



SCALING UP RENEWABLE ENERGY (SURE) EGYPT ENERGY SECTOR ASSESSMENT

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EGYPT ENERGY SECTOR ASSESSMENT

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ACRONYMS

CAPEX	Capital Expenditure
CC	Combined Cycle
CDCS	Country Development Cooperation Strategy
COEE	USAID Center of Excellence for Energy
COP	United Nations Climate Change Conference
EBRD	European Bank for Reconstruction and Development
EEHC	Egyptian Electricity Holding Company
EETC	Egyptian Electricity Transmission Company
EU	European Union
FIT	Feed-In Tariff
GOE	Government of Egypt
GW	Gigawatt
IFI	International Financial Institution
ISO	Independent System Operator
kWh	Kilowatt-Hour
LNG	Liquefied Natural Gas
MoERE	Ministry of Electricity and Renewable Energy
MOU	Memorandum of Understanding
MW	Megawatt
MWh	Megawatt-Hour
NCCS	National Climate Change Strategy
NEEAP	National Energy Efficiency Action Plan
N-EP	NWFE Energy Pillar
NGO	Nongovernmental Organization
NREL	National Renewable Energy Laboratory
NWFE	Nexus of Water, Food, and Energy
PV	Photovoltaic
SURE	Scaling Up Renewable Energy
TWh	Terawatt-Hour
UAE	United Arab Emirates
USAID	U.S. Agency for International Development

EXECUTIVE SUMMARY

This U.S. Agency for International Development (USAID) Egypt Energy Assessment reviews dynamics and current conditions in Egypt's energy sector to identify areas where a potential new USAID/Egypt energy activity can support the goals of the Government of Egypt (GOE) and broader public and private energy sector development objectives. It gives special focus to the government's Nexus of Water, Food, and Energy (NWFE) program and the related Energy Wealth Initiative, which seek to achieve Egypt's Energy Strategy target of 42 percent of electricity produced by renewables by 2035.¹

While the assessment focuses on large-scale renewables under the NWFE-Energy Pillar (N-EP) and the Energy Wealth Initiative, the assessment team also examined needs and opportunities for broader sectoral performance improvement and decarbonization, as well as interventions to promote equity and social inclusion and to create sustainable economic opportunities for more people.

Key findings and takeaways for USAID

The 28 gigawatts (GW) of wind power under memoranda of understanding (MOUs) with Saudi, Emirati, Norwegian, and Egyptian developers as part of the Energy Wealth Initiative and the 10 GW of solar power to be developed under the N-EP represent a large and credible decarbonization opportunity for Egypt. These two pools of prospective renewable power have the potential to mitigate over 25 percent of Egypt's current carbon dioxide (CO₂) emissions.² The plans have significant GOE backing, private sector involvement, and the support of development finance institutions, donors, and Gulf-ally investors. Furthermore, large-scale renewable electricity is a precondition to decarbonization through the electrification and powering of other sectors, including hydrogen, transport, industry, and buildings.

- Introducing this amount of renewables will require an extensive expansion and modernization program for Egypt's electricity grid, paired with greater system flexibility to cope with variable solar and wind integration. Supporting the N-EP and the broader Energy Wealth Initiative to scale up centralized renewable energy represents USAID's largest opportunity to promote decarbonization in Egypt. To engage in this space, USAID will need to navigate a crowded donor landscape and rely on GOE counterparts' capacity to better define and coordinate donor efforts through a nascent donor-government steering committee led by the European Bank for Reconstruction and Development (EBRD).

Egypt has embarked on a path of liberalizing its power sector and transitioning from a historically state-run system to one that is more conducive to private sector participation. Furthermore, sector performance issues such as incomplete cost recovery and subsidies could create difficulties for Egypt's ability to execute its plan and make the investments that will be necessary for high penetration of renewables. Egypt's current economic situation has caused international finance institutions (IFIs) and Gulf-ally lenders to apply renewed advocacy for the GOE to adopt more competitive market practices.

¹ This target has also been approved by the Supreme Energy Council, chaired by the prime minister.

² There are over 28 GW and possibly over 38 GW of signed MOUs, plus additional projects announced under NWFE, but the exact total that is being developed is not firmly determined. Masdar estimates that its 10 GW of wind will represent a 9 percent reduction of total Egyptian CO₂ emissions. The team assumes that ACWA Power's 10 GW of wind will result in a similar reduction. The 10 GW under the N-EP might represent another 7 percent, as it includes only solar. The assessment also assumes that this energy will replace thermal generation.

If this creates momentum around efforts like the introduction of an electricity market and facilitates the participation of the private sector, it can assist Egypt's energy transition efforts.

- Advancing key aspects of Egypt's ongoing power sector reform and improving performance would support Egypt's ability to achieve its aspirations for the development of large-scale renewable energy.

Decarbonization opportunities exist with respect to the adoption of distributed renewable energy and energy efficiency. Overall, increased energy efficiency could deliver benefits to the GOE—from decreasing outlays from the Ministry of Petroleum and the Ministry of Finance to load management—but there is room for additional alignment and coordination among agencies. Furthermore, distributed renewable energy can contribute to the 42 percent target by 2035 and the goals of decarbonization, equity, inclusion, and job creation. It can also improve customer involvement in the energy sector.

- Though these immediate decarbonization impacts may be more modest than that of large-scale renewable energy in the current environment, they could provide USAID with additional avenues for expanding its pool of potential counterparts, working with the private sector, and engaging women and youth.

The team identified cross-cutting constraints to advance development objectives including limited public reporting of sector performance, the 21 percent participation rate of women in the power sector,³ and potential needs related to environmental practices that are important to developing energy infrastructure at scale.

- USAID could support the GOE to improve public reporting, social inclusion, and the environmental sustainability of the sector.

³ Chemonics Egypt and Palladium, funded by EBRD and Green Climate Fund, *Why Gender Inclusion Matters?*, 2023, no further publication reference is cited on the document.

I. INTRODUCTION

This energy sector assessment reviews dynamics and current conditions in Egypt's energy sector to identify areas where a potential new USAID/Egypt energy activity can support GOE goals and broader public and private energy sector development objectives.

The assessment is structured as follows:

- Section 2 lays out key drivers of the energy transition, including climate change threats, the GOE's vision for the energy transition as a means to achieve sustainable economic growth, and key aspects of achieving these ambitions. It covers historic dynamics that could hold back this transition as well as reinforcers of the GOE's vision.
- Section 3 makes a case for the electricity sector as the most important enabler of decarbonization for Egypt and a key part of advancing Egypt's energy sector reform and cost-recovery efforts to achieve a more efficient and high-performing sector.
- Section 4 assesses the implementation components of the N-EP, its funding and economic viability, and key risks and enablers needed for the program to succeed. Its objective is to develop recommendations on USAID support.
- Section 5 identifies high-impact areas and interventions that could support Egypt's energy transition and suggests possible interventions for USAID to validate with the GOE.
- Section 6 concludes and provides possible next steps for program design.

2. DRIVERS OF THE ENERGY TRANSITION IN EGYPT

Egypt is at a pivotal time in the development of its energy sector. Faced with existential threats caused by climate change, Egypt has laid ambitious plans for scaling up renewable energy and reducing dependence on fossil fuels. At the same time, the low cost of renewables and recent highs in global gas prices make the energy transition seem economically attractive in light of low domestic gas prices and the inefficient use of gas in power generation and industry.

However, in realizing this transition, Egypt will have to balance the need for reliable and available energy against the desire to mobilize needed investment in a sector that is still dominated by state-run entities.

Changes in Egypt's power sector will be key to its ability to realize its climate goals and the energy transition. All net-zero pathways include three fundamental energy sector components:

- 1) decarbonization of electricity and other fuels, 2) efficient use of energy resources, and 3) electrification of energy end uses powered by clean energy.⁴

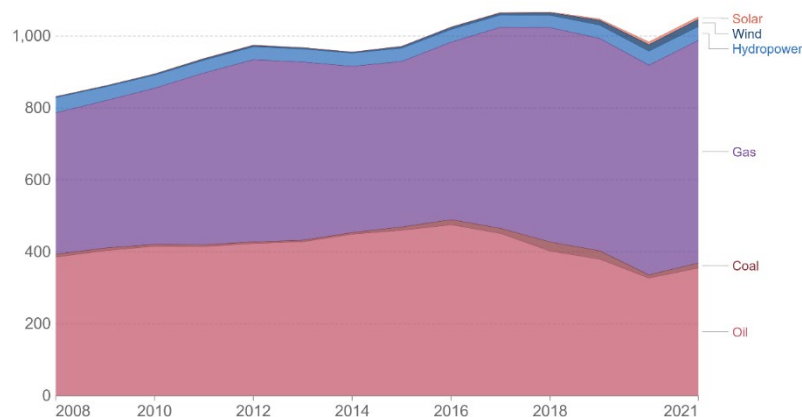
⁴ Joeri Rogelj et al, "Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development," in *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, 2018, https://www.ipcc.ch/site/assets/uploads/sites/2/2019/02/SR15_Chapter2_Low_Res.pdf

2.1. CLIMATE CHANGE AND A FOSSIL FUEL-DOMINATED ECONOMY

In 2018, Egypt emitted 320 million tons (Mt) of CO₂ equivalent (CO_{2e}),⁵ ranking 25th globally in terms of energy-related CO₂ emissions, with a 0.75 percent share of global emissions and 2.5 tons of CO_{2e} emissions per capita.⁶ This places Egypt among the top seven USAID partner countries in terms of total emissions and among the top 25 for emission intensity.⁷

Natural gas and oil have long comprised the vast majority of energy consumed in Egypt. As seen in the figure below, notable additions of wind and solar have only been made in recent years and still contribute just 2 percent to Egypt's energy consumption.

Figure 1. Energy consumption by source, Egypt⁸



Source: Our World in Data based on BP Statistical Review of World Energy

On the climate front, Egyptian authorities recognize that they face challenges related to energy and water and that these are interdependent. These challenges include the following:

- Egypt is experiencing high evaporation rates, crop transpiration, and soil aridity, all of which will accelerate with higher temperatures and more heat waves. These climate change effects will in turn elevate water requirements for human consumption and agriculture.⁹
- Agricultural production will decrease due to increasing temperatures and water supply constraints. The output of various staple foods (wheat, maize, sugar cane, milk, etc.) may be reduced by between 10 to 25 percent by 2060.¹⁰

⁵ CO₂ equivalent emissions is a measure used to compare the emissions from various greenhouse gases on the basis of their global-warming potential by converting amounts of other gases (e.g., methane, hydrofluorocarbons, and black carbon) to the equivalent amount of CO₂ with the same global-warming potential.

⁶ Climate Watch, Data Explorer, 2023, <https://www.climatewatchdata.org/data-explorer/historical-emissions?historical-emissions-data-sources=climate-watch&historical-emissions-gases=all-ghg&historical-emissions-regions=All%20Selected&historical-emissions-sectors=total-including-lucf%2Ctotal-i>

⁷ International Energy Agency (IEA), CO₂ Emissions from Fuel Combustion, <https://www.iea.org/data-and-statistics/data-sets/CO2-emissions-from-fuel-combustion>

⁸ Primary energy consumption is measured in terawatt-hours (TWh). Here, an inefficiency factor (the substitution method) has been applied for fossil fuels, meaning the shares by energy source give a better approximation of final energy consumption.

⁹ World Bank, *Egypt Country Climate and Development Report*, 2022, <https://www.worldbank.org/en/country/egypt/publication/egypt-country-and-climate-development-report>

¹⁰ Ibid.

- Water flows in the Nile River are decreasing due to Ethiopia’s filling a large dam in the headwaters, climate change, and salination in the Nile Delta. This is causing Egyptian authorities to experiment with large-scale desalination to augment fresh water supply.
- With rising temperatures, population growth, urbanization and land reclamation projects, growing incomes, and industrial development, energy demand (such as for cooling) will increase.¹¹

2.2. EGYPT’S VISION

Emerging from an economic crisis in 2013–2014, Egypt set out a vision to transform its energy sector as a pillar to achieve economic stability and growth and to meet its sustainable development objectives.¹² Egypt, historically an exporter of gas, became a net importer in 2015, reached double-digit unemployment rates, saw foreign exchange reserves fall from over \$35 billion to \$17 billion in three years,¹³ and experienced widespread load shedding. As a result, Egypt set out to make the following changes:

- Increase the role of the private sector
- Reform Egypt’s legislative framework to improve the investment climate
- Continue energy sector restructuring
- Improve the efficiency of energy subsidies
- Maximize the efficient use of traditional and renewable energy resources
- Transform Egypt’s power and hydrogen sectors to become a regional pivot (or hub).

The GOE also made public international commitments at the 2022 United Nations Climate Change Conference (COP27) to use its extensive wind and solar resources and to become a major global hydrogen and hydrogen derivatives exporter.

2.2.1. HISTORICAL IMPORTANCE OF NATURAL GAS

Egypt is the third-largest producer of natural gas in Africa, and the oil and gas industry is by far Egypt’s largest, representing approximately 24 percent of gross domestic product in Fiscal Year 2019–2020.¹⁴ Historically, Egypt has been a net exporter of natural gas, which has contributed significantly to its foreign exchange, while domestic prices have been subsidized (a common wealth-sharing measure among fossil fuel-producing nations). In the mid-2010s, a number of crises motivated reforms to reduce

¹¹ Ibid.

¹² Ministry of Finance of the Arab Republic of Egypt, “About,” accessed April 2023, <https://mof.gov.eg/en/About/5fbd28790f63030007fec9bb/5fe3763a7bfc600007cbce92>

¹³ Mohsin Khan, *The Turnaround of the Egyptian Economy in 2014*, 2014, <https://www.atlanticcouncil.org/blogs/menasource/the-turnaround-of-the-egyptian-economy-in-2014/>

¹⁴ U.S. International Trade Administration, “Oil and Gas Equipment,” *Egypt – Country Commercial Guide*, 2022, <https://www.trade.gov/country-commercial-guides/egypt-oil-and-gas-equipment>

subsidies, increase private sector participation, and for the first time, look to native wind and solar resources as low-cost sources of energy.

