunities for billions of people. Action involves meeting growing demand with grid-based renewable and not fossil fuels, scaling investments in distributed and grid-scale renewables to end energy poverty, while at the same time exploring options to retire existing coal assets and replace them with clean power. The barriers in each case are extremely challenging to overcome, and will require dedicated effort, attention, political focus, resources, expertise and a spirit of trust and collaboration between countries.

The world must come together to provide a concrete, finance-ready pathway for developing and emerging economies to accomplish their energy transitions and dramatically expand energy access. Doing so will offer all countries a compelling and positive reason to cooperate with global efforts to keep the world on a climate-safe pathway.



Appendix

75 Countries that have not reached Modern Energy Minimum (We classify these as Energy-Poor)

	COUNTRY	UNDER MODERN ENERGY MINIMUM	UNRELIABLE GRID	ACCESS DEFICIT
Sub-Saharan Africa	Zambia	Yes	Yes	Yes
Sub-Saharan Africa	Zimbabwe	Yes	Yes	Yes
Sub-Saharan Africa	Angola	Yes	Yes	Yes
Sub-Saharan Africa	Benin	Yes	Yes	Yes
Sub-Saharan Africa	Côte d'Ivoire	Yes	Yes	Yes
Sub-Saharan Africa	Cameroon	Yes	Yes	Yes
Sub-Saharan Africa	Congo (Brazzaville)	Yes	Yes	Yes
Sub-Saharan Africa	DRC	Yes	Yes	Yes
Sub-Saharan Africa	Eritrea	Yes	No	Yes
Sub-Saharan Africa	Ethiopia	Yes	Yes	Yes
Sub-Saharan Africa	Ghana	Yes	Yes	Yes
Sub-Saharan Africa	Kenya	Yes	Yes	Yes
Sub-Saharan Africa	Mozambique	Yes	No	Yes
Sub-Saharan Africa	Niger	Yes	Yes	Yes
Sub-Saharan Africa	Nigeria	Yes	Yes	Yes
Sub-Saharan Africa	Sudan	Yes	No	Yes
Sub-Saharan Africa	Senegal	Yes	No	Yes
Sub-Saharan Africa	South Sudan	Yes	No	Yes
Sub-Saharan Africa	Togo	Yes	No	Yes
Sub-Saharan Africa	Tanzania	Yes	Yes	Yes
Sub-Saharan Africa	Burundi	Yes	Yes	Yes
Sub-Saharan Africa	Burkina Faso	Yes	Yes	Yes
Sub-Saharan Africa	CAR	Yes	Yes	Yes
Sub-Saharan Africa	Comoros	Yes	Yes	Yes
Sub-Saharan Africa	Cabo Verde	Yes	Yes	Yes
Sub-Saharan Africa	Guinea	Yes	Yes	Yes
Sub-Saharan Africa	Gambia, The	Yes	Yes	Yes
Sub-Saharan Africa	Guinea-Bissau	Yes	Yes	Yes
Sub-Saharan Africa	Liberia	Yes	Yes	Yes

REGION	COUNTRY	UNDER MODERN ENERGY MINIMUM	UNRELIABLE GRID	ACCESS DEFICIT
Sub-Saharan Africa	Lesotho	Yes	Yes	Yes
Sub-Saharan Africa	Madagascar	Yes	Yes	Yes
Sub-Saharan Africa	Mali	Yes	Yes	Yes
Sub-Saharan Africa	Mauritania	Yes	Yes	Yes
Sub-Saharan Africa	Malawi	Yes	Yes	Yes
Sub-Saharan Africa	Rwanda	Yes	No	Yes
Sub-Saharan Africa	Sierra Leone	Yes	Yes	Yes
Sub-Saharan Africa	Somalia	Yes	Yes	Yes
Sub-Saharan Africa	Sao Tome and Principe	Yes	Yes	Yes
Sub-Saharan Africa	Eswatini	Yes	Yes	Yes
Sub-Saharan Africa	Chad	Yes	Yes	Yes
Sub-Saharan Africa	Uganda	Yes	Yes	Yes
East Asia and the Pacific	Fiji	Yes	No	No
East Asia and the Pacific	Micronesia	Yes	No	No
East Asia and the Pacific	Kiribati	Yes	Yes	No
East Asia and the Pacific	Marshall Islands	Yes	Yes	No
East Asia and the Pacific	Papua New Guinea	Yes	Yes	Yes
East Asia and the Pacific	Solomon Islands	Yes	Yes	Yes
East Asia and the Pacific	Timor-Leste	Yes	No	Yes
East Asia and the Pacific	Tonga	Yes	No	No
East Asia and the Pacific	Tuvalu	Yes	Yes	No
East Asia and the Pacific	Vanuatu	Yes	No	Yes
East Asia and the Pacific	Samoa	Yes	Yes	No
East Asia and the Pacific	Indonesia	Yes	No	Yes
East Asia and the Pacific	Cambodia	Yes	No	Yes
East Asia and the Pacific	Laos	Yes	No	Yes
East Asia and the Pacific	Philippines	Yes	No	Yes
East Asia and the Pacific	North Korea	Yes	Yes	Yes
East Asia and the Pacific	Myanmar	Yes	Yes	Yes
South Asia	Bangladesh	Yes	Yes	Yes
South Asia	Nepal	Yes	Yes	Yes
South Asia	Afghanistan	Yes	Yes	Yes
South Asia	Maldives	Yes	No	No

