TRIPLING RENEWABLE ENERGY: MASDAR'S PERSPECTIVE

CONTENTS

03 Statement from our Chairman

04 Statement from our CEO

05 The exponential growth and evolution of renewables

08 Masdar targets 3x renewables capacity by 2030

14 Implications and the road ahead

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Statement from our Chairman

The Global Stocktake is telling us that the world is falling short and collectively we must all do more to get back on track. We must cut 22 gigatons of greenhouse gas emissions in the next seven years to keep 1.5 within reach. Renewable energy sources will play a vital role in achieving that goal.

In the last decade, we have seen renewables capacity more than double. Undoubtedly, there have been great strides forward in the adoption of renewables, with 83% of all new power adoption in 2022 coming from this clean energy source. We have seen exponential growth in wind and solar, with advanced technologies driving down production costs to make them more cost-competitive compared with traditional fuels.

But it is not enough, and it is not fast enough. That's why, globally, we must triple renewable energy capacity by 2030.

There is no denying that this is a huge task. And it's a task for all nations, all governments, the private and public sectors. We need a unified response and a practical plan and roadmap that will deliver course-correcting action, protect lives and livelihoods, and safeguard our planet.

Masdar is determined to play its part in creating solutions. We are following our mission, to accelerate the energy transition by delivering clean energy solutions that help countries meet their net-zero goals. As we plan to increase from 20 gigawatts (GW) today to 100 GW by 2030, this report outlines how we will get there and what we need to do across industries and nations to deliver that course-correcting, collective action.

H.E. Dr. Sultan Ahmed Al Jaber
UAE Minister of Industry and Advanced Technology,
COP28 President-Designate, and
Chairman of Masdar

Statement from our CEO

With COP28 in the UAE serving as a stark reminder of the urgent need to accelerate clean energy deployment and drive forward climate action, the global renewable energy industry has united under a powerful call to action: to triple global renewable energy capacity by 2030.

As the UAE's clean energy pioneer, Masdar has been focused on deploying clean technologies at home and around the world for nearly 20 years, and this is a call to action that we are proud to answer. With some of the most ambitious clean energy targets in the world – 100 GW of renewable energy capacity and 1 million tons of green hydrogen production capacity by 2030 – our sights are firmly set on more than tripling our own clean energy capacity in line with what the world needs to contain global emissions to under 1.5 degrees Celsius.

In response to the COP28 Presidency, International Renewable Energy Agency (IRENA), and Global Renewables Alliance report 'Tripling renewable power and doubling energy efficiency by 2030', Masdar has developed this companion report which outlines our own commitment to tripling our renewable energy capacity, the steps we are taking to get there, and how the world can better enable the global renewable energy industry to do the same.

This report identifies three fundamental enablers to accelerating clean energy deployment; growing capacity in the supply chain, building out and strengthening the infrastructure grid, and transforming the way we consume energy. The common theme across all of these enablers is partnership. It will require investors, developers, suppliers, and governments all coming together to solve challenges and help put the world on the path towards tripling global renewable energy capacity by 2030.

From what we are seeing on the ground at Masdar, these partnerships are happening at an ever-growing pace, with COP28 will only solidify their strength. Tripling renewable energy capacity is indeed a challenging ambition, but I am confident that by continuing to forge strong partnerships, both Masdar and the world will succeed.

Mohamed Jameel Al Ramahi
Chief Executive Officer, Masdar

The exponential growth and evolution of renewables

Energy, like nothing else on earth, is fundamental to how we live, what we eat, our health care, which goods we have access to, where people migrate, and how we prosper. We are at an inflection point. On the one hand, we need **more energy** to serve those who have limited or no access today. On the other, we need to **reduce the energy intensity** of those who have access. In parallel to these movements, we need to make sure that the energy we consume is green to the extent possible, because three-quarters of global greenhouse gas emissions come from energy.[1]

The transition to renewables as our dominant source of energy is the only solution to this dilemma. And within the renewables space, wind and solar power have been the major drivers for growth as these are the only two scalable generation technologies. Wind and sun are available in abundance – especially relevant for countries that lack their own fossil energy resources or are unable to afford them. Two minutes of the solar power that reaches the earth is sufficient to cover a year's worth of global energy demand.[2] We are only beginning to capture this valuable resource.

The extraordinary rise of renewables over the past decade is a story of the virtuous cycle of policy incentivizing the supply side, rapid growth, and falling costs.

