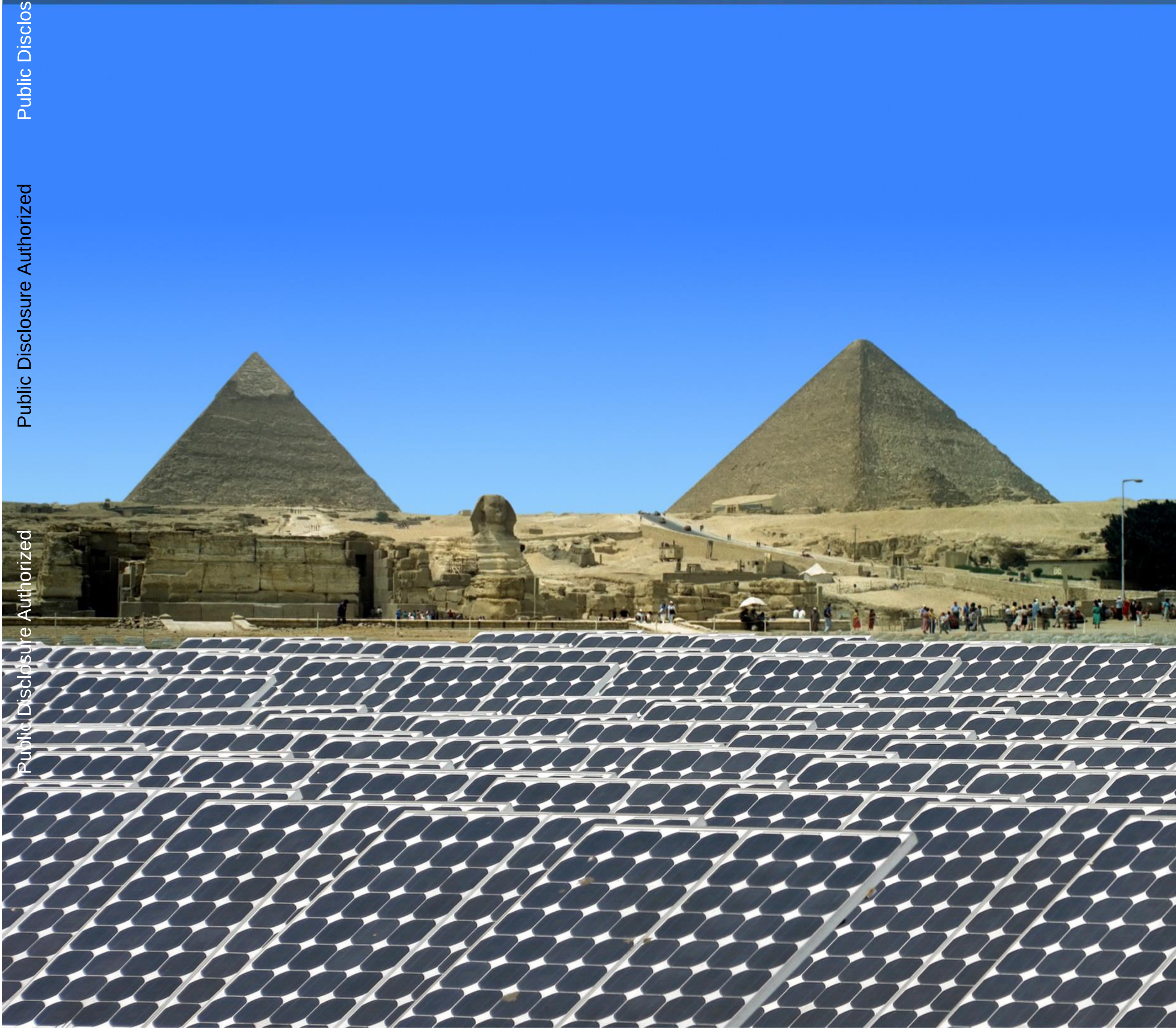
THE WORLD BANK

ESMAP
Energy Sector Management Assistance Program

JOB CREATION AND SKILLS DEVELOPMENT DURING THE ENERGY TRANSITION - EGYPT

JAN 2024 // PREPARED BY THE WORLD BANK MENA ENERGY



International Bank for Reconstruction and Development

The World Bank Group

1818 H Street NW, Washington, DC 20433 USA

DISCLAIMER

RIGHTS AND PERMISSIONS

Please cite this work as follows: World Bank. 2024. “The Disruptive Energy Transition and Opportunities for Job Creation in the Middle East and North Africa: Case Study—Egypt.” World Bank, Washington, DC.

Cover: Solar panels and the Pyramids in Egypt.

Photo credits: © EDG /Shutterstock

CONTENTS

LIST OF BOXES

LIST OF FIGURES

LIST OF TABLES

Abbreviations

CAPMAS	Central Agency for Public Mobilization and Statistics
CSP	concentrated solar power
EBRD	European Bank for Reconstruction and Development
ECO FEI	Environmental Compliance Office of the Federation of Egyptian Industries
EEHC	Egyptian Electricity Holding Company
EETC	Egyptian Electricity Transmission Company
EgyptERA	Egyptian Electricity Utility and Consumer Protection Agency
EMIS	education management information system
ENCPC	Egypt National Cleaner Production Centre
ESMAP	Energy Sector Management Assistance Program
EV	electric vehicle
GDP	gross domestic product
GIZ	German Agency for International Cooperation
GW	gigawatts
GWh	gigawatt-hours
ICT	information and communication technology
ILO	International Labour Organization
ISES	Integrated Sustainable Energy Strategy.
JCEE	Egyptian-German Joint Committee on Renewable Energy, Energy Efficiency, and Environmental Protection
LED	light-emitting diode
LFS	Labor Force Survey
LMIS	labor market information system
MENA	Middle East and North Africa
MoE	Ministry of Environment
MoERE	Ministry of Electricity and Renewable Energy
MoETE	Ministry of Education and Technical Education
MoHESR	Ministry of Higher Education and Scientific Research
MoM	Ministry of Manpower
MoPED	Ministry of Planning and Economic Development