In 2003–2014, high electricity subsidies led to the accumulation of arrears¹⁵ for natural gas supplied for power generation, which in turn led to underinvestment in the upstream gas sector and dwindling gas reserves at a time when domestic demand for energy was growing rapidly.¹⁶ These factors contributed to a crisis in the power sector in 2013–2014, when widespread load shedding lasted up to six hours per day and became a source of social discontent.¹⁷ Fiscal and economic crises also mounted during this period, with fossil fuel subsidies reaching one-fifth of the total budget, exceeding combined expenditures in health, education, and social protection.¹⁸ This left the GOE limited fiscal space to respond to an unemployment rate rising above 13 percent.¹⁹

This period led to a number of significant developments that have implications for Egypt's energy transition. First, in 2014–2015 Egypt was able to reduce energy subsidies for the first time in decades (though prices were kept below those of much of the world).²⁰

Second, in response to the power-sector crisis, Egypt made large emergency investments in new generation capacity, including 2 GW of private sector–supplied solar and wind. The assessment team speculates that this initial success in securing renewable energy generation at favorable prices has helped solidify the GOE's commitment to its plans to massively scale centralized renewables (to be discussed extensively in section 4). Global prices for renewable energy continue to be very competitive, with Egyptian solar photovoltaic (PV) power cheaper than any other source of new bulk generation in 2021.²¹

Finally, though Egypt briefly became an importer of liquefied natural gas (LNG) in 2015, policy measures incentivized gas exploration among the private sector, leading to the discovery of new gas fields (the Zohr field, the West Nile Delta field, the Greater Nooros and Atoll fields) and again providing sufficient gas to export.²² In 2022, Egypt exported approximately 8 billion tons of LNG, worth approximately \$8 billion.²³ Maximizing profits from exports rather than subsidizing local power generation is a powerful motivator for Egypt's energy transition.

2.2.2. IMPLICATIONS OF THE CURRENT MACROECONOMIC SITUATION IN EGYPT

Since March 2022, Egypt's economy has faced challenges related to the depreciating Egyptian pound, rising inflation, decreasing availability of foreign exchange, and deteriorating economic conditions for the poor. At the end of 2022, the International Monetary Fund and Egypt agreed to a \$3 billion financing

¹⁵ Debt eventually reached \$6.8 billion by 2014.

¹⁶ Anshul Rana and Ashish Khanna, *Learning from Power Sector Reform, The Case of the Arab Republic of Egypt*, 2020, <https://elibrary.worldbank.org/doi/abs/10.1596/1813-9450-9162>

¹⁷ Ibid.

¹⁸ Ibid.

¹⁹ World Resources Institute, *Egypt: Transitioning Away from Subsidizing Fossil Fuels*, 2021, <https://www.wri.org/update/egypt-transitioning-away-subsidizing-fossil-fuels>

²⁰ Ibid.

²¹ BloombergNEF, "Climatescope: Egypt," <https://www.global-climatescope.org/markets/eg/>

²² Mostefa Ouki, *Egypt – A Return to a Balanced Gas Market?*, 2018, <https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2018/06/Egypt-a-return-to-a-balanced-gas-market-NG-131.pdf>

²³ Charles Kennedy, "Egypt's Natural Gas Exports Surge," *OilPrice.com*, January 12, 2023, <https://oilprice.com/Latest-Energy-News/World-News/Egypt-Natural-Gas-Exports-Surge.html>

package with conditions including floating the exchange rate, slowing large public infrastructure projects, and divesting public enterprise.

Advocacy for reform has intensified in statements issued by traditional Gulf allies. For example, at the World Governance Summit in Dubai in February 2023, the Saudi Minister of Finance stated, “We used to give direct grants and deposits without strings attached, and we are changing that.” In Davos, he added that they need to “see reforms.”

These statements are encouraging the GOE to reduce subsidies and protections for Egyptian businesses, increase private sector participation in the energy sector, and liberalize the power sector, as discussed in the following section.

2.3. ELEMENTS FOR ACHIEVING EGYPT’S ENERGY VISION

2.3.1. RENEWABLE ENERGY INVESTMENT AND DEVELOPMENT

Building on the dual drivers of climate change and the favorable economics of renewables, Egypt has laid plans to massively scale up renewable energy. On November 15, 2022, the Minister of Petroleum and Mineral Resources stated that Egypt’s strategy to accelerate the transition to renewable energy includes reaching 42 percent renewables by 2035. This was originally stated in the GOE Integrated Sustainable Energy Strategy issued in November 2015, updated in August 2017, and approved by the Supreme Energy Council.

The most significant piece of this strategy are two program elements—the **NWFE Energy Pillar (N-EP)** and the **Energy Wealth Initiative**—that could add 38 GW of new centralized renewable energy capacity.²⁴ These efforts have secured financial commitments from the EBRD, the European Union (EU), USAID, Saudi Arabia (ACWA Power), and the United Arab Emirates (UAE) (Masdar), among others.

- **NWFE Energy Pillar (N-EP).** Egypt’s National Climate Change Strategy (NCCS) for 2050 contains projects bundled around three main pillars—water, food, and energy. Energy projects under the NCCS are referred to as the NWFE Program: Energy Pillar, or N-EP. With the support of EBRD, this effort supports the installation of 10 GW of new renewable energy capacity and the retirement of 5 GW of inefficient gas plants.
- **Energy Wealth Initiative.** The GOE launched this initiative at COP27, accelerating the implementation of the May 2022 NCCS. It also aims to facilitate investments to support the N-EP and build an additional 28 GW of renewable energy through MOUs signed between the GOE, Masdar, ACWA-Power, Scatec, and Orascom at COP27.

Egypt has also been supporting the scale-up of distributed renewable energy and generation projects for self-consumption at industrial or commercial sites. For example, the government has issued policy measures such as net metering to compensate these consumers for excess power, making investment more attractive.²⁵ The GOE appears to envision a transition from a fully centralized system to a more

²⁴ There could be some project overlaps between the 28 GW and 10 GW because 6 GW of NWFE have not been defined yet. For example, it is possible that ACWA Power will count the commissioned 1.1 GW wind farm towards its 10 GW MOU. Furthermore, the MOUs have been announced but not firmly determined yet, and the GOE has not publicly reconciled this.

²⁵ The GOE issued around ten circulars for this purpose from February 2013 through January 2023.

decentralized one, with a bulk electricity system coexisting with distributed renewable resources.²⁶ Tripling the desalination capacity (section 2.3.3) and meeting the needs of other industrial loads will likely entail increasing distributed capacity and reinforce these efforts.

2.3.2. HYDROGEN

Hydrogen is a component of the N-EP and Egypt's broader energy strategy (section 4.1.7). One-third of the 10 GW in the N-EP is planned as direct contracts for hydrogen production. Beyond the N-EP, efforts to develop an Egyptian hydrogen export industry are moving forward, with investment commitments signed and some facilities built. Egypt has competitive advantages in supplying green hydrogen to the world market. Alternatives beyond decarbonizing the electric grid will push Egypt to use hydrogen to decarbonize other sectors. The country will focus on using hydrogen to decarbonize steel manufacturing and using green hydrogen in the domestic industrial and residential sectors.

2.3.3. CROSS-BORDER ELECTRICITY TRADE

Egypt seeks to expand its cross-border electricity trade from current levels (1.4 terawatt-hours, or TWh, exported in 2020–2021, out of a total of 205 TWh produced) and develop a unified national grid to transform Egypt into a regional and global hub for energy exchange between the Arab countries, Africa, and Europe.²⁷ Additionally, Egypt is planning construction of new high-voltage interconnections including a 3 GW Egyptian/Saudi interconnection, a 2 GW Egyptian/Cypriot/Greek interconnection, an Egyptian/Gulf interconnection, and a 3 GW Egyptian/Greek interconnection. Most of the resulting increase in electricity demand, if not all, will be met with renewable energy, combined with the planned 4.8 GW El Dabaa Nuclear Power Plant.

2.3.4. DESALINATION

Authorities in water-scarce Egypt aim to more than quadruple the country's desalination capacity over the next five years. Through the Sovereign Wealth Fund, the government plans to award 21 water desalination plants worth \$3 billion that will draw on cheap renewable energy, guarantee purchase of water, and subsidize the cost to consumers.²⁸

2.3.5. ENERGY EFFICIENCY

The GOE recognizes the importance of energy efficiency in its path to decarbonization. The 2015 Electricity Law, Vision 2030, and the National Energy Efficiency Action Plan 2018–2022 (NEEAP II) all set a vision for improving the efficiency of energy use. The NEEAP II aims to implement the Electricity Law's energy efficiency articles and its executive regulations, issued in 2016. In line with the Supreme Council of Energy, it also aims to empower energy efficiency units in various economic sectors throughout the government.

²⁶ 2015 National Energy Strategy.

²⁷ Egyptian Electricity Holding Company (EEHC), *Annual Report 2020/2021*, http://www.moee.gov.eg/english_new/EEHC_Rep/REP2021-2022en.pdf

²⁸ Aidan Lewis, "Egypt to build 21 desalination plants in phase I or scheme – sovereign fund," *Reuters*, December 1, 2022, <https://www.reuters.com/markets/commodities/egypt-build-21-desalination-plants-phase-I-scheme-sovereign-fund-2022-12-01/>

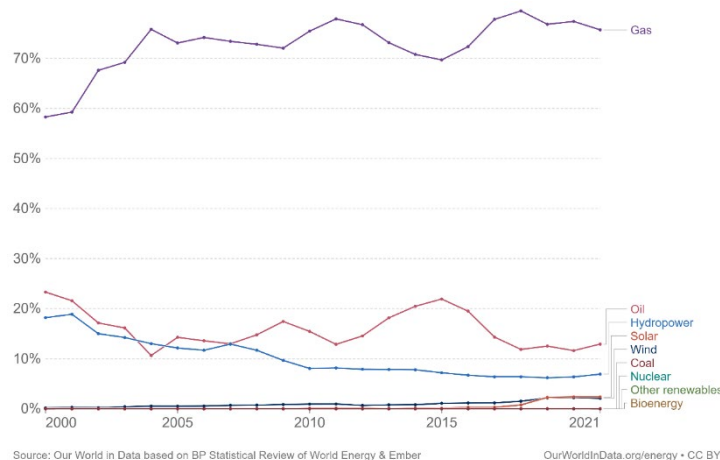
3. THE POWER SECTOR AS AN ENABLER OF DECARBONIZATION AND ECONOMIC PROSPERITY

The power sector is key to Egypt's goal of decarbonization. As noted above, low-carbon pathways require a transition to clean electricity, the efficient use of energy resources, and the electrification of end uses such as cooling, transportation, and industrial processes. The GOE recognizes that improving the performance of the power sector and its constituent institutions is vital to its decarbonization efforts as well as its economic and development ambitions. It is likely that the GOE will need to balance objectives related to providing low-cost, reliable power to all Egyptians, a goal that has historically implied a range of subsidies, and a need to incentivize investments in renewable energy and energy efficiency. Successful execution of plans to scale up renewables will depend on the operational capacity of the sector to adapt to the technical demands of managing large amounts of intermittent resources and the financial capacity to make the necessary investments in grid modernization (section 4). Furthermore, key legal and regulatory aspects of Egypt's ongoing power sector reform process can facilitate the integration of variable renewables and help achieve lower-cost outcomes.

3.1. EGYPT'S POWER SECTOR IS KEY TO DECARBONIZATION

Egypt's electrical power generation sector is responsible for the largest share of emissions (40 percent).²⁹ Egypt's generation is primarily fossil fuel-based, with steam and combined-cycle gas plants representing over 80 percent of its installed generation.

Figure 2. Share of electricity production by source, Egypt



Source: Our World in Data based on BP Statistical Review of World Energy & Ember

Furthermore, the efficiency of many plants in the current gas fleet is low. Two-thirds of the fleet operate in the 20–45 percent range.³⁰ The use of some older, inefficient gas plants is still required to serve load in congested areas at times of peak demand; this reflects the need to expedite improvement plans to strengthen the transmission network. While no significant retirements of older gas plants have been made, the GOE plans to retire 5 GW of this inefficient plant capacity.

²⁹ Lamiaa Abdallah and Tarek El-Shennawy, "Evaluation of CO₂ emission from Egypt's future power plants," *Euro-Mediterranean Journal for Environmental Integration*, 2020, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7502305/>

³⁰ EEHC, *Annual Report 2020/2021*.

The rest of the economy lags in energy efficiency as well. Egyptian industrial processes, equipment, and consumer appliances are 20 percent more energy-intensive than international benchmarks; while the GOE has not set specific national energy efficiency targets, studies indicate that there is a potential to reduce 23 percent of energy consumption through energy efficiency.³¹

Despite current oversupply, new generation capacity will still be needed. In recent years, Egyptian electricity demand has grown strongly, with a combined annual growth rate of 3.5 percent between 2015 and 2021. If the country maintains this rate of growth, electricity demand has been projected to reach circa 350 TWh by 2035, a significant growth from the 205 TWh demanded in 2020–2021. Furthermore, these forecasts do not take into account loads that could drive demand much higher: green hydrogen, water desalination, electricity exports, and the potential scaling of electric vehicles. A new least-cost generation and transmission master plan (latest published scenarios date from 2017) will need to reconcile these various sources of demand, plant retirements, the entry into operation of an estimated 38 GW of renewable energy, and the investment requirements to maintain a reliable operation of the system.

3.2. SECTOR REFORM AND DECARBONIZATION

Since the 1990s, the international community has pushed a fairly standard set of sector reform measures: unbundling of vertically integrated national monopoly electric utilities; private sector participation in generation and distribution; implementation of power markets to introduce competition, and establishment of an autonomous regulator to set and oversee the rules of the sector and market. These reforms are often carried out to attract private capital and reduce the government's fiscal burden, creating a more efficient sector.

Despite the uneven results of reform efforts around the world,³² power sector reform can be conducive to decarbonization efforts. The scale-up of renewable generation and the electrification of end uses require massive investments in grid modernization and innovation, which the public sector may find challenging to finance. At the same time, competitive markets can drive low prices for renewable energy generation and enable the efficient provision of flexibility resources such as ancillary services.

In recent years, Egypt has undertaken a number of reform measures which, if sustained, may have positive impacts on the sector and support decarbonization efforts. However, by themselves, these measures are not likely to result in the desired scale-up of renewable energy generation, and additional policy measures are needed. Key regulatory changes that will be needed include the following (see section 5.2.1):

- Comprehensive transmission access and pricing arrangements
- Mechanisms for ensuring visibility, control, and procurement of flexibility and balancing resources
- Regulations on curtailment, forecasting, and voltage and frequency control

³¹ Amal Khashab, *Lessons Learned: Reasons of Egypt's Energy Efficiency Poor Performance*, 2020, <https://energycentral.com/c/ee/lessons-learned-reasons-egypt%E2%80%99s-energy-efficiency-poor-performance>

³² Robert Bacon, *Taking Stock of the Impact of Power Utility Reform in Developing Countries: A Literature Review*, 2018, <https://openknowledge.worldbank.org/server/api/core/bitstreams/99315b74-b641-5c99-b910-567d869566e0/content>

- Regulations and markets to allow trading in clean energy.