Installed capacity has almost tripled since 2010

Between 2010 and 2022, installed renewables capacity grew by 2.75 times, led by almost **5 times growth in wind capacity** and a stunning **25 times growth in solar capacity**. Renewable deployments have accelerated over time, coming to dominate new additions in the power sector, accounting for a record 83% of all power generation capacity additions globally in 2022.[3]

Yet this rapid pace must further accelerate this decade: To keep the 1.5° target in reach, we need to have 11,000 GW of renewables operating by 2030. This is reflected in COP28's call to triple installations, just under double the rate of deployment the world achieved over the past seven years.[4]

Incentivizing the supply side

Transitions are driven by supply-side and demand-side impulses. Demand-side drivers come into place when a new product has a new value proposition or is much less expensive than a current product. **Supply-side drivers are typically regulatory** (i.e., the ban on chlorofluorocarbons (CFC) in refrigerators) or the result of industry replacing a scarce product with a new technology.

Renewables have significantly benefitted from supply-side drivers. Guaranteed power prices and mandated renewables quotas have kickstarted the positive feedback loop of rising adoption and lower costs. As the costs for renewables have come down, countries have increasingly moved toward tender or auction systems in which developers bid against each other to offer lower-cost power to win an offtake agreement. Tender systems were in use in less than 40 countries in 2011, but in 131 countries by 2021.[5]

In parallel to incentive systems becoming more competitive and market oriented, we have seen more countries deploying such tools. The number of countries with regulatory incentives or mandates for renewable power grew from less than 100 in 2011 to 156 in 2021 and 135 countries have some form of renewable energy targets.[6] This also reflects a broader proliferation of renewables into more markets. These kinds of policies have helped drive global investments in renewable energy

Figure 1: Global weighted 2010-2022 average LCOE of solar and wind has declined with the cumulated installed capacity

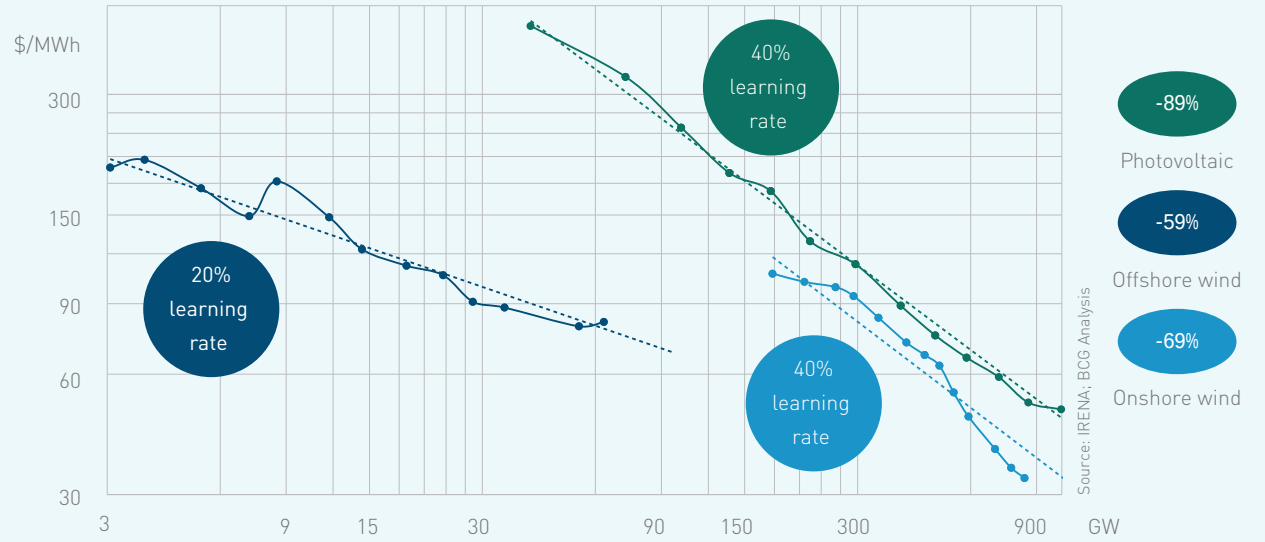
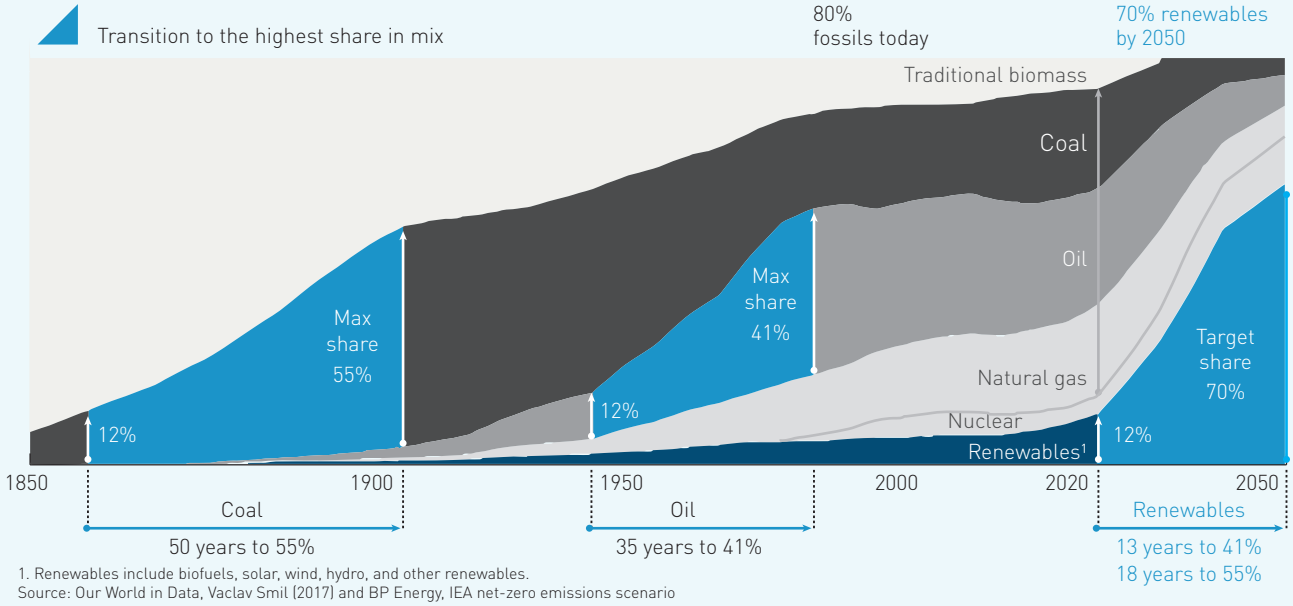