MoPMR	Ministry of Petroleum and Mineral Resources
MoSEA	Ministry of State for Environmental Affairs
MW	megawatt
NEEAP	National Energy Efficiency Action Plan
NREA	New and Renewable Energy Agency
O&M	operation and maintenance
OPEC	Organization of the Petroleum Exporting Countries.
PV	photovoltaic
PVTD	Productivity and Vocational Training Department
R&D	research and development
RCREEE	Regional Center for Renewable Energy and Energy Efficiency
RE-ACTIVATE	Renewable Energy and Energy Efficiency in the Middle East and North Africa
RENAC	German Renewables Academy
SMEs	small and medium enterprises
SSCs	sector skills councils
SWH	solar water heater
TU	technological university
TVET II	Technical and Vocational Education and Training Reform Project—Phase II
TVET	technical and vocational education and training
UNIDO	United Nations Industrial Development Organization
WEF	World Economic Forum
WISE	Workforce Improvement and Skills Enhancement Project

ACKNOWLEDGMENTS

The Energy Sector Management Assistance Program (ESMAP) is a partnership between the World Bank and 24 partners to help low- and middle-income countries reduce poverty and boost growth through sustainable energy solutions. ESMAP's analytical and advisory services are fully integrated within the World Bank's country financing and policy dialogue in the energy sector. Through the World Bank, ESMAP works to accelerate the energy transition required to achieve Sustainable Development Goal (SDG) 7 to ensure access to affordable, reliable, sustainable, and modern energy for all. It helps to shape World Bank strategies and programs to achieve the World Bank's Climate Change Action Plan targets.

This report on Egypt is one of three country case studies under Phase 2 of an umbrella project, **The Disruptive Energy Transition and Opportunities for Job Creation in the Middle East and North Africa**. This project, made possible by funding from ESMAP and the Climate Support Facility, was initiated in 2019 in response to requests from various governments in the Middle East and North Africa (MENA) to explore the nexus between the clean energy transition and employment. Phase 2 of the umbrella project was led by Tu Chi Nguyen and Ashok Sarkar (MENA Energy and Extractives Global Practice, World Bank) and includes Alpha Balume, Cornelia Jesse, Manjula Luthria, and Yao Zhao.

This report was authored by the EY-Paris team, including Alexis Gazzo, Jean-Gabriel Robert, Camille Decoopman, and Meryem Ben Dhiaf, as well as Ghada Amin and Ihab Elmassry (consultants in Egypt).

The task team wishes to thank senior management in the World Bank, particularly Paul Noumba Um (Regional Director, MENA Infrastructure), Husam Beides (Practice Manager, MENA Energy and Extractives Global Practice), and Erik Fernstrom (former Practice Manager, MENA Energy and Extractives Global Practice), for their continued support and guidance. We also thank Xiaonan Cao and Zuzana Dobrotkova for their peer review comments.

Questions on this report may be directed to Tu Chi Nguyen (tnguyen19@worldbank.org), Ashok Sarkar (asarkar@worldbank.org), and Yao Zhao (yzhao5@worldbank.org).

EXECUTIVE SUMMARY

THE ENERGY TRANSITION IS A DRIVER FOR THE CREATION OF DECENT AND INCLUSIVE GREEN JOBS IN EGYPT.

The clean energy transition is expected to have a positive impact on the Egyptian labor market by creating over net 67,000 jobs per year over the period 2020 to 2050.

Egypt has set ambitious targets for the growth of the renewable energy and energy efficiency sectors. The Sustainable Development Strategy: Egypt Vision 2030 (MoP 2015) states that overall economic energy intensity shall decline 14 percent by 2030 compared to 2015, meaning a massive increase in energy efficiency. The Egypt National Climate Change Strategy 2050, published in May 2022, and the First Updated Nationally Determined Contributions, submitted in June 2022, state that the share of renewable energy is expected to be about 40 percent of the electric generation capacity in 2030 and that it should reach 42 percent in 2035. While 6.5 gigawatts (GW) of renewable energy already exist, an ambitious Nexus of Water, Food and Energy (NWFE) program was recently announced to add 10 GW of renewable energy. The Sustainable Development Strategy is being updated to raise the renewable energy share.

The clean energy transition, by driving the growth of the renewable energy and energy efficiency sectors, should have a positive impact on the Egyptian labor market. Investments to achieve the renewable energy and energy efficiency targets of 2030 alone could support the creation of 67,000 net jobs per year over the period 2020–50 in Egypt (a number that would benefit 2.2 percent of the unemployed in 2020), according to the results of the first phase of the World Bank project, **The Disruptive Energy Transition and Opportunities for Job Creation in the Middle East and North Africa** (World Bank 2022a).

