Capturing economic opportunities from wind power in developing economies

GWEC
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Attribution

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Image credits

Foreword

The window of opportunity to accelerate wind energy for a more resilient and sustainable future is closing fast. We now less than seven years from 2030, a key moment on the energy transition journey. Three years ago, as widespread lockdowns caused a dramatic reduction in carbon emissions, the wind industry joined climate scientists and concerned civil society groups to warn governments that without decisive action to phase out fossil fuels, emissions would quickly rebound to pre-pandemic levels.

Post pandemic, in February 2022 the Russian invasion of Ukraine added another layer to the energy challenge, forcing energy security to the front of policymakers' minds. The twin crises of climate change and energy security were now joined together by their shared solution.

As we enter 2023, we are seeing coal powered generation reaching a record peak, natural gas prices at all-time highs and—as predicted— emissions rebounding alongside economic recovery. This comes at a time when wind energy has never been more price competitive.

There are reasons to be optimistic however, as the policy environment evolves to enable the development in both emerged and emerging economies. This report looks at five countries where a strong policy environment can deliver enormous benefits for the local economy as well as delivering tangible benefits for local communities.

Wind energy delivers wide-ranging benefits, from job creations to saving water. That makes wind energy particularly beneficial for developing economies addressing the phase out of fossil fuels alongside economic growth, a growing demand for electricity and the challenge of energy security.

Wind projects have shown a significant cost reduction in established markets over the past twenty years. This report shows how support from government, through policy certainty and government commitment, can help new industries avoid the risk of higher potential costs. Wind energy also has the benefit of being predictable, as there are no fuel costs once installed so governments can benefit from that stability.

This report looks at five countries – Argentina, Colombia, Egypt, Indonesia, and Morocco – that have significant and largely untapped wind resource potential. The report aims to demonstrate the huge socioeconomic benefits that wind energy development can deliver alongside the positive environmental outcomes. This report identifies three common hurdles for policymakers trying to accelerate the deployment of wind energy and outlines how to overcome those challenges.

The wind industry has demonstrated its pivotal role in supporting thriving local economies through skilled jobs creation and the maintaining of critical infrastructure while dramatically contributing to reducing carbon emissions and delivering clean, affordable and secure energy. GWEC will continue to collaborate with governments to ensure that the world is well equipped to harness the full socioeconomic benefits of the energy transition.

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Glossary

ABEEólica	Associação Brasileira de Energia Eólica
ANEEL	National Electric Energy Agency (Brazil)
BAU	Business as usual
BNDES	National Bank for Economic and Social Development (Brazil)
COP26	26th Conference of the Parties
CO_2e	Carbon dioxide equivalent
CPPA	Corporate power purchase agreement
EPE	Energy Research Office (Brazil)
ESKOM	Electricity Supply Commission (South Africa)
EVOSS	Energy virtual one stop shop
FTE	Full time equivalent
GDP	Gross domestic product
GHG	Greenhouse gases
GRS	Green recovery scenario
GVA	Gross value added
GWEC	Global Wind Energy Council
IEA	International Energy Agency
IPP	Independent power producer
IRENA	International Renewable Energy Agency
MME	Ministry of Mines and Energy (Brazil)
NDC	Nationally determined contribution
NERSA	National Energy Regulator of South Africa
PDE	Ten-Year Energy Expansion Plan (Brazil)
PPA	Power purchase agreement
PROINFA	Incentive Program for Alternative Sources of Electric Energy (Brazil)
SAWEA	South African Wind Energy Association
UNFCCC	United Nations Framework Convention on Climate Change

EXECUTIVE SUMMARY

An increasing number of countries are recognising the key role of wind energy in supporting a global clean energy transition, in energy security, and achieving stable energy prices. The urgency to scale up clean power generation and shift away from unabated coal power were key elements of the Glasgow Climate Pact, endorsed at COP26 summit in November 2021 by the nearly 200 countries signed up to the Paris Agreement. This was further cemented at the COP27 summit in Sharm El-Sheikh, held in November 2022. Renewable energy is a component of the Nationally Determined Contributions (NDCs) for most of the Parties to the Paris Agreement, and more than 100 Parties have a quantified clean power target within their NDCs.

There is a growing mismatch between energy transition ambitions, net zero targets and market realities, however. Accelerated deployment of renewable energy, and particularly large-scale sources of clean power like wind and solar energy, are needed worldwide to limit the most harmful impacts of climate change.

To reach our shared global goal of limiting temperature rise by the end of the century to 1.5°C, the volume of annual wind energy installations must scale up roughly four times over the next decade. This is a huge challenge which will require shared vision and collaboration between governments, industry, and society. Given the urgency of the energy transition, it is vital that the deployment of wind energy does not face unnecessary delays due to resolvable challenges, such as bureaucratic permitting procedures and market barriers to investment.

The resources and coordination required for this scale of action have been stretched over the last few years, due to the COVID-19 pandemic and recent commodity price increases. This challenge is particularly acute in developing economies, where public spending and policy response have focused on short-term protections of society and economy. As countries learn to manage the difficulties of the pandemic and economic activity returns, it is time to undertake the actions which will benefit society and economy in the long term.

Wind energy can play a vital role in improving a country's energy security and increasing its energy independence. This has been highlighted by Russia's invasion of Ukraine in February 2022, following which many countries have examined their own balance between energy imports and exports. Countries reliant on fossil fuel imports are vulnerable to sudden changes in trade agreements and volatile international pricing markets. Wind energy offers a secure, reliable and affordable long term source of clean power generation. Wind energy also provides a boost to economic activity. Wind energy projects generate significant amounts of capital expenditure and create jobs and other economic benefits for local economies through their construction and operation.

The opportunities in developing economies

There is a growing body of evidence which shows that wind energy can help governments accelerate a green economic growth, and form a bedrock for sustainable economic growth in the future. The benefits of wind energy are wide-ranging and expand beyond clean power generation. They include sustainable job creation, public health cost savings which would be spent redressing the impacts of fossil fuel generation, water consumption savings which would otherwise be used for thermal generation, and a significant capital injection in a local value chain. The sector is particularly attractive for developing economies which need to phase out fossil fuels while maintaining economic growth, meeting fast-growing electricity demand, safeguarding energy security and prices.

To decarbonise power, transport and heating is expected to significantly increase electricity demand. For example, the UK has legally committed to achieve net-zero in 2050 and it is expected to have about the same end user demand then as it has now. To achieve net-zero it will require 3 times as much energy supplied in the form of electricity than it is now. Almost all wind projects installed between 2023 to 2027 will still be generating in 2050 and contributing to achieving net-zero.

Wind energy has achieved significant cost reduction and technological excellence over the past two decades, establishing it as a proven and market-ready alternative to fossil fuels. While costs might initially be higher in developing economies where the wind industry is new – due to factors such as less experienced personnel, start-up costs, initial investment uncertainty and lack of established supply chain – these costs can quickly reduce with government commitment, policy certainty and market forces. Wind energy has no fuel costs so once installed its costs remain stable and predictable.

This report reflects a study of wind energy potential in developing economies around the world over the next five years, 2023-2027, with the aim to highlight the vast and largely unexploited socioeconomic and environmental opportunities attached to wind energy. Accelerated deployment of wind projects will not only support climate action, but help countries to realise a range of benefits from job creation to cleaner air. The study identifies three common barriers facing wind energy deployment in developing economies and provides recommendations on how these barriers can be overcome.

Five developing economies in particular were selected as country studies: Argentina, Colombia, Egypt, Indonesia, and Morocco. These were selected because they have significant and still largely untapped wind energy resource.

Findings of the study: upsides of accelerated wind deployment in a wind acceleration scenario

The findings of this study, summarised in Table 1 below, show that a wind acceleration scenario of wind deployment from 2023-2027 would realise tremendous socioeconomic benefits for each country. For developing economies facing the difficult balance of ensuring economic growth while maintaining energy security and resilience, investment in the wind sector offers a pathway to a robust and sustainable recovery.

Table 1 Summary of wind growth impacts in business-as-usual scenario versus wind acceleration scenario for 2023-2027.

Country	2023-2027	New wind installations (MW)	FTE jobs created over wind farm lifetimes (jobs)	Gross value added to economy over wind farm lifetimes ($)	Homes powered by clean energy annually from 2027 (homes)	Tons of carbon emissions saved over wind farm lifetimes (tons)	Litres of water saved annually from 2027 (litres)
Argentina	BAU	1,500	112,000	3.3 billion	1.7 million	71 million	12 million
	Wind Acceleration	1,965	176,000	4.7 billion	2.2 million	93 million	16 million
	Potential Upside	465	64,000	1 billion	0.5 million	21 million	4 million
	% increase	31%	57%	45%	30%	30%	31%
Colombia	BAU	2,700	191,000	4.9 billion	5.5 million	233 million	15.5 million
	Wind Acceleration	3,900	339,000	8.1 billion	7.8 million	336 million	22.5 million
	Potential Upside	1,200	148,000	3 billion	2.3 million	103 million	7 million
	% increase	44%	77%	65%	43%	44%	44%
Egypt	BAU	2,602	242,000	3.5 billion	6.5 million	225 million	21 million
	Wind Acceleration	3,758	406,000	5.6 billion	9.2 million	326 million	31 million
	Potential Upside	1,158	164,000	2.1 billion	2.8 million	101 million	10 million
	% increase	45%	68%	60%	43%	45%	45%
Indonesia	BAU	450	34,000	1.2 billion	1 million	23 million	2.6 million
	Wind Acceleration	565	51,000	1.6 billion	1.2 million	29 million	3.2 million
	Potential Upside	115	17,000	400 million	0.2 million	6 million	0.7 million
	% increase	26%	50%	36%	24%	26%	26%
Morocco	BAU	1,500	99,000	2.1 billion	4.7 million	77 million	8.6 million
	Wind Acceleration	2,138	174,000	3.4 billion	6.6 million	110 million	12.3 million
	Potential Upside	638	75,000	1.3 billion	1.9 million	12.3 million	3.7 million
	% increase	43%	76%	63%	40%	42%	43%

While this report includes only five country studies, similar socioeconomic benefits can be achieved by other countries. A previous report in early 2022 studied this for Brazil, India, Mexico, South Africa and The Philippines, published by GWEC in February 2022. The study analysed international experience of the onshore wind industry and found that typically a 1 GW/year installation rate over 5 years could unlock nearly 157,000 new jobs and $13.8 billion gross value added (GVA) to national economies over wind farms' lifetime, among other benefits.

Recommendations to support wind growth in developing economies

In the course of the study and conversations with industry and investment experts around the world (see the Methodology in Appendix A), several barriers to wind energy deployment were identified that are common to developing economies. The most significant common barriers are a lack of clear policy commitment, insufficient transmission system infrastructure, limited investment in grid upgrade and expansion, and complex regulatory frameworks.

Addressing these barriers proactively, in coordination with the wind energy industry and other relevant stakeholders, can support accelerated deployment of wind energy and a wind acceleration in developing economies.

Policy commitment: provide clarity and ambition for wind energy

Lack of policy commitment to consistently promote and enable wind energy is a barrier to wind energy deployment common to many developing economies. In many countries, governments remain committed to conventional fossil fuel-based electricity generation, particularly if it is a good source of foreign investment.

Even in countries where the government is positive towards renewable energy, there can be a lack of enabling policy frameworks and regulation to adequately support investment in wind energy and other renewables.

Invest to expand transmission system infrastructure

Wind energy projects rely on land availability, wind resource, and grid connection points. This means that projects can't always be developed in areas where the grid is well developed. This is particularly an issue for multi-island nations like Indonesia, in which the country's best wind resources can be found on sparsely populated islands.

In many countries, development of transmission system infrastructure is coordinated by a separate organisation to that for the development and planning for electricity generation. In other countries the governance of the transmission system and generation is split into regions. This fragmentation can lead to the transmission system not being efficiently developed in the optimal areas or at the necessary time for connecting wind energy projects, which can delay the deployment of new capacity, raise investment risk and hamper efforts to meet targets.

Greater public and private investment in secure, smart and flexible grids which enable ever-larger shares of renewable energy is necessary to meet the urgent pace of the energy transition.

Simplify permitting frameworks for renewable energy

Too many countries are unable to leverage the enormous interest from investors to deploy wind energy projects due to inefficient permitting schemes. Frameworks for leasing, permitting, and power procurement can be overly complex and bureaucratic, which can delay wind energy deployment if projects cannot obtain the necessary permits and approvals in a sensible timeframe.

These processes can cover spatial planning, environmental and social impact assessment, planning authorisation, grid connection, and legal challenges to project proposals. In many countries, developers must submit documents and applications to multiple national and local agencies. A lack of clarity on procedures and timelines and poor coordination between agencies and jurisdictions leads to delays, uncertainty, and inefficiencies.

Based on industry experience to date, a country which installs 1 GW of onshore wind energy capacity per year from 2023 to 2027 could unlock a range of socioeconomic and environmental benefits*:

A total of 130,000 jobs during the development, construction, and installation phase of the wind farms

US$12.5 billion gross value added (GVA) to national economies over the lifetime of the wind farms

12,000 local jobs annually during the 25-year operations and maintenance phase of the wind farms

28.8 million litres of water saved annually from 2026

Power 4.9 million homes with clean energy per year from 2026

240 million metric tons of carbon emissions equivalent saved of carbon emissions over the lifetime of the wind farms

The resulting 5 GW of wind energy:

Mitigates 240 million metric tons of CO_2 emissions over the lifetime of the wind farms, which is the equivalent of:

83.5 million return flights from New York to Sharm el-Sheikh

Taking **53 million** internal combustion engine cars off the road for one year

Planting and maintaining **6.4 million** trees for 10 years

** Assuming a cost of £2 million/MW, and 25 years of operation. Assumes all major components are sourced in country, except for the turbine, where we assume only blades and towers manufactured locally. One job is defined as full-time employment for one person for one calendar year.*

1. Introduction

An increasing number of countries have set wind energy targets in the coming decades, recognising wind energy's key role in supporting a clean energy transition and achieving Nationally Determined Contributions (NDCs) and net zero targets under the Paris Agreement.

The importance of energy security has also been brought into sharp focus in light of February 2022 Russian invasion of Ukraine. It is widely acknowledged that wind energy can play a key role in improving a country's energy security, increasing self-reliance and providing a sustainable, reliable and affordable source of clean electricity generation independent of future fossil fuel prices and their associated uncertainty. Also in many countries, onshore wind power is the cheapest form of electrical energy.

The development of wind energy also can be a major boost to economic activity forming a bedrock for sustainable economic growth. This is particularly critical given the current global energy crisis and volatility of energy markets around the world. The International Energy Agency's (IEA) recent World Energy Outlook 2022[1] asserts that current events are a reminder of the vulnerabilities of the current global energy system, and will fast-track structural change towards the clean energy transition.

This report provides a:

- Study of wind energy potential in five developing economies around the world over the next five years, with the aim to highlight the vast and largely unexploited socioeconomic, energy security-related, and environmental opportunities attached to wind energy.
- Discussion of the common barriers facing wind energy deployment in developing economies, and
- Recommendations on how these barriers can be overcome.

This report examines five developing economies, as shown in Figure 1. These countries were selected because they face particular socio-political and economic challenges which threaten to slow down the clean energy transition, as well as for having significant and still largely untapped wind energy resource.

A previous report in early 2022 provided likewise for Brazil, India, Mexico, South Africa and The Philippines.[2] Since then the relative economics of wind power has increased further, making the transition to wind more cost effective.

Note on offshore wind

Given the five-year horizon and the countries selected for study, only onshore wind capacity and no offshore wind capacity has been included into the analysis of the countries discussed. While offshore wind makes up zero or a small proportion of the wind capacity in each of the countries discussed, all of the countries have significant offshore wind potential which could be realised in the coming decades. This is particularly the case for Argentina. Many of the broader recommendations made in this document are relevant for offshore wind.

1 International Energy Agency, World Energy Outlook 2022, October 2022, available online at: https://iea.blob.core.windows.net/assets/fe7c251b-8651-4d3a-8362-0ffe3e50d37b/Executivesummary_WorldEnergyOutlook2022.pdf

2 GWEC, Capturing Green Recovery Opportunities from Wind Power in Developing Economies, Feb 2022, available online at: https://gwec.net/report-capturing-green-recovery-opportunities-from-wind-power-in-emerging-economies/

Figure 1 Countries examined in this study.

2. General barriers to wind energy deployment

While the benefits of wind energy are great and numerous, there are a number of barriers to sector development which are common to the five countries selected for this study, as well as many developing economies around the world.

Lack of clear policy commitment

Lack of policy commitment to consistently promote and enable wind energy is a barrier to wind energy deployment common to many developing economies. In many countries, governments remain committed to conventional fossil fuel-based electricity generation, particularly if it is a good source of foreign investment.

Even in countries where the government is positive towards renewable energy, there can be a lack of enabling policy frameworks and regulation to adequately support investment in wind energy and other renewables.