Figure 2: The transition to net zero needs to happen 3x faster than previous transitions



1. Renewables include biofuels, solar, wind, hydro, and other renewables.
Source: Our World in Data, Vaclav Smil (2017) and BP Energy, IEA net-zero emissions scenario

to a series of record highs, with US$ 499 billion invested in 2022 and a global ecosystem supporting 13.7 million jobs.[7]

Rapid growth and falling costs

The rapid adoption of wind and solar power has corresponded with a dramatic decrease in cost and an increase in technological improvements. The positive feedback loop between demand, serial production, technological improvements, and lower costs has been pronounced. Greater demand has helped spur progress in manufacturing and increased competition among producers that improved technology and quality, and helped lower costs over time.

This **learning rate** in renewables is 20-40%, which is much higher than the 6-8% we see in thermal power generation.[8] The learning rate describes the cost reduction we see with every doubling of generation assets. The high learning rate combined with a young industry and a relatively small number of assets has created the significant cost reductions as illustrated in Figure 1.

Between 2010 and 2022 the **levelized cost of electricity (LCOE) of solar projects fell 89%**. While the cost decline was driven by capex reductions, particularly for modules, all components of the LCOE declined.[9] Similarly, the **LCOE of onshore wind power fell 69% between 2010 and 2022** globally.[10] Helping drive the change, capex costs fell as the quality of wind turbines improved dramatically, with larger turbines able to generate more electricity. Globally, capacity factors rose from 27% in 2010 to 37% in 2021 while the hub height increased from 83 m to 112 m and rotor diameter increased from 112 m to 174 m.[11]

Renewables deployment must further accelerate

As impressive as these achievements are, **we are not moving fast enough**. The world's renewable energy transition needs to happen about three times faster than previous transitions we have seen in the energy sector (see Figure 2).

To achieve net zero by 2050, as the UAE and many other countries have targeted at a national level, the vast majority of all electricity must come from renewables.