THIS STUDY IDENTIFIES OPPORTUNITIES TO OPTIMIZE EGYPT'S GREEN JOB POTENTIAL

In this second phase of the same project, the World Bank aims to assess the opportunities and challenges to realize this job creation potential and to help countries formulate, adopt, and implement relevant policies, incentive systems, infrastructure, institutions, programs, and human capital development frameworks. In particular, frameworks will support an enabling environment for job creation and transformation, particularly to develop the green workforce necessary for the clean energy transition. This report focuses on the renewable energy sector (solar photovoltaic, concentrated solar power, and wind) as well as on energy efficiency in the buildings sector. Aside from providing inputs to clean energy and education projects, this study has also informed the recent Egypt Country Climate and Development Report. To meet this objective, the study has drawn on the following sources of information:

1. Review of relevant literature to better understand national contexts and other similar studies.
2. Eleven in-person interviews with public and private entities involved in the energy transition sector.
3. An online survey collecting data on the general operations of Moroccan renewable energy and energy efficiency companies, and their perceptions of the obstacles to job recruitment.
4. Interviews with three companies operating in the renewable energy and energy efficiency sectors to deepen the results of the online survey.

FIRMS IN THE CLEAN ENERGY VALUE CHAIN IDENTIFIED HIGH-LEVEL TECHNICAL SKILLS AS DIFFICULT TO FIND IN THE LOCAL MARKET

The analysis maps the jobs needed along the value chains for each phase of renewable energy or energy efficiency project development and operation, from planning to decommissioning. It identified the jobs created by the growth of the renewable energy sector to include solar installers, solar/wind turbine service technicians, solar/wind plant managers, and quality engineers. Since energy efficiency projects cover a wider range of sectors, job creation has a broader scope and includes energy efficiency auditors and managers. At the same time, there are jobs in conventional energy that can be converted to work in renewable energy and energy efficiency through retraining, which is beneficial given the large oil and gas sector in Egypt. However, the online survey revealed that companies mostly employ highly skilled workers, and some skills are deemed difficult to find, such as systems and risk analysis (for plant managers and technicians), innovation (for engineers), strategy and leadership (business developers and plant directors), and environmental awareness.

STAKEHOLDERS IDENTIFIED A SKILLS MISMATCH ACROSS GOVERNORATES AND AMONG YOUNG GRADUATES

As per the international literature, the main levers for job creation, particularly in developing countries, include business development. Net job creation is typically led by a few start-ups. Policy makers also play a major role in job creation. They can support this process by making technology, capital, and finance available, or by promoting business networks. Similarly, labor market policy plays a central role in supporting job creation. It is important to ensure that companies have access to people with the right skills so they can start up and grow. In addition, flexible training, education, and employment services are needed to address potential skills gaps that can act as barriers to business growth and expansion.

The overall business environment is favorable for renewable energy and energy efficiency development in Egypt, but companies have identified barriers like lengthy administrative processes and burdensome fees, the dominance of the public sector in the energy field, high interest rates for small and medium enterprises, and high up-front costs. The institutional structure for renewable energy and energy efficiency is also complex, creating some incoherence about the various initiatives.

In terms of the labor market, most jobs are concentrated in three governorates, economic inactivity is high among women, and unemployment is high among the educated and youth, raising issues about inclusivity. At the same time, companies are not satisfied with applicants' technical and soft skills, and at times opt for foreign workers. The skills shortages can be broken down into two types: a shortage of technicians (especially outside Alexandria, Cairo, and Giza) and a general shortage of *transversal* skills that pertain to critical thinking, leadership, and interpersonal skills transcending an occupational niche. These challenges mainly derive from the dearth of well-trained technicians, underinvestment in capacity building, and want of professional experience among young graduates.

TO REACH THE FULL JOB POTENTIAL OF CLEAN ENERGY TRANSITION, THE EGYPTIAN GOVERNMENT, LOCAL AUTHORITIES, EDUCATIONAL INSTITUTIONS, AND COMPANIES SHOULD CONSIDER THESE TWO PILLARS:

1. Clear institutional frameworks that boost investment in businesses and maximize job creation.
2. Hiring that prioritizes graduates of Egyptian educational and training systems or workers from Egyptian companies.

PILLAR 1: CLEAR INSTITUTIONAL FRAMEWORKS THAT BOOST INVESTMENT IN BUSINESSES AND MAXIMIZE JOB CREATION.

Many actors are involved in the launch of programs dedicated either to developing clean energy or to training that supports the job transition. While it shows a strong will of the government to accelerate a just job-enhancing clean energy transition, poor coordination and lack of communication among these actors sometimes have counterproductive effects—for example, overlapping programs. Therefore, there is a need to **reinforce the coordination among these complex institutional frameworks and to clarify roles** to better define and implement strategies and action plans.

Sectoral Skills Councils dedicated to the renewable energy and energy efficiency sectors should help link the ministries and organizations concerned with energy, jobs, and skills. These sector-specific organizations should have a skills development mandate to shift education and training systems from a focus on skills supply to skills demand. By supporting the development of training and tertiary and technical education programs that meet the needs of companies, such councils could prevent overlapping programs and ensure that challenges are both detected and addressed.

Clear frameworks and roles reinforce the trust of companies and investors in Egypt's clean energy transition, increasing private investments and consequently job creation. The energy efficiency sector in particular needs more investment given its strong growth potential and the risk perceptions of private companies. Workshops to raise awareness among companies of the economic and environmental benefits of investing in the sector would help address adverse perceptions.

PILLAR 2: HIRING THAT PRIORITIZES GRADUATES OF EGYPTIAN EDUCATIONAL AND TRAINING PROGRAMS OR WORKERS FROM EGYPTIAN COMPANIES.