A clear route to market is needed to decrease investment risk and cost of capital for developers. Similarly, long-term ambitions for wind energy ease pressures on local investment in a supply chain. Governments must increase wind power ambition and reflect this in updated NDCs and targets, comprehensive national climate strategies, and short- and long-term energy plans. The Glasgow Climate Pact called upon all Parties to COP to submit updated and strengthened NDCs by COP27. Beyond NDCs, national visions or policies should include concrete wind energy capacity or generation targets, with a clear, detailed timeline and a roadmap to achieve installation volumes.

Insufficient transmission system infrastructure and investment

Wind energy projects rely on land availability, wind resource, and grid connection points. This means that projects can't always be developed in areas where the grid is well developed. This is particularly an issue for multi-island nations, in which the country's best wind resources can be found on sparsely populated islands.

In many countries, development of transmission system infrastructure is coordinated by a separate organisation to that for the development and planning for electricity generation. In other countries the governance of the transmission system and generation is split into regions. This fragmentation can lead to the transmission system not being efficiently developed in the optimal areas or at the necessary time for connecting wind energy projects, which can delay the deployment of new capacity, raise investment risk and hamper efforts to meet targets.

Greater public and private investment in secure, smart and flexible grids which enable ever-larger shares of renewable energy is necessary to meet the urgent pace of the energy transition.

Forward-planning of transmission network expansion and investment in developing the network should be accelerated to increase the potential sites developers will consider for wind projects, as well as to avoid delays and grid congestion in the future. Through pooling expertise among system operators, regulators and utilities, public authorities can undertake long-term forward-planning on grid expansion and reinforcement, electrification of transport, as well as creating regional markets for power export and trading.

Complex permitting frameworks

Too many countries are unable to leverage the enormous interest from investors to deploy wind energy projects due to inefficient permitting schemes. Frameworks for leasing, permitting, and power procurement can be overly complex and bureaucratic, which can delay wind energy deployment if projects cannot obtain the necessary permits and approvals in a sensible timeframe.

These processes can cover spatial planning, environmental and social impact assessment, planning authorisation, grid connection, and legal challenges to project proposals. In many countries, developers must submit documents and applications to multiple national and local agencies. A lack of clarity on procedures and timelines and poor coordination between agencies and jurisdictions leads to delays, uncertainty, and inefficiencies.

For onshore wind projects, permitting can take more than 8 years in Spain, Italy, Greece, Sweden, Belgium (Flanders) and Croatia, including the time taken by any legal challenges, according to WindEurope. In Japan it can take up to 5 years to complete the complex environmental impact assessment process.

Policymakers must ensure that bureaucracy and red tape are not obstructions to achieving energy and climate goals. Lack of a consistent, clear permitting process adds risk for investors and developers and adversely impacts industry confidence in a country. Frameworks related to permitting, leasing, and auctions should be simplified to increase wind energy deployment. Consider establishing a single agency, or 'one-stop shop', to manage and coordinate all documentation and applications to greatly help simplify processes.

Strong coordination between different framework administrators is key. This includes administrators of leasing, permitting, revenue support, and other frameworks, and ministries responsible for energy and environment. This ensures that processes fit well together, and that each can cater for the volumes of projects progressing.

COUNTRY STUDY

Argentina

Argentina currently has 3,300 MW of installed onshore wind capacity, and is forecast by GWEC to install around 300 MW per year under a business-as-usual scenario from 2023 to 2027.

Current situation

Argentina has some of the best wind resources in the world, with high wind speeds and extremely high potential capacity factors of up to 70%, as well as large amounts of open space for wind farm development.

The largest contributors to Argentina's electricity mix are currently natural gas and hydropower. On average, Argentina produces 500,000 barrels per day (bpd) of oil, of which around 20% is exported. Despite this, Argentina is a net importer of fossil fuels.

Inflation in Argentina has been rising for several years and is forecast to average 98% for the year 2023, causing economic uncertainty. These macroeconomic conditions, as well as turbulent financial markets, dampen investor confidence. Appetite for investment is still present, however, due to Argentina's huge technical potential and growing energy demand. The move to renewable energy will reduce the dependence on fossil fuels for power generation and the rising costs associated with natural gas and oil, as well as unleash international investor confidence in the growing renewables sector.

Argentina currently has 3,300 MW of installed onshore wind capacity, and is forecast by GWEC to install around 300 MW per year under a business-as-usual scenario from 2023 to 2027. Under an accelerated transition scenario, if barriers to policy frameworks, transmission infrastructure and permitting schemes were resolved, Argentina could install 31% more onshore wind energy capacity in the next five years.

Energy mix and targets

Argentina ratified the Paris agreement on the 21st of September 2016. It has an NDC to reach net-zero carbon emissions by 2050.

It has set the goal of not exceeding the net emission of 349 $MtCO_2e$ in 2030, which is a 19% reduction compared to peak levels set in 2007.

In 2015, the Government passed Law 27.191, which sets a non-hydro renewable energy target of 20% by 2025 with the potential of 25% by 2030. Of this, 65% will be wind power. Relevant targets are shown in Table 2.

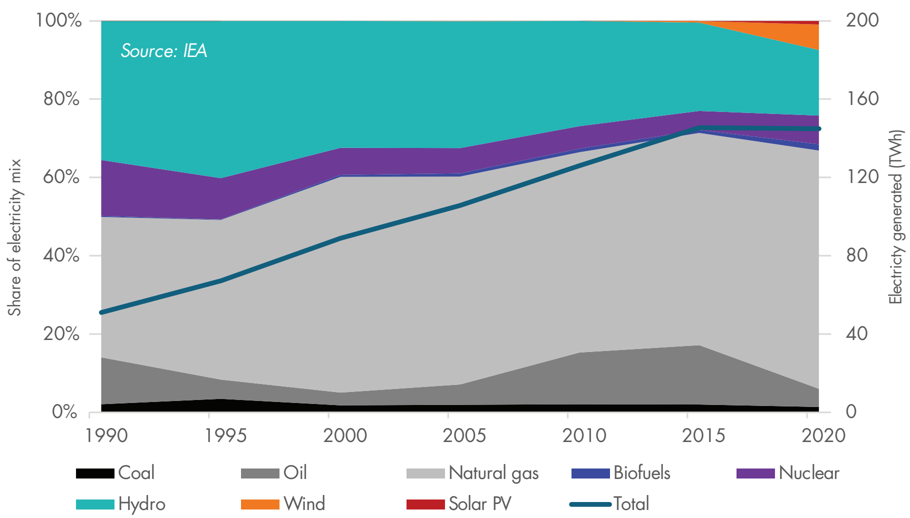
Table 2 Argentina targets.

Parameter	2030 target
Reduction of emissions intensity compared to 2007 levels (NDC as of November 2021)	19%
Share of non-fossil fuel sources (non-hydro) in installed electricity capacity mix	20% (2025)
Share of wind power in installed electricity capacity mix	13%

With increased focus these targets are realistic, as wind energy has been steadily increasing as a proportion of the total mix over the past five years. Continuation of this progress depends on the state of the local economy, however.

Argentina's electricity energy mix and dependence on natural gas and oil is shown in Figure 2. In 2020 (most recent data available), the share of non-hydro renewables was 7.4% of the total mix.

Figure 2 Argentina electricity energy mix by source.



Economic stimulus and laws for clean energy

Vital to wind development in Argentina is Law 27.191 (2015), which established a framework for renewable energy development. Central to this was the creation of the Renewable Energy Trust Fund (FODER) which is used to provide payment guarantees and project finance to renewable energy developers. This law grants multiple tax incentives to wind developers. These include:

- Accelerated depreciation of assets
- VAT refunds on pre-COD purchases
- Tax deduction of all financial expenses
- Extension of income tax loss credits to 10 years, and
- 20% tax credit available to local independent power producers that achieve 30% local content.

The Ministry of Energy and Mines (MINEM) sets energy sector policies and oversees their implementation. The local wholesale market, Mercado Electrico Mayorista (MEM) is administered by state utility CAMMESA which is owned by MINEM (20%) and private sector companies (80%).

To reduce the production of GHG associated with its energy generation, the Government created the RenovAr program in 2016, which aims to increase the development of renewable energy projects through competitive auctions and to establish 20-year power purchase agreements (PPAs) between renewables projects and CAMMESA. This programme seeks to increase the bankability of projects through a few measures:

- Payment and liquidity guarantee from FODER
- Provision of dispatch priority to renewables projects, and
- Issue of PPA tariffs in $USD that are payable in ARS.

Since its launch in 2016, the RenovAr program has awarded 244 renewable energy projects, achieving 6.3 GW of installed capacity throughout its auction rounds of which 74% has been wind.

In response to recent political and economic uncertainty that saw several large-scale projects fail to reach financial close, and in a bid to better utilise Argentina's medium voltage grid network, Round 3 of the RenovAr aimed at incentivising small-scale decentralised projects up to 10 MW in capacity.

Current barriers to wind energy

Grid development

A programme of expansion across the country's high voltage and medium voltage grid networks is urgently required to support the planned expansion of wind energy. Though proposals have been brought forward by regulators, substantial progress in this area has been slow, mostly due to embedded government bureaucracy and lack of government focus.

Investment environment

Inflation in Argentina for 2022 averaged approximately 75% and has been over 40% since 2019. This has created an unstable environment for investors. Developers have been able to help account for these inflationary pressures through contracting strategies, but problems are compounded by foreign exchange limitations that are enforced as a legacy of recent financial instability. These limitations prevent investment dollars from being expatriated outside Argentina to preserve the financial strength of the Argentine Peso, and severely dampen investor appetite in the region as any profits or revenue cannot be converted to other currencies.

This restricts the amount of foreign investment in the country, the financing options available to developers, and the extent to which equipment can be purchased overseas. It has limited involvement in the market to smaller national power providers and limits the scope for private overseas investment in critical high-voltage network upgrades needed to accommodate future growth.

Changes to auction eligibility

Large wind projects (larger than 10 MW) were excluded from the latest round of the RenovAr programme, which is targeted at small scale de-centralised generation projects. Wind projects are less attractive at this scale as economies of scale during maintenance are not possible. Although large scale wind projects can still find a route to market via the MATER framework, which seeks to incentives corporate PPAs between developers and large users of power with average demand more than 0.3 MW, the rate of project development under this framework has historically been slow.

Case study
PEPE III wind project

The PEPE III wind project is the twin to its predecessor PEPE II, located off 3 km from the City of Bahia Blanca, a province of Buenos Aires. This project was commissioned in 2019 and came into operation in 2020. As of 2021 both PEPE II and III are authorised under the International Renewable Energy Certificates (IREC) standard.

As of 2020, the installed capacity can generate 243GWh of clean power.[3] This generation comes from the 53 MW of capacity produced by 14 wind turbines procured from Vestas.[4]

While the job creation from this exact project is not entirely clear, there has been significant value created, reflected in investment in the wind industry of approximately $4.6 billion since 2016. Argentina being Latin America's second largest producer of wind this is a positive signal that a significant work force will be required.

PEPE III is one of many projects in nine provinces in Argentina which have collectively contributed towards the mitigations of over 5.8 million tonnes of CO_2 emissions annually.[5]

3 Pampa Energía, Pampa Energía Wind Farm III ('PEPE III'), available online at: https://ri.pampaenergia.com/en/our-assets/electricity-power/generation/pampa-energia-wind-farm-iii-pepe-iii/
4 Vestas, New 106 MW order extends Vestas' Argentinean leadership, May 2018, available online at: https://www.vestas.com/en/media/company-news/2018/new-106-mw-order-extends-vestas-argentinean-leadership-c2963383
5 Cámara Eólica Argentina, Activity, available online at: https://camaraeolicaargentina.com.ar/?page_id=6076

Recommendations for wind acceleration

- **Allow the expatriation of the revenue and profit of wind projects in dollars.** This will greatly improve investor appetite as the chances of wind projects succeeding will not be tied down directly to the local economy.
- **Incentivise the next round of the RenovAr programme to allow for small and medium sized decentralised projects (up to 50 MW).** This will continue the best use of Argentina's medium voltage grid network, while increasing the capacity of most projects slightly to further accelerate wind capacity and encourage the shift to a high voltage network. Larger projects will also increase the need and incentive to develop a skills base in Argentina.
- **Improve wind industry visibility by establishing an auction pipeline with at least a 3–4 year timeframe.** This will allow developers time to prepare their bids, increase investor certainty and increase competition in the market by de-risking the market for smaller developers. A longer-term auction framework can also support more efficient coordination with grid planning.
- **Increase coordination between strategic grid development and future energy generation plans**, to streamline future grid connection planning for wind energy projects. The planning timelines for grid connection should be aligned with the implementation of grid augmentation, as well as the shift from the current medium voltage grid to high voltage. Construction of additional substations should be prioritised to ensure that renewable energy can be integrated across different regions of the country.

Project pipeline scenarios

The methodology for these scenario forecasts is in Appendix A.

In the business-as-usual scenario we forecast that almost 1.5 GW of wind capacity will be installed between 2023 and 2027.

If wind is accelerated and barriers are removed, we forecast a fast acceleration of wind capacity from

2025 which would result in almost 2 GW being installed between 2023 and 2027 – a potential upside of 500 MW. The greatest difference is seen in 2027, and this trend is expected continue past 2027.

Figure 3 shows the forecast pipeline in the two scenarios between 2023 and 2027.

Table 3 shows the forecast installed capacity in MW in the two scenarios between 2023 and 2027.

Figure 3 **Forecast of installed capacity in Argentina in the two scenarios..**

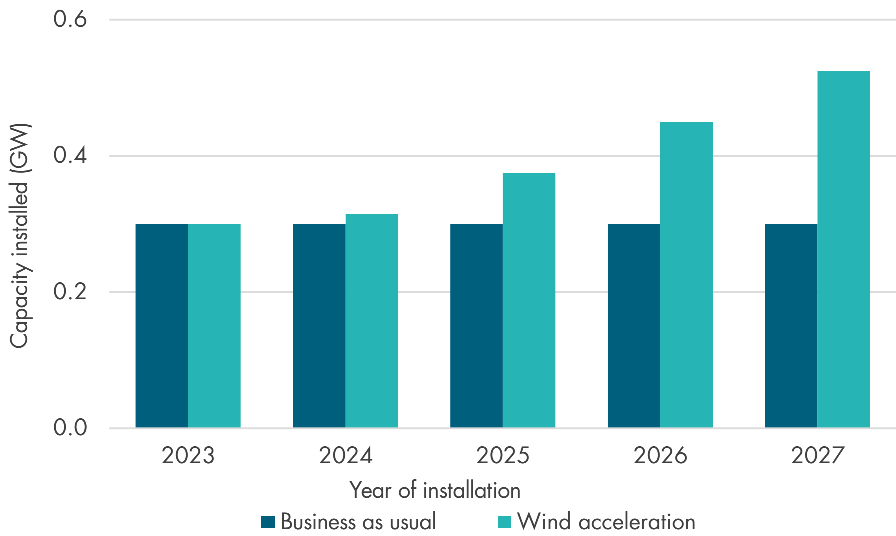


Table 3 **Forecast of installed capacity in Argentina in the two scenarios.**

New wind installed capacity (MW)	2023	2024	2025	2026	2027
Business as usual	300	300	300	300	300
Wind acceleration	300	315	375	450	525

Impacts analysis

In the business-as-usual scenario, 41,000 direct and indirect FTE job years are created by wind energy in Argentina between 2023 and 2027 in the development, construction, and installation phase. In addition, 2,900 annual direct and indirect FTE job years are created in OMS, which continue for the lifetime of the wind farms.

Figure 4 shows the annual FTE years created in the business-as-usual scenario by supply chain category. Examples of occupations across different segments of an onshore wind farm can be found in the Appendix B.