1. Greenhouse Gas Emissions from Energy Data Explorer, IEA
2. Two minutes of sun enough to power a year's usage of humanity, Gulf News
3. Renewable Capacity Statistics 2023, IRENA
4. Renewables capacity grew 1.67 times between 2016 and 2022; Renewable Capacity Statistics 2023, IRENA
5. Renewables 2022 Global Status Report, REN21
6. Renewables 2022 Global Status Report, REN21
7. World Energy Transitions Outlook 2023, IRENA; Renewable energy and jobs: Annual review 2023, IRENA
8. BCG analysis
9. Renewable power generation costs in 2022, IRENA
10. 2010 Cost of Wind Energy Review, NREL; 2021 Cost of Wind Energy Review, NREL; Renewable power generation costs in 2022, IRENA
11. Between 2010 and 2022; Renewable power generation costs in 2022, IRENA

Masdar targets 3x renewables capacity by 2030

Effective climate action necessitates an urgency to accelerate global clean energy growth and expand renewable energy capacity by tripling renewable power by 2030. Having emerged as one of the world's leading renewable energy companies at the forefront of the global energy transition, the Abu Dhabi Future Energy Company (Masdar) is poised to meet this challenge.

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From an estimated 20 gigawatts in 2022, Masdar has committed to **accelerating growth** to reach 100 GW of renewable energy production and one million tons of green hydrogen by 2030, envisioning a step change in capacity between 2022 and 2030.

Established in 2006 with a mandate to advance the development, deployment, and commercialization of cutting-edge clean and renewable energy solutions, Masdar has developed a global track record and foundational expertise, while supporting the diversification of the UAE's economy and energy sources for the benefit of future generations.

The target of reaching 100 GW by 2030 requires a **strategic approach to the commitment of resources** and builds on Masdar's operational capacity. With projects developed across **40 countries**, in a global investment portfolio of more than US$ 30 billion across six continents, Masdar has a portfolio of more than 20 GW of renewable energy – enough to power over 5.25 million homes. Masdar's installed and in-development projects around the world have the capacity to offset 30 million tons of carbon dioxide annually.

Over the course of nearly two decades, Masdar has built extensive in-house expertise through its investments across the globe. This expertise spans the lifecycle of projects, from origination to development and from construction to operations. This footprint enables Masdar to invest in a variety of technologies and geographies, while providing robust delivery and risk-mitigation tools.

Masdar's expertise

Masdar has spent the past nearly 20 years **pioneering the clean energy agenda around the world,** utilizing this experience to hone its expertise working in various regulatory regimes and markets. This has enabled a deep familiarity with the challenges faced by the sector, including supply disruptions, changes in regulations, delays in permitting, and how to apply the fit-for-purpose technologies and commercial structures. A collaborative approach, by partnering with others across the value chain, ensures that the right enablers are in place to succeed.

In addition, Masdar leverages best practices in originating, developing and delivering projects compliant with pertinent local regulations, as well as the latest ESG standards, taking into account biodiversity, community health and safety, indigenous people, and cultural heritage. Masdar's expertise spans the entire project lifecycle:

Securing land lease agreements: Masdar clearly defines the requirements for the project, such as size, location, and specific characteristics such as proximity to transmission lines and environmental considerations. The process includes legal due diligence, engaging with landowners, understanding local zoning laws, and verification of land titles.

Conducting grid impact assessments: Masdar analyzes the technical requirements and specifications of the existing electrical grid to which the project will connect. This includes voltage levels, capacity constraints, and other technical standards. A detailed feasibility study is undertaken to analyze the technical and economic feasibility of the interconnection, carefully considering the impact on grid reliability, stability, and the cost of necessary upgrades.

Securing interconnections: This requires following the interconnection application process outlined by the grid operator and submitting all required documentation, including the results of grid impact assessment and any other technical details.

Securing permits: Early identification of specific permits required for the project and early engagement with regulatory authorities is part of Masdar's process proficiency. This includes environmental permits, land use permits, construction permits, air quality permits, water discharge permits, and any others, depending on the nature of the project and local regulations.

Conducting Environmental Impact Assessment (EIA): The findings and results of EIA or equivalent studies required by local regulations are submitted to the relevant environmental authorities so that any concerns raised during the review process can be addressed. ESG criteria that promote bio-diversity, community health and safety, indigenous people, and cultural heritage, among others, are also included.

Risk assessment and management: Masdar's team of experts ensures financial feasibility by commercially structuring projects to manage risk and ensure the interests of all stakeholders.

Enabling financial support: Meeting the financing requirements of challenging projects is part of Masdar's expertise. For example, Masdar secured a 12-year limited-recourse project financing of up to GBP 266 million for its stake in Phase One of the London Array Offshore Wind Farm. The landmark financing is the first time that a limited-recourse structure was completed for an un-incorporated joint venture within the renewable energy industry.