To ensure that local graduates and workers are hired for jobs in the renewable energy and energy efficiency sectors, assessments **need to track gaps between skills** in the labor market and companies' needs. Assessments should look at current and prospective gaps.

To bridge gaps, the government should **raise awareness among companies regarding the importance of investing in employee training (through reskilling/upskilling short-term programs),** helping them to adapt to new skills requirements, especially for young graduates who are often thought to lack practical training. The government should also address two of the main challenges that workers encounter when they want to operate in clean energy: (1) the loss of income when training for clean energy, and (2) the cost of relocating to cities with job offerings (amid the heterogeneous geographical development of the clean energy market). Addressing these two challenges requires a monetary assistance fund. Such a fund could help companies attract a larger pool of applicants and skills and enable a fairer job transition through facilitated training and relocation fees.

As of now, the main gap identified is a critical shortage of skilled technicians. **More training programs dedicated to technicians** should therefore be created throughout all Egyptian governorates (not only where market demand is high) and should cover all renewable energy and energy efficiency technologies (instead of just photovoltaic solar). In addition, to boost the number of students choosing this career, such programs need to be presented as attractive alternate pathways to higher education. At the same time, **awareness should be raised to empower women** to study and work as technicians in clean energy, increasing the numbers of skilled technicians.

Future skills and occupations shortages may stem from mismatches between existing educational programs and future companies' needs, itself caused by the emerging and innovative nature of renewable energy and energy efficiency sectors. Labor market information is neither exhaustive nor regularly updated, so it cannot accurately reflect companies' needs. At the same time, the educational system does not track the professional outcomes of its graduates, a lack of knowledge that prevents them from gauging the relevance of their academic content. Consequently, clear institutional frameworks should name the actors (e.g., the sectoral skills councils, according to this report's recommendations) in charge of implementing (1) a **Labor Market Information System** that collects data and provides analysis of the occupations and skills companies need; and (2) an **Education Information System** in charge of collecting data and providing analysis on existing educational programs and the professional outcomes of their graduates. Skills and occupation gaps should be detectable from the data gathered by both systems, enabling program providers to hone their program offerings accordingly.

At the same time, **apprenticeships and on-the-job training programs,** which are an interface for the academic and the professional worlds, should be more structured and deployed nationally. While apprenticeships already exist, their visibility among companies is limited, hence the need for better structuring. Such programs could address several of the challenges noted above by helping: (1) implement the labor market and education information systems (as a source of information and a way to test the conclusions of these systems); (2) ensure that young graduates gain the experience they need to find jobs upon graduation without having to pay for additional practical training; and (3) encourage employers to take part in shaping educational content to foster helpful connections between education and the industry.

Table ES.1 A synopsis of recommendations to support the clean energy transition's job creation potential

Recommendation	Challenge addressed	Priority	Complexity
Recommendations to favor the growth of the renewable energy and energy efficiency sectors			
1. Create structured and coordinated institutional frameworks for both renewable energy and energy efficiency	Lack of coordination among the institutional frameworks creates overlapping outcomes and conceals some challenges	●●●	●●●
2. Establish sectoral skills councils dedicated to renewable energy and energy efficiency	Employers not engaged in shaping education and training programs; skills generated by existing programs are incommensurate with skills needed Few project-based/donor-funded initiatives address skills needed in renewable energy and energy efficiency	●●●	●●○
3. Make companies aware of the economic value that could result from investing in energy efficiency	Lack of investments in energy efficiency throughout Egypt	●●○	●○○
Recommendations to ensure that available jobs are occupied by local graduates and workers			
4. Create and implement a Labor Market Information System	Insufficient labor market information on skills needs and shortages	●●●	●●●
5. Create and implement an Education Management Information System	Data on professional outcomes incommensurate with the market's needs	●●●	●●●
6. Deploy more structured apprenticeships dedicated to renewable energy and energy efficiency	Market needs for skills not matched by educational/training programs; slow integration of new entrants into labor market Existing apprenticeship programs/schemes are unknown by companies	●●●	●●○
7. Dedicate monetary assistance to workers who want to work in the renewable energy and energy efficiency sectors so they can either get proper training or move out to their new jobs' locations	Income loss for workers wanting to get proper training, and relocation hardships for those who find jobs outside of their governorates	●●○	●●●

8. Create training programs dedicated to technicians, as alternative pathways to higher education	Pervasive shortages of training programs for technicians (not only in a few governorates), and for all the technologies (not only solar)	●●○	●●○
9. Raise awareness among companies and families regarding the inclusion of women in the renewable energy and energy efficiency sectors	Lack of inclusion of women in the renewable energy and energy efficiency sectors, workers who could be recruits for technician positions	●●○	●○○
10. Alert companies to the importance of investing in their employees' training	Employers underinvest in employee training that could prevent or reduce skills shortages	●●○	●○○

Note: Low: ●○○; Medium: ●●○; High: ●●●.

1. INTRODUCTION AND METHODOLOGY

Countries in the Middle East and North Africa (MENA) are among the global frontrunners in the clean energy transition. With favorable weather conditions and the current modest use of renewables (1 percent of total energy mix compared with the world average of 13 percent) (World Energy Council 2018), MENA has enormous growth potential in the use of solar and wind energy resources. With higher energy intensities across all demand-side sectors such as building, industry, public facilities, and services (compared with other countries and the global average), improvements in energy efficiency improvements promise significant gains.