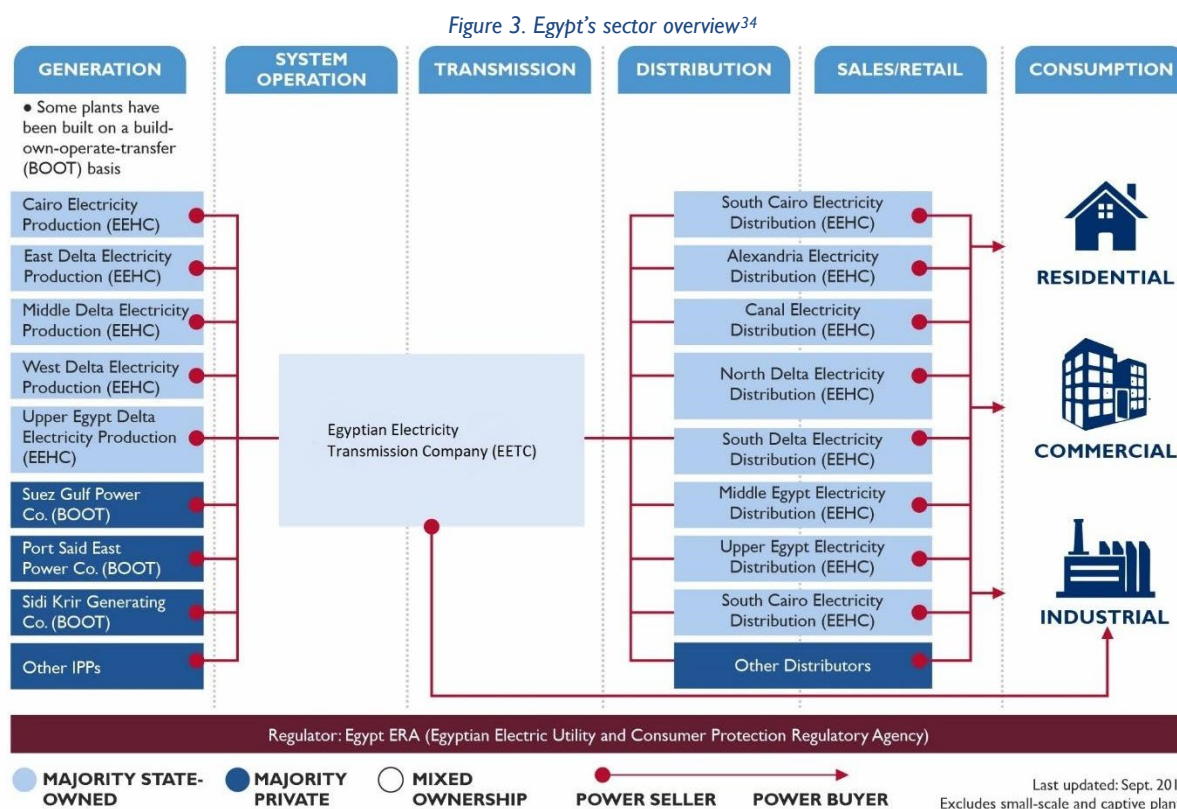
These elements can help facilitate the participation of the private sector, ensure efficient integration of variable renewables, and provide the require balancing and flexibility services in a cost-effective manner.

The Egyptian power sector is in a process of liberalization

The Egyptian electricity market has historically operated on a vertically integrated basis, with the government responsible for everything from generation to distribution. Though reforms have been discussed since the 1970s, they have been implemented in short bursts with long pauses in between, resulting in limited private sector participation until recently.³³ As a result of the power crisis in 2014 described above, reform measures have been adopted to liberalize the sector and increase private sector participation, though many policy measures have a long timeline for implementation and are still only partially enacted.

In July 2015, a new law for electricity was issued (the Electricity Law, Law No. 87 of 2015) to regulate all electricity activities with the aim of unbundling state-owned electricity entities and replacing the single-buyer model. The Egyptian Electricity Holding Company (EEHC), previously named the Electricity Authority, owns most power generation and distribution companies in Egypt. Until recently, one of these was the joint-stock Egyptian Electricity Transmission Company (EETC). As a result of the Electricity Law, EETC became independent from any electricity company or entity engaged in the field of electricity production, transmission, network operation, distribution, and sale. It is now a state-owned company unaffiliated with EEHC, though it still works in close coordination with EEHC.

³³ Rana and Khanna, 2020.



Source: Based on BNEF country profile.

The regulator, EgyptERA, began operating in 2001 through a presidential decree to perform regulatory functions such as managing licensing, operating dispute resolution mechanisms, and ensuring just relations between service providers and end users. The 2015 Electricity Law codifies these functions at a higher legislative level, clarifies that EgyptERA is responsible for designing and approving tariff schemes, and specifies that the Minister of Electricity and Renewable Energy chairs EgyptERA's board of directors, among others.

The Electricity Law also mandates the establishment of a competitive electricity market, though with a long timeframe: eight years to move from a single-buyer model to a regime in which power is traded between generators and eligible consumers.³⁵ However, the competitive electricity market has not yet been implemented, and the time period for implementation was recently extended by the Cabinet for two years (through 2025) and may be extended by decree for another two years.³⁶

Moves toward transparent, competitive wholesale electricity markets would provide critical support to scaling up renewables in Egypt.

3.3. COST RECOVERY AND DECARBONIZATION

Unlike many state-run power sectors in the developing world, Egypt has largely been able to provide universal affordable, reliable power. It reached universal access in the early 2000s, and power has

³⁴ For a complete list of all sector actors and legal framework, refer to Mariam Fahmy and Nada Hussein, "Electricity regulation in Egypt: overview," *Thomson Reuters Practical Law*, 2020, <https://uk.practicallaw.thomsonreuters.com/w-028-8626>

³⁵ Now traded between generators and EETC through power purchase agreements.

³⁶ Fahmy and Hussein, 2020.

generally been reliable and of sufficient quality to power commercial and industrial growth. Egypt's historical policy decision was to use the power sector as a part of its social compact, subsidizing tariffs as well as inputs, and absorbing large numbers of people in public employment. However, this came with opportunity costs and likely suboptimal outcomes with respect to efficiency, innovation, and modernization.³⁷

As described above, the energy crisis in 2014 demonstrated the need for improved efficiency and cost recovery in the sector, generating some political will for sector reforms. However, Egypt's decarbonization goals bring with them new reasons to improve sector financial performance and continue liberalizing the power sector. Subsidy reductions can spur uptake of renewables and end-use energy efficiency measures, while increased revenues would facilitate the large investments in transmission and distribution infrastructure needed to incorporate renewables.

Cost recovery is difficult to determine for the purposes of this assessment. This reflects the various subsidies and other price adjustments that are used in the electricity sector. Estimates of 55 percent, 80 percent, and 100 percent cost recovery were provided to the assessment team in various meetings.

Since 2015, momentum toward cost reflectivity in tariffs has largely been sustained, with significant rate increases occurring on a regular basis.³⁸ A number of subsidies remain, including:

- Direct subsidy provided from the Ministry of Finance, with tariffs planned to reach full cost reflectivity by 2025,³⁹ though recently rates have been frozen.⁴⁰
- Cross-subsidies across customer classes, with heavy consumers paying higher tariffs than light consumers and with commercial and industrial consumers paying more than residential consumers.
- Reduced electricity rates from the transmission company to distribution companies with larger shares of customers in lower rate classes, such as residential consumers.

Additionally, as noted above, gas is provided to generators at a rate far below prices on international spot markets, creating an opportunity cost. Gas prices also likely vary per plant. A recently published decree by the Prime Minister stated that the fuel cost to state-owned generation is only \$3 per million British thermal units (mBTU). Others cite \$3.5 per mBTU.

Distribution company losses also appear to be significant—between 18 and 22 percent, based on data in EEHC's Annual Report 2020/2021.⁴¹ This is compared to approximately 7 percent total aggregate

³⁷ World Bank, *Rethinking Power Sector Reforms in the Developing World*, 2019.

³⁸ Breisinger et al. calculate that electricity tariffs increased by 26 percent in 2014, 17.3 percent in 2015, 30 percent in 2016, and 40 percent in 2017.

³⁹ Mohamed Farag, "Electricity prices still subsidised, increases included in restructuring plan until 2025: Electricity Minister," *Daily news Egypt*, April 25, 2022, <https://dailynewsegypt.com/2022/04/25/electricity-prices-still-subsidised-increases-included-in-restructuring-plan-until-2025-electricity-minister/>

⁴⁰ Recently, due to the financial crisis, Egypt's leadership has intervened to block or slow electricity rate increases that were required under national regulations. In June 2022, rate increases were postponed by presidential directive for six months, resulting in a cost to the state of approximately EGP 10 billion (\$534 million). As of February 13, 2023, the GOE was considering a proposal to reset electricity prices every three to six months.

⁴¹ This is based on data on electricity purchased and electricity sold by EETC. However, the 22.5 percent should be taken as a very rough estimate, because the term "electricity sold" is not defined in the report.

technical and commercial losses considered to be healthy for the region.⁴² However, the World Bank's Learning from Power Sector Reform analysis claims that distribution companies have historically performed quite well when it comes to collecting bills from private citizens, and losses are instead driven by an inability to collect from public institutions.⁴³

The assessment team was unable to confirm current conditions with similar disaggregated loss data; however, it seems that distribution companies are taking measures within their control to reduce commercial losses. For instance, Egypt has an extensive pre-paid meter program, with 11.7 million pre-paid meters installed as of September 2021 and another two million planned to be installed in 2022 as of the writing of EEHC's latest annual report.⁴⁴

Implications for Egypt's clean energy transition

These factors have significant implications for Egypt's clean energy transition. As noted above, the opportunity cost of supplying natural gas to inefficient plants at rates below international markets provides a powerful incentive to reduce the consumption of gas in the power sector, while continuing subsidies also provide an overall impetus to reduce costs of generation. These likely combine to be one of the GOE's primary motivations for scaling up renewable energy.

However, because electricity tariffs are reported to exclude capital outlays for new generation, transmission, and distribution assets, Egypt depends heavily on donors and foreign investors for these funds (donors for grid investments and Gulf investors for wind and solar). Scaling up grid-scale renewables requires massive investments in grid expansion and modernization, which will be a challenge to procure if expected to come from state sources.

Subsidies disincentivize consumer investments in energy efficiency and distributed renewables. Although when taken as a whole, the financial benefit in terms of reducing domestic gas consumption and electricity subsidy outlays may be large, only higher rate classes may see a return on energy efficiency investments. Furthermore, distribution companies may see this as a short-term threat to their financial performance if energy efficiency measures cannibalize customers that cross-subsidize the lower rate-classes and may not appreciate the potential for reducing investments needed for capacity expansion. A program that supports a realignment of incentives, taking into account the factors described above, could be useful for scaling energy efficiency measures substantially.

4. ASSESSMENT OF THE N-EP AND GAPS FOR INTERVENTION

This section assesses the implementation components of the N-EP, its funding and economic viability, and key risks and enablers needed for the program to succeed. The objective is to develop recommendations on USAID direct and enabling support.

The government is pursuing two program elements (the N-EP and the Energy Wealth Initiative) that could add 38 GW of new renewable energy capacity. While the initial objective was to evaluate N-EP gaps and opportunities to provide USAID support, these initiatives should be considered both individually and as a whole, as they will require major changes in the way Egypt's power system works

⁴² Rana and Khanna, 2020.

⁴³ Ibid.

⁴⁴ EEHC, *Annual Report 2020/2021*.

and significant additional investments in the power grid and flexibility to manage such large amounts of wind and solar generation.

NWFE Energy Pillar (N-EP). Egypt's NCCS for 2050 contains projects bundled around three main pillars—water, food, and energy. Energy projects under the NCCS are referred to as the NWFE Program: Energy Pillar, or N-EP. Under the N-EP, the EBRD has offered to help coordinate and mobilize financing for 10 GW of new renewable energy. The N-EP also includes the decommissioning of 5 GW of older thermal plants.

The energy pillar is one of nine projects under the larger NWFE program, which will work through various procurement approaches and will be open to local and international project developers and investors.⁴⁵ This initiative is supported by the \$480 million public investment pillar of the N-EP, which will pay to close inefficient fossil fuel-based plants and invest in grid strengthening and energy storage to facilitate the absorption of renewable energy.

The N-EP includes a \$20 million package for institutional support for Egyptian authorities to develop and implement a just transition plan to support affected workers, a support scheme for local businesses to develop production of green technologies and services, and a program of technical and commercial support for the absorption of renewable energy and program implementation.

A statement from the EU, GOE, and EBRD states, “NWFE’s energy pillar will contribute to achieving Egypt’s objectives of ‘installing additional renewable energy capacities to reach electric power contribution target of 42 percent by 2035’ and ‘improve the energy efficiency of electricity by the maintenance, upgrade and replacement programmes for obsolete power plants.’ ”⁴⁶

Energy Wealth Initiative. This initiative was launched by the Egyptian government at the COP27 climate change summit, accelerating the implementation of the May 2022 NCCS. It aims to facilitate investments to support the installation of the 10 GW under the N-EP. At COP27, the European Commission committed to contribute up to €35 million (\$36 million) in support of the Energy Wealth Initiative through a grant to the EBRD under the EU Economic and Investment Plan for the Southern Neighbourhood. It also aims to facilitate investments to support the N-EP and build an additional 28 GW of renewable energy through MOUs signed between the GOE, Masdar, ACWA-Power, Scatec, and Orascom at COP27.

The Energy Wealth Initiative is being implemented in part via private sector MOUs to build 28 GW of renewable energy. The MOUs were signed between the GOE, Masdar (10 GW), ACWA-Power (10 GW), Scatec (5 GW), and Orascom (3 GW) at COP27. There could be some project overlaps between the 28 GW and 10 GW, because 6 GW of the NWFE are not procured yet. For example, it is possible that ACWA Power will count the commissioned 1100 MW wind farm towards its 10 GW MOU, and the GOE has not publicly reconciled this.

⁴⁵ N-EP Technical Note, August 2022.