Masdar also works extensively with Development Finance Institutions (DFIs) to unlock renewables growth in emerging markets. For example, Masdar's Nur Navoi 100 MW Solar PV scheme is Uzbekistan's first solar IPP, financed in 2020 by the International Finance Corporation (IFC), the Asian Development Bank (ADB), the World Bank, and the European Bank for Reconstruction and Development (EBRD). Two years later, Masdar had the backing of five development finance institutions for project financing its US$ 580 million 500 MW Zarafshan Wind Farm – the first wind Independent Power Producer (IPP) to reach financial close in Uzbekistan. Masdar also works with governments and financial institutions to solve bankability challenges including availability of sovereign guarantees, indexation to hard currency, and availability, convertibility, and transferability of foreign currency.

Innovation to achieve scale

Masdar has supported the UAE's vision of becoming a clean energy global powerhouse to ensure a **just and orderly clean energy transition**. Within the 17 years since Masdar's inception, the UAE has emerged as one of the world leaders in solar energy consumption. Home to three of the world's largest solar sites, the UAE is the 6th highest per capita consumer of solar energy globally, after Australia, The Netherlands, Japan, Israel, and Chile.

Masdar deploys the latest technologies identified and secured through its extensive knowledge of technology innovation and supply chain capacities. While Masdar is technology agnostic, it has often taken a **strategic and forward-looking approach to research and innovation.** Investment risk on key renewables technologies early on has proven to be effective. The portfolio includes:

- First utility scale floating offshore wind (Hywind, Scotland).
- The largest floating PV farm in South-East Asia (Cirata, Indonesia).
- Early investments in carbon capture, usage, and storage (CCUS – Al Reyadah) and concentrated solar power (CSP – Shams, Torresol) and pilots of technologies (solar desalination pilots and batteries in Batwind, among others)
- Masdar is currently exploring ways to harness energy even from low-speed wind previously thought of as uneconomic, using advanced turbine technology through the UAE Wind Program inaugurated in 2023.

Growth vectors

Masdar's strategic plan is based on diversification anchored on a handful of key jurisdictions. The GCC and the broader Middle East region will play a central role to Masdar's growth; there the company can leverage its dominant position to capitalize on the ambitious renewables plans of the UAE, Saudi Arabia, and other countries. Further from Masdar's home region, core countries, including the United States, United Kingdom, Spain, Egypt, Uzbekistan, Indonesia, India, and Germany are expected to contribute an equally significant portion of future growth.

In terms of technologies, grid-connected solar PV and onshore wind will comprise the bulk of the growth, offshore wind is expected to deliver up to 10 GW, while renewables capacity dedicated to green hydrogen production will also be a significant contributor.

A global solar portfolio

Masdar has played a key role in collaborating with government and private sector partners in developing solar mega projects, including Shams and Al Dhafra in Abu Dhabi, as well as the 3rd phase of the largest single-site project in the world at Mohammed Bin Rashid Al Maktoum Solar Park in Dubai.

Apart from ground-mounted solar PV systems, Masdar has been a pioneer in fostering and using solar innovation, including developing CSP systems. Currently, it utilizes the three most commercially viable types of solar panels to convert the sun's energy into electricity. Masdar deploys advanced technologies to enhance the performance of its solar photovoltaic (PV) plants. These include technology to track the path of the sun to maximize output, utilizing bifacial PV, and using custom-made robots to clean panels without the need for water.

Its solar portfolio is innovative and includes innovative solutions tailored to the requirements of each project. One such technology solution is floating photovoltaic (FPV) solar PV in which solar panels are installed floaters anchored on the bottom of a water surface, such as a lake or water reservoir. Masdar developed and delivered the 145 MW FPV Cirata plant in Indonesia, on a 250-hectare plot of the 6,200-hectare Cirata Reservoir, in the West Java region. The Cirata FPV, the largest in Southeast Asia, is one of the biggest FPV plants in the world and was inaugurated by HR the President of Indonesia in November 2023.

145MW

Cirata project is the the world's largest floating solar plant in the world

Harnessing onshore and offshore wind

Masdar has been active in the development of both onshore and offshore wind farms.