Policy makers in many MENA countries, having recognized this potential for sustainable energy options, have recently begun to scale up their targets and investments in renewable energy and energy efficiency.

An energy transition can generate productive jobs that are critical for the region. The International Renewable Energy Agency (IRENA 2017) estimates that the transition could create 26 million jobs in the energy sector worldwide by 2050. The estimated job creation stems from greater labor intensity as the electricity sector shifts away from a centralized, fossil fuel–dependent supply chain and shifts toward the large-scale deployment of renewable energy and energy efficiency infrastructure and a supply chain dominated by smaller, private sector–owned distributed energy resources—working with demand-side management and demand response options.

More labor intensity and stronger technological shifts can both create and transform jobs (shifting skills profiles or altering job quality). The benefits of jobs created through the energy transition will have to be weighed against likely job eliminations in legacy subsectors and job categories. A well-managed job transition will be critical if the shift is to lead to net job creation and/or improved job quality, spurring economic development.

The World Bank, with funding from the Energy Sector Management Assistance Program (ESMAP)[1] and in collaboration with the Green, Resilient, and Inclusive Recovery in Morocco project, conducted an analytical activity to build evidence for the potential of job creation and employment shifts in Egypt so the country can formulate, adopt, and implement the policies, incentive systems, infrastructure, institutions, programs, and human capital development frameworks to create a conducive environment for job creation and transformation in ways that complement sustainable energy growth paths.

The first analytical phase estimates that the clean energy transition—reflected in the growth of the renewable energy and energy efficiency sectors—should have a positive impact on the Egyptian labor market through the creation of over 2 million net jobs/year over the period 2020–50 in Egypt. This phase included a deep-dive analysis on the opportunities and challenges of job creation and transformation in Egypt, focusing on sectors offering the best employment opportunities, in particular, the renewable energy sector (solar photovoltaic, concentrated solar power, and wind) and the energy efficiency of building sectors and their associated value chains (e.g., manufacturing, finance, support sectors), in addition to the development of policy recommendations that maximize opportunities and address the challenges identified.

[1] ESMAP is a partnership between the World Bank Group and 18 partners. Its focus is to help low and middle-income countries reduce poverty and boost growth, through environmentally sustainable energy solutions. More details can be found at http://esmap.org/node/70853.

METHODOLOGY

OVERALL APPROACH OF THE ANALYSIS

The report presents job creation in Egypt, its opportunities, and challenges, through the lens of the country's clean energy transition. Policies are recommended to boost the opportunities and to mitigate any identified challenges. The report was produced in three steps (table 1.1).

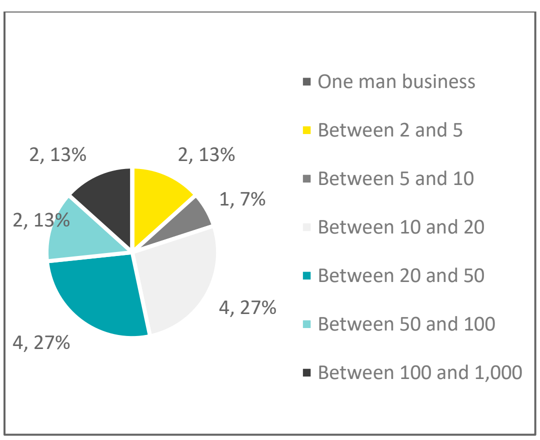
Table 1.1 The three steps followed in producing the report

Inception	Data collection	Data analysis
• **Overview of the initial work** performed by the World Bank *(Phase 1)* • Conduct of a preliminary literature review to **identify knowledge gaps** to be filled during the data collection phase	• In-depth **review of the existing literature** • Conduct of **interviews** of key public stakeholders • Release of an **online survey** intended for companies of the renewable energy and energy efficiency sectors	• **Analysis** of the collected data • Elaboration of **recommendations** • **Synthesis** in the present report

DATA COLLECTION

Several sources of information have been used throughout the analysis in order to gather the required data:

Figure 1.1 Number and size of firms surveyed



- **Literature review:** A review of available literature (e.g., recent market insights or socioeconomic impact assessments) was carried out to better understand national contexts and assess opportunities and challenges for job transition through the clean energy transition.

- **Online survey:** Conducted from November 2021 to March 2022, this online survey obtained insights from local companies (both private and public) operating in the renewable energy and energy efficiency sectors in Egypt. The survey was sent to 215 recipients; 41 recipients responded (17 complete answers, 24 incomplete answers). The objective was to gather perceptions about the clean energy transition and the effectiveness of efforts to promote job transition. The survey also sought to obtain quantitative data on the jobs affected by the shift. Figures 1.1 and table 1.2 characterize the survey respondents.

Table 1.2 Headcount of online survey respondents

Technological area	Number of respondents*
Industrial sector distributed solar photovoltaic (PV)	13
Residential rooftop solar PV	12
Utility-scale solar PV	8
Concentrated solar power	3
Utility-scale wind	2
Commercial building energy efficiency	7
Other energy efficiency	5
Battery storage	5
Electric mobility (electric vehicles and charging infrastructure)	4
Conventional power generation	1
Other	7

Position in the value chain	Number of respondents*
Project planning and development	11
Legal and financial structuring	3
Financing	3
Equipment manufacturing	1
Procurement *(import, export, transport, logistics)*	5
Wholesale	1
Retail and distribution	5
Engineering	12
Construction and equipment installation	10
Plant operation	5
Plant maintenance	7
Decommissioning and recycling	1
Other activity	4

*A company might operate in several technological areas and be positioned in several segments of the value chain.