⁴⁶ Priyanka Shrestha, “COP27: EU commits €35m to support Egypt’s Energy Wealth Initiative,” *Future Net Zero*, November 18, 2022, <https://www.futurenetzero.com/2022/11/18/cop27-eu-commits-e35m-to-support-egypts-energy-wealth-initiative>

4.1. N-EP IMPLEMENTATION PLANS

4.1.1. ROLE OF THE EBRD

To support the N-EP, the EBRD will provide targeted regulatory support to the GOE and launch an investor forum composed of IFIs (including other multilateral development banks and the U.S. Development Finance Corporation), institutional investors, commercial banks, and others. Forum members will commit to mobilize \$10 billion in investments in new renewables, including solar and wind.⁴⁷

The EBRD estimates that it will need \$500 million in concessional finance, \$200 million of which would come from donors in the form of grants, guarantees, and low-cost financing. The other \$300 million would come from low-interest rate loans from the EBRD and other multilateral development banks.

The \$500 million in concessional finance will support:

- Gas plant decommissioning
- Investments in grid infrastructure, including transmission capabilities and energy storage
- Technical work to develop a just transition plan for affected workers
- A plan to support the development of domestic manufacturing capabilities for renewable energy technology components and assembly.⁴⁸

The program has strong buy-in from the GOE: the Ministries of Electricity and Renewable Energy, International Cooperation, and Environment have formally expressed their support and asked that the EBRD continue to develop the components and seek donor implementation support.⁴⁹

4.1.2. RENEWABLE ENERGY PROJECTS IDENTIFIED UNDER THE N-EP

According to the Technical Note of September 2022, “Egypt’s Country Platform for the NWFE: The Energy Program,” the 10 GW of capacity to be procured under the program has mostly been identified, and 3,230 MW (one-third) is now being implemented, designated under corporate contracts with private generators for hydrogen production (listed in Annex II). Therefore, it appears that the N-EP needs little project identification, and that little support is needed to procure most of these projects.

Information collected during the assessment also indicates the existence of the following larger procurement pipeline; the team has not verified this with existing agreements, but news articles and officials confirm MOUs between Egyptian authorities and Masdar, ACWA Power, Scatec, and Orascom.

Interviewees explained that these will be build-own-operate projects and may have generation rates established by the feed-in tariffs (FITs). Given that the commissioning of the 28 GW is expected to be spread over the next decade (from 2023), the team cannot say with certainty what the generation

⁴⁷ EBRD Egypt Green Initiative summary program description; informal document without publication details. Further information is also available from the EBRD: <https://www.ebrd.com/news/2022/ebd-promotes-green-energy-transition-in-egypt-.html>.

⁴⁸ Ibid.

⁴⁹ Ibid.

procurement rates are. However, the Ministry of Electricity and Renewable Energy (MoERE) has stated that the feed-in rate for wind energy projects will be 3 U.S. cents per kWh and 2 U.S. cents for solar PV projects. How long these rates will apply is a matter of evolving policy.

The team was also told that additional “smaller” projects under the N-EP are planned to be tendered in auctions.

4.1.3. ROLE OF AUCTIONS IN PROCURING N-EP CAPACITY

The team was told that “smaller amounts” of renewables—in lots of 300 MW—will be procured in auctions. The recently used FIT of 2.4 U.S. cents per kilowatt-hour (kWh) for wind can be achieved primarily through low- or no-cost Gulf financing.⁵⁰ A transition from FITs to auctions and the participation of other developers may result in offers above the current FIT level, but it would also allow for price discovery and diversify market participants. Ensuring auction tariff ceilings and auction design are reflective of the regulatory framework, transaction costs, market risk premiums, financing conditions, and technology costs can ensure the long-term sustainability of projects awarded, encourage new private sector participants, and avoid excessive producer revenue.

4.1.4. ROLE OF RENEWABLE ENERGY ZONES

Renewable energy zones play an important role in large-scale renewable energy development programs. They are used by countries including Chile, India, Saudi Arabia, South Africa, the UAE, and the United States. Such zones allow areas with a combination of low-cost land and excellent resources to be used for large-scale renewable generation. In addition, they lower the cost of evacuation by concentrating large capacities on fully loaded dedicated transmission lines and substations.

Egypt has well developed plans for both land allocation and zone development. Recently, the area designated for wind and solar development was reduced from 7,600 km² to 5,200 km², as cited in the MoERE/American Chamber of Commerce energy overview, but this is still a large area that can host far more than the 10 GW envisioned in the N-EP.

According to the chair of the Suez Canal Economic Zone, the Suez Canal zones are for the production of hydrogen, not renewable electricity. Renewables will be located outside these zones.

4.1.5. PLAN FOR N-EP INSTITUTIONAL TRANSITION

The N-EP has an institutional transition plan, summarized in the N-EP Technical Note of August 2022. It includes a package of institutional support to ensure that the key features of the fossil fuel decommissioning and renewables build-out are delivered efficiently, sustainably, and in a manner that maximizes socioeconomic benefits for Egypt. This package has four elements: 1) the Just Transition Plan, 2) support to network investment planning and implementation, 3) support to network operations, and 4) assistance for the development of market-based mechanisms to support investment. The Just Transition Plan is highly defined in terms of budget and initial technical approach and is discussed below. Document review indicates that the remaining components are defined only at the highest level in terms of budget, scope, and approach; according to interviewees, they do not have committed funding. They

⁵⁰ There is a lot of flux in FITs. Prior rounds of build-own-operate procurements used FITs of 14.2 U.S. cents per kWh. The procurement rounds ended in 2018. More recent FITs were also cited at 2.4 U.S. cents. It has also been stated that the FITs are adjusted according to location and resource conditions.

include elements to provide technical, operational, commercial, and legal support to the MoERE and EETC in areas including preparing a grid master plan, providing training and support in grid operation with increased renewable penetration, implementing a renewable energy procurement/tendering plan, developing an associated market (including guarantees of origin, competitive procurement, and carbon pricing), and building associated capacity.

Just Transition Plan

The Just Transition Plan seeks to protect workers, communities, and regions reliant on assets that are to be decommissioned. The elimination of existing jobs from state-run entities can introduce resistance to renewable energy development, if not handled with sensitivity. According to the NWFE, an estimated 6,000 workers will be directly affected by the decommissioning of fossil fuel assets, although one interviewee indicated that the average old 1,000 MW gas plant in Egypt employs about 1,400 workers, which would suggest that 7,000 workers might be affected.

Regarding the planned 5 GW of thermal plants that will be closed under the N-EP, the EBRD will support the MoERE and other stakeholders in developing a “just transition diagnostic” and action plan to support the provision of alternative jobs for affected workers. The assignment was planned to be launched after COP27. The diagnostic and action plan will be supplemented by stakeholder engagement to generate buy-in and promote participation of affected populations. The second stage will deliver re-skilling programs and job search support and will implement the action plan.

This is consistent with the way public sector redundancies are managed in power sectors worldwide. Typically, laid-off employees are given some combination of severance, pensions, and alternative employment opportunities.

The Global Wind Energy Council estimates that every megawatt of wind generates seven direct jobs, saying, “peer reviewed studies found that investment in renewables creates more jobs than equivalent investment in fossil fuel generation capacity.” According to the Council, for every \$1 million invested in renewable generation, 7.49 jobs are created (net creation of approximately 5 jobs).⁵¹ This is nearly three times the 2.66 full-time-equivalent jobs generated by the same spending on fossil fuel capacity, so switching to renewables results in a net gain in jobs compared to existing thermal generation. The renewable energy targets in Egypt’s nationally determined contributions and the N-EP can generate economic opportunities across renewable supply chains, creating many new jobs. To this end, the N-EP will support the development of an action plan targeting measures to incentivize the development of local value chain components and services for renewables and low-carbon technologies.

Though the team could not determine the exact source of funding, a dedicated technical assistance activity to the GOE and market stakeholders will be designed and implemented in 2023–2024, including mapping of new energy services and supply chain industry development.

⁵¹ Global Wind Energy Council, April 2021.

4.1.6. PLANS FOR DECOMMISSIONING THE 5 GW OF GAS PLANTS

Criteria and location

According to the N-EP Technical Note of August 2022, the N-EP targets the retirement of 5 GW of existing capacity, comprising 42 units across 12 plants, primarily located in the north of the country (listed in Annex III). Based on historical data from EEHC, it is estimated that this group of installations is responsible for a net supply of about 10 million megawatt-hours (MWh) of electricity (5 percent of total domestic generation), emitting around 7 million tons of CO₂ annually.

Costs

According to the N-EP Technical Note of August 2022, the cost of decommissioning the 12 identified plants, including environmental cleanup and remediation to allow reuse of the sites, will fall on the state-owned EEHC and its subsidiaries, which own the plants. This cost is estimated at \$160 million, which seems reasonable when compared to decommissioning costs in the United States. No detailed breakdown was available to the assessment team, so it is not clear whether this amount includes payments for workers.

Economics of substituting renewable energy for gas

The EBRD estimates that closing 5 GW of inefficient thermal generation as part of this initiative would free at least 2.2 billion cubic meters of gas per year—equivalent to the annual gas consumption of the entire economy of Finland. Egypt has more than enough spare gas export capacity to bring this gas to Europe with existing LNG export infrastructure, which would help to replace the EU's consumption of Russian gas and boost European energy security. Accelerating the renewable energy build-out is one of the fastest options to enhance global gas supply.⁵²

Senior officers at the largest private gas distribution firm estimated that every gigawatt of inefficient thermal plants that is closed can generate approximately \$1 billion if the gas is exported to Europe at the market prices prevailing at the end of 2022. However, gas prices in both the United States and Europe have quickly fallen back to their levels before the start of the Ukraine conflict, so the income generated will now be far smaller than that mentioned by these officers in assessment meetings. In addition, the World Bank's Egypt gas expert noted that there are more economically beneficial uses for any gas that is saved. The assessment team did not conduct further research on the alternative uses or their economic values.

4.1.7. ROLE OF HYDROGEN

Egypt has a long history of producing and using green and gray hydrogen. Starting in 1960, KIMA Fertilizer Company in Aswan Governorate operated the world's largest green hydrogen plant at 150 MW using hydroelectric power from the Aswan Dam. The original electrolyzers were replaced in 1977 and operated until 2019, when the plant was decommissioned and replaced with a natural gas-based gray hydrogen plant. The main driver of this switch was to free up power generation capacity.

⁵² EBRD Egypt Green Initiative document.

Hydrogen is a component of the N-EP and Egypt's broader energy strategy. One-third of the 10 GW in the N-EP is planned as direct contracts for hydrogen production. Beyond the N-EP, efforts to develop an Egyptian hydrogen export industry are moving forward, with investment commitments signed and some facilities built. Egypt has competitive advantages in supplying green hydrogen to the world market.

Egypt announced an outline of a low-carbon hydrogen strategy at COP27, with backing from Egypt's Sovereign Fund and the EBRD. The country signed eight framework agreements to develop green hydrogen and ammonia projects in November 2022 and stated that Egypt aims to become a hub for hydrogen production and to win 5 percent of the global market by 2040.⁵³

The EU and Egypt also established a strategic partnership on renewable hydrogen as part of the groundwork for a just energy transition in Egypt. The MOU is a framework to develop a renewable hydrogen industry and trade across the EU and Egypt, including infrastructure and financing. It will support the EU's ambition of reaching 20 million tons of renewable hydrogen consumption by 2030, as outlined in the REPowerEU plan. The MOU will facilitate investment in renewables and boost the decarbonization process in Egypt. It will contribute to the establishment of a framework for a global rules-based market for hydrogen-based solutions, including harmonized safety and environmental standards.

Two considerations in Egypt's plans to become a green hydrogen exporter include whether there is sufficient low-cost renewable electricity generation capacity and the cost of electricity. Despite current plans, there is recognition that individual solar PV or wind plants dedicated to a single hydrogen or desalination production facility are probably not economical. This is because the variability of electricity from a single plant appears to be too high to provide reliable supply to a hydrogen production plant, and supply from multiple renewable plants will be needed. If hydrogen production is supplemented by electricity from the grid, Egypt's hydrogen exports may not meet EU rules for renewable hydrogen.⁵⁴ Therefore, some form of green electricity market for hydrogen production to source electricity and a verification system to certify compliance with these rules may be needed (section 5.2.1).

EBRD consultants have come up with the following three-phase hydrogen development program:⁵⁵

- **Short term: 2020–2030.** For the next ten years, EBRD's consultants expect to see an increase in ambition (initially at the pilot scale), as renewables capacity and international demand for low-carbon hydrogen and derivatives increase.
- **Medium term: 2030–2040.** In the medium term, increased infrastructure, favorable legislation, and increased technical know-how are expected to reduce the cost of low-carbon hydrogen production and its derivatives. This period could see the first economically viable projects coming online.

⁵³ . <https://www.reuters.com/world/middle-east/egypt-signs-framework-deals-bid-launch-hydrogen-industry-2022-11-15/>

⁵⁴ In February 2023, the EU published rules for renewable hydrogen through two Delegated Acts to implement the requirements of Art. 27 (3) and Art. 25 (2), 28 (5) of the Renewable Energy Directive 2018/2001 (RED II).

⁵⁵ Advisian, funded by EBRD, Egypt Hydrogen Strategy Full Version Draft, 2nd September 2022, 215-00078.

- **Long term: 2040–2050.** In the long term, global demand for low-carbon hydrogen and derivatives is expected to increase as countries look for options to achieve net-zero emissions and as carbon prices make low-carbon alternatives competitive.

Alternatives beyond decarbonizing the electric grid will push Egypt to use hydrogen to decarbonize other sectors. The country will focus on using hydrogen to decarbonize steel manufacturing and using green hydrogen in the domestic industrial and residential sectors.

4.2. FUNDING AND ECONOMIC FEASIBILITY

4.2.1. SOURCES AND USES OF FUNDING OF THE N-EP

The N-EP's estimated financing needs are \$10.5 billion, of which international commercial investors have committed to \$10 billion in loans, some of which may be concessional from sovereign wealth funds. The balance of \$500 million is required for public goods, including decommissioning costs, network investment, and institutional support through donor and IFI grants and concessional loans. The N-EP investment program is summarized below.