The company leveraged its expertise to develop the Middle East's largest operational wind farm, the 400 MW Dumat Al Jandal project in Saudi Arabia. Masdar has also developed the first large-scale wind farms in Jordan, Serbia and the Seychelles, with the 117 MW Tafila wind plant in Jordan, the 158MW Cibuk 1 in Serbia and the 6 MW Port Victoria Wind Power Project in the Seychelles, respectively.

Masdar has also developed Central Asia's largest wind farm, the 500 MW Zarafshan project, which generates enough renewable energy to power half a million homes. This is Masdar's second utility-scale project in Uzbekistan following the agreement to design, finance, build, and operate the country's first public-private partnership (PPP) solar power plant. This project is a perfect example of Masdar's ability to develop new markets in collaboration with governments by bringing the full suite of development expertise from solving bankability challenges to site identification, securing land lease agreements, and developing auxiliary infrastructure. Masdar subsequently expanded its footprint in Uzbekistan with the signing of agreements to develop two additional PV power projects in the country for a combined capacity of 440 MW and continues to work with the government to further scale renewable capacity in the country.

Using an effective partnership with Norwegian energy giant Equinor, Masdar developed the world's first floating offshore wind farm, following a similarly successful collaboration in developing and delivering the 401MW Dudgeon offshore wind farm. The 30 MW Hywind project, off the coast of Scotland, powers 22,000 homes and displaces 63,000 tons of carbon emissions per year. In July 2023, Masdar signed an agreement to develop the 476 MW Baltic Eagle offshore wind farm off the coast of Germany's Rügen Island to supply renewable energy to approximately 475,000 homes.

Masdar has supported the UAE government in pushing the envelope in terms of innovation at home. For example, the UAE Wind Program encompasses the establishment of the region's first wind power station on Sir Bani Yas Island. Inaugurated in 2023, the complete program features four wind farms in four separate sites, with total combined capacity of 100+ MW, to power more than 23,000 homes and displace 120,000 tons of CO_2 per year.

This project is a prime demonstration of Masdar's ability to pioneer and implement innovations in renewable energy technologies. The project marks the first time the UAE has added utility-scale wind power to its energy mix by making use of technology to exploit low wind speeds. The project's turbines can exploit low wind speeds at scale, thanks to advances in materials science and aerodynamics that make wind power possible despite the heat and humidity. As wind power is strongest at night in the UAE, this initiative complements the country's existing solar power generation.

A green hydrogen pioneer

Masdar targets the production of up to one million tons of green hydrogen per annum globally by 2030. Achieving this target will require 25 to 30 GW of renewables capacity to power the electrolysis. Masdar's strategy includes a variety of uses of green hydrogen, serving sectors such as power, manufacturing, or transportation, supporting the decarbonization of hard-to-abate sectors like steel, cement, shipping, and aviation. Of the one million tons capacity, half is targeted to be produced in Abu Dhabi, partly for exports and partly for local demand, which is projected at approximately 200,000 tons per year.

Masdar is adopting a 'smart first-mover' approach by investing in and developing strategic projects and building scalable platforms in key markets. This will support the establishment of green hydrogen production within the UAE and will also drive the development of green hydrogen across the world.

Masdar in Africa

Africa is of great strategic importance for Masdar, as is evident by long-term partnerships and projects on the continent. Masdar is taking bold steps to unlock much needed climate finance to support the Africa's energy transition. Masdar operates on the continent through Infinity Power Holding, a JV between Masdar and Infinity Energy. Masdar also develops projects directly in a number of countries.

In early 2023, Infinity Power, a joint venture between Egypt's Infinity and Masdar, completed the acquisition of Lekela Power. The transaction made Infinity Power the largest renewable energy company on the African continent with operational footprint in Egypt, South Africa and Senegal as well as extensive development operations.

In January 2023, under the umbrella of Etihad 7 – a global development fund launched by the UAE to provide 100 million people across the African continent with clean electricity by 2035 – Masdar signed agreements with Angola, Uganda, and Zambia, among others to develop renewable energy projects with a combined capacity of up to 5 GW.

In September 2023, Masdar announced a partnership with Africa50, the pan-African infrastructure investment platform, to identify, fast-track and scale clean energy projects across the continent. Masdar has committed a total of US$ 10 billion in clean energy finance, through a combination of equity and project finance. This landmark investment will target the delivery of 10 GW of clean energy capacity in Africa by 2030.