- **Interviews with local public stakeholders:** Interviews with 11 key public stakeholders captured complementary qualitative data. The result: a more representative point of view on the clean energy transition and its impact on the national labor market (expectations regarding job transition, perception of current gaps to be filled, possible mitigation measures). These stakeholders were asked about the impact of the clean energy transition on jobs and required skills, about opportunities and challenges for job transitions, and about enabling factors for a job-enhancing clean energy transition. The complete interview guide is presented in appendix 1. Table 1.3 lists the interviews completed for this project.

Table 1.3 Key public stakeholders interviewed

Category	Organization	Date
Energy-related stakeholders		
Ministry	Electricity and Renewable Energy (MoERE)	11/01/2022
Energy public agency	New and Renewable Energy Authority (NREA)	11/01/2022
Regional nonprofit organization	Regional Center for Renewable Energy and Energy Efficiency (RCREEE)	11/01/2022
Trade association	Federation of Egyptian Industries	06/01/2022
Education- and employment-related stakeholders		
Ministry	Education and Technical Education (MoETE)	01/12/2021
Ministry	Higher Education and Scientific Research (MoHESR)	24/01/2022
Ministerial department	Productivity and Vocational Training Department (PVTD), administered by the Ministry of Trade and Industry	11/01/2022
Nationwide initiative, cofunded by the government	Technical and Vocational Education and Training Reform Project—Phase II (TVET II)	07/03/2022
Public company	Egyptian Electricity Holding Company (EEHC)	11/01/2022
Development bank	KfW	24/01/2022

- **Interviews with local companies:** To deepen the survey results, interviews were conducted with three companies operating in Egypt's renewable energy and energy efficiency sectors. An effort was made to show public stakeholders what private operators were seeing in the field. What challenges had these stakeholders encountered in recruiting workers? What was the rationale for training their employees as they do?

Except where otherwise noted, findings are based on interviews and the online survey of stakeholders.

2. COUNTRY CONTEXT

This section presents the context for Egypt's clean energy transition as it:

- Focuses on the renewable energy and energy efficiency targets and policies set by the government of Egypt.
- Reviews the institutional frameworks, national programs, and educational systems designed to attain these targets.
- Analyzes what results have obtained in both the renewable energy and energy efficiency sectors.
- Summarizes the outlook and trend of the clean energy transition over the next 10 years.
- Provides an analysis of the Egyptian labor market as context for a job transition, with a focus on the green economy.

RENEWABLE ENERGY AND ENERGY EFFICIENCY TARGETS AND POLICIES

The energy sector is a key driver for Egypt's socioeconomic development, representing around 13 percent of gross domestic product (GDP) (IRENA 2018). Economic growth is contingent upon the security and stability of energy supply. Since 2014, Egypt has dealt with an energy supply deficit in connection with a stark rise in energy consumption and declining investments in oil and gas fields after the 2011 revolution. With the depletion of domestic oil and gas fields, Egypt's position as gas exporter shifted to that of gas importer.

Egypt has since reverted to its accustomed position as net exporter of natural gas (World Bank 2022b). Still, issues remain. Recent events highlight the tasks facing the energy sector, including electricity shortages, caused in part by declines in domestic gas production (natural gas is the main fuel for power generation), highly subsidized energy prices, and adverse fiscal implications posed by dwindling government revenues.

In response, the government of Egypt adopted a diversification strategy that embraces renewable energy and energy efficiency, including assertive measures around rehabilitation and maintenance for the power sector. In 2015, the government of Egypt adopted a 20-year strategy, the Integrated Sustainable Energy Strategy to 2035 (ISES 2035),[2] through a project funded by the European Union and implemented with relevant national partners. Initially, Egypt's renewable energy objective was 20 percent of the electricity mix by 2020. The Egypt National Climate Change Strategy (NCCS) 2050, published in May 2022, and the First Updated Nationally Determined Contributions (NDC), submitted in June 2022, state that the share of renewable energy capacities is expected to rise to 40 percent of the electric power contribution in 2030 and that it should reach 42 percent in 2035. In February 2022, Mohamed Shaker, minister of electricity and renewable energy, announced that Egypt will raise green electricity generation capacities to 10 gigawatts (GW) by 2023 (Renewables Now 2022), boosting the renewable energy share of the country beyond 20 percent of total capacity generated (EcomNews Med 2022). Table 2.1 presents the renewable energy installed power (megawatts, MW) up to October 2021. Egypt's peak load demand was 33.8 GW in August 2021, while renewable generation capacities represented less than 10 percent of the peak load, the rest being covered by natural gas, followed by oil (RCREEE and GIZ 2017).

[2] The strategy is being updated by an EU-funded project.

Table 2.1 Installed power (MW) by October 2021

Sector	Installed generation capacity (MW) by FY 2021							
	PV-FiT	PV-net metering	Bio	Wind	Hydro	CSP	PV	Total
Private	1,465	120	11.5	510	-	-	-	**2,107**
Public	-	-	-	1,125	2,832	20	26	**4,003**
Total	**1,465**	**120**	**11.5**	**1,635**	**2,832**	**20**	**26**	**6,110**

Source: Local energy expert, information from NREA.
Note: CSP = concentrated solar power; FiT = feed-in tariff; MW = megawatt; PV = photovoltaic.