In the wind acceleration scenario, 50,000 direct and indirect FTE job years are created from wind energy in Argentina between 2023 and 2027 in the development, construction, and installation phase. In addition, 5,000 annual direct and indirect FTE job years are created in O&M, which continues for the lifetime of the wind farms. Figure 5 shows the annual FTE years created in the wind acceleration scenario by supply chain category. There is a potential upside of 64,000 new FTE jobs created in a wind

Figure 4 **FTE years created in the business-as-usual scenario in Argentina.**

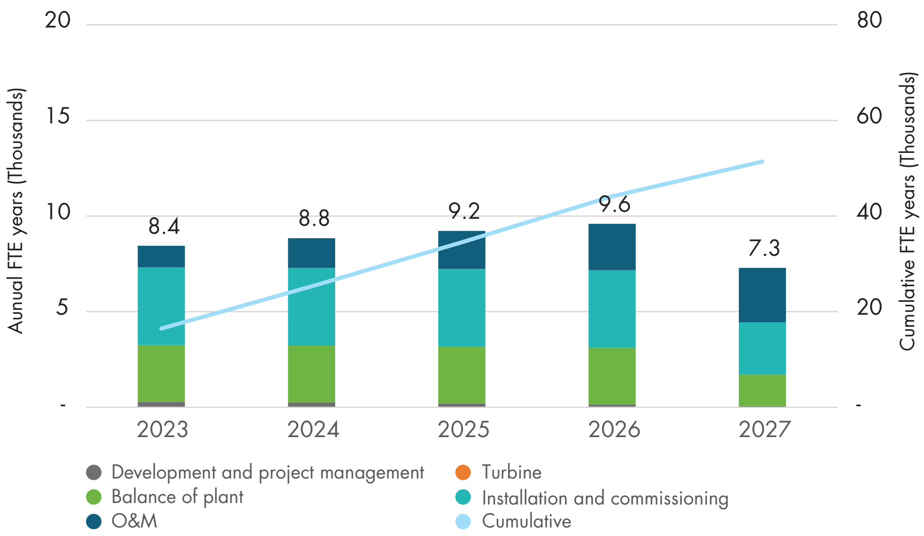
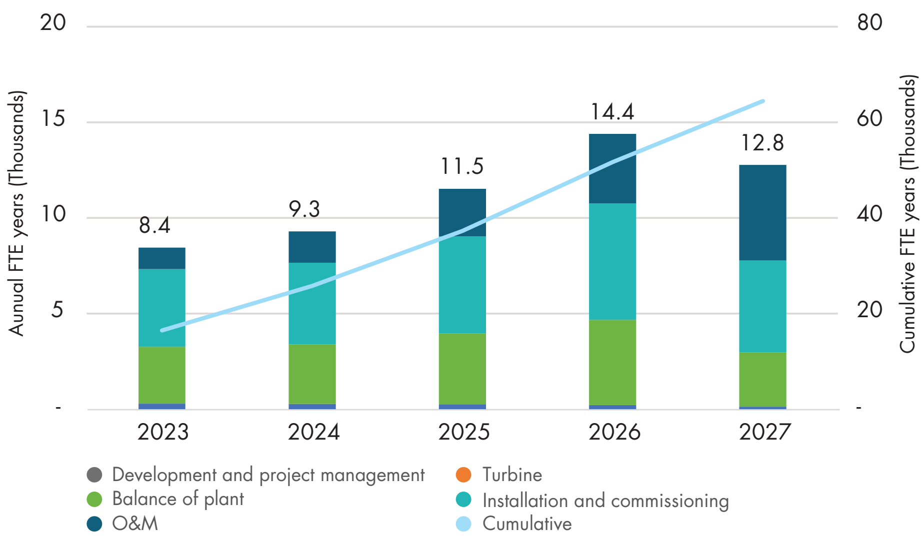
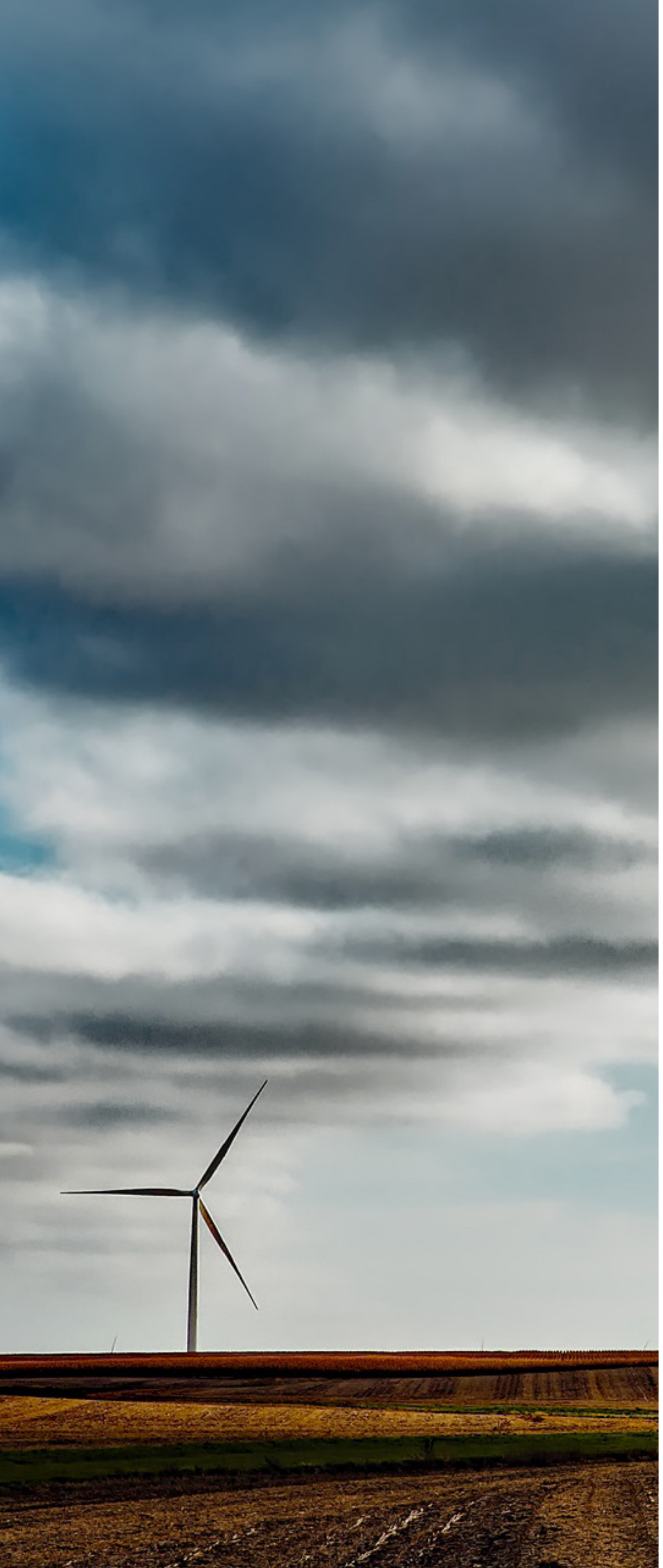


Figure 5 **FTE years created in the wind acceleration scenario in Argentina.**





acceleration scenario over the lifetime of the wind farms.

$1.9 billion direct and indirect gross value added is created from wind energy in Argentina between 2023 and 2027 in the business-as-usual scenario over the lifetime of the wind farms. Figure 6 shows the GVA created in the business-as-usual scenario by supply chain category.

$2.4 billion direct and indirect gross value added is created from wind energy in Argentina between 2023 and 2027 in the wind acceleration scenario over the lifetime of the wind farms. Figure 7 shows the GVA created in the wind acceleration scenario by supply chain category, with a difference of $500 million from the BAU scenario.

Figure 6 Gross value added created in the business-as-usual scenario in Argentina.

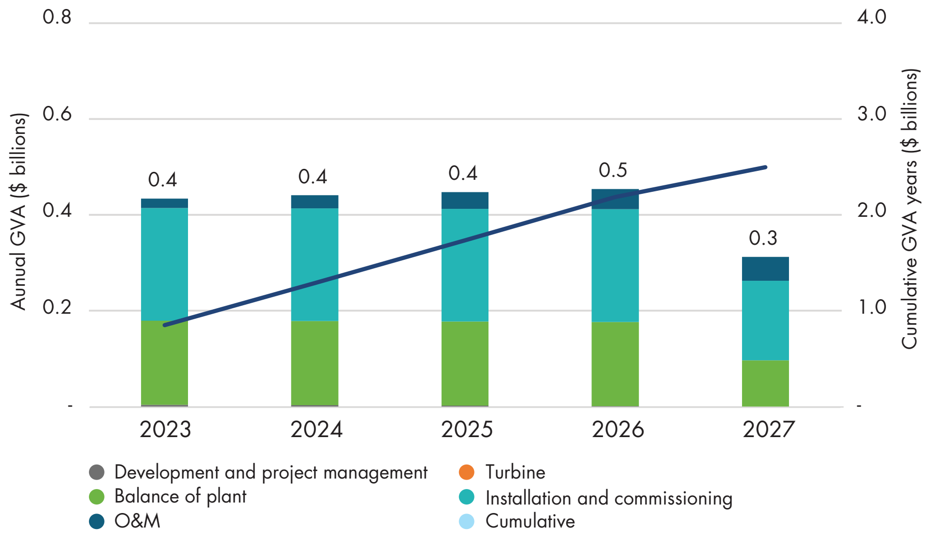
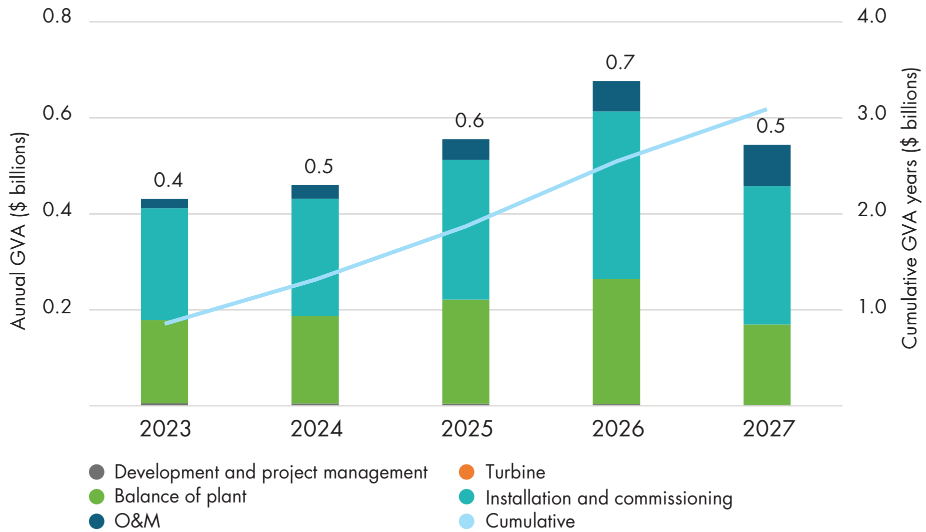


Figure 7 Gross value added created in the wind acceleration scenario in Argentina.



Impacts created in Argentina in the business as usual scenario

A total of 112,000 FTE job years created over the lifetime of the wind farms

US$3.3 billion gross value added (GVA) to national economies over the lifetime of the wind farms

6,570 GWh electricity produced per year from 2027, which is the same as

- 1.7 million homes powered with clean energy per year
- 1.8 million electric vehicles powered annually from 2027

71 million tonnes of carbon emissions saved during the lifetime of the wind farm, which is the same as:

- 15.5 million cars of the road
- 21.2 million return flights from Buenos Aires to Sharm el-Sheikh
- Planting and maintaining 1.9 million trees for 10 years

12 million litres of water saved annually from 2027 which would otherwise be used for thermal power generation

Impacts created in Argentina in the green recovery scenario

A total of 176,000 FTE job years created over the lifetime of the wind farms

US$4.7 billion gross value added (GVA) to national economies over the lifetime of the wind farms

8,600 GWh electricity produced per year from 2027, which is the same as

- 2.2 million homes powered with clean energy per year
- 2.3 million electric vehicles powered annually from 2027

93 million tonnes of carbon emissions saved during the lifetime of the wind farm, which is the same as:

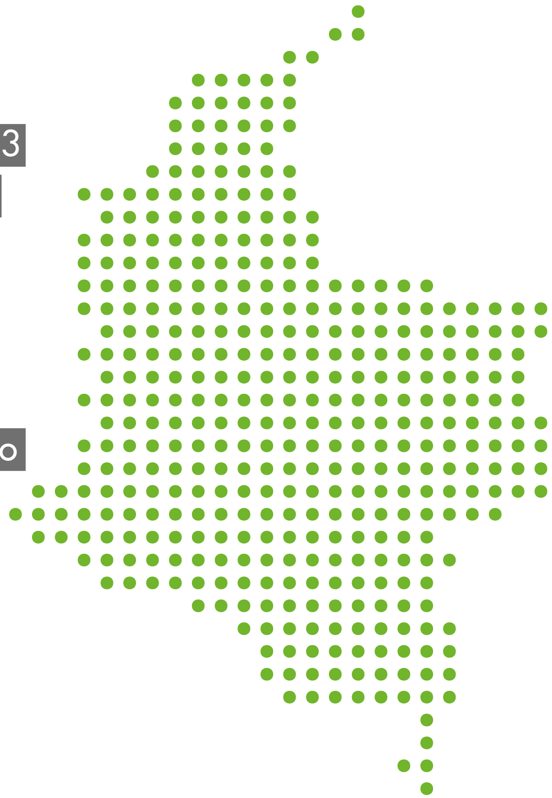
- 20.2 million cars of the road
- 27.6 million return flights from Buenos Aires to Sharm el-Sheikh
- Planting and maintaining 2.5 million trees for 10 years

16 million litres of water saved annually from 2027 which would otherwise be used for thermal power generation

COUNTRY STUDY

Colombia

Colombia currently has 23 MW of installed onshore wind capacity, and is forecast by GWEC to install around 300-800 MW per year under a business-as-usual scenario from 2023 to 2027.



Current situation

Colombia has started to develop an onshore wind industry, with substantial policy frameworks and regulations, and a project pipeline for wind projects of over 2 GW. Colombia has large regions of both untapped onshore and offshore wind potential.

Despite government efforts, Colombia is still a large greenhouse gases (GHG) emitter. The largest contributions to emissions come from the transport sector at 41%, with the industrial sector following behind at 28% and electricity and heating at 10%.

With an energy mix that heavily relies on hydropower, the system is vulnerable to El Niño weather patterns with drier years causing the country to utilise more fossil fuel combustion for power generation. More renewables in the energy mix will provide greater energy security and less reliance on fossil fuels in drier years.

In mid-2022 a new political party came into power with environmental issues at the centre of its campaign and is likely to boost Colombia's renewable ambitions further. The public and private sector are working collaboratively to make Colombia a leader in wind power in Latin American markets. Additionally, Colombia has begun enacting policies outlined in its offshore wind and hydrogen roadmaps[6,7], signalling political ambition.

Colombia currently has 23 MW of installed onshore wind capacity, and is forecast by GWEC to install around 300-800 MW per year under a business-as-usual scenario from 2023 to 2027. Under an accelerated transition scenario, if barriers to policy frameworks, transmission infrastructure and permitting schemes were resolved, Colombia could install 44% more onshore wind energy capacity in the next five years.

Energy mix and targets

Colombia ratified the Paris agreement on 12 July 2018, and announced its NDC in December 2020 to reduce emissions 51% by 2030 compared to the 2014 levels. This represents a

6 The World Bank, Colombia Offshore Wind Roadmap, 2022, available online at: https://www.minenergia.gov.co/documents/5859/Colombia_Offshore_Wind_Roadmap_VE_compressed.pdf

7 Inter-American Development Bank, Colombia Hydrogen Roadmap, 2021, available online at: https://www.trade.gov/market-intelligence/colombia-hydrogen-roadmap

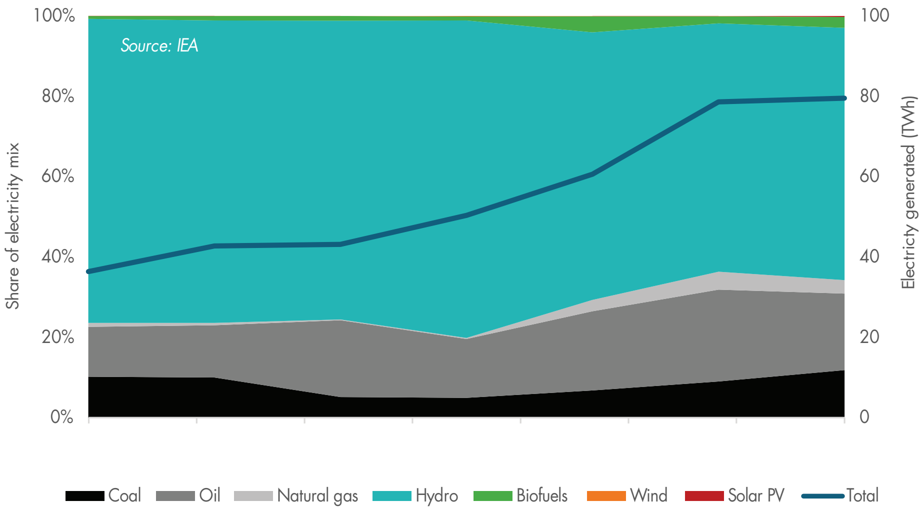
maximum of country emissions of 169.44 MtCO2eq in 2030. It has the goal to reach net zero by 2050. Other relevant targets are shown in Table 4.

Colombia's targets are realistic. The new government installed in 2022 will likely ensure these targets maintain a priority, and the country already has a strong track record of expanding renewables generation, mostly via hydropower. Alternative renewable energy should continue to however, to diversify the electricity mix and thus help increase energy security.

Table 4 Colombia targets.

Parameter	2030 target
Level of deforestation	Zero deforestation
Reduction of emissions intensity compared to 2014 levels (NDC as of November 2021)	51%
Share of non-fossil fuel sources in installed electricity capacity mix	70%

Figure 8 Colombia electricity energy mix by source.



Despite being the largest coal producer in Latin America, only 5% of the total electricity was generated from coal in 2021, as shown in Figure 8.

Colombia's electricity energy mix has remained remarkably constant over the past two decades, with the proportion of renewables (dominated by hydropower) gradually increasing from 76.4% in 1990 to 76.6% in 2021. Of this, wind comprised 0.1% of the electricity mix in 2021.

Economic stimulus and laws for clean energy

The Sustainable and Inclusive Reactivation and Growth Policy (PRCSI), a recovery plan for a just energy transition, was launched in 2020. This focuses on developing Colombia's energy infrastructure for better integration of renewables and inter-region connectivity.