Table 1. Summary of N-EP funding uses and sources

COMPONENTS	TOTAL CAPEX (\$M)	GRANTS – TC (\$M)	GRANTS – INVESTMENT (\$M)	CONCESSIONAL/ SOVEREIGN IFI FINANCE (\$M)	PRIVATE CLIMATE FINANCE (\$M)	USES OF FUNDING
Renewable energy plants	10,000	0	0	250 ⁵⁶	10,000	Construction, financing, and operation of 10,000 MW of new wind and solar capacity
Fossil fuel power plants decommissioning	160	0	100–160	0–60	0	Capital expenditure (CAPEX) for dismantling, recycling, remediation Studies and permitting, project management/ supervision
Grid strengthening/ renewables absorption	320	0	40–100	220–280	0	CAPEX for grid extension and modernization, digitalization, and battery storage Studies and permitting, project management/ supervision
Just Transition Plan	n/a	5	0	0	0	Just transition and diagnostic and action plan Re-skilling/retraining program for the workforce Support for economic diversification activities
Local supply chain development	n/a	3	0	0	0	Action plan to create measures and programs to support the development of local supply chains and low-carbon technologies and services that are compatible with World Trade Organization rules

⁵⁶ The base case planning for the N-EP assumes no concessional support for the development of renewables. However, a guarantee scheme for specific risks associated with novel and unproven business or technical models (such as private-to-private projects or green hydrogen) would accelerate uptake and reduce first-mover costs.

COMPONENTS	TOTAL CAPEX (\$M)	GRANTS – TC (\$M)	GRANTS – INVESTMENT (\$M)	CONCESSIONAL/ SOVEREIGN IFI FINANCE (\$M)	PRIVATE CLIMATE FINANCE (\$M)	USES OF FUNDING
Renewable energy absorption	n/a	10	0	0	0	Development of grid master plan Capacity-building and support for grid operation Renewable auctions implementation Regulatory development and market-building
N-EP implementation	n/a	2	0	0	0	Program management Stakeholder engagement and coordination Progress and funding control; reporting
TOTAL		20	180	300	10,000	

4.2.2. N-EP FUNDING ASSESSMENT AND GAPS

The team evaluated the adequacy of funding across key components of the N-EP, including renewable energy, the closure of the gas plants, and grid extension and enhancement.

Renewable energy

The private sector resources for building the 10 GW of wind and solar capacity are probably available. Egypt has set very low FITs, at 2.4 U.S. cents per kWh for wind. This could be a barrier to success because interest rates and the cost of materials and inputs have risen since earlier Egyptian projects in 2020–2022. Major developers stated that without capital subsidies, this level of FIT for wind is too low to develop projects. One major wind equipment supplier stated that it would need to be above 3 U.S. cents per kWh to justify investment by private firms. However, it is reported that sovereign wealth funds may provide below-market lending rates.

For smaller projects, there is a question of whether developers will bid rates that are attractive and affordable to the GOE in auctions. This can be determined through a bidding process and the financial modeling of the buyer's financial obligations.

Gas plants closure

Financial support for the closure of 5 GW of old gas plants appears sufficient. Data from the United States indicate that the cost of decommissioning gas and petroleum plants was around \$10,000 to \$20,000 per MW in 2016, with some plants costing between \$40,000 and \$50,000 per MW. Assuming an average today of \$30,000 per MW (using U.S. data), a budget of \$150 million is reasonable.⁵⁷

Grid extension and enhancement

There are questions about whether EETC has the large financial and contracting resources to coordinate the execution of the lines and substations needed to evacuate 10 GW into Egypt's grid in a timely manner. Investments and upgrades needed for an additional 28 GW will further compound these challenges. There is still discussion of whether all the hydrogen electricity requirements will be served by stand-alone transmission facilities. It remains to be seen whether this is feasible.

A total of \$380 million is budgeted for grid expansion and modernization, part of a \$2 billion overall network investment strategy. This may be enough to support the first 10 GW, but benchmarks from European and U.S. grid modernization programs suggest that far more investment in the grid and flexibility is needed for 28 GW of wind and solar (Annex III). Grid requirements should be estimated through a rolling process of grid development planning that is likely to span a 20-year period.

The budget of \$60 million for “digitalization and storage” is small, but whether it is enough depends on the full specifications of work to be done. As a rough comparison, in the Southern California Edison grid, with a capacity twice as large as Egypt's, digitalization and modernization of substations (modern protection, remote fault indicators and automation) cost between \$200 and \$300 million over a six-year period. This does not include storage and other existing assets that are the early backbone of a modern

⁵⁷ Daniel Raimi, *Decommissioning US Power Plants: Decisions, Costs, and Key Issues*, 2017, <https://www.rff.org/publications/reports/decommissioning-us-power-plants-decisions-costs-and-key-issues/>

grid capable of integrating renewables at scale. Therefore, the \$60 million budgeted seems quite constrained to digitalize a national system and add storage.

Institutional transition

As discussed in section 4.1.5, the institutional plan includes four elements: 1) the Just Transition Plan, 2) support to network investment planning and implementation, 3) support to network operations, and 4) assistance for the development of market-based mechanisms to support investment. The Just Transition Plan is highly defined in terms of budget and initial technical approach, and the funding appears to be secured. According to interviewees, donors have not yet committed to all activities for the remaining three. This GOE-led process is ongoing and will likely require additional funding.

Strategic sector planning

Planning is essential for developing and maintaining the power system over time to serve load, be resilient to shocks such as extreme weather events, and achieve policy goals (decarbonization, access, energy security, etc.) Egypt scores high on the Rethinking Power Sector reform planning benchmark. The assessment team heard regularly that Egyptian technical capacity is high.

It should be noted that Egypt's historical experience is in planning for a fossil fuel-based power system. The sort of planning needed for high penetration of renewables (including grid modernization and increased flexibility) may require developing new approaches and capabilities and does not seem to be covered under the N-EP.

4.2.3. FEASIBILITY OF FUNDING UNDER CURRENT ECONOMIC CONDITIONS

Meetings with developers and energy investors indicated the following regarding the availability of capital for the N-EP and the Energy Wealth Initiative:

- Local Egyptian bank debt is too expensive (15 percent) and too short in tenor (five years) to be useful for new generation projects.
- According to one major developer, term loans in U.S. dollars currently cost 8 to 9 percent (February 2023). Another said that the developer's required internal rate of return is 15 percent, with an 18-year loan tenor, and that to achieve this rate, they need dollar or euro debt in the 6-to-7 percent range.
- Sovereign wealth funds in the Gulf may offer low interest rates to meet GOE price expectations. These low rates would make it possible to execute projects at the current wind and solar FITs.
- Several IFIs and developers said that there is a payment risk if too much capacity is contracted. IFIs noted that there does not seem to be any financial modeling of the financial obligations of Egyptian buyers.

The overall conclusion is that dollar (or euro) debt and equity capital are both available, but the amounts available depend on several factors, including the following:

- The prices that the GOE decides to pay for generation
- Capital subsidies that sovereign wealth funds decide to provide
- Trends in global interest rates, which currently are rising.

5. OPPORTUNITIES FOR USAID PROGRAMMING

This section identifies high-impact areas that could support Egypt's energy transition and suggests possible interventions to achieve the following:

- Support Egypt's decarbonization and energy transition, focused on the N-EP and the broader goal of scaling renewables.
- Enable Egypt's energy transition by promoting regulatory reform and the creation of dynamic markets, improving sector performance, and strengthening equity, inclusion, transparency, and environmental best practices.
- Drive further decarbonization through advanced energy technologies such as energy efficiency, distributed renewable energy, and electric mobility.

5.1. N-EP AND LARGE-SCALE RENEWABLES

The N-EP's 10 GW and the 28 GW of wind power under Energy Wealth Initiative MOUs represent the largest and most credible opportunity to advance Egypt's energy transition, both because of their potential to replace existing thermal generation and because they put Egypt on a path to transition to a wide range of low-carbon investments, such as electrified transport. This new renewable capacity can replace a large share of the current thermal generation fleet. It also makes it unnecessary to build new thermal plants, such as the new coal plants that the GOE had planned before COP27. Assuming an additional 38 GW of renewable energy in Egypt, we estimate this could replace approximately 25 percent of Egypt's 2022 CO₂ emissions, including the decommissioning of thermal plants.⁵⁸

But large-scale renewables are not feasible without major changes in the way Egypt's power system works, and the country will need large additional investments in its power grid and flexibility to manage such large planned amounts of wind and solar generation. This component is missing or vaguely specified in other donors' N-EP and Energy Wealth Initiative plans, and USAID has been a leader among donors in grid integration, flexibility, and grid modernization. Few donors have the practical experience—and successes—that USAID has in working with large systems to scale up renewables. Furthermore, U.S. firms lead in this space and could play a role through trade, investment, joint ventures, and training.

⁵⁸ Masdar estimates that its 10 GW of wind will represent a 9 percent reduction of total Egyptian CO₂ emissions. The team assumes that ACWA Power's 10 GW will result in a similar reduction. The 10 GW under the N-EP might represent another 7 percent, as it only includes solar. The assessment also assumes that this energy will replace thermal generation.

In sum, the big challenge for the low-carbon transition in Egypt rests on several tasks:

- Planning and executing a large parallel investment in upgrading and modernizing transmission
- Building visibility, control, and flexibility in the grid
- Improving overall sector planning for the integration of renewables
- Establishing markets to allow competitive and efficient trade in electricity (further examined in section 5.2.1).

Potential interventions

- **Grid development.** Work with EEHC, EETC, lead donors in the grid area, and potential external partners on planning, modeling, and analysis related to expanding and modernizing the grid. This is a diverse area of technical assistance, training, and pilots in addition to study tours to U.S. utilities and independent system operators (ISOs).
- **System operations.** Train system operators, conduct modeling to support innovation in system operations, and provide grants for pilots related to visibility and control, flexibility, storage, and transmission and distribution management. Counterparts would include the Egyptian system operator; regional load dispatch centers, including those in the distribution companies; associations representing generators; potentially Gulf system operators; and U.S. partners, including ISOs.
- **Flexibility.** Flexibility is essential to scale up renewables. Increasing the flexibility of the Egyptian grid could be an area for analysis, modeling, plant testing, and pilots to determine how much operating reserve the system will require when plants are commissioned and to identify the best flexible options to provide the required reserves, among others. This would involve working with the system operator, generating companies, and private providers of systems, platforms, and services in the flexibility area.
- **Implementation plans and finance for grid development.** Strategies and implementation plans for grid development are important to meet the challenge of grid development for large-scale renewable fleets. These need to be “rolling” in the sense of being revised every three or five years. This should begin with power systems modeling that correctly accounts for a projection of the growing renewable energy fleet, including locations and grid constraints. A USAID-supported activity could involve technical assistance and modeling related to grid development as well as assistance from specialists to prepare a grid development strategy and implementation plan. Counterparts would include EETC, EgyptERA, the system operator, selected distribution companies, potentially a university, and potentially U.S. private systems collaborators such as Schweitzer Engineering Labs and GE, among others.
- **Auctions.** N-EP includes approximately 3 GW that the GOE has said will be procured through auctions. The team was told that 300 MW lots of renewables will be procured in auctions, but several donors and developers raised the question of why the GOE is not using competition to procure renewables beyond these small lots. Auctions can help policymakers achieve sustainable

cost reductions while increasing transparency in the procurement process. Compared to negotiated procurements, auctions often allow for faster project execution and offer policymakers greater volume control and ease in scaling for multiple projects and rounds. USAID has a track record of successful auction support, including in the design of auctions and auction platforms;⁵⁹ this could be an area for support if the GOE decides to use auctions more extensively.

- **Transmission corridors.** The assessment team recommends further analysis and modeling of the feasibility for dedicated green transmission corridors. Variable renewables might face problems fully loading dedicated lines if there is no diversity of supply in a wide geographical area. Similarly, balancing and frequency control might be difficult on a dedicated line unless there are other source of balancing and ancillary services. USAID can support rigorous modeling and technical and financial analyses to evaluate viability and support decision-making.

Why USAID may or may not support this area

- USAID has been a leader among donors in grid integration, flexibility, and grid modernization. Few donors have had the practical experience or successes that USAID has had in working with large systems to scale up renewables. In addition, this component is missing or vaguely specified in other donors' N-EP and Energy Wealth Initiative plans.
- Grid development is key to decarbonization. Without solving the grid integration, modernization, and market issues related to renewable energy, it is unlikely that Egypt's major renewable energy program will be successful. Given the lack of donor focus and USAID's traditional strength, support in these areas is a reasonable option. Other donors have capital funds for grid development, which will take billions of dollars over the next 15 years.
- U.S. firms lead in this space and could play a role. This is an area where U.S. firms could be involved in trade, investment, joint ventures, and training.
- Grid development is slow and expensive. USAID's role would be limited to the planning, analysis, and capacity-building needed in the early stage of grid development. Initial results will come after two years, and major results after four or five years.
- Given the state control of transmission and system operations, getting this activity started may take time—probably a year or two. State institutions could be reluctant to collaborate; only by collaborating with other donors, particularly those with investment funds, will they be likely to want to work with USAID.

5.2. ENABLERS OF EGYPT'S POWER SECTOR TRANSITION

In addition to its efforts to scale up renewables, Egypt's vision is to achieve a power sector that is modern, efficient, and high performing. To achieve this, it will be essential to advance Egypt's sector reform as well as energy policy, regulations, and programs that promote transparency, competition, equity, and private investment. These efforts will also support Egypt's energy transition.

⁵⁹ USAID, *Renewable Energy Auctions Toolkit*, n.d., <https://www.usaid.gov/energy/auctions>

5.2.1. REGULATORY REFORMS AND MARKETS

Egypt has already embarked on a path of sector reform (described in section 3) whose key elements, such as a competitive wholesale power market and fair and equitable access to the grid, will also support the scale-up of renewable energy generation. The country will also need a range of changes and additions that USAID can support opportunistically, such as revisions to Egypt's grid, transmission, and distribution codes to accommodate large amounts of renewable generation as well as new services such as electric vehicle charging.

Potential interventions

- **Transition to a wholesale market as dictated by the law.** This would involve working with EgyptERA, U.S. market design specialists (potentially a U.S. ISO), EETC, and EEHC. The activity would support preliminary market designs, pilots, analysis of commercial accounting, metering, billing and settlement systems, market software, and study tours. The market design process must be owned by Egyptian entities such as EgyptERA and EETC and engage the full range of stakeholders in the market, such as distribution companies and generators, to determine the market design that is best suited to the needs of the country and its power system. USAID support could be relevant at all the major stages of market development:
 - A concept phase in which the major design options are considered
 - A design phase in which the overall market structure and the way it will function are developed
 - A pilot phase in which the market is run on a limited basis for a period of time to see if it works acceptably
 - An implementation phase in which the market begins to function and problems are addressed.

The implementation phase would require an implementation plan, which would include a work plan and budget and would specify any major systems that are necessary for the market, such as advanced metering, scheduling, accounting, and settlement systems.