624 MW of wind projects across South Africa: Masdar's Infinity Power platform operates five utility-scale wind farms across South Africa. The plants generate enough renewable electricity to power around 628,000 homes, displacing over 960,000 tons of CO_2 emissions per year. Over 2,000 local jobs were created during the construction phase. Communities also benefit from shareholdings in the wind farms through community trusts. This allows access to funding for life-changing projects such as childhood development programs and scholarships for local students.

486 MW in Egypt: The Benban Solar Development Complex is one of the largest utility-scale grid-connected complexes in the world. Masdar's Infinity Power platform contributes around 18 percent of the total capacity of the Benban solar park. The 234 MW complex powers 252,300 homes and displaces over 205,000 tons of CO_2 per year. The 252 MW West Bakr wind farm produces enough electricity to power around 450,000 homes and displaces 360,000 tons of CO_2 per year.

In the pipeline in Egypt, albeit at early stages of development, are a 10 GW wind program, which will be Africa's largest wind farm, and a 4 GW green hydrogen production program, both secured through agreements with the Egyptian government.

158.7 MW in Senegal: Senegal's first utility-scale wind energy project in Taiba N'Diaye, generates enough electricity to power around 180,000 homes per year. The wind farm provides a 15 percent increase in electricity generation capacity for the country.

Implications and the road ahead

To make real progress on our climate goals and provide energy to those who have limited or no access today, **we need to make the shift to renewables**.

COP28, the International Energy Agency (IEA), and the International Renewable Energy Agency (IRENA) have called for the tripling of renewable energy to 11,000 GW as a key step in the path to limit global warming to 1.5°C.[1]

Industry has also rallied around the targets, brought together under the headline of "Doubling down and tripling up," an initiative launched by the Global Renewables Alliance (GRA) at Climate Week New York this year. This initiative is backed by over 250 organizations and corporations, including Masdar.

Tripling global installed renewables is an ambitious but achievable task, as outlined most recently by the COP28-IRENA-GRA report "Tripling renewable power and doubling energy efficiency by 2030: Crucial steps toward 1.5°C."[2] We now see increasing momentum, because in addition to the supply-side drivers being implemented in more and more countries, demand-side drivers are also coming into play. Demand-side drivers traditionally have a stronger impact than supply-side drivers.

The main demand drivers are falling costs for off-grid and on-grid solutions as well as greater demand for resilience.

Off-grid costs have come down to such an extent that a new value proposition is in the making. Renewables can bring power to the estimated 745 million people who lack access to electricity.[3] The first off-grid solutions were very expensive; now they cost less than diesel generators or building new grid connections. While mini, micro, and off-grid solutions cannot deliver 24/7 electricity without large and still-expensive batteries, they will further proliferate.

The cost-competitiveness of grid-connected renewable power versus fossil generation is so great that renewable power costs less than the marginal cost of fuel in some markets. While large-scale deployment of renewables presents the challenge of variability, there is a positive business case for every hour of fossil generation that can be replaced.

745m
people without access to electricity can benefit from increasing renewables

Resilience has become a higher priority for governments and individuals as the world has become more uncertain. Renewable power provides resilience and greater independence from imported fossil fuels – and most countries in the world are net importers of fossil energy. Energy storage and complementary portfolios of wind and solar generation allow variable renewable energy to meet a growing share of electricity needs.

Still, the world must further unlock key enablers to ride this wave of supply-side and demand-side drivers to achieve targets.

Open new markets and expand financing

While the world's expansion of renewable energy has been dramatic, it has been concentrated in a few markets. East Asia, North America, and Europe together accounted for about 90% of all renewable energy investment in 2022 – over 50% of the global population received only 15% of total global renewables investment.[4] Africa is home to less than 2% of the world's installed capacity.[4]

Addressing these disparities will require investors, developers, and governments to work together. All market openings in the past have come together with some combination of push from the government with renewables and climate vision and targets, **regulatory changes** (e.g., making power a freely traded product and the unbundling of the power sector), **power market reforms** (e.g., in markets where power is subsidized, establishing a power exchange), and changes to the **business approach** (e.g., privatization). These changes help attract investment in renewables by reducing uncertainty and improving the business case.

These are difficult political processes. They will not be easy, but there is significant experience in international organizations like IRENA and development banks that can be leveraged. Renewables are high in capex and low in opex, making risk profiles and the regulatory environment critical for securing affordable financing.