Additionally, Law 2169/2021, passed in 2021, is inspired by Colombia's NDC targets and establishes a goal of reducing Colombia's Greenhouse gas emissions by 51% against a 2014 reference.

Colombia established an overarching legal framework for the development of onshore wind energy in 2014 (Law 1517/2014). This has been continually updated and amended in the years since, and grants multiple tax incentives to developers, and is in force until 2051. Incentives include:

- Exclusion of sales tax on goods and services
- Exemption of import tariffs
- The right to discount up to 50% of total investment values from tax revenues over the first 15 years of a project's operational lifetime, and
- Tax recovery is supported by an accelerated depreciation mechanism, which allows annual depreciation of up to 33.3% to be applied to assets. This allows developers reduce their tax burden.

Decree 570 of 2018 established the Ministry of Mines and Energy as the authority responsible for regulating, planning co-ordinating and monitoring the development of wind energy. This includes defining target volumes, as well as developing competitive allocation schemes and the assessment criteria that will be used to develop wind projects.

Auctions are run by Colombia's Mining and Energy Planning Unit (UPME), a technical unit within the Ministry.

Colombia has hosted three stand-alone technology neutral auctions since 2019. The first was unsuccessful, as stringent prequalification requirements were not met. These requirements were dropped for subsequent rounds, which were more successful as a result. An additional key reason for the success of subsequent rounds was the enaction of a 10% mandatory renewable energy target in the 2019 National Plan of Development. Renewables auctions have adopted a design that matches pre-qualified buyers and sellers to determine long term PPAs.

Current barriers to wind energy

Lack of auction visibility

Colombia has hosted two successful auctions, but these have been issued on an ad-hoc basis. This lack of certainty over the timing and size of future rounds hampers the ability of market players to make long term plans, providing a barrier to supply chain participation and growth. Market schemes have been implemented to encourage the development of corporate PPAs, but volumes are still small.

Social and environmental licencing

The social and environmental licencing process in Colombia is supposed to take 110 working days for a project, plus the additional time to deal with any problems encountered during the evaluation of paperwork. Environmental permitting has been a source of significant delay for wind energy projects however, with delays of multiple months.

A problematic part of the process is the need for infrastructure developers to establish free, prior, informed consent with indigenous and ethnic groups as a fundamental part of the environmental and social licencing process. This is managed by the Directorate of Prior Consultation and requires significant resources of development teams that struggle to manage multiple applications in tandem. Developers are eager to meet prior consent requirements projects but would like to see clearer regulation to streamline the process and limit development risk.

Grid development

One of the least developed areas of the energy transmission system is in the wind-rich region of La Guajira. The lack of transmission development means wind farms struggle to begin operations due to lack of grid connection point availability. The Colombian energy sector is structured and overseen by the Ministry of Mines and Energy, which can intervene to help with expansion of the energy network to remote areas of the country.

Case study
La Guajira wind farm

La Guajira, Colombia's first wind farm after a 17-year hiatus, came online in January 2022. The Colombian multinational Elecnor and energy generator Isagen formed a partnership to develop this wind farm. This partnership between an electricity utility and an operations and maintenance company can be valuable when looking at synergies for collaboration along the value chain. Vestas was commissioned to supply 10 turbines, which together can generate up to 20 MW of clean energy for the region.[8]

This project alone created over 50 jobs and generated in the region of $75,000 million pesos. As this project is one of 14 in the pipeline, more jobs and further investment can be expected in the region. In 2022, Colombia experienced a record high of investment million in renewable energy investment in the region of $800 million pesos, the positive effects of which will be felt throughout the local economy.

8 Vestas, Vestas enters new market with an order in Colombia, September 20, available online at: https://www.vestas.com/en/media/company-news/2020/vestas-enters-new-market-with-an-order-in-colombia-c3196448

Recommendations for wind acceleration

- **Improve wind industry visibility by establishing an auction pipeline with a 3–4 year timeframe at least.** This will allow developers time to prepare their bids and increase investor certainty. In addition to the further encouragement of corporate PPAs, this will increase competition in the market by de-risking the market for smaller developers.
- **Simplify the permitting, environmental and social licencing process**, especially to streamline the process for achieving informed consent with indigenous and ethnic groups. Expanding the number of staff at the Directorate of Prior Consultation will also allow the faster processing of applications.
- **Increase government spending commitments directed at grid modernisation and expansion to promote a reliable operation and prevent bottlenecks**, especially in the La Guajira region, and to help futureproof the system for further low-cost wind additions. Failure to adapt market design to the needs of the future energy system may result in higher long-term costs, higher electricity prices for consumers and systematic integration challenges for clean energy.
- **Continue to strengthen the dialogue between the government and renewable energy stakeholders**, including investors in the sector, IPPs and civil society organisations representing community, especially ingenious groups, interests. Limited channels for dialogue can make it challenging to assess investment risk in wind projects, particularly in an environment of policy variability and new institutional frameworks. Establishing a semi-permanent forum for dialogue and consultation between the government, industry and wider stakeholders would allow for more effective responses and contributions to policy changes.

Project pipeline scenarios

The methodology for these scenario forecasts is in Appendix A.

In the business-as-usual scenario we forecast that 2.7 GW of wind capacity will be installed between 2023 and 2027.

If wind is accelerated and barriers are removed, almost 4 GW of wind capacity will be installed between 2023 and 2027– an upside of over 1 GW of more wind energy installed over the five-year period. The greatest difference is seen in 2027, and this trend is expected continue past 2027.

Figure 9 shows the forecast pipeline in the two scenarios between 2023 and 2027.

Table 5 shows the forecast installed capacity in MW in the two scenarios between 2023 and 2027.

Figure 9 Forecast of installed capacity in Colombia in the two scenarios.

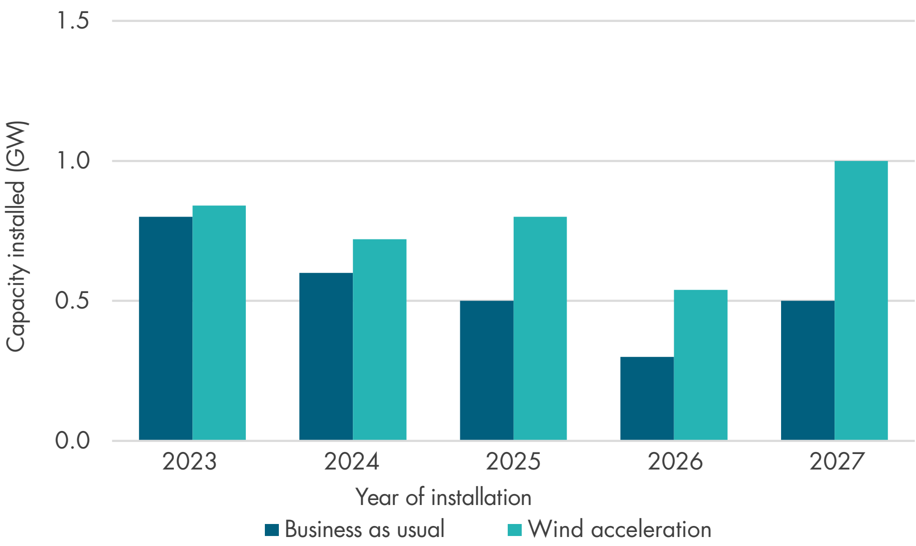


Table 5 Forecast of installed capacity in Colombia in the two scenarios.

New wind installed capacity (MW)	2023	2024	2025	2026	2027
Business as usual	800	600	500	300	500
Wind acceleration	840	720	800	540	1000

Impacts analysis

In the business-as-usual scenario, 68,000 direct and indirect FTE job years are created by wind energy in Colombia between 2023 and 2027

in the development, construction, and installation phase. In addition, 4,800 annual direct and indirect FTE job years are created in O&M, which continues for the lifetime of the wind farms. Figure 10 shows the annual FTE years created in the business-as-usual scenario by supply chain category. Examples of occupations across different segments of an onshore wind farm can be found in the Appendix B.

In the wind acceleration scenario, 92,500 direct and indirect FTE job years are created from wind energy in Colombia between 2023 and 2027 in the development, construction, and installation phase. In addition 9,500 annual direct and indirect FTE job years are created in O&M, which continues for the lifetime of the wind farms. Figure 11 shows the annual FTE years created in the wind acceleration scenario by supply chain category. There is a potential upside of 148,000 new FTE jobs created in a wind acceleration scenario over the lifetime of the wind farms.

$2.6 billion direct and indirect gross value added is created from wind energy in Colombia between 2023 and 2027 in the business-as-usual scenario over the lifetime of the wind

Figure 10 **FTE years created in the business-as-usual scenario in Colombia.**

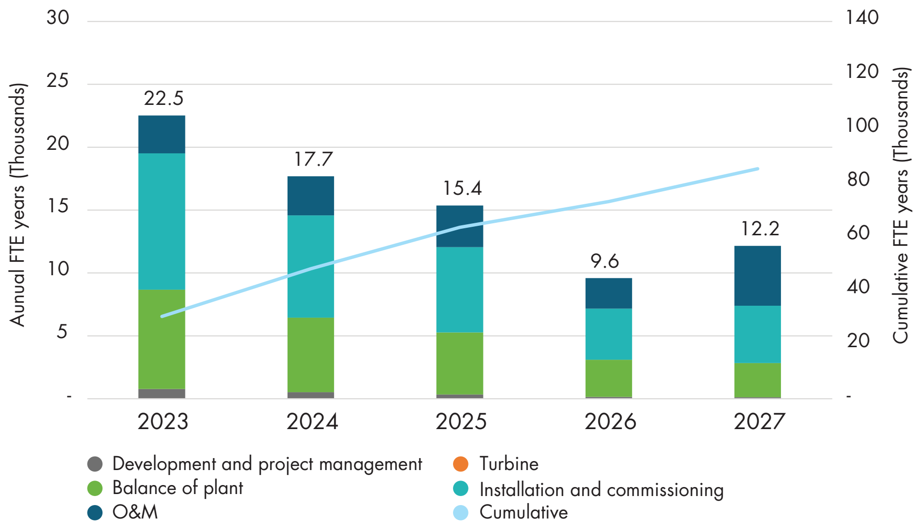
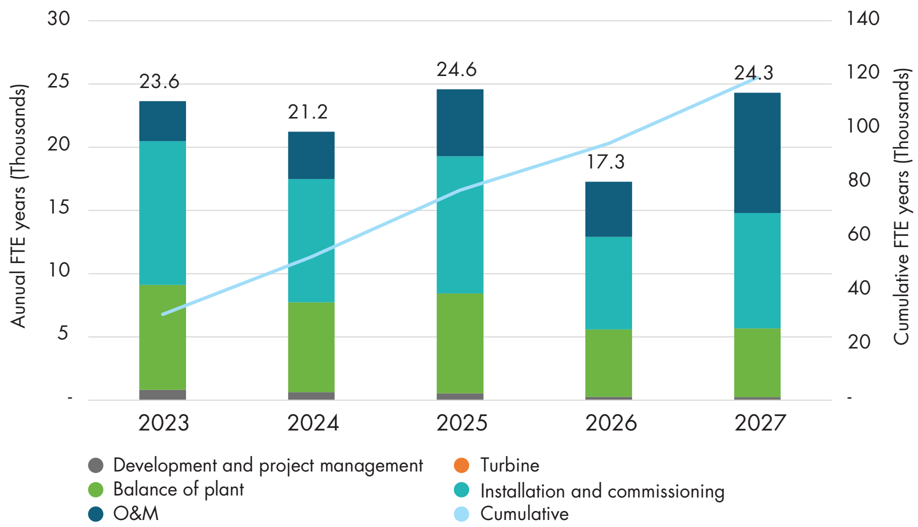


Figure 11 **FTE years created in the wind acceleration scenario in Colombia.**



farms. Figure 12 shows the GVA created in the business-as-usual scenario by supply chain category.

$3.7 billion direct and indirect GVA is created from wind energy in Colombia between 2023 and 2027 in the wind acceleration scenario over the lifetime of the wind farms. Figure 13 shows the GVA created in the wind acceleration scenario by supply chain category. The potential upside in the wind acceleration scenario is $1.1 billion direct and indirect GVA.

Figure 12 Gross value added created in the business-as-usual scenario in Colombia.

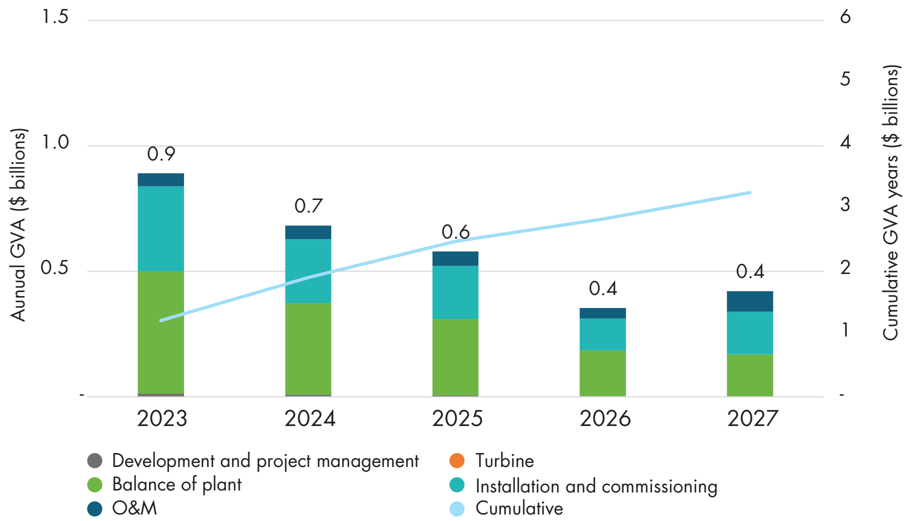
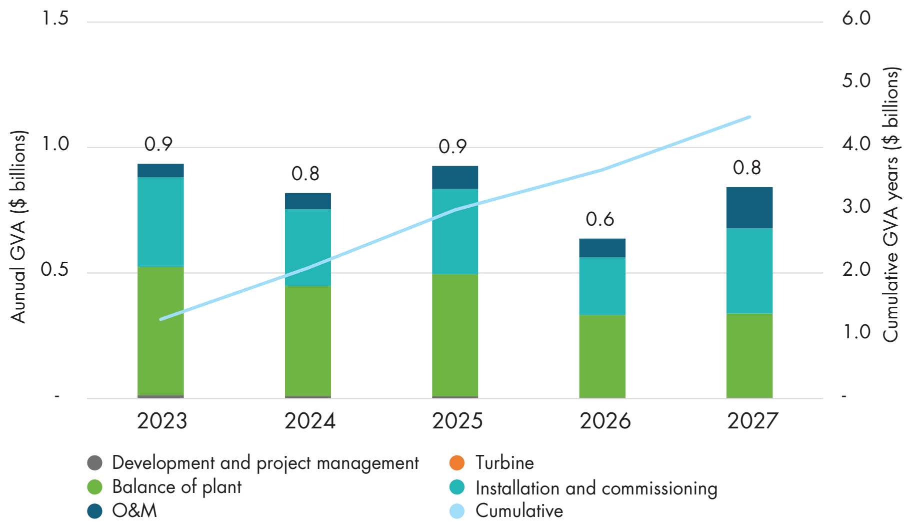


Figure 13 Gross value added created in the wind acceleration scenario in Colombia.



Impacts created in Colombia in the business as usual scenario

A total of 191,000 FTE job years created over the lifetime of the wind farms

US$4.9 billion gross value added (GVA) to national economies over the lifetime of the wind farms

8,300 GWh electricity produced per year from 2027, which is the same as

- 5.5 million homes powered with clean energy per year
- 2.3 million electric vehicles powered annually from 2027

233 million tonnes of carbon emissions saved during the lifetime of the wind farm, which is the same as:

- 51 million cars of the road
- 80 million return flights from Bogotá to Sharm el-Sheikh
- Planting and maintaining 6 million trees for 10 years

15.5 million litres of water saved annually from 2027 which would otherwise be used for thermal power generation

Impacts created in Colombia in the wind acceleration scenario

A total of 339,000 FTE job years created over the lifetime of the wind farms

US$8.1 billion gross value added (GVA) to national economies over the lifetime of the wind farms

12,000 GWh electricity produced per year from 2027, which is the same as

- 7.8 million homes powered with clean energy per year
- 3.3 million electric vehicles powered annually from 2027

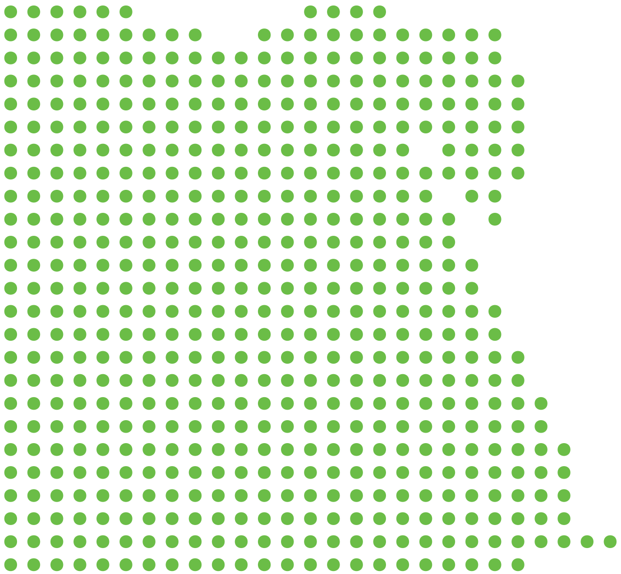
336 million tonnes of carbon emissions saved during the lifetime of the wind farm, which is the same as:

- 73 million cars of the road
- 115 million return flights from Bogotá to Sharm el-Sheikh
- Planting and maintaining 8.8 million trees for 10 years

22.5 million litres of water saved annually from 2027 which would otherwise be used for thermal power generation

COUNTRY STUDY

Egypt



Egypt currently has 1,700 MW of installed onshore wind capacity, and is forecast by GWEC to install around 250-700 MW per year under a business-as-usual scenario between 2023 to 2027.