- **Flexibility markets.** In the short term, if all of the renewables under the N-EP are contracted through power purchase agreements, markets for ancillary services will not be essential immediately. However, as the system operator needs to control more flexibility and ancillary services, markets will become important for the efficient procurement of these services. In addition, over the longer term, Egypt will likely need wholesale and balancing markets that allow the participation of renewable energy. Typically, a balancing and an ancillary services market would be introduced parallel to or immediately following the introduction of a wholesale market.

The process of introducing flexibility markets will be similar to that for the wholesale market, and USAID could provide technical assistance in the form of trainings, study tours, targeted analyses around the market design, pilot, and implementation.

- **Renewable energy market.** The GOE aims to power hydrogen, desalination, and other energy-intensive industries with dedicated renewable energy plants to decarbonize its economy, reduce costs, and meet guarantees-of-origin requirements. However, applications that need 24/7 supply will be unable to meet their needs by drawing electricity from one dedicated facility. A more feasible scenario is that multiple generation sources will have to serve multiple demand locations through lines also used for conventional generation. This would raise two parallel needs: 1) market mechanisms as the most efficient means to allocate supply and demand, and 2) a verification system to certify that the energy the buyer withdraws from the grid is clean.

The EU will likely lead support for the verification system based on what is being developed in the EU, as well as compliance with EU rules for renewable hydrogen. However, USAID could support the development of the market mechanisms for trading renewable energy. There are different approaches to these arrangements, such as bilateral contracts for specific volumes allocated via auctions or other market mechanisms, or synthetic contracts for renewable energy, in which the buyer signs a power purchase agreement and an aggregator bundles a portfolio of diverse generation assets at different grid connection points and dispatches by virtual control systems. USAID could play a role in bringing global best practices to the inception, design, and piloting of such market mechanisms.

- **Comprehensive transmission access and pricing arrangements.** Egypt could benefit from mechanisms to ensure fair access to the grid and stability of charges for private developers and independent power producers to participate in the provision of renewable energy power. In the case of markets, ensuring equitable access to the grid is the preeminent responsibility of the system operator. Even when markets are not fully implemented, improved enforcement of wheeling regulations and more transparent setting of wheeling transmission rates are needed. USAID could provide support in analyzing and implementing transmission access policies, protocols, and pricing mechanisms, which will need to run parallel to the introduction of new arrangements for visibility and control of distributed energy resources, such as ramping and balancing capacity. USAID could also support in areas such as analyzing and implementing the modifications to the grid; generation and distribution codes will be needed to accommodate both new market arrangements and large-scale wind and solar generation.

Why USAID may or may not support this area

- These efforts would help Egypt complete elements of its power sector reform agenda while also promoting elements of power sector operations that support high renewable energy penetration.
- The ability to access wholesale and flexibility markets will provide renewable generators additional business opportunities. This will improve the financial performance of renewables and over time will lead to lower-cost renewable energy.
- These efforts (such as a well-run market) may also serve to improve transparency in the sector while increasing private sector participation.
- Market development is frequently a lengthy process, and Egypt has been extending the timeline needed to transition to market-based operations.

5.2.2. PLANNING FOR RENEWABLE ENERGY INTEGRATION

There was a recognition among interviewees that integrating an estimated 38 GW of wind and solar generation into Egypt's grid over the next 12 years will be a major challenge. Many said that no solution is currently being proposed at the scale that would be needed for integrating the planned wind and solar capacity. It was called "the million-dollar question" in one meeting with a major developer. Two of the IFIs working on the NWFE stated in meetings that grid integration and grid development will be the most important challenges in the large-scale renewable energy transition.

Effective energy planning determines when, where, and how to expand generation and transmission capacity to meet growing demand while making power supplies cleaner, sustainable, reliable, and cost-effective. As their shares of renewable energy increase, countries must also upgrade grid policies, operational and commercial practices, and power system infrastructure to be more reliable and flexible and to accommodate renewables and new energy services.

While technical capacity at EETC, EEHC, EgyptERA, and other power sector actors is high, current planning practices and system operations reflect a system heavily based on fossil fuels. Power system planning will need to be strengthened in areas related to managing a large fleet of variable renewables, grid development, and energy markets to support trade of electricity and services such as flexibility.

Potential interventions

- Provide training and technical assistance to the GOE agencies involved in planning in the following areas:
 - Co-optimization of the expansion of generation and transmission systems to lay the groundwork for the reliable, secure, and cost-effective integration of future projects
 - Integration of large amounts of variable renewables
 - Grid development required to manage a large fleet of renewables
 - Market mechanisms, or other mechanisms, that enable the efficient procurement of services required for systems with large amounts of renewables, such as ancillary services or balancing and flexibility services
 - Certification, commercial metering, scheduling, accounting, billing, and settlement for renewable energy and related services.
- Conduct study tours and twinning arrangements to enable Egyptian power system planners, grid developers, and market operators to interact with counterparts in the United States.
- Promote pilots, demonstrations, and joint ventures related to the deployment of new technologies used for grid integration, such as forecasting, flexibility services, and visibility and control of distributed energy resources.

Why USAID may or may not support this area

Grid development, new approaches to system operations, and energy services such as flexibility are necessary preconditions to adding large amounts of wind and solar generation. However, two questions will need to be answered:

- Whether Egyptian officials and technical counterparts want to collaborate in these areas.
- Which areas related to grid and market development planning, system operations, and grid integration other donors intend to support.

5.2.3. PERFORMANCE OF DISTRIBUTION COMPANIES

Integrating distributed renewable energy at scale also requires the active participation, planning, and investment of distribution companies. Egypt's electricity distribution sector is deploying new technologies, systems, and platforms to improve performance, including a pilot program for smart meters manufactured in Egypt.⁶⁰ These can help in several areas relevant to a USAID energy program, including the following:

- **Energy efficiency.** Energy efficiency can be improved through demand-side management, smart appliances, dynamic tariff rates, and improved customer care.
- **Renewable energy management.** Distribution companies play a wide range of roles related to renewables, including the management of mid-sized renewable plants connected to the distribution grid, distributed rooftop solar, demand-side management, and aggregation of flexibility and demand. All of these require improved IT systems and platforms.
- **Loss reduction.** Egypt's distribution sector appeared to have 18 to 22 percent losses in 2021, which is high by global benchmarks. Progress in loss reduction will help resolve the fiscal burden of the power sector on the GOE and provide stronger consumer incentives for energy efficiency and distributed renewable energy.

Potential interventions

- **Distribution utilities collaboration platform.** The distribution utilities platform could bring together Egyptian public distribution utilities and private distribution companies. The platform would work with these parties to identify innovative technologies and systems, customer service innovations, and policy ideas to improve the distribution sector. The platform could be allocated an annual grant for innovation pilots in the technology, systems, and services area. In addition, it would receive an annual grant for a secretariat and an annual work program.
- **Private sector distribution innovation platform.** USAID would work with the Federation of Egyptian Industries and the American Chamber of Commerce to operate a distribution sector innovation group with the following responsibilities:

⁶⁰ EEHC, Annual Report 2020/2021.

- Advocate for policies that support new IT platforms, systems, and services in the distribution business.
- Use an annual grant fund and award process to support innovation pilots by private firms working with distribution utilities on service innovations.
- Working with Egyptian utilities, run annual workshops on distribution business innovation, including energy efficiency, customer service, and new business models such as peer-to-peer electricity trading, aggregation, and rooftop solar systems.

Why USAID may or may not support this area

- Distribution innovation addresses several problems in the Egyptian power sector. These include making energy efficiency work, reducing Egypt’s high distribution losses, and enabling the grid to manage increased renewable energy.
- Distribution utilities are currently on this path. This would accelerate an ongoing trend that was partly started by USAID decades ago with improved metering and SCADA systems.

5.2.4. PRIVATE SECTOR FOR LARGE RENEWABLE ENERGY

The large-scale renewable energy private sector is currently dominated by large international developers backed by Saudi Arabia and the UAE. Supporting the growth of a national industry of private organizations involved in the energy sector can help the industry grow and ensure the sustainability of the transition. Furthermore, while wind and solar developers interviewed by the assessment team spoke highly of their experience working with their GOE counterparts, they also noted challenges around coordinating and scheduling project inputs, receiving approvals and site clearances, and managing other logistical issues.

Potential interventions

- Work with Egyptian universities to develop and increase the capacity of the workforce by strengthening curricula and research around the integration of large-scale renewable energy and grid development as well as by leveraging existing partnerships and the work of the USAID Center of Excellence for Energy (COEE).
- Include innovation grant cycles to enable public-private collaboration on technology, system operation, and other areas of renewable energy development.
- Promote spaces for policy dialogue between the private sector and the government to encourage public-private collaboration.
- Provide targeted technical assistance and training on technical and financial tools, business models and demonstration pilots, and how to mobilize local and international capital.
- Support coordination efforts of private renewable energy developers. For instance, the assessment team learned of developers in Benban improving efficiency by coordinating (with the support of Regional Center for Renewable Energy and Energy Efficiency) on things like site

security. USAID may identify additional opportunities along these lines, for instance, by supporting the nascent wind developers association.

Why USAID may or may not support this area

- Working directly with the private sector can help USAID diversify support to large-scale renewable development and increase the sustainability of programs. It can often help achieve tangible and shorter-term results compared to longer-term support provided to the government.
- Promoting public-private cooperation around key policy issues can promote participatory, efficient, and transparent processes. Direct support to the private sector can create the perception of conflict of interest, which should be carefully managed.

5.2.5. HYDROGEN

Egypt's hydrogen industry is developing, but achieving the planned scale will require a wide range of new businesses, human resources, and infrastructure. Given that the United States has traditionally been a leader in the hydrogen economy, it makes sense to consider how U.S. expertise and business interests could be involved.

Potential interventions

- Involve U.S. businesses and expertise in various topics, including generation systems using hydrogen or derivatives and developing safety training and systems.
- Develop ancillary businesses in the hydrogen value chain by involving U.S. firms. Use a joint-venture reimbursable grant or loan program. Collaborate with the U.S. Trade and Development Agency on business exchanges. Fund pilots to demonstrate technologies and systems.
- Support modeling of the grid impacts of green hydrogen facilities.

Why USAID may or may not support this area

- The United States has traditionally had leading industries in the hydrogen business.
- The United States also has the full ecosystem of businesses that comprise the hydrogen industry.
- In the long term, hydrogen is one of the largest decarbonization opportunities available to Egypt.
- The hydrogen industry will take 10 to 20 years to develop in Egypt. Development will be slow for the next two or three years.
- Europeans and Gulf investors have taken the lead in the hydrogen industry in Egypt.

5.2.6. COOPERATION WITH THE UAE AND SAUDI ARABIA

USAID's energy program could cooperate with Saudi Arabia (ACWA Power) and the UAE (Masdar) in activities related to large-scale renewable energy and grid development. ACWA Power and Masdar are

signatories to 20 GW worth of MOUs for wind power development. They have an interest in the success of the sector, including solutions to the challenges of grid integration, flexibility, and modernization. They also have regulators, particularly in the UAE, who are known for innovation in power and water sector regulation and have training institutions and universities that may be relevant to developing and delivering curricula that support Egypt's program. There are multiple modes of potential cooperation that may be worth discussing with representatives of the governments and the two power development companies.

Potential interventions

- Involve Gulf partners in modeling and research activities on Egypt's power system, emphasizing the role of their large renewable energy fleets.
- Collaborate with Gulf regulators on solutions for emerging renewable energy regulatory challenges.
- Coordinate on grid modernization planning and implementation.

Why USAID may or may not support this area

- There is no indication yet that the Gulf entities want to collaborate with USAID on large-scale renewables. However, USAID's technical capabilities could be attractive to Gulf partners as more renewable energy projects are commissioned and grid constraints are revealed.
- There is no track record of this kind of collaboration. However, firms like Masdar and ACWA Power are at the cutting edge of deployment of large-scale, low-cost renewables in the Gulf region, and they also have a solid record of innovation in relevant areas such as hydrogen and desalination.

5.3. DRIVE FURTHER DECARBONIZATION THROUGH DECENTRALIZED ADVANCED ENERGY TECHNOLOGIES

The USAID Climate Strategy targets near-term reductions in greenhouse gas emissions that can support partner countries to chart pathways to decarbonization. The GOE has included in its NCCS, 2015 energy strategy, and sustainable energy action plans efforts to promote energy efficiency and distributed renewable energy and to activate distribution companies to reach scale in distributed renewable energy, energy efficiency, and electric mobility.⁶¹

5.3.1. SUSTAINABLE END-USE ENERGY EFFICIENCY PROGRAMS

Energy efficiency is often cited as the “first fuel,” given its cost-effectiveness for mitigating climate change. With increased energy demand and the pursuit of decarbonization, energy efficiency is critical for financial viability and energy security.

In Egypt, limited awareness of energy efficiency's benefits, financial constraints and prevalent subsidies, and institutional challenges have resulted in limited uptake of energy-efficient technologies. Overall,

⁶¹ Government of Egypt, Egypt's First Updated nationally Determined Contributions, 2022, <https://unfccc.int/sites/default/files/NDC/2022-07/Egypt%20Updated%20NDC.pdf.pdf>

increased energy efficiency could deliver strong benefits to the GOE—from decreasing outlays from the Ministry of Petroleum and the Ministry of Finance to load management—but incentives may be misaligned among agencies.

Egypt’s Electricity Law and NEEAP II recognize the importance of energy efficiency. Described as aspirational, the NEEAP II aims to implement the Electricity Law’s energy efficiency articles and its executive regulations, issued in 2016. In line with the Supreme Council of Energy, it also aims to empower energy efficiency units in various economic sectors throughout the government; some have been established, such as within the MoERE. However, there are limited resources and capacity within these units and there is no single host entity or champion that can coordinate and drive efforts across government entities. Furthermore, incentives to drive energy efficiency are often not aligned between entities that can reduce outlays from the implementation of energy efficiency measures, such as the Ministry of Finance or the Ministry of Petroleum, and those that can drive end-user savings, such as the MoERE or the distribution companies. As a result, the lack of a centralized champion can limit the ability of the government to drive the implementation of initiatives.

A more detailed EU-funded master plan, not yet adopted, sets out short- and long-term targets, including 10 percent and 18 percent energy consumption reduction by 2027 and 2035 respectively. Monitoring GOE adoption and implementation of this master plan can help align USAID interventions with government priorities.