REGION	COUNTRY	UNDER MODERN ENERGY MINIMUM	UNRELIABLE GRID	ACCESS DEFICIT
South Asia	India	Yes	Yes	Yes
South Asia	Sri Lanka	Yes	No	Yes
South Asia	Pakistan	Yes	Yes	Yes
Middle East and North Africa	Morocco	Yes	No	No
Middle East and North Africa	Syria	Yes	Yes	Yes
Middle East and North Africa	Yemen	Yes	Yes	Yes
Middle East and North Africa	Djibouti	Yes	No	Yes
Latin America and The Caribbean	Bolivia	Yes	No	Yes
Latin America and The Caribbean	Guatemala	Yes	No	Yes
Latin America and The Caribbean	Honduras	Yes	No	Yes
Latin America and The Caribbean	Nicaragua	Yes	No	Yes
Latin America and The Caribbean	El Salvador	Yes	No	No
Latin America and The Caribbean	Haiti	Yes	Yes	Yes

6 countries that have an unreliable grid (but have met Modern Energy Minimum) [We classify as Energy-Poor]

REGION	COUNTRY	UNDER MODERN ENERGY MINIMUM	UNRELIABLE GRID	ACCESS DEFICIT
Sub-Saharan Africa	Gabon	No	Yes	Yes
Sub-Saharan Africa	South Africa	No	Yes	Yes
Middle East and North Africa	Iraq	No	Yes	Yes
Middle East and North Africa	West Bank and Gaza	No	Yes	No
Latin America and The Caribbean	Dominican Republic	No	Yes	No
Latin America and The Caribbean	Guyana	No	Yes	Yes

8 countries that are not energy-poor but suffer from an access deficit

REGION	COUNTRY	UNDER MODERN ENERGY MINIMUM	UNRELIABLE GRID	ACCESS DEFICIT
Sub-Saharan Africa	Botswana	No	No	Yes
Sub-Saharan Africa	Namibia	No	No	Yes
Middle East and North Africa	Libya	No	No	Yes
East Asia and the Pacific	Mongolia	No	No	Yes
South Asia	Tajikistan	No	No	Yes
Latin America and The Caribbean	Jamaica	No	No	Yes
Latin America and The Caribbean	Peru	No	No	Yes
Latin America and The Caribbean	Colombia	No	No	Yes

3 countries that are not energy-poor but are lower-middle income and are coal dependent

REGION	COUNTRY
Sub-Saharan Africa	Egypt
Europe	Ukraine
East Asia Pacific	Vietnam

Annual emissions reduction in the *Energy-Poor Left Behind* transition scenario

		2022-25	2026-29	2030-39	2040+
HIGH RESPONSIBILITY COUNTRIES		−5.0%	−5.0%	−7.5%	−10%
MEDIUM RESPONSIBILITY COUNTRIES	MEDIUM–HIGH	−1.1%	−2.5%	−5.0%	−7.5%
	MEDIUM–LOW	−1.1%	−0.5%	−2.5%	−5%
LOW RESPONSIBILITY COUNTRIES		BAU GROWTH	BAU GROWTH	BAU GROWTH	BAU GROWTH

Footnotes

1 https://www.iea.org/reports/energy-access-outlook-2017

2 https://about.bnef.com/new-energy-outlook/

3 IPCC (2018) estimate that renewables could account for to 85 percent of electricity by 2050 in climate-safe scenario. Some studies have concluded that an electrical system powered 100% by renewable energy is technically and economically feasible, https://web.stanford.edu/group/efmh/jacobson/Articles/I/USStatesWWS.pdf but this finding has been contested https://blogs.scientificamerican.com/plugged-in/landmark-100-percent-renewable-energy-study-flawed-say-21-leading-experts/