Current situation

As country host of COP27 in late 2022, governments worldwide will be looking to Egypt to demonstrate leadership and initiative on climate change, including wind power acceleration and progress towards its NDCs, most recently updated in July 2022.

Egypt is currently responsible for over one-third of Africa's total natural gas consumption, and has a predicted increase in emissions of 50% from 2022 levels by 2030. The government is committed to renewable energy expansion however, to ensure the country's continuous energy security and stability of energy supply.

Egypt has a long history with wind energy, having first developed projects in the early 1990s. Its wind industry was boosted through the World Bank and foreign government support in 2014, with Denmark and Japan providing wind turbines and expertise.

Egypt has a large wind energy potential, with high wind speeds along the Red Sea coast and the Gulf of Suez. Its wind capacity is expected to reach 7 GW by the end of 2022 making it an important contributor to its electricity energy mix.

Egypt currently has 1,700 MW of installed onshore wind capacity, and is forecast by GWEC to install around 250-700 MW per year under a business-as-usual scenario between 2023 to 2027. Under an accelerated transition scenario, if barriers to policy frameworks, transmission infrastructure and permitting schemes are resolved, Egypt could install 45% more onshore wind energy capacity in the next five years.

Energy mix and targets

The Paris agreement was ratified by Egypt on 29 June 2017, with targets of net GHG emission reductions of 22% by 2022 and 42% by 2035 conditional on international support, though these vary by sector. Egypt has a target of wind making up 14% of the electricity mix by 2035. Relevant targets are shown in Table 6.

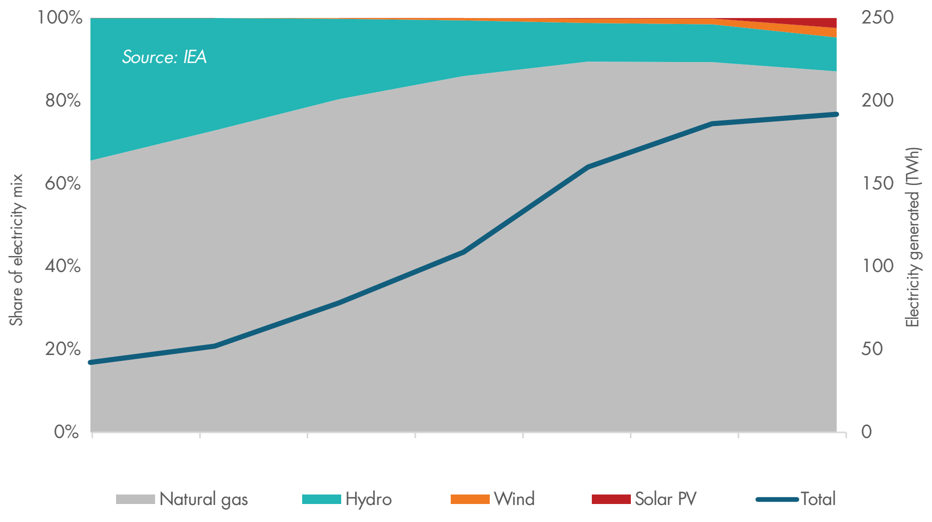
It is uncertain whether Egypt will meet these targets, in particular the target of 14% share of wind capacity in the electricity mix by 2035. A sharp increase of focus and resource in expanding wind capacity will be required by government agencies and the private sector.

The share of fossil fuels in the electricity energy mix has increased over the past two decades, rising from around 77% in 1990 to 88% in 2020. Natural gas use has increased sharply since 2015, replacing oil. Meanwhile, the use of renewable energy sources including hydro has stayed relatively constant in this timeframe.

Table 6 **Egypt targets.**

Egypt 2030 targets	
Reduction of emissions intensity compared to BAU scenario (NDC as of July 2022)	33% (in power generation, transmission and distribution)
Share of non-fossil fuel sources in installed electricity capacity mix	42% (2035)
Share of wind capacity in electricity mix	14% (2035)

Table 14 **Egypt electricity energy mix by source.**



Economic stimulus and laws for clean energy

Law 203, introduced in 2014 and assisted by the World Bank, has helped encourage private investment in renewables. There remains concerns from foreign investors however, due to the slow and bureaucratic nature of the permitting process.

The General Authority for Freezones and Investment (GAFI) issues so-called "golden licenses". These are single-approval licenses that allow some investors to secure a single document that covers land allocation, building licencing, and operations. Projects eligible for these licences must remain compliant with the usual regulatory requirements but the process spares developers from having to seek individual approvals from different entities. Renewable energy projects are eligible for these projects, as are green hydrogen and desalination projects.

Eligibility requirements for projects seeking GAFI licenses include:

- A 50% local content quota
- An ability to export 50% of output from the project, and
- A reliance on financing from foreign funders and investors.
- Current barriers to wind energy

Bankability

Wind developers in Egypt have expressed concern that the Government tariffs to support wind projects continue to reduce when global wind energy supply chain costs are rising, making the economics of new projects challenging.

Energy over-supply

Peak electricity demand in Egypt stands at around 30 GW, however there is currently 60 GW of generation capacity operational in the country, the majority of which is from dispatchable sources like gas and hydro that can be switched off and on according to market demand. The Government has moved to prioritise the development of renewable energy projects by cancelling the development of non-renewable power plants, however, there is no urgent supply need for the country to increase the size of its intermittent renewables generation capability, which limits incentives for developers and investors.

Lack of competition in offtake market

The Egyptian energy sector is largely a single-buyer market. The Egyptian Electricity Holding Company (EEHC) owns almost all transmission and distribution assets. Meanwhile, the state-owned company Egyptian Electricity Transmission Company (EETC) executes power purchase agreements with public and private generation companies, and sells power to the nine main distribution companies in Egypt.

Egyptian legislation does not allow private offtake agreements for projects over 20 MW, which means the larger and more economic wind projects can struggle to find a route to market. The government has taken steps to liberalise its energy sector, but progress has been slow.

Case study
West Bakr Wind Farm

The West Bakr Wind Farm is located 30 km away from the historically oil producing town of Ras Ghareb, Egypt. The area's high wind speeds give the wind farm the potential to produce of 262 MW of energy. Project installation started in 2020 and commercial operation began 2021, an impressive one-year turnaround for construction. Turbines were supplied by Siemens Gamesa Renewable Energy (SGRE).

Lekela Power completed the PPA with the Egyptian Electricity Transmission Company and the New and Renewable Energy Authority (NREA) in February 2019.

The project created opportunities for local employment and boosted socio-economic activity in the Ras Ghareb and surrounding areas. During construction peak, up to 550 people were employed, with over 25% of the wind farm being constructed by those from the local region.9 In regions where an oil industry once thrived, clean energy jobs have been created, providing a significant boost to the local economy.

The West Bakr Wind Farm mitigates 550 MT of CO2 emissions annually and produces 1000 GWh of clean energy per year to the region.

9 SGRE, Egypt: Wind brings clean energy, growth and hope, November 2020, available online at: https://www.siemensgamesa.com/en-int/explore/journal/2020/11/siemens-gamesa-pwp-egypt-ras-ghareb

Recommendations for wind acceleration

- **The Government should continue to increase or at least maintain the level of tariffs that support wind energy.** This will improve investor confidence that Egypt has the correct economic conditions for continuing to increase wind capacity in the country.
- **Accelerate the electrification of transport and industry, and interconnections between neighbouring countries.** This will further increase electricity demand as well as the means to export electricity, and so increase the incentive to increase renewables capacity, which requires more urgency.
- **Allow private offtake agreements for larger wind projects.** This will increase the possible route to markets for projects over 20 MW and increase investor confidence and incentives to develop wind capacity. Larger projects will also allow for a greater amount of the wind energy supply chain to be set up in the country, creating further jobs and local investment.

Project pipeline scenarios

The methodology for these scenario forecasts is in Appendix A.

In the business-as-usual scenario we forecast that 2.6 GW of wind capacity will be installed between 2023 and 2027.

If wind is accelerated and barriers are removed, we forecast a fast acceleration of wind capacity from 2025 which would result in almost 4 GW being installed between 2023 and 2027 – a potential upside of over 1 GW. The greatest difference is seen in 2027, and this trend is expected continue past 2027.

Figure 15 shows the forecast pipeline in the two scenarios between 2023 and 2027.

Table 7 shows the forecast installed capacity in MW in the two scenarios between 2023 and 2027.

Table 15 Forecast of installed capacity in Egypt in the two scenarios.

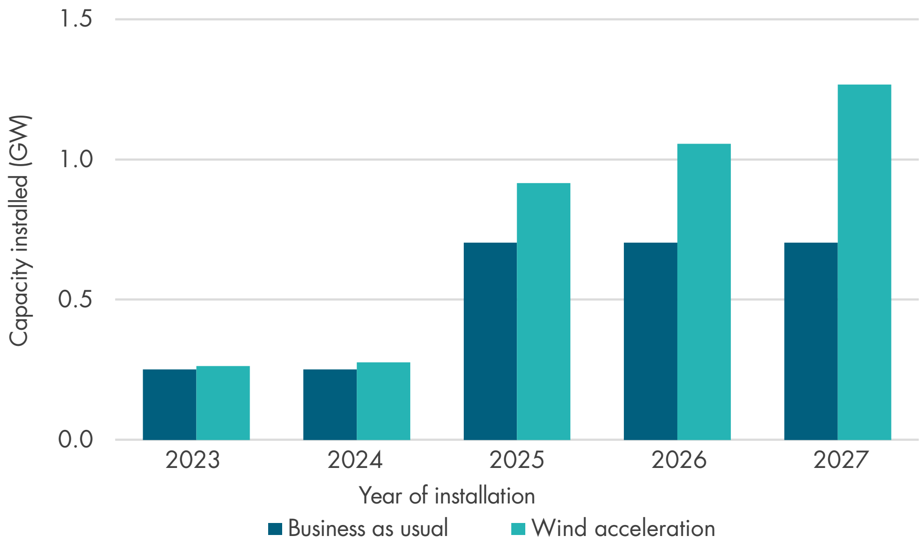


Table 7 Forecast of installed capacity in Egypt in the two scenarios..

New wind installed capacity (MW)	2023	2024	2025	2026	2027
Business as usual	250	250	700	700	700
Wind acceleration	263	275	910	1050	1260

Impacts analysis

In the business-as-usual scenario, 70,500 direct and indirect FTE job years are created by wind energy in Egypt between 2023 and 2027 in the development, construction, and installation phase. In addition, 6,700 annual direct and indirect FTE job years are created in O&M, which continues for the lifetime of the wind farms.

Figure 16 shows the annual FTE years created in the business-as-usual scenario by supply chain category. Examples of occupations across different segments of an onshore wind farm can be found in the Appendix B.

In the wind acceleration scenario, 96,000 direct and indirect FTE job years are created from wind energy in Egypt between 2023 and 2027 in the development, construction, and installation phase. In addition, 12,000 annual direct and indirect FTE job years are created in O&M, which continues for the lifetime of the wind farms.

Table 16 FTE years created in the business-as-usual scenario in Egypt.

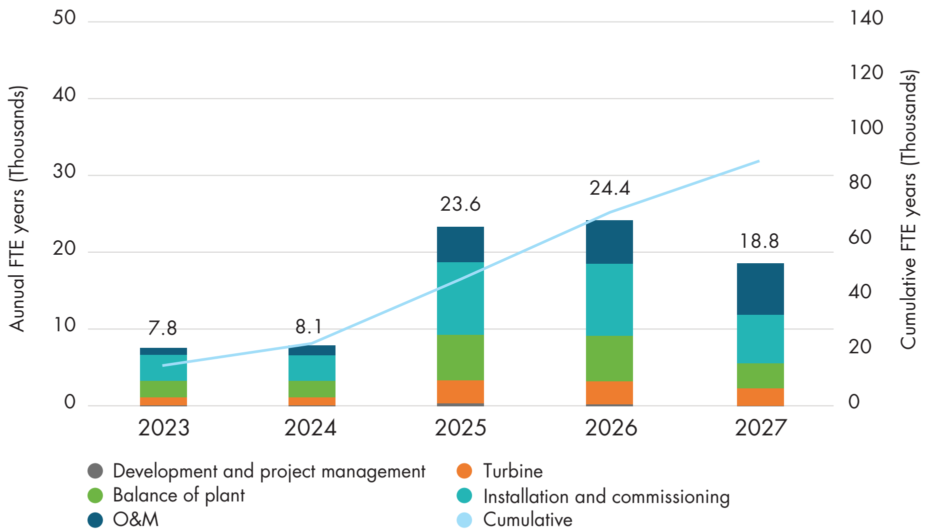


Figure 17 shows the annual FTE years created in the wind acceleration scenario by supply chain category. There is a potential upside of 164,000 new FTE jobs created in a wind acceleration scenario over the lifetime of the wind farms.

$1.7 billion direct and indirect gross value added is created from wind energy in Egypt between 2023 and 2027 in the business-as-usual scenario over the lifetime of the wind farms. Figure 18 shows the GVA created in the business-as-usual scenario by supply chain category.

Table 17 FTE years created in the wind acceleration scenario in Egypt.

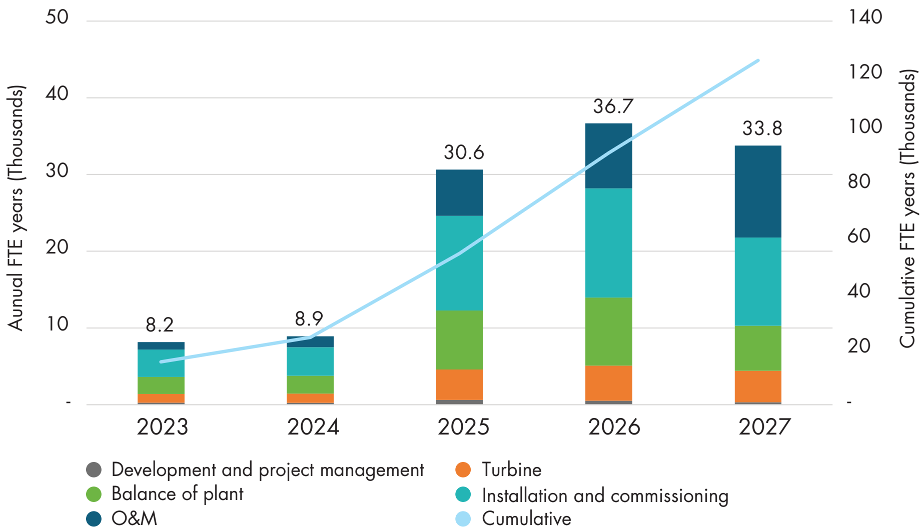
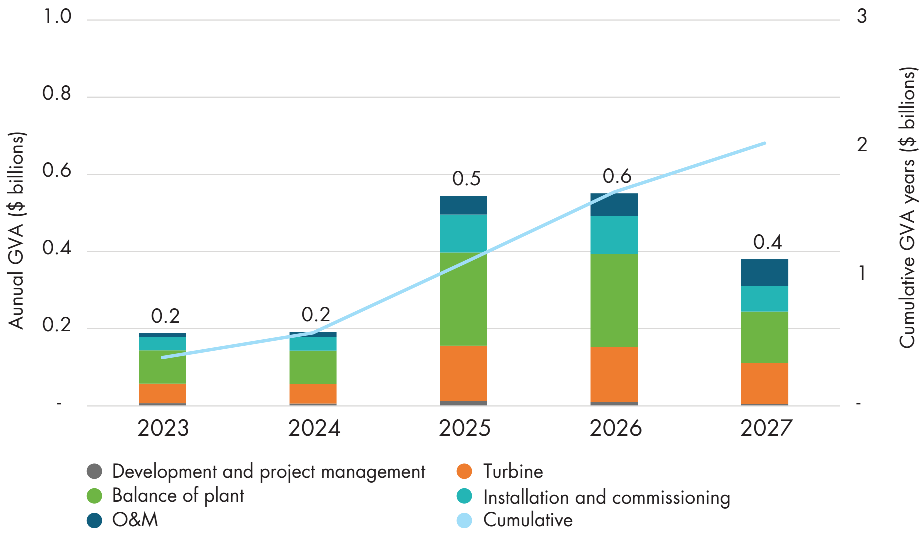
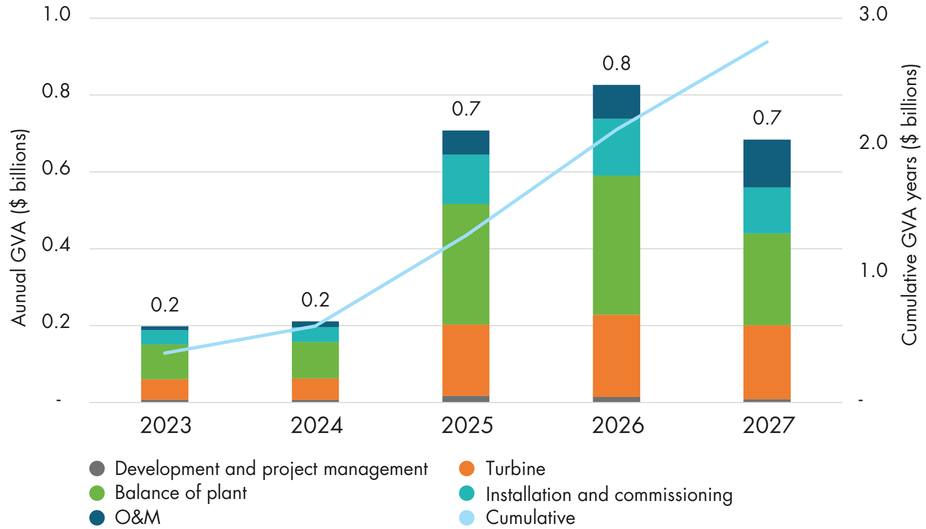


Table 18 Gross value added created in the business-as-usual scenario in Egypt.