Interviews cited limited energy efficiency scale-up after donor-driven funding programs end and a lack of institutional champions. Therefore, potential USAID interventions should prioritize securing government champions, including active participation from distribution companies, and supporting the long-term sustainability of energy efficiency programs. USAID interventions should focus on the highest-emitting sectors: industry (estimated to be 50 percent more energy-intensive than international benchmarks⁶²) and buildings, given that Egypt will require an additional 3.8–4.2 million housing units by 2030, along with nonresidential buildings.⁶³

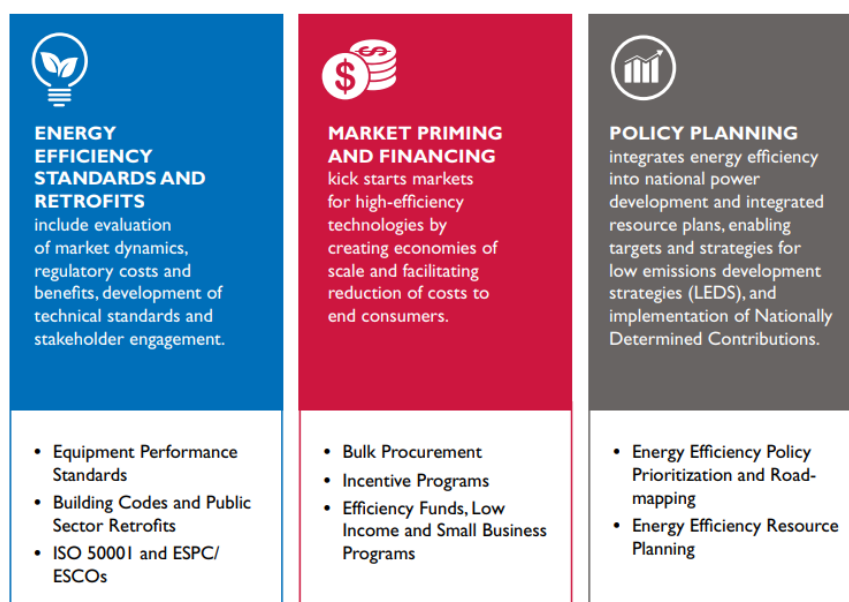
Potential interventions

USAID can provide support around key energy efficiency building blocks to achieve market penetration of high-efficiency technologies: 1) energy efficiency standards and retrofits that “raise the floor” and cut out the worst-performing elements of the market; 2) market priming and financing, which “raise the ceiling” by stimulating adoption; and 3) policy planning, which seeks to promote rational decision-making and least-cost outcomes by integrating energy efficiency into power development plans and policy decisions.

⁶² Interview with Chemonics Egypt February 2023.

⁶³ World Bank, *Egypt Country Climate and Development Report*, 2022.

Figure 4. Building blocks of energy efficiency



Source: USAID Scaling Up Energy Efficiency in Developing Countries, 2020

- Support the GOE to establish a centralized champion, responsible for coordinating within and across government institutions and strengthening energy efficiency programs. This could build on existing NEEAP efforts to establish energy efficiency units in various economic sectors throughout the government, drive further initiatives such as the development of energy service companies, and better align incentives between government entities.
- Undertake a study on the quality and performance of codes and standards. Egypt has adopted a set of codes and standards for equipment, buildings, and larger industrial clients. These programs can be quite effective, even in markets where consumers are not incentivized to choose energy efficiency on the basis of cost, because they set a floor on performance that can impact the entire market. In many places, however, standards are set too high to have an impact, or there are other issues, such as enforcement. This analysis is beyond the scope of the current assessment and would be the first step in engaging in this space. In South Africa, a similar activity achieved considerable impact, and USAID helped review and update the country's minimum energy performance standards. This low-budget activity is expected to result in avoiding capacity equivalent to a 1.2 GW thermal plant.⁶⁴
- Work with distribution companies to promote energy efficiency. Egypt's NDC calls for "activating the role of the distribution company" to achieve energy efficiency. Currently, the distribution company may see energy efficiency as a threat to its core business of selling energy, especially if high-rate classes adopt energy-efficient technologies first. If a program could address this by mandating or incentivizing distribution companies to support energy efficiency, the company would create a pathway to scale for whatever energy efficiency measures are adopted. (For instance, in Jordan, the distribution company supported the uptake of LED lighting.)

⁶⁴ USAID, *Success Story: Energy Efficiency Standards and Labeling in South Africa*, 2021, https://pdf.usaid.gov/pdf_docs/PA00XHNI.pdf

- Support the design of an incentive program for energy efficiency. The first step would be to work with a relevant GOE counterpart (for instance, the Ministry of Finance) to study the potential financial benefits of an energy efficiency program. In an environment of subsidies, the benefits of an incentive program would accrue to the GOE and not the end user, and the case for this benefit would need to be made. In Mexico, for instance, USAID has supported a pilot program to rechannel electricity subsidies to energy efficiency upgrades and distributed solar for low-income consumers, decreasing costs for both the government and the end users.⁶⁵

Why USAID may or may not support this area

- Energy efficiency measures, if implemented, could have significant impact. The draft energy efficiency master plan targets an 18 percent reduction from energy consumption in the business-as-usual scenario by 2035. This is nearly as large as the carbon mitigation potential from an estimated 38 GW of new renewable energy generation capacity.
- Historically, energy efficiency efforts may have been stymied by high electricity subsidies. Egypt has plans to continue reducing subsidies, and as they move forward, the market environment may become more conducive to energy efficiency.
- Comprehensive energy efficiency programming in either the industrial or building sector requires engagement with and awareness of a range of actors beyond the power sector, including consumers, vendors, financiers, and distinct skills. Frequently, these efforts must be sustained over time.
- European donors have already invested considerably in energy efficiency and continue to have programming that has shown limited success; there does not appear to be a fully functioning coordinating body for energy efficiency activities within the GOE. USAID also has a multi-decade history of providing support for energy efficiency programs in Egypt. It is possible that a review of the results of these investments would help guide the energy efficiency program recommendations contained here.
- Discrete energy efficiency measures can be integrated into a power sector-focused program based on shared programmatic objectives (e.g., distribution company load management) rather than stand-alone energy efficiency programming.

5.3.2. DISTRIBUTED RENEWABLE ENERGY

In addition to contributing to the 42 percent target by 2035 and decarbonization goals, scaling the deployment of distributed renewable energy can help meet equity, inclusion, and job creation goals and improve end-user experience. As an early-stage market, key barriers include the following:

- Limited financial attractiveness due to subsidies, the prevailing exchange rate, and inadequate policy incentives (FIT and own consumption)

⁶⁵ “ICM propone transformar subsidios eléctricos en bonos solares para generación distribuida,” *Energía Estratégica*, December 17, 2020, <https://www.energiaestrategica.com/icm-propone-transformar-subsidios-electricos-en-bonos-solares-para-generacion-distribuida/>

- Lack of awareness of benefits and perceived risk of technologies
- Limited project pipeline and financing available
- Limited assurance of the quality and long-term sustainability of technologies.

USAID/Egypt has two initiatives with energy work streams that are supporting the deployment of small-scale renewables. Both initiatives could provide platforms for collaboration to support the growth of distributed renewable energy markets:

- The COEE, launched in 2021, partners with three local universities on curriculum development, research, policy dialogues with the government, and technical certificates, among other areas. The COEE is developing a sustainability plan and committee to secure the long-term sustainability of the program.
- Business Egypt is a five-year program that supports entrepreneurs, including small-scale renewables developers and small and medium-sized enterprises, through incubators, accelerators, and centers of excellence.

Potential interventions

- Support EgyptERA to develop regulations: distributed renewable energy is currently regulated by circulars, the lowest level of regulation. This allows for dynamism in the space, but also may fail to provide certainty to market participants. While the current net-metering regulation has failed to result in large growth of distributed renewable energy, adjustments to the regulations may help support growth in the sector.
- Work with the banking sector on finance for commercial and industrial clients. While these clients might see a benefit to installing renewable energy, the banking sector typically lags in offering the long-tenor financing products needed for the financial viability of renewable energy installations. USAID could help banks understand the business models and develop the right financial products for the space.
- Build the capacity of the government, private sector, and consumers to assess the cost and benefits of installing distributed renewable energy to meet their energy needs.

Why USAID may or may not support this area

- Distributed renewable applications have a number of benefits over large-scale renewables:
 - They provide electricity at the demand point, and therefore do not require large grid expansion investments.
 - They have shorter development and installation lead times (days to months, depending on the size) rather than years.
 - They can be a tool for poverty alleviation and reduction of commercial losses through utility renewable energy service company (RESCO) business models.

- Distributed renewable energy presents challenges to the operation and planning of the system and requires complementary support to strengthen distribution utilities (see section 5.2.3).
- Unlike efforts to scale centralized renewable energy, distributed renewable energy is less dependent on government counterparts. USAID may have opportunities to achieve impact by working with financial institutions and the private sector if and when there are delays in GOE-focused efforts.
- Unlike for large-scale renewable energy, the GOE has not explicitly set targets for distributed renewable energy.

5.3.3. ELECTRIC MOBILITY

Transport is the fastest-growing sector in Egypt; it accounts for 30 percent of energy consumption, is the second-largest emitter of CO₂ emissions, and is one of the largest emitters of other types of air pollution.⁶⁶

The GOE has pursued efforts in electric mobility, driven first by air pollution, then by climate change priorities. The NCCS also sets a direction to expand mass transit networks based on electricity, such as metro networks, electric trains, and buses. Most recently, the GOE issued a regulation to license and set tariffs for charging stations. However, interviewees indicated that this tariff does not sufficiently incentivize entry.

A key concern is Egypt's readiness for the uptake of electric mobility given complex subsidization schemes, grid readiness, and availability of supply. The GOE's current thinking is that additional demand will be supplied from wind, solar, and green hydrogen. However, unlike for desalination, green hydrogen, and telecommunications, there are no plans considered for dedicated generation to supply electric mobility.

Supporting the electrification of transport will require strengthening the power distribution system, expanding transmission capacity to serve new loads, developing methods to ensure that electric vehicle charging occurs at times of day when there is low-cost electricity, and strengthening the planning capacity needs of energy sector actors, including distribution companies, EETC, EEHC, and EgyptERA. These are areas where USAID can play a substantial role as it supports the N-EP.

Potential interventions

- Build capacity around planning, including demand and grid studies for charging stations and potential for on-site renewable energy storage.
- Support pilot projects, including feasibility studies and mobilization of finance.

⁶⁶ World Bank, *Egypt Country Climate and Development Report*, 2022.

Why USAID may or may not support this area

- Transport is the fastest-growing and second-largest emitter, presenting substantial opportunities for decarbonization through electrification.
- Electric mobility is nascent in Egypt, with no single entity championing it. While getting this industry started and to scale will take a long time, early entrance may give USAID a leading role, along with the World Bank and the Japan International Cooperation Agency.
- This area is not yet prioritized by the GOE.

5.4. CROSS-CUTTING ACTIVITIES TO ADVANCE USAID/EGYPT'S CDCS

While the Country Development Cooperation Strategy (CDCS) does not explicitly include energy sector activities, the proposed energy interventions should contribute to its three development objectives by design: strengthened GOE institutions, enabling conditions for social equity, and inclusive economic development. The team identified cross-cutting considerations and interventions that can be considered to advance transparency, gender equality, environmental practices, and circular economy principles.

5.4.1. REPORTING OF ENERGY PERFORMANCE INFORMATION

Public reporting of performance metrics helps keep the sector accountable, improve governance, enable private sector participation, and track the benefits and challenges of decarbonization efforts. Multiple factors indicate that public reporting in Egypt's power sector is low by international standards:

- **Annual reports.** EEHC produces an annual consolidated report for all public utilities in the power sector, with limited disaggregation by company. The report does not include measures of subsidies or financial cost recovery, nor common measures of reliability such as system average interruption duration index (SAIDI) and system average interruption frequency index (SAIFI). However, more complete reporting may be available in individual agencies and companies. These additional reports may be available to the boards of directors and other senior management. This assessment did not examine internal reporting.
- **Cost of service and cost recovery.** MoERE and EgyptERA do not report cost of service and cost recovery.
- **Information on reliability and outages.** Key performance metrics, including on system outages and supply interruptions (such as SAIDI and SAIFI), are not available on the Internet or in EEHC's annual report.
- **Board of director reports.** Board and audit reports and minutes do not appear to be public.
- **Financial statements.** Statements of accounting policies do not appear to be available for Egyptian public electricity utility entities.
- **Regulatory information.** EgyptERA does not appear to publish performance evaluation and evaluation factors for distribution utilities.

- **Information on the 28 GW National Renewables Development Program.** News articles about the 28 GW are available on the Internet, but no information is available online about the terms of these MOUs, including pricing, locations, processes of public information and comment, environmental procedures, and so forth.

Potential interventions

- Provide technical assistance and capacity-building, including twinning and study tours on public reporting and involvement in public power utilities.
- Raise awareness and provide executive leadership training of board members on a corporate governance program.

Why USAID may or may not support this area

- The availability of information on Egypt's power sector is low compared to that of other emerging markets of its size and sophistication, and therefore, there is room for improvement.
- We expect high political sensitivity regarding national governance issues.

5.4.2. GENDER EQUALITY AND SOCIAL INCLUSION

As Egypt embarks on a massive transformation, it is important to ensure equitable economic prosperity. A 2017 World Bank study found that women's overall labor force participation rate in the power sector is about 21 percent.⁶⁷ It also found that the top barriers to women entering the sector include:

- Lack of science, technology, engineering, and mathematics (STEM) background in the talent pool⁶⁸
- Perception of gender roles, or how women are viewed in society in terms of the role they can play within the sector⁶⁹
- Limited mobility due to family-related commitments, which can restrict their ability to travel for work, and safety concerns, which affect women's ability to work long hours in remote places.

Globally:⁷⁰

- Women and gender considerations are often excluded from decision- and policymaking in the energy and renewable energy sectors.
- Women-led businesses and female professionals are underrepresented in the renewable energy sector.

⁶⁷ EBRD and Green Climate Fund, *Why Gender Inclusion Matters?*, 2023.

⁶⁸ Study participants reported that they did not receive enough applications from women with a STEM background.

⁶⁹ Some study participants expressed the view that having women on-site could be problematic, as workplace culture may not always be accepting of women.

⁷⁰ USAID, *SURE Gender Strategy*.

- Women and girls are disproportionately impacted by energy poverty compared to men and boys.

Beyond the context of the N-EP just energy transition and the workforce development components within its interventions, the assessment team did not collect information on other aspects of social inclusion, such as access or land tenure for solar, wind, and hydrogen sites or business models for sharing benefits from energy projects with local communities. USAID's [Auction Design and the Social Impact of Renewable Energy Projects](#) compiles global case studies that can be tailored to the Egyptian context. These aspects should be further studied so that USAID can develop targeted interventions.