4 https://www.iea.org/reports/net-zero-by-2050

5 This is inclusive of both 300 kWh of household and 700 kWh of non-household electricity consumption: See: https://www.energyforgrowth.org/wp-content/uploads/2021/01/SHORT-Modern-Energy-Minimum-Final-Jan2021.pdf

6 Unreliability is defined here as more than 12 hours of outage per month. These countries are South Africa, Gabon, Iraq, West Bank, Dominican Republic and Guyana.

7 Estimate provided by Catalyst Off Grid Advisors, November 2020

8 For all modelling work undertaken in this report we include 75 energy-poor countries and the additional 6 countries that have grid reliability issues

9 https://www.mrfcj.org/principles-of-climate-justice/

10 Or they suffer from extreme grid reliability challenges like Gabon and South Africa

11 For this calculation we consider only C02 due to the better availability of historical data and the longer atmospheric lifetime of CO_2 compared to most other greenhouse gasses. See: https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-wg1-chapter2-1.pdf#table-2-14

12 Based on https://ourworldindata.org/contributed-most-global-co2

13 https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/United%20States%20of%20America%20First/United%20States%20NDC%20April%2021%202021%20Final.pdf

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18 See https://www.nature.com/articles/s41893-019-0339-6 and see also: https://files.wri.org/d8/s3fs-public/turning-points-trends-countries-reaching-peak-greenhouse-gas-emissions-over-time.pdf

19 See: https://klimalog.die-gdi.de/ndc/#NDCExplorer/worldMap?NDC??financeandsupport???cat41

20 See: https://klimalog.die-gdi.de/ndc/#NDCExplorer/worldMap?NDC??financeandsupport???cat41 See also: https://www.tandfonline.com/doi/full/10.1080/14693062.2019.1635874

21 https://www.un.org/sites/un2.un.org/files/100_billion_climate_finance_report.pdf

22 https://wedocs.unep.org/bitstream/handle/20.500.11822/30798/EGR19ESEN.pdf?sequence=13

23 See: https://newclimateeconomy.report/2018/wp-content/uploads/sites/6/2018/09/NCE_2018_FULL-REPORT.pdf or https://www.edf.org/media/new-tool-shows-power-transportation-sectors-offer-biggest-climate-pollution-cuts-lowest-cost

24 India's electric mobility transformation, NITI Aayog, 2019

25 https://www.iea.org/reports/electric-vehicles

26 https://www.rockefellerfoundation.org/wp-content/uploads/2021/09/Transforming-a-Billion-Lives-The-Job-Creation-Potential-from-a-Green-Power-Transition-in-the-Energy-Poor-World.pdf

27 https://www.sciencedirect.com/science/article/pii/S2214629618301087

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29 https://www.mckinsey.com/business-functions/sustainability/our-insights/how-industry-can-move-toward-a-low-carbon-future

30 For example, Prime Minister Modi wants India to become a major global hub for green hydrogen production and export: https://www.chemistryworld.com/news/india-pushes-renewables-and-green-hydrogen/4014426.article

31 This is in-line with the “No New Coal Power Compact” announced by a group of countries in September 24th https://www.seforall.org/press-releases/governments-launch-unprecedented-initiative-to-end-new-coal-power

32 This is a trajectory consistent with achieving a Modern Energy Minimum of 1000kWh per person per capita everywhere except extremely low demand countries, most of which are located in Sub-Saharan Africa. In this scenario these countries achieve a Modern Energy Minimum by 2040.

33 See, for example, this analysis of India's planned and permitted coal plants: https://ember-climate.org/wp-content/uploads/2021/09/Ember-Report-Indias-Zombie-Threat.pdf

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54 Donald P. Kanak (2019) For Health and Climate: Retiring Coal-Fired Electricity and Promoting Sustainable Energy Transition in Developing Countries

55 https://rmi.org/wp-content/uploads/2021/03/rmi_how_to_retire_early.pdf

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58 Declining utilization rates for coal plants are a feature a in many markets. See, for example this analysis of India: https://www.bloomberg.com/news/articles/2021-06-24/india-s-coal-dominated-power-market-is-tilting-toward-solar?sref=JMv1OWqN

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Global Energy Alliance for People and Planet (GEAPP)

www.globalenergyalliance.org