$2.3 billion direct and indirect gross value added is created from wind energy in Egypt between 2023 and 2027 in the wind acceleration scenario over the lifetime of the wind farms. Figure 19 shows the GVA created in the wind acceleration scenario by supply chain category, with a difference of $600 million in GVA over the forecast period.

Table 19 Gross value added created in the wind acceleration scenario in Egypt.



Impacts created in Egypt in the business as usual scenario

A total of 242,000 FTE job years created over the lifetime of the wind farms

US$3.5 billion gross value added (GVA) to national economies over the lifetime of the wind farms

11,400 GWh electricity produced per year from 2027, which is the same as

- 6.5 million homes powered with clean energy per year
- 3 million electric vehicles powered annually from 2027

225 million tonnes of carbon emissions saved during the lifetime of the wind farm, which is the same as:

- 49 million cars of the road
- 2 billion return flights from Cairo to Sharm el-Sheikh
- Planting and maintaining 6 million trees for 10 years

21 million litres of water saved annually from 2027 which would otherwise be used for thermal power generation

Impacts created in Egypt in the wind acceleration scenario

A total of 406,000 FTE job years created over the lifetime of the wind farms

US$5.6 billion gross value added (GVA) to national economies over the lifetime of the wind farms

16,500 GWh electricity produced per year from 2027, which is the same as

- 9.2 million homes powered with clean energy per year
- 4.5 million electric vehicles powered annually from 2027

326 million tonnes of carbon emissions saved during the lifetime of the wind farm, which is the same as:

- 71 million cars of the road
- 3 billion return flights from Cairo to Sharm el-Sheikh
- Planting and maintaining 8.6 million trees for 10 years

31 million litres of water saved annually from 2027 which would otherwise be used for thermal power generation

COUNTRY STUDY:

Indonesia

Indonesia currently has 150 MW of installed onshore wind capacity, and is forecast by GWEC to install about 75-100 MW per year under a business-as-usual scenario from 2023 to 2027.

Current situation

Home to the fourth-largest population in the world, Indonesia is a large contributor of GHG emissions, with coal being its biggest energy export as well as accounting for over 50% of its electricity mix. This contrasts its stated Paris Agreement commitments, which outline a long-term strategy of peak GHG emissions by 2030 and aims to achieve net-zero emissions by 2060.

Indonesia consists of several large land masses and islands. As a result, an interconnected national grid system would be challenging. This, combined with the best wind resources located away from large population centres, makes it difficult to accelerate wind deployment. Renewables expansion is necessary, however, for energy security. In addition to coal export dependency, Indonesia currently imports a large amount of its oil, and so is vulnerable to volatile market prices.

To partly address energy security, the National Economic Recovery (PEN) program ringfenced 3.5% of its budget for support of renewables. This has been overshadowed by the continued expansion of fossil fuel use, missing an opportunity for wind acceleration and boosting Indonesia's reliance on fossil fuels imports.

Indonesia aims to meet a large share of its climate commitments through emission reductions, primarily by reducing deforestation levels. This is expected to contribute to almost 60% of the emissions reductions necessary to meet both conditional and unconditional NDC targets.

Indonesia currently has 150 MW of installed onshore wind capacity, and is forecast by GWEC to install about 75-100 MW per year under a business-as-usual scenario from 2023 to 2027. Under an accelerated transition scenario, if barriers to policy frameworks, transmission infrastructure and permitting schemes were resolved, Indonesia could install 26% more onshore wind energy capacity in the next five years.

Energy mix and targets

Indonesia ratified the Paris Agreement on 23 April 2016 through Law No. 16/2016, with the target goals of 23% renewables by 2025 and 31% by 2050. It aims to be carbon neutral by 2060, although this is not ratified through any legislation or executive motions.

Indonesia aims to meet a large share of its commitments through emission reductions by reducing deforestation levels. This is expected to contribute to almost 60% of the emissions reductions necessary to meet both conditional and unconditional NDC targets. Relevant targets are shown in Table 8.

Indonesia's renewables target is realistic if the rate of renewables expansion increases or remains on course. The 2030 wind target is unlikely to be met, however, as an extremely large increase in installed capacity is required in a short amount of time.

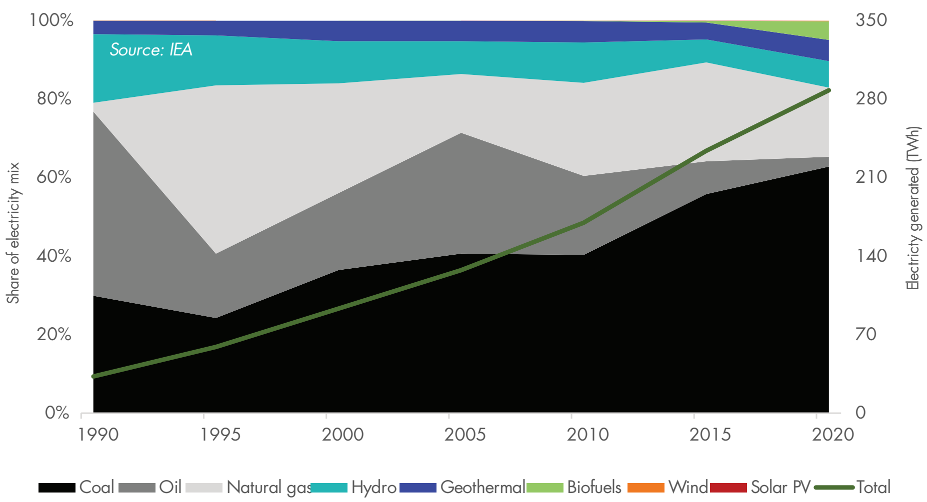
Even if the renewables target is met, the past recent expansion of the use of coal is concerning and will partly counteract any progress made on renewables, even with a recently announced moratorium on coal.

Indonesia's electricity energy mix is dominated by fossil fuels, which have increased over the past two decades. The use of renewables has increased at a steady rate, but just behind the rate needed to maintain its share of the energy mix as shown in Figure 20.

Table 8 Indonesia targets.

Parameter	2030 target
Reduction of emissions intensity compared to BAU scenario (NDC as of September 2022)	32% unconditional 43% conditional
Share of non-fossil fuel sources in installed electricity capacity mix	23% (2025)
Wind capacity in electricity mix	1.8 GW

Table 20 Indonesia electricity energy mix by source.



Economic stimulus and laws for clean energy

Law 112 of 2022 seeks to address perceived bottlenecks in the development of renewables and provide a framework for the procurement of renewable energy.

It allows state-owned electricity company PLN to sign offtake agreements up to 30 years in length with generators of selected projects.

Potential projects are initially screened to ensure they meet minimum administrative, technical and financial requirements. Then projects are bid in an auction with a pre-defined ceiling price adjusted by locational factors for projects connecting in different regions of the country. The ceiling price for proposed extensions of existing projects is capped at 70% of the original project price. PLN's procurement quotas are set by the Minister of Energy and Resources. These quotas use the Government's Electric Business Plan (RUPTL), which sets out Indonesia's future electricity capacity and network development plans up to 2030, as the main guideline for procurement.

Law 112 also mandates that no new coal fired power plants can be built in the country and sets out a framework for the early retirement of coal assets. Domestic and international funding is available to support the early retirement of coal power assets via a Clean Energy Fund that can support the development of renewables projects.

Renewable energy projects are also eligible for other forms of government support including import duty exemptions, land availability guarantees, and land and building tax facilities.

Current barriers to wind energy

Inadequate project screening

There are currently doubts about the deliverability of the 600 MW of wind energy capacity that PLN has committed to. This is because projects can currently secure offtake deals without having to demonstrate permitting, feasibility or sufficient wind resource. They merely need to be led by entities that meet financial, technical and administrative criteria. This, combined with a lack of penalties for non-delivery, has led to projects that are not credible or robust securing offtake agreements. This presents a challenge to Indonesia's ability to hit its renewable energy targets and potentially damages trust in the wind industry.

Grid planning

Grid planning in Indonesia is complicated by the nature of the country's archipelagic geography. This means having a centralised grid is extremely difficult and not practical, making grid planning uniquely difficult in Indonesia comparted to other countries in this study. An opportunity from this would be to implement smaller decentralised micro grids with wind energy as a key generator. This allows for the reliance on fossil fuel generators to be negated and increase energy security within these isolated regions.

Government will

- While the Indonesian Government publicly supports the expansion of renewables, there has been a reluctance to meaningfully invest in wind energy to date due to several factors:
- Continued focus on fossil fuels, particularly coal production, which is a large source of income for the state
- Reliance on reducing deforestation as a means to meet climate goals, and
- Lack of certainty on optimal locations for wind projects.

Case study
Sidrap Wind Farm

Indonesia currently has just one utility scale wind farm project, Sidrap wind farm, which came online in March 2018. The 75 MW project comprises of 30 SGRE turbines rated at 2.5 MW which provides power to the Sulawesi PLN grid in South Sulawesi.

The Sidrap project was developed in partnership between UPC Renewables and AC Energy Holding, a subsidiary of Ayala Corporation based in the Philippines. This project received funding from the U.S Overseas Private Investment Corporation and was completed on time and on budget.

The project is in a windy area of the Sidrap region that has a large onshore wind energy potential.

Sidrap Wind Farm has been well received by the local community which is supportive of the growth of wind energy in the region. Jobs have been created as a result of the wind farm being built, in both project development and construction sectors. A majority of these jobs have been occupied by the local people from the Sidrap region.[10]

As of 2021 the renewable energy output of the wind farm had positively contributed towards a reduction in annual emissions of 129,460 MT CO_2e.[11]

10 UPC Renewables, Project details – Sidrap Wind Farm, 2018, available online at: https://www.upcrenewables.com/pf/sidrap/
11 ACEN Renewables, Sidrap Wind, 2021, available online at: https://www.acenrenewables.com/project/sidrap-wind/

Recommendations for wind acceleration

- **Broaden pre-qualification criteria to cover project viability**. A more comprehensive set of pre-qualification criteria for participation in procurement rounds would help ensure that Indonesia has a more viable pipeline of projects. These criteria should include metrics related to resource analysis, permitting status, stakeholder engagement status, site control, and procurement, transportation, and logistics plans.
- **Commission a government-funded study to establish the optimal locations for wind energy projects and ringfence the selected locations for wind development only.** This will increase investor confidence as it will signal the government is making a commitment on wind energy. It will also give project developers greater amount of time to plan and develop projects as the locations are known further in advance.
- **Increase government spending commitments directed at grid modernisation and expansion to promote a reliable operation and prevent bottlenecks**. This is especially the case of Indonesia, an island nation, and will help futureproof the system for further low-cost wind additions.
- **Promote diversification of the energy mix and competitive procurement processes to ensure low-cost renewable energy supply to meet decarbonisation commitments.** This includes establishing priority dispatch for renewable energy generation on the grid.

Project pipeline scenarios

The methodology for these scenario forecasts is in Appendix A.

In the business-as-usual scenario we forecast that about 450 MW of wind capacity will be installed between 2023 and 2027.

If wind is accelerated and barriers are removed, we forecast about 550 MW being installed between 2023 and 2027. The greatest difference is seen in 2027, and this trend is expected continue past 2027.

Figure 21 shows the forecast pipeline in the two scenarios between 2023 and 2027.

Table 9 shows the forecast installed capacity in MW in the two scenarios between 2023 and 2027.

Figure 21 Forecast of installed capacity in indonesia in the two scenarios.

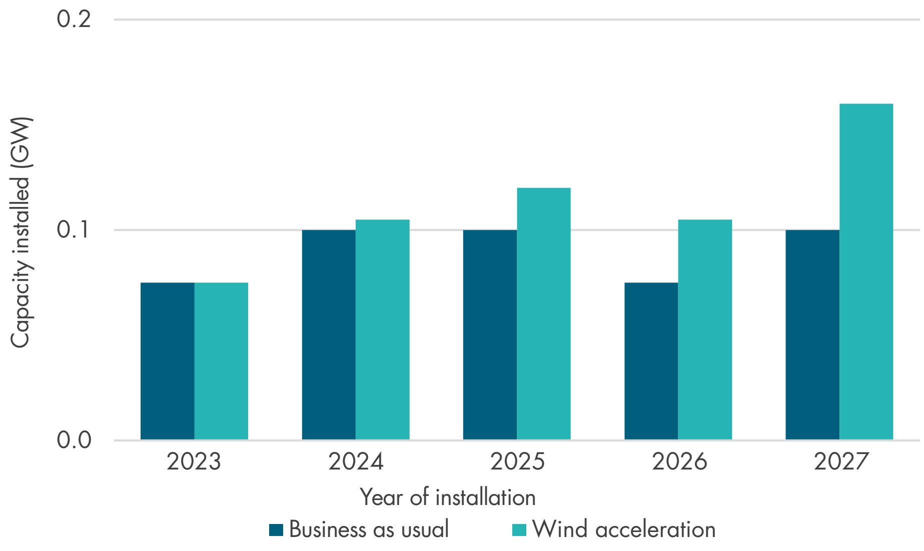


Table 9 Forecast of installed capacity in Indonesia in the two scenarios.

New wind installed capacity (MW)	2023	2024	2025	2026	2027
Business as usual	75	100	100	75	100
Wind acceleration	75	105	120	105	160

Impacts analysis

In the business-as-usual scenario, 8,300 direct and indirect FTE job years are created by wind energy in the Indonesia between 2023 and 2027 in the development, construction, and installation phase. In addition, 950 annual direct and indirect FTE job years are created in O&M, which continues for the lifetime of the wind farms.

Figure 22 shows the annual FTE years created in the business-as-usual scenario by supply chain category.

Examples of occupations across different segments of an onshore wind farm can be found in the Appendix B.

In the wind acceleration scenario, 10,100 direct and indirect FTE job years are created from wind energy in the Indonesia between 2023 and 2027 in the development, construction, and installation phase. In addition, 1,500 annual direct and indirect FTE job years are created in O&M, which continues for the lifetime of the wind farms. Figure 23 shows the annual FTE years created in the wind acceleration scenario by supply chain

Figure 22 FTE years created in the business-as-usual scenario in Indonesia.

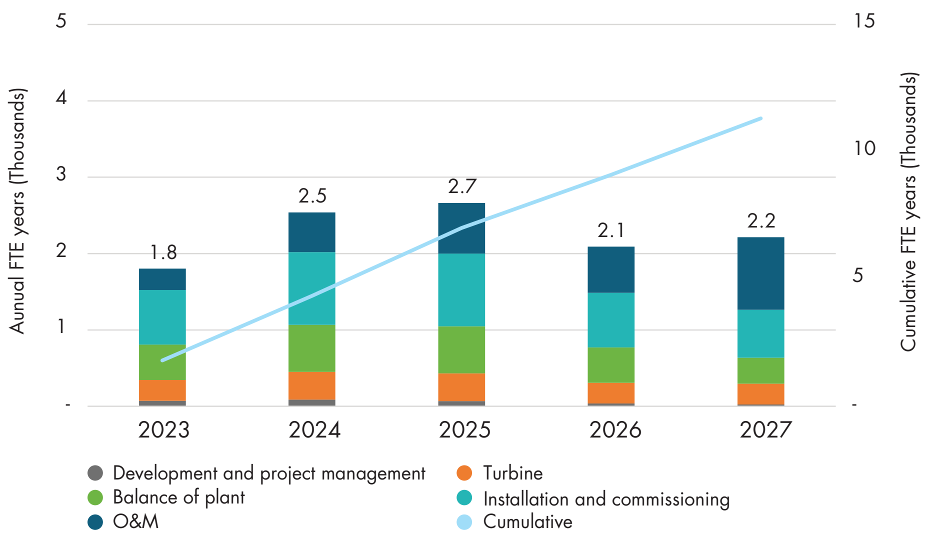


Figure 23 FTE years created in the wind acceleration scenario in Indonesia.