Blended finance mechanisms together with the necessary reforms will help open new markets and kickstart investments. There is an opportunity to dramatically expand blended finance with wider participation by banks, family offices, and foundations, via program spending and their balance sheets.[5] For its part, Masdar has partnered with Swiss RE, IRENA, development banks, and development finance institutions like the Abu Dhabi Fund for Development to back the Energy Transition Accelerator Financing (ETAF) platform, which helps de-risk and fund renewables projects around the world. In some markets, financiers also have the opportunity to bundle renewables projects together into securitized products, reducing risk in the overall portfolio and attracting new investors.

Developers like Masdar also have a significant role to play as they seek new opportunities around the world. Developers willing to forge deep partnerships with governments and take risks on new markets can lower other developers' and financiers' risk perceptions, spurring further investment in additional projects.

2%
or less of the world's installed renewables capacity is in Africa

Industrialize and globalize renewables supply, and transform power demand

In the past 10 years, the solar supply chain has become concentrated in China and industrialized at scale. The **PV supply chain has become dynamic**; building a new production site takes only between 1.5 and 2 years.[6] The IEA estimates that there is enough current and planned PV manufacturing capacity to meet the world's needs to 2030; announced expansion plans would raise global capacity to 790 GW by 2027.[7] Still more investment will likely be required as the lower costs of production at new facilities can rapidly render older plants uneconomic.

The supply chain for wind has a much broader global footprint. Chinese OEMs are producing in China for China and the Western and Indian OEMs are producing in a broad range of countries. Most Western Tier One suppliers have manufacturing sites in several countries, including China.

To continue driving costs down, **the wind industry will need to industrialize**, designs will need to become modular and more standard, and manufacturing will have to mature and scale. The industry will also need to solve the capacity utilization challenge in the face of market volatility. Current production capacity is based on companies' demand expectations, which are lower than suggested by the 2030 global renewables target. Overall, the IEA estimates a 70% gap between current and planned wind production capacity and the capacity required to meet 2030 targets; closing the gap would require about US$ 90 billion of additional investment.[8]

Competitive regional production hubs that can supply other regions in case of temporary demand-supply mismatches are required as the level of globalization that wind and PV need to achieve.

$90bn

investment is needed to close the gap between planned and required wind production by 2030

We are seeing great progress in that direction. The development of the global industrial footprint is strongly influenced by subsidies and trade barriers, exemplified by the US's local content initiatives and Inflation Reduction Act and the EU's Net-Zero Industry Act and Critical Raw Materials Act. Supply chains for both solar and wind must remain resilient, as the world needs a combination of both generation profiles to help meet consumer needs.

As important as it is to build elements of the supply chain in each region, these regional hubs should not be decoupled from the global learning curve. If trade barriers lead to a decoupling, local players will be unable to help meet global demand, leading to imbalances that slow or even reverse the steady decrease in costs that renewables have experienced.

The greening of the grid as renewables contribute ever greater shares of electricity production must go hand-in-hand with the greater electrification of the world's energy demand. The **'electrification of everything'** – from much of road transport and building heating and cooling to industry – is creating new power demand. This power demand must become a flexible demand, so it can be adjusted to the variability of the renewable power supply. This is a fundamentally new way of consuming power. New technologies and market mechanisms will be applied to create **demand response** systems. Based on the availability of variable power, smart meters can pause electric vehicle charging or automatically adjust building and appliance heating and cooling.

Build fast, and build at scale

The pace of renewable energy's march forward risks being dictated not by direct costs but by the speed at which it can be built and the strength of related infrastructure. Developed countries such as the US and Germany have announced ambitions to generate 80% or more of their electricity from renewables by 2030, underscoring the need to build fast and improve management of variability.[9]

We must **accelerate the permitting of projects** in many markets. In some developed markets, delays are measured in years for both renewable generation and the enabling infrastructure such as grids.

The energy transition, energy availability, affordability, and sustainability are of national importance yet permitting decisions are often pushed down to the lowest level. Reforms such as granting renewables projects priority status in permitting and land use, centralizing and digitizing permitting, and making permits more flexible, could cut permitting times in half in many markets. Proactive community engagement by developers is also critical to reducing potential opposition and time-consuming legal challenges that projects can face.[10] Momentum is building around reforms, including in Europe and the US, and interest in digital systems to streamline processes is growing.

Developed countries need to invest as much in **transmission and distribution infrastructure** as they do in renewables in the coming years. Improved grids are mutually beneficial, with bi-directional interconnections enhancing resilience and transforming the traditional fixed buyer-seller relationship. Smart grids and grids with a large geographic coverage will assume an important role in this balancing, alongside stationary and mobile energy storage solutions.

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