Potential interventions

- Support the systematic integration of considerations of gender equality and women's empowerment into USAID activities and help break away from the unequal gender status quo in the energy sector, raising awareness among stakeholders to increase gender equality and women's political, social, and economic participation in the sector.
- Cooperate with USAID's flagship Engendering Industries program, which works to advance gender equality in male-dominated sectors throughout the world. This intervention would involve developing and delivering (annually) an Egypt-specific version of Engendering Industries' Workforce Gender Equality [Accelerated Program](#), a leadership program that develops the skills and tools needed to increase gender equality, diversity, and inclusion in the workforce. Through such a program, USAID can work with both public and private entities to build their tools and capacity and can provide grants to institutions committed to implementation.
- Work with the GOE to help strengthen laws, regulations, and policies that increase gender equality, diversity, and inclusion in the workplace, building on the work of EBRD and others.
- Develop male engagement strategies and workshops tailored to the Egyptian context.

Why USAID may or may not support this area

- USAID has substantial and tangible results in this area in public and privately owned utilities, private sector companies, and government institutions.
- Despite the fact that a handful of high-visibility positions are occupied by women, Egypt is at a very early stage of integrating women into the workforce. High-impact interventions may be met with resistance and will require trust-building from GOE officials.

5.4.3. ENVIRONMENTAL PRACTICES

Building an estimated 38 GW of renewable energy in Egypt's deserts will potentially have very large environmental impacts. One of the areas where USAID might consider support to the GOE and renewables industry is in the protection and monitoring of migratory birds. Egypt hosts major migratory bird populations during their annual migration cycles. Wind farms are a significant threat that the

Egyptian Minister of Environment estimated could cause 30 percent mortality among birds along the Red Sea if not properly mitigated.⁷¹

For example, the Lekela Wind Farm, one of Egypt's first large-scale wind installations, has put in place a comprehensive program to minimize harm to transnational migratory bird populations. This program includes various elements designed according to global best practices, including the following:

- Monitoring of bird migration events through both direct human observation and radar.
- Oversight of bird mortality to track the effectiveness of the program.

In general, building and operating an estimated 38 GW of wind and solar generation will have environmental and biological impacts. These can be mitigated by the GOE, lenders, and equity investors properly following environmental impact analysis and management regulations. This is both a matter of continually improving standards and practices and properly enforcing those standards. The risk could also be mitigated to some extent by involving environmental NGOs in monitoring the broader environmental footprint of the large-scale renewables program.

Potential interventions

The assessment team does not have an environmental or biological damage mitigation specialist due to the short duration and scale of the assessment. Possible interventions should be developed by experts in these fields with current knowledge of global best practices for large-scale wind and solar development.

Why USAID may or may not support this area

USAID would need to determine what other donor and NGO assistance is being proposed for the environment and biological risk management area.

5.4.4. CIRCULAR ECONOMY PRINCIPLES

Deployment of an estimated 38 GW of renewable energy equipment in Egypt will result in the accumulation of waste after the equipment reaches the end of its useful life. Applying circular economy principles maximizes products' life spans and resource recovery, resulting in less waste, lower emissions, and fewer resources extracted; it also leads to resilient supply chains that are less dependent on imports. Such practices can also drive emerging businesses, marketplaces, and jobs to localize reuse, repair, remanufacture, and second-life applications of used renewable energy equipment. Examples of global applications include life cycle extension services such as repair centers and remanufacturing; reverse logistics and innovative packaging businesses to take back end-of-life or damaged equipment; recycling plants to recover materials and feed them back to production plants; and second-life applications of used equipment such as marketplaces for secondhand or refurbished PV panels, repurposing of used batteries for off-grid applications, or reuse of PV panels for educational purposes in vocational institutions and training centers.

⁷¹ Samar Samir, "Safe flyway in Egypt: How did mortality rate of migrating birds over wind power farms decline to 1 percent?" *Egypt Today*, October 10, 2022, <https://www.egypttoday.com/Article/1/119761/Safe-flyway-in-Egypt-How-did-mortality-rate-of-migrating>

Potential interventions

- Use the USAID Scaling Up Renewable Energy (SURE) program's Circular Economy Enablers Framework to identify context-appropriate emerging circular economy economic opportunities, such as business models focused on reuse, repair, recycling, remanufacturing, and logistics of end-of-life renewable energy equipment.
- Work with the GOE and facilitate cross-sector collaboration between the energy sector and the waste management sector to develop necessary laws and regulations that include circular economy principles. The GOE has an opportunity to take necessary preemptive measures before waste resulting from end-of-life renewable energy equipment accumulates.
- Explore the use of sustainability standards in procurement documents and contracts to encourage end-of-life management and design for recycling, and promote the transition from a linear economy to a circular economy. For example, the World Bank uses EPEAT silver I in its vendor code of conduct as a minimum specification for its public and private sector institutional purchasers globally. EPEAT is managed by the Global Electronics Council and is the leading life cycle-based Type-I ecolabel.

Why USAID may or may not support this area

- Because the life span of renewable energy equipment is up to 25 years, this problem is not an immediate or urgent problem for Egypt yet.
- The circular economy is a nascent topic for USAID and for the energy sector at large. Emerging interventions by the public and private sector in this space are not holistic and are often product-specific, targeting specific segments of the value chain.
- This is a strategic area that aligns with USAID's Climate Strategy and addresses a wide range of USAID priorities related to gender equality and social inclusion, job creation, private sector engagement, critical minerals, countering malign influence, resilient supply chains, and localization. Support in this area can help further position USAID as a leader in the circular economy space.

6. CONCLUSION AND NEXT STEPS

USAID has committed funding to help the GOE and the private sector make the N-EP programs work. However, the N-EP should be considered in the broader context of the larger GOE renewable energy initiatives. The GOE has commitments for an estimated 38 GW of renewable generation, enough to replace over 25 percent of Egypt's CO₂ emissions. If this succeeds, the impact on carbon emissions will be huge and progressive. It will have a major impact on the availability of gas for other uses, including exports. Over time, it will also give Egypt's power sector access to very-low-cost generation as well, thereby containing the cost of energy for the entire economy.

But large-scale renewables cannot be achieved without a modernized and expanded grid, which will require comprehensively remaking Egypt's grid. It will also require new ways of trading electricity as well as liberalized power markets. In this sense, large-scale decarbonization depends on success in the large-

scale renewables program, combined with new market mechanisms and the liberalization of the energy market.

In addition, there are opportunities to support Egypt's ambitions to achieve a power sector that is modern, efficient, and high-performing and to become a regional energy hub, which will support Egypt's energy transition. Further decarbonization of the sector can occur through sustainable end-use energy efficiency, promotion of distributed renewable energy, and the electrification of electric vehicles.

Possible next steps:

1. Reach consensus within USAID on the focus of USAID/Egypt's energy program.
2. Gain agreement from the GOE on USAID's support for a new energy program, including the focus on large-scale renewables and on making the grid capable of managing renewables. Include agreement to support the development of electricity markets as an added focus area.
3. Make preliminary decisions on implementation options.
4. Given procurement timelines, consider some transitional implementation arrangements. Options might include the following:
 - 4.1. Buy in to NREL contract to work on grid studies and integration advice.
 - 4.2. Buy in to the United States Energy Association to involve one or more U.S. ISOs in early advisory work on coping with large-scale renewables as well as market and grid development.
 - 4.3. Buy in to the National Association of Regulatory Utility Commissioners to hold dialogues with EgyptERA on regulating large-scale renewables and the energy transition.
5. Gain preliminary agreement from the GOE and nongovernmental implementing partners prior to undertaking a full design.
6. Design program.

ANNEX I – INTERVIEWEES

The team met with key public- and private sector energy representatives, including the chairs of EEHC, EETC, and the Suez Economic Zone. Team members also met with Egyptian energy companies, including Taqa Arabia, Infinity, Lekela, and Siemens Gamesa.

Table 2. Meetings held February 7-27, 2023

DATE	INSTITUTION
07-Feb	EBRD
09-Feb	International Finance Corporation
09-Feb	World Bank
12-Feb	Mazghouny Law Firm
13-Feb	Siemens GAMESA
14-Feb	Lekela
14-Feb	Infinity
15-Feb	German Embassy, GIZ, KfW
15-Feb	TAQA Arabia
19-Feb	Chemonics
20-Feb	ECO-FEI
21-Feb	Suez Economics Zone

ANNEX II – INDICATIVE PROJECTS IN THE N-EP

The indicative projects in the technical note include the following:

- 500 MW of wind under the existing Gulf of Suez II wind farm contract, with construction expected to start in late 2022.
- 270 MW of solar to be tendered for construction on the unused plots at the Benban Solar Park, with construction expected to start in the second half of 2023.
- 200 MW of wind under the existing Ras Ghareb wind farm contract, with construction expected to start in the second half of 2023.
- 200 MW of solar under the existing Kom Ombo solar farm contract, with construction expected to start in the second half of 2023.

- 1,100 MW of wind under a contractual arrangement with ACWA Power, replacing the previously tendered Dairut thermal power plant, with construction expected to start in 2024.
- 500 MW of solar under the existing Kom Ombo solar farm contract, with construction expected to start in mid-2024.
- 1,000 (2x500) MW of solar power under the existing Gulf of Suez contract, with construction expected to start at the end of 2024.
- Around 3,000 MW of wind and solar to be tendered under competitive procedures to domestic and international developers in 2023–2028 and constructed in the West Nile area.
- A further 3,230 MW of wind and solar capacity developed by private developers on land from the GOE in the East Nile area. The renewable energy produced by these plants is expected to be sold to other entities and utilized to produce green hydrogen.

ANNEX III – PLANTS IDENTIFIED FOR DECOMMISSIONING

According to the N-EP Technical Note of August 2022, the N-EP targets the retirement of 5,000 MW of existing capacity, comprising 42 units across 12 plants, primarily located in the north of the country.

Table 3. Plants identified for decommissioning (data from fiscal year 2020–2021)⁷²

PLANT	LOCATION	CAPACITY (MW)	ANNUAL ELECTRICITY GENERATION (GROSS) MWH	GAS CONSUMPTION (M ³ , MILLION)	HEAVY FUEL OIL CONSUMPTION (TONS)	ANNUAL CO ₂ EMISSIONS (TONS)
Shoubra El-Kheima (St)	Cairo	1,295	5,534,314	982	517,451	3,945,734
Damietta (CC)	Damietta	600	2,461,975	564	-	1,264,146
Abo Sultan (St)	Ismailia	600	1,376,140	251	145,599	1,052,658
Arish (St)	North Sinai	66	444,563	143	-	319,790
Talkha 210 (St)	Dakahlia	420	367,059	108	2,506	250,224
Ataqa (St)	Suez	600	245,351	77	-	172,481
Abu Qir (St)	Alexandria	600	204,545	60	-	135,022
Cairo South (CC)	Cairo	165	72,977	23	-	51,079

⁷² N-EP Technical Note, August 2022.

PLANT	LOCATION	CAPACITY (MW)	ANNUAL ELECTRICITY GENERATION (GROSS) MWH	GAS CONSUMPTION (M ³ , MILLION)	HEAVY FUEL OIL CONSUMPTION (TONS)	ANNUAL CO ₂ EMISSIONS (TONS)
Mahmoudeya (CC)	Beheira	159	11,710	6	-	12,338
Talkha (CC)	Dakahlia	191	10,079	4	-	8,104
Kafr El-Dawwar (St)	Beheira	220	0	-	-	-
Damanhour (CC)	Beheira	83	0	-	-	-
Grand Total		4,998	10,728,713	2,217	665,555	7,211,575

Based on historical data from EEHC, it is estimated that this group of installations is responsible for a net supply of about 10 million MWh of electricity (5 percent of total domestic generation), emitting around 7 million tons of CO₂ annually.

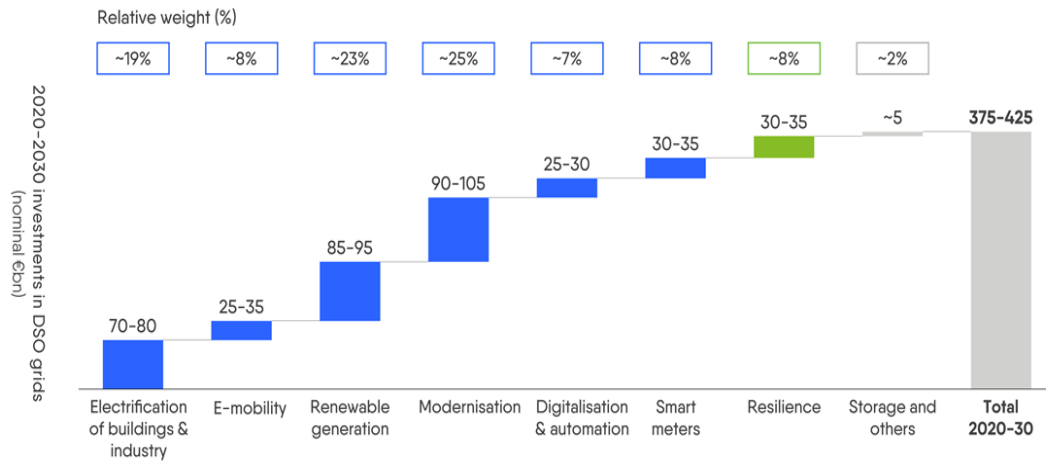
ANNEX IV – INTERNATIONAL BENCHMARKS FROM EUROPEAN AND U.S. GRID MODERNIZATION PROGRAMS

U.S. grid investment in both transmission and distribution began to rise quickly after about 2005, as the wind and solar generation fleets in the United States took off. Grid investments have more than doubled since, to \$50 billion per year.

Eurelectric, the European power industry association, explains that this rising investment is not just for renewables; it actually serves multiple new developments in a transitioning power system, as explained below (Figure 5). It estimates that about €375 to €425 million (\$399 to \$453 million) in new investment is needed in the European distribution grids between 2020 and 2030 to cope with the energy transition.⁷³ This trend toward heavy and accelerating grid investment would apply to Egypt as well, although at what magnitude needs to be determined by more careful planning.

⁷³ Eurelectric, “Connecting the dots: Distribution grid investment to power the energy transition,” n.d., <https://www.eurelectric.org/connecting-the-dots/>

Figure 5. Key investment drivers: modernization, renewables, and electrification



Source: Distribution system operators and national associations; Monitor Deloitte