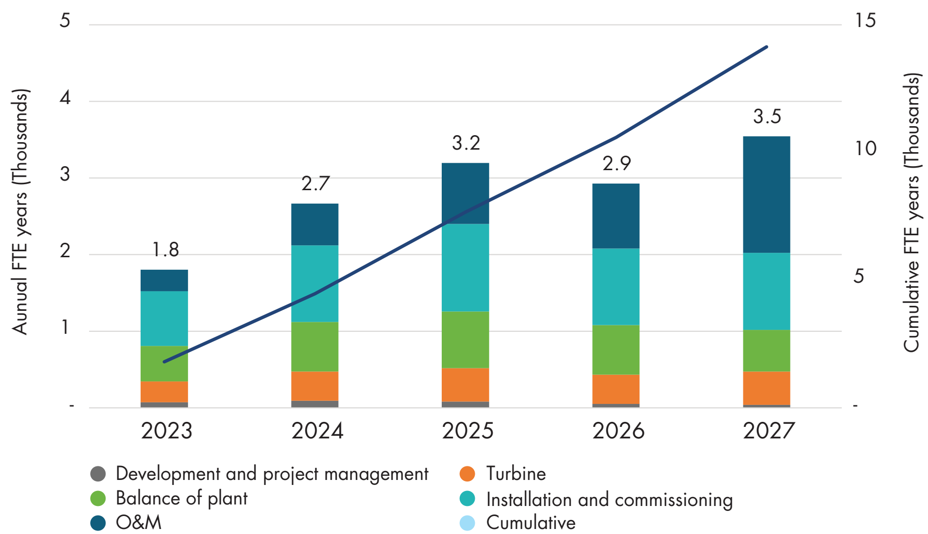


Figure 24 **Gross value added created in the business-as-usual scenario in Indonesia.**

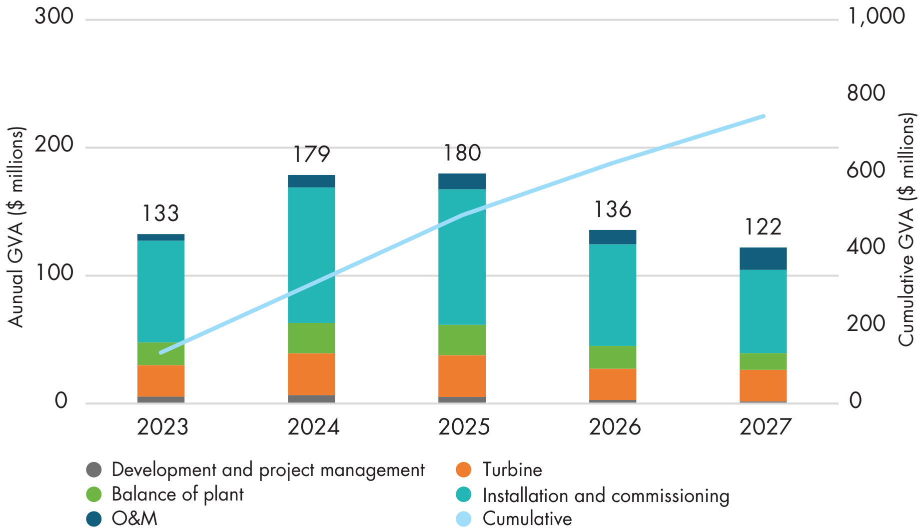
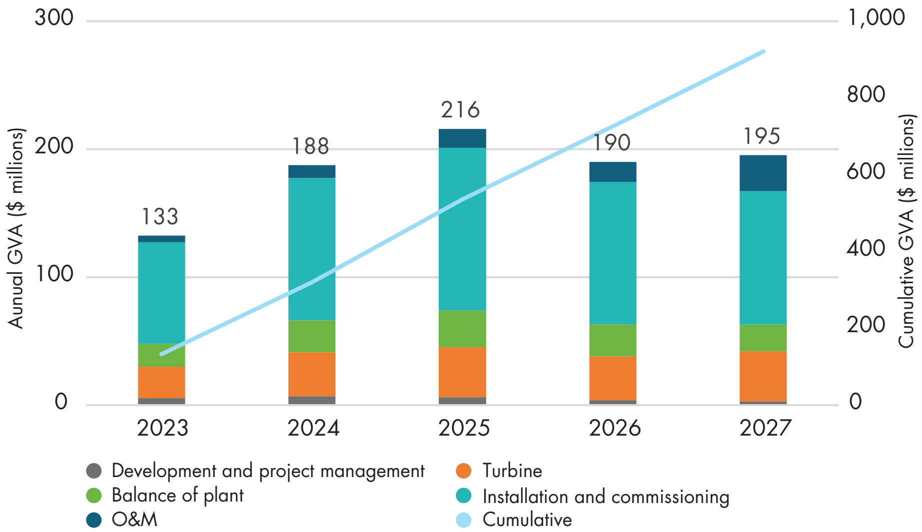


Figure 25 **Gross value added created in the wind acceleration scenario in Indonesia.**



category, with a potential upside of 17,000 new jobs created compared to the BAU scenario over the lifetime of the wind farms.

$700 million direct and indirect gross value added is created from wind energy in the Indonesia between 2023 and 2027 in the business-as-usual scenario over the lifetime of the wind farms. Figure 24 shows the GVA created in the business-as-usual scenario by supply chain category.

$850 million direct and indirect gross value added is created from wind energy in the Indonesia between 2023 and 2027 in the wind acceleration scenario over the lifetime of the wind farms. Figure 25 shows the GVA created in the wind acceleration scenario by supply chain category, with a difference of $150 million compared to the BAU scenario.

Impacts created in Indonesia in the business as usual scenario

A total of 34,000 FTE job years created over the lifetime of the wind farms

US$1.2 billion gross value added (GVA) to national economies over the lifetime of the wind farms

1,400 GWh electricity produced per year from 2027, which is the same as

- 1 million homes powered with clean energy per year
- 0.4 million electric vehicles powered annually from 2027

23 million tonnes of carbon emissions saved during the lifetime of the wind farm, which is the same as:

- 5 million cars of the road
- 7.6 million return flights from Jakarta to Sharm el-Sheikh
- Planting and maintaining 0.6 million trees for 10 years

2.6 million litres of water saved annually from 2027 which would otherwise be used for thermal power generation

Impacts created in Indonesia in the wind acceleration scenario

A total of 51,000 FTE job years created over the lifetime of the wind farms

US$1.6 billion gross value added (GVA) to national economies over the lifetime of the wind farms

1,700 GWh electricity produced per year from 2027, which is the same as

- 1.2 million homes powered with clean energy per year
- 0.5 million electric vehicles powered annually from 2027

29 million tonnes of carbon emissions saved during the lifetime of the wind farm, which is the same as:

- 6 million cars of the road
- 9.5 million return flights from Jakarta to Sharm el-Sheikh
- Planting and maintaining 0.8 million trees for 10 years

3.3 million litres of water saved annually from 2027 which would otherwise be used for thermal power generation

COUNTRY STUDY

Morocco

Morocco currently has 1,512 MW of installed onshore wind capacity, and is forecast by GWEC Market Intelligence to install about 200-510 MW per year under a business-as-usual scenario from 2023 to 2027.

Morocco hosted COP22 in 2016 and has since launched further reforms to develop its renewable energy sector. This involves a target of producing over half of its energy requirements from renewable sources by 2030, up from around 15% today. As a developing country with low per capita emissions, Morocco is already implementing measures to achieve its updated 2021 NDC targets.

Morocco remains largely dependent on the international energy market, as it imports more than 90% of its energy needs. Achieving energy security has been a top priority for Morocco over the last decade, and current high gas prices have greatly increased national energy costs, underscoring the need for Morocco to adopt a more self-sufficient energy policy. The Government of Morocco seeks to increase security of supply by reducing dependence on energy imports, including through the expansion of renewable sources for electricity production.

Morocco has excellent wind resources, and currently has one of the largest onshore wind fleets on the African continent, after South Africa and Egypt. Installed capacity is forecast to reach 5 GW by 2035, supported by aggressive renewable energy targets.

Morocco currently has 1,512 MW of installed onshore wind capacity, and is forecast by GWEC Market Intelligence to install about 200-510 MW per year under a business-as-usual scenario from 2023 to 2027. Under an accelerated transition scenario, if barriers to policy frameworks, transmission infrastructure and permitting schemes were resolved, Morocco could install 43% more onshore wind energy capacity in the next five years.

Energy mix and targets

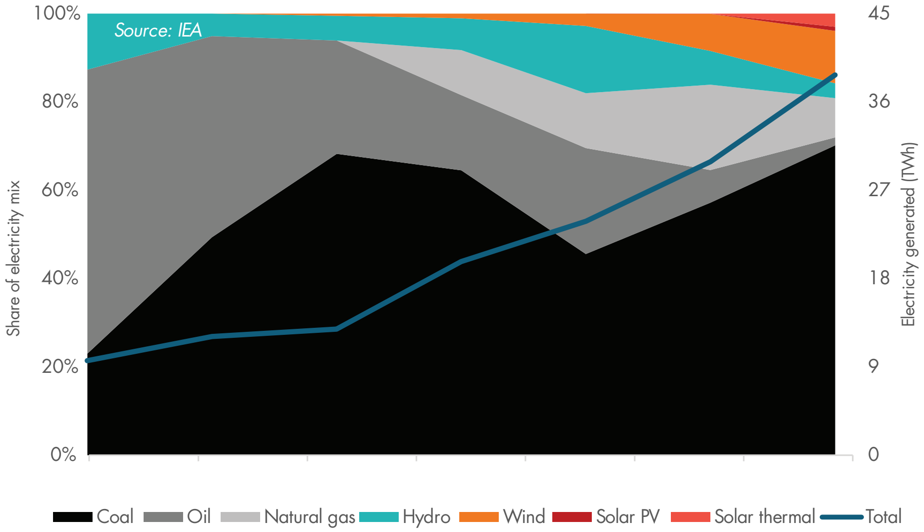
Morocco ratified the Paris Agreement on the 21 September 2016. It passed the Climate Change Policy of Morocco in 2019, which has the aim to add 10 GW of renewable energy capacity by 2030, of which 4.2 GW will be wind and 4.5 GW solar. Further plans aim to have 80% of the energy supplied by renewable energy by 2050. Relevant 2030 targets are shown in Table 10.

Morocco hit its 2020 target of achieving 42% renewable energy by 2020 and a 10% growth in renewables out to 2030 seems reasonable. Wind

Table 10 **Morocco targets.**

Parameter	2030 target
Reduction of emissions intensity compared to BAU scenario (NDC as of July 2021)	29% unconditional 45% conditional
Share of non-fossil fuel sources in installed electricity capacity mix	52%
Wind capacity in electricity mix	4.3 GW

Figure 26 **Morocco's electricity energy mix by source.**



capacity targets may prove more challenging. Morocco was unable to meet its 2020 target for wind energy of 2 GW, though capacity expanded continually up to then, as can be seen in Figure 26.

Figure 26 shows Morocco's electricity energy mix is highly fossil fuel dependant, though the share of renewables has been steadily increasing over the past decade. The continued expansion of coal in recent

years threatens to undo any progress made in renewables expansion.

Economic stimulus and laws for clean energy

Law 345/68 (1968) granted Morocco's National Electricity Office monopoly control over energy generators and limited self-generation by industrial sites to 10 MW of capacity, but an amendment in 2008 aimed at encouraging wind energy expansion raised this cap to 50 MW.

Law 13.09/2009 establishes the core mechanism for the production and commercialisation of renewable energy. It allows independent producers to sell electricity from renewable energy projects to the national market, or private consumers connected to the medium and high voltage grids.

Law 57.09/2009 created the National Agency for Solar Energy to manage and promote the solar sector. The remit of this body changed in 2016 when it became the Moroccan Agency for Solar Energy (MASEN). It is responsible for the development of international investments in renewable energy projects as Morocco looks to liberalise its renewable energy market. Energy project development was previously dominated by the Moroccan National Office for Electricity and Potable Water (ONEE).

Wind projects in Morocco are largely financed by project finance mechanisms. There are well-developed capital markets in Morocco, primarily local banks. National subsidiaries of international outfits have also supported the development of wind projects. State-backed multilateral climate and development funds, such as the Climate Investment Fund and the European Bank for Reconstruction and Development, have also backed projects in addition to participation from private equity funds.

The authorisation process for wind projects is run by The Ministry of Energy, Mines and Sustainable Development (MEM). Developers are able to secure the right to operate projects for 25 years with the option of securing a 25-year extension. Provisional permits enabling construction to commence are released following a technical review. MEM awards final permits after checking installations conform with the provisional consent terms.

Current barriers to wind energy

Grid legislation

New grid codes detailing the technical requirements for connecting to the grid have been published by MASEN. Turbine suppliers are struggling to meet some of these requirements which is complicating the project development process and delaying projects.

New costs for grid usage have been introduced which increase the selling price of electricity for independent power producers, making their projects less competitive against those led by ONEE.

Competition with solar

Laws currently do not allow wind and solar projects to share grid connection points. Hybrid wind and solar projects are also not allowed. This increases competition for space between developers and reduces the opportunities for cost reductions that co-development of dual technology projects would enable.

Offtake mechanisms

The Moroccan Government's tendering of renewables projects to the private sector has been slow. The current legal framework for PPAs puts the obligation solely on private producers to identify companies to enter into agreements with, rather than the government acting as an intermediary. This adds a time constraint and is challenging for developers and means wind projects can struggle to enter PPAs.

Case study
Midelt wind project

The 210 MW Midelt onshore wind project came online in 2020. The project came online quickly, with construction starting in 2018 and commercial operation beginning in 2020. SGRE supplied 50 turbines each with a rating of 4.2 MW.[12]

This project is the result of a joint venture between Enel Green Power and Nareva. The Midelt wind farm is one of the first in a project pipeline known as Projet Éolien Intégré, secured by both companies after they were successfully awarded an international tender.[13]

The socioeconomic benefits of the wind farm have been experienced by the local community, with the project employing 500 people, of which 250 came from local communities. Providing local jobs has generated job security and economic growth in the site area. In excess of 2000 hours were spent on training workers along the value chain, including in quality, as well as health and safety. Local businesses and communities are also able to benefit from the external benefits facilitated by the investment brought by the project, including the refurbishment of local infrastructure like roads and bridges.

The electricity generated from the wind farm offsets 326 MT of CO_2e annually.

12 Power Technology, Midelt Wind Farm, Morocco, Dec 2021, available online at: https://www.power-technology.com/marketdata/midelt-wind-farm-morocco/
13 Enel Green Power, Midelt, Enel Green Power's best sustainable building site, Oct 2019, available online at: https://www.enelgreenpower.com/stories/articles/2019/10/sustainable-development-construction-site-wind-farm-midelt

Recommendations for wind acceleration

- **Equalise the grid costs for independent power producers and ONEE.** This will increase the competitiveness of private wind projects, lower project costs in the long term, and increase returns on investment. This will subsequently boost investor confidence and the rate of installation.
- **Allow wind and solar projects to share grid connection points.** This efficiency would remove an element of competition between projects, incentivise collaboration between renewable developers and support a complimentary renewable technology. It would also likely improve investor confidence, as it is more likely that more projects will be connected to the grid and in a timely manner.
- **Utilise Morocco's large green hydrogen targets to further incentivise wind energy production.** Morocco has high green hydrogen targets. The country's hydrogen roadmap is due to be updated, but current targets are significant, with 8 GW by 2023 and 40 GW by 2040. To meet these targets successfully, the government should promote wind energy expansion and new wind farm connections to hydrogen production facilities.
- **The Government should facilitate PPA matchmaking.** This will allow wind developers and private companies to more easily find each other, facilitating greater confidence in the wind industry and increasing investor confidence that private buyers of electricity could be found.

Project pipeline scenarios

The methodology for these scenario forecasts is in Appendix A.

In the business-as-usual scenario we forecast that 1.5 GW of wind capacity will be installed between 2023 and 2027.

If wind is accelerated and barriers are removed, we forecast that over 2.1 GW being installed between 2023 and 2027.

Figure 27 shows the forecast pipeline in the two scenarios between 2023 and 2027. The greatest difference is seen in 2027, and this trend is expected continue past 2027.

Table 1111 shows the forecast installed capacity in MW in the two scenarios between 2023 and 2027.