In 2021, Egypt generated 10,202 gigawatt-hours (GWh) of renewable energy (solar and wind), of which over 4,500 GWh was generated by solar power plants. A further 14,769 GWh came from hydropower plants, and biofuel projects produced 86 GWh (Renewables Now 2022).

The Sustainable Development Strategy: Egypt Vision 2030 (MoP 2015) (hereafter, the SDS) also suggests targets and indicators regarding energy efficiency: overall economic energy intensity shall decline by 14 percent by 2030, compared with 2015's overall energy efficiency levels, meaning a massive increase in energy efficiency (IRENA 2018). Table 2.2 shows some key performance indicators for the energy sector that are listed in the SDS (MoP 2015). More specifically, the Integrated Sustainable Energy Strategy 2035 targeted total energy savings of 18 percent between 2015 and 2035 (18 percent in the industry, 16 percent in the buildings sector, and 23 percent in transport).

Table 2.2 Key performance indicators for the energy sector

Indicator	Definition	2015 value (%)	2020 target (%)	2030 target (%)
Ratio of primary energy supply to the total planned energy consumption	Measures the state's ability to meet its energy needs by comparing primary supply of energy (domestic production and imports) with expected energy consumption Measured quarterly to meet spikes in demand	NA	100	100
Percentage change in energy intensity	Reflects trends in the ratio of total energy use to the GDP	0.65	-1.3	-14
Share of energy sector to GDP (%)	Measures contribution of the energy sector to the GDP	13.1	20	25
Percentage decline in GHG emissions from energy sector	Measures total GHGs emitted during production, transfer, and use of energy	NA	-5	-10
Efficiency of electricity transmission and distribution	Measures the efficiency of electricity systems by calculating total losses during transmission and distribution	15	12	8

Source: MoP 2015.
Note: GDP = gross domestic product; GHG = greenhouse gas; NA = not available.

In addition to these strategic documents, other national policies, laws, and decrees have been adopted since 2008 to enable the growth of the renewable energy and energy efficiency sectors. The key policies are presented in appendix 2.

INSTITUTIONAL FRAMEWORK, NATIONAL PROGRAMS, AND EDUCATIONAL INITIATIVES TO ACHIEVE OR SUPPORT THE RENEWABLE ENERGY AND ENERGY EFFICIENCY TARGETS

INSTITUTIONAL FRAMEWORK TO ACHIEVE OR SUPPORT THE RENEWABLE ENERGY AND ENERGY EFFICIENCY TARGETS

- Objective 1: Organize and structure the promotion of renewable energy/energy efficiency to achieve the country's renewable energy and energy efficiency targets.

- Objective 2: Support attainment of these targets by promoting a job transition.

Key stakeholders are presented in appendix 3.

With the establishment of national programs to help realize the country's renewable energy and energy efficiency targets (described in section 3.1), Egypt is also seeking to shape the economy for a job transition that favors the clean energy sector. Several programs have eyed energy-related targets and workforce training to make the job transition possible. In addition, many of these programs collaborated with international labor organizations, associations, development banks and funds, private international companies, and so on.

PROGRAMS THAT SUPPORT SKILLS DEVELOPMENT FOR THE RENEWABLE ENERGY SECTOR

Several programs help Egypt develop renewable energy and the associated job transition:

- **Workforce Improvement and Skills Enhancement** (**WISE) Project**, a project funded by the United States Agency for International Development (USAID) and implemented by the Ministry of Education and Technical Education (MoETE).[3] In 2016, WISE, through engagement of private sector employers in the renewable energy industry, developed a three-year program for solar and wind energy technicians, offering a technical diploma. The employers' engagement was crucial for identifying what occupational standards were needed for wind and solar energy. These standards were fed into a new program rolled out in two industrial technical secondary schools (in Aswan and the Red Sea area). A first batch of students was admitted to the program in academic year 2017–18. Since then, the MoETE has introduced this program in other schools. The program benefited from private sector employers who identified important occupational standards. As a result, Egypt has a new secondary-education technical curriculum (USAID 2015). The MoETE may expand this curriculum to a five-year program that confers an advanced technical diploma.

- **TVET II (Technical and Vocational Education and Training—phase II)**, also sometimes referred to as TVET Egypt, is a €116 million project, jointly funded by the Egyptian government and the European Union (2015–22). Under the direct supervision of the Ministry of Trade and Industry, its aim is structural reform of TVET governance, quality, and relevance along with school-to-work transitions. Since its launch, TVET II has supported stakeholders offering programs for the renewable energy sector (nine technical secondary schools, three productivity and vocational training departments, and one technical institute

[3] The first phase took place between 2015 and 2020, and the second phase started in 2021, with a budget twice as big as that of the first phase.

affiliated with the Ministry of Higher Education). By connecting several institutions and their initiatives for coordinated national action, TVET II has the mandate to create a labor market information system (LMIS) for identifying skills in anticipation of market needs.

PROGRAMS FOCUSED ON ENERGY EFFICIENCY

Several programs strengthen Egypt's energy efficiency and the associated job transition:

- Technical support for energy efficiency and clean production is being expanded through the **Egypt National Cleaner Production Centre (ENCPC).** Established in 2005 by the Ministry of Foreign Trade and Industry in cooperation with the United Nations Industrial Development Organization (UNIDO 2014), ENCPC assists companies with technology transfer in energy efficiency.