Figure 27 **Forecast of installed capacity in Morocco in the two scenarios.**

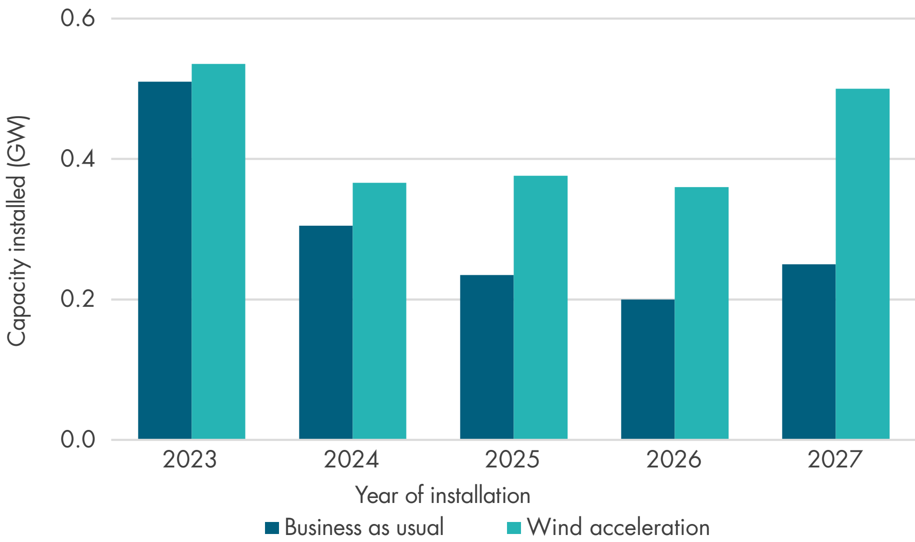


Table 11 **Forecast of installed capacity in Morocco in the two scenarios.**

New wind installed capacity (MW)	2023	2024	2025	2026	2027
Business as usual	510	305	235	200	250
Wind acceleration	536	366	376	360	500

Impacts analysis

In the business-as-usual scenario, 45,000 direct and indirect FTE job years are created by wind energy in Morocco between 2023 and 2027 in the development, construction, and installation phase. In addition, 2,400 annual direct and indirect FTE job years are created in O&M, which continues for the lifetime of the wind farms.

Figure 28 shows the annual FTE years created in the business-as-usual scenario by supply chain category. Examples of occupations across different segments of an onshore wind farm can be found in the Appendix B.

Figure 28 FTE years created in the business-as-usual scenario in Morocco.

In the wind acceleration scenario, 57,700 direct and indirect FTE job years are created from wind energy in Morocco between 2023 and 2027 in the development, construction, and installation phase. In addition, 4,800 annual direct and indirect FTE job years are created in O&M, which continues for the lifetime of the wind farms. Figure 29 shows the annual FTE years created in the wind

acceleration scenario by supply chain category.

There is a potential upside of 75,000 additional FTE job years created in a wind acceleration scenario over the lifetime of the wind farms.

$1.2 billion direct and indirect gross value added is created from wind energy in Morocco between 2023 and 2027 in the business-as-usual scenario over the lifetime of the wind farms. Figure 30 shows the GVA created in the business-as-usual scenario by supply chain category.

$1.7 billion direct and indirect gross value added is created from wind energy in Morocco between 2023 and 2027 in the wind acceleration scenario over the lifetime of the wind farms. Figure 31 shows the GVA created in the wind acceleration scenario by supply chain category, which provides a $500 million improvement on the business-as-usual scenario.

Figure 28 **FTE years created in the business-as-usual scenario in Morocco.**

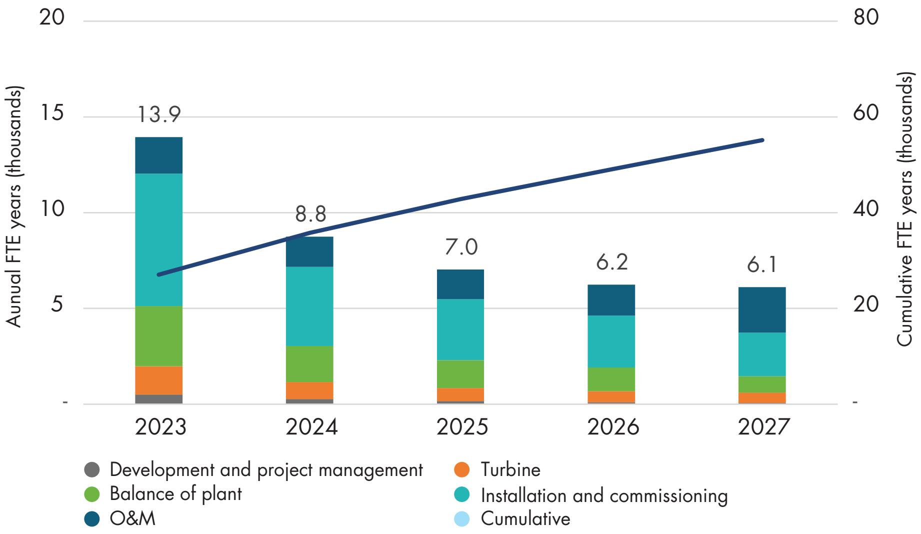


Figure 29 **FTE years created in the wind acceleration scenario in Morocco.**

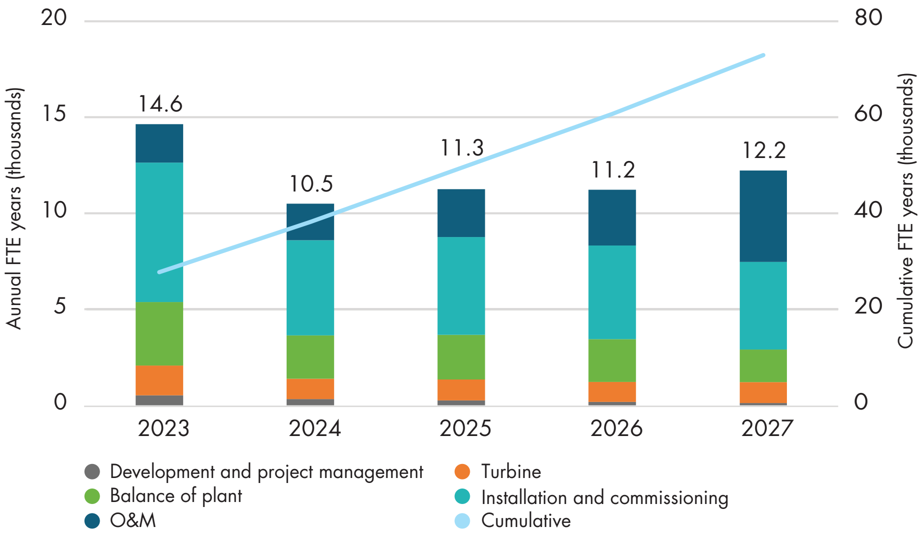


Figure 30 **Gross value added created in the business-as-usual scenario in Morocco.**

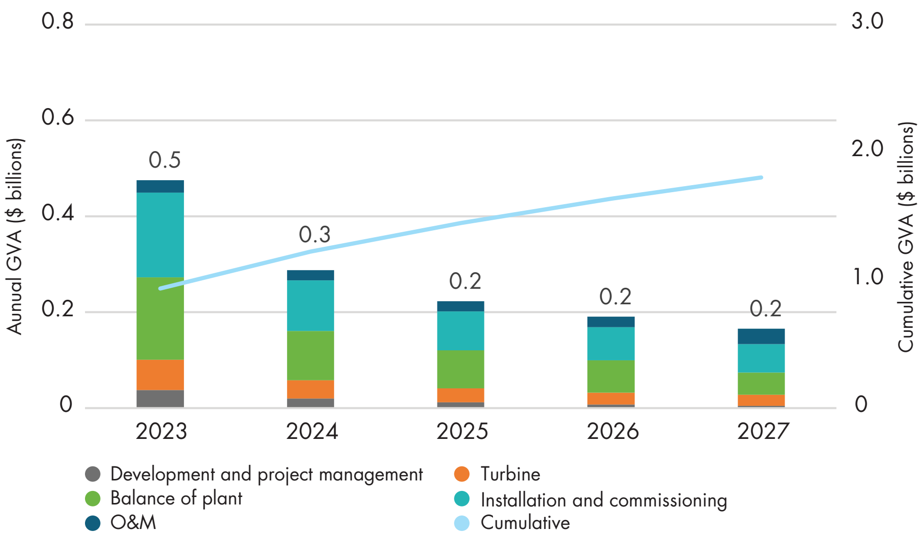
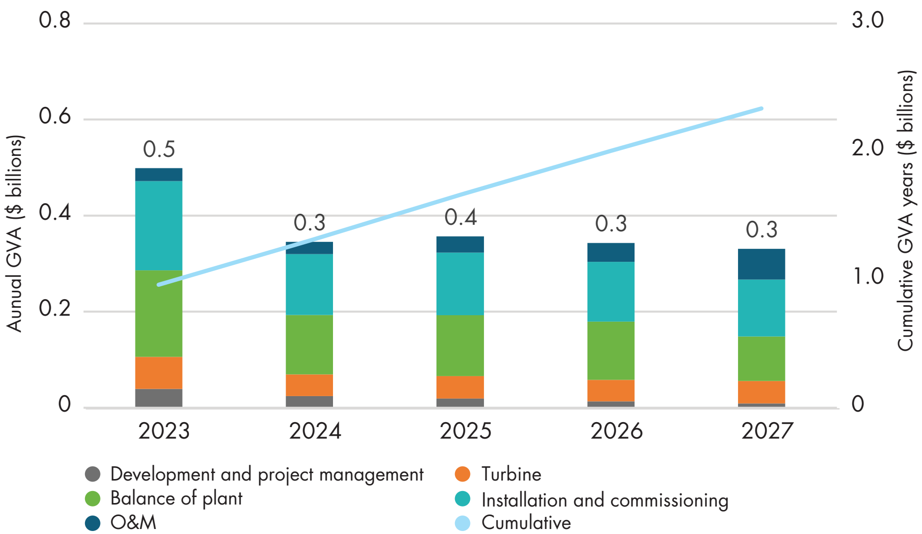


Figure 31 **Gross value added created in the wind acceleration scenario in Morocco.**



Impacts created in Morocco in the business as usual scenario

A total of 99,000 FTE job years created over the lifetime of the wind farms

US$2.1 billion gross value added (GVA) to national economies over the lifetime of the wind farms

4,600 GWh electricity produced per year from 2027, which is the same as

- 4.7 million homes powered with clean energy per year
- 1.3 million electric vehicles powered annually from 2027

77 million tonnes of carbon emissions saved during the lifetime of the wind farm, which is the same as:

- 17 million cars of the road
- 67 million return flights from Rabat to Sharm el-Sheikh
- Planting and maintaining 2 million trees for 10 years

8.6 million litres of water saved annually from 2027 which would otherwise be used for thermal power generation

Impacts created in Morocco in the wind acceleration scenario

A total of 174,000 FTE job years created over the lifetime of the wind farms

US$3.4 billion gross value added (GVA) to national economies over the lifetime of the wind farms

6,500 GWh electricity produced per year from 2027, which is the same as

- 6.6 million homes powered with clean energy per year
- 1.8 million electric vehicles powered annually from 2027

110 million tonnes of carbon emissions saved during the lifetime of the wind farm, which is the same as:

- 24 million cars of the road
- 95 million return flights from Rabat to Sharm el-Sheikh
- Planting and maintaining 2.9 million trees for 10 years

12 million litres of water saved annually from 2027 which would otherwise be used for thermal power generation

Conclusion

This report demonstrates the wider socioeconomic benefits realised by wind energy deployment. These include supporting economic growth, bringing more than clean power to communities, and boosting energy security in developing economies. Shifts in policy and public stimulus spending to increase deployment of wind can potentially unlock a significant and ongoing scale-up of capital investment, job creation, and social and environmental gains.

The analysis of wind installation impacts in two scenarios, BAU and wind acceleration, in Argentina, Colombia, Egypt, Indonesia, and Morocco, quantifies this.

For each country specific recommendations are given on how to capture these benefits.

The most opportunity is enabled through improved policy commitment, grid and transmission system infrastructure, and regulatory frameworks for permitting. Addressing these areas proactively, in coordination with the wind energy industry and other relevant stakeholders, can support accelerated deployment of wind energy, boost job creation and local supply chains, and boost energy security in developing economies.

Appendix A

Methodology

The work was carried out in six stages:

Data collection and engagement

Country studies of five countries with developing economies

Identify project pipeline scenarios

Conduct economic impact analysis

Closed-door discussion with financial institutions, and

Deliver recommendations based on the studies and research conducted above.

Identifying and finding required data through engagement

We worked with national wind energy associations and private companies in each country to collect required data and to understand the current barriers and challenges to wind energy deployment. The associations and companies we engaged with were:

Argentina: CEA (Camara Eolica Argentina)

Colombia: SER (Colombia Asociación energías renovables)

Egypt: Infinity Power

Indonesia: UPC Renewables

Morocco: SGRE.

Five country studies

Based on the engagement and the data collected, we provided a brief overview of the energy transition situation in the country and any challenges to wind energy and general renewable energy deployment.

The energy transition summary included a brief overview of the current energy mix and a brief overview of public targets and commitments, and what is needed still to get there. This summary was then shared with the relevant country associations.

Project pipeline scenarios

We developed a 2023-2027 project pipeline forecast under a business-as-usual scenario and a wind acceleration scenario.

The business-as-usual scenario is the current 2023-2026 GWEC forecast, that was extended to 2027. We assumed that the build rate from 2026 grows at a steady rate to 2027.

In the wind acceleration scenario, we applied an annual % increase to the business-as-usual forecast, arrived at by looking at the potential impact of following the recommendations in this study.

The barriers that we assume are overcome in each of the five countries were:

In **Argentina** we assumed that the transmission infrastructure was improved, wind energy revenue and profits could be expatriated in US dollars, and larger wind projects were incentivised.

In **Colombia** we assumed that a pipeline of auctions was established, the permitting process was streamlined and the transmission system was improved.

In **Egypt** we assumed that the government increased tariffs to support wind energy, domestic electricity demand increased and private offtake for larger wind projects was allowed.

In **Indonesia** we assumed that the prequalification criteria for wind projects was expanded, suitable wind energy project locations were found, and the transmission system was improved and expanded.

In **Morocco** we assumed grid utilisation costs were equalised between the state and private developers, wind and solar projects were allowed to share grid connection points, and matchmaking between developers and private companies was facilitated.

Because the measures we assumed the countries put in place to overcome the barriers take time, it is not until 2025 we started seeing a significant difference in the scenarios. Significant impact will continue beyond 2027.

Economic impacts analysis

For the analysis of economic impacts, we used a supply chain breakdown as a framework to help identify where local jobs in the supply chain will arise in the five countries.

We received input from the local wind energy associations to arrive at a local content percentage in each of the categories, and the typical costs for wind farms in each country.

Based on known data from onshore wind energy projects we modelled the typical number of jobs created per MW for each supply chain category and multiplied this with the annual installed capacity and local content percentage for each country to arrive at the number of full time equivalent (FTE) job years created.

We then used country specific multipliers derived from the differences in project costs between the countries to arrive at the gross value added (GVA) created in each country per year.

Environmental impacts analysis

We used a country-specific capacity factor to calculate the annual power production from the two scenarios for each country. We then divided this by the annual household electricity consumption in each country to arrive at the number of households powered.

We calculated the reduction in the carbon footprint of the energy production in the five countries, using the annual energy mix and associated emissions in each country and accounted for what the extra wind energy generation would displace.

Closed-door expert discussion

We discussed with relevant international finance institutions (IFIs), development finance institutions (DFIs) and multilateral development banks (MDBs) the risks related to investment and finance, and to understand how this could be de-risked.

Recommendations

Based on the findings in our analysis and engagement we provided broad recommendations, as well as country-specific recommendations for each of the five countries, to accelerate wind acceleration by clearing implementation and investment barriers to ensure long-term growth and sustainability of the sector.

Example jobs at an onshore wind farm

Segment of the Wind Value Chain	Example Activities	Example Jobs
Development and Project Management	• Site selection • Feasibility studies • Environmental impact assessments • Community engagement • Engineering design • Project development	• Legal, property and tax experts • Financial analysts • Engineers • Environmental and geotechnical scientists
Manufacturing / Balance of plant	• Manufacturing and assembly of nacelles, blades and towers • Manufacturing of monitor and control systems • Design specifications • Sourcing	• Factory workers • Quality control • Marketing and sales • Engineers • Management • Sourcing specialists • Engineers
Installation	• Project site preparation • Civil works • On-site assembly of components • Transport of components	• Construction workers • Technical personnel • Engineers • Health and safety experts • Logistics and quality control experts • Drivers • Logistics experts • Technical personnel
Grid connection and commissioning	• Cabling and grid connection • Project commissioning	• Construction workers • Technical personnel • Engineers • Health and safety experts

Segment of the Wind Value Chain	Example Activities	Example Jobs
Operation and maintenance (O&M)	• Ongoing O&M over project lifetime (typically 25 years)	• Operators • Engineers • Construction workers • Technical personnel • Lawyers • Management • Asset management • Accountants
Development and Project Management (Decommissioning)	• Planning decommissioning or repowering • Dismantling the project on-site • Disposal and recycling of components • Site clearing	• Construction workers • Technical personnel • Drivers • Engineers • Environmental scientists • Health and safety experts

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