- The Egyptian **National Energy Efficiency Action Plan (NEEAP),** in compliance with ISES to 2035, strengthens institutional structures by completing, activating, and empowering energy efficiency units across economic sectors. The NEEAP devises ways to stem distribution-network losses, assert control over such networks, and introduce the use of smart meters. It gives distribution companies tools for promoting energy efficiency among consumers as set out in the Electricity Law. On the demand side, buildings, tourism, industry, public lighting, and education sectors are all targeted, while the NEEAP also focuses on LED[4] lightbulbs in the residential sector (Supreme Energy Council 2018). NEEAP identified 10 training fields, adapting several tools to serve in training and capacity-building programs. Beneficiaries included universities and educational centers, along with training centers, which gained accreditation. Specialized training programs were established as well, in cooperation with energy efficiency sectoral units.

- The **Ministry of State for Environmental Affairs (MoSEA)**—supported by UNIDO, the Industrial Modernization Centre, and the Federation of Egyptian Industries—implemented the **Industrial Energy Efficiency (IEE)** project from 2013 to 2018. The project saved 1,277 GWh annually (with a corresponding drop in greenhouse gas emissions of 2.9 million tonnes of carbon dioxide [CO_2]) through implementing the International Organization for Standardization's energy management standard (ISO 50001). The ISO standard helps organizations use energy more efficiently and develop energy management systems. In addition to training 400 industry representatives from a range of sectors (cement, metallurgy, ceramics, paper, chemicals, and fertilizer) it has trained government agency professionals and raised up a cadre of experts able to implement energy management systems in their factories (UNIDO 2016).

- In 2017 the Ministry of Petroleum launched a modernization program, a pillar of which is downstream performance and energy efficiency, worth an investment of $4.5 billion (MoPMR 2016).

[4] Light-emitting diode.

PROGRAMS DEDICATED TO BOTH RENEWABLE ENERGY AND ENERGY EFFICIENCY SECTORS

Diverse programs and initiatives crisscross energy efficiency and renewable energy simultaneously:

- The **Egyptian-German Joint Committee on Renewable Energy, Energy Efficiency, and Environmental Protection** (*JCEE 2019/23*) is a platform for high-level policy coordination and implementation between Egypt and Germany in the electricity sector. For example, in 2019, in conjunction with the Ministry of Electricity and Renewable Energy (MoERE), the program launched the Electrical Intelligence campaign that deployed social media to present energy-saving measures, show short educational videos, and share promotional materials and events (Friedrich Ebert Stifung 2021). In 2021, the JCEE program trained 300 engineers and installers from Egyptian companies operating in the supply, installation, operation, and maintenance of rooftop PV systems (less than 500 kilowatt-peak) (Friedrich Ebert Stifung 2021).

- Financial support of the **Environmental Compliance Office of the Federation of Egyptian Industries (ECO FEI)** helps develop energy efficiency and spread renewable energy production technologies among members, replacing conventional energy (e.g., through financial support for installing solar PV panels on buildings).

- **RE-ACTIVATE** is a regional project for Promoting Employment through Renewable Energy and Energy Efficiency in the Middle East and North Africa (RE-ACTIVATE), funded by the Federal Ministry for Economic Cooperation and Development and implemented by the German Agency for International Cooperation (GIZ) in cooperation with RCREEE. Its objective is to support Egyptian and regional cross-border cooperation and knowledge transfer on employment promotion through renewable energy and energy efficiency in the MENA region (RCREEE and GIZ 2017).

NATIONAL TRAINING AND EDUCATIONAL INITIATIVES TO MEET THE SKILL REQUIREMENTS OF THE RENEWABLE ENERGY AND ENERGY EFFICIENCY SECTORS

The national commitment to shaping a quality workforce for the renewable energy/energy efficiency sectors has two types of initiatives. The first type **trains and educates students for the existing workforce**. The second type **eases the job transition**.

Some of these initiatives were introduced by the national educational system (secondary, tertiary, or technical programs). Others are public or private independent measures headed up by public agencies, international institutions, labor associations, and companies from the private sector.

The most important national education initiatives include the following.

- **Three-year program for solar and wind energy technicians:** The program was developed by the MoETE and supported by WISE (a USAID-funded project), as described above. The curriculum grew out of requests from the governorates that were hosting solar and wind energy plants but could not find qualified workers (Aswan and Red Sea). The first cohort graduated in 2019. The WISE program has since been scaled up by the MoETE to 17 schools across governorates. The MoETE is considering an extra two years of technical education leading to a higher diploma. To date, the program has delivered training and education through two schools in Red Sea and Aswan, graduating up to 500 students.

- **Three-year vocational programs:** Designed for graduates of preparatory school, aged 15, the three-year programs issue a Productivity and Vocational Training Department (PVTD) diploma. This diploma is recognized by the MoETE, 45 vocational training centers, and 69 training stations. The factory-based schools were established through a PVTD memorandum of understanding (MOU) with companies. Over the past 4 years, PVTD and Global Affairs Canada created two training programs for solar technicians in Aswan vocational and training institutes and generated jobs at the solar energy mega project at Benban Aswan. Employers active in the Industrial Advisory Group for Solar Skills helped with program design. More programs are being developed for electric vehicle production and maintenance technicians, along with cooling and refrigeration programs that comply with new standards.

- **Programs targeting engineering and technical students are** delivered by the ECO FEI to equip graduates with the right skills for jobs in renewable energy/energy efficiency. They take courses in maintenance and installation. Orientations are available to students outside of Cairo and Alexandria, who are less familiar with renewables and energy efficiency.

- **Competency centers:** The MoETE has three competency centers at the earliest stages of development, in cooperation with the German investment and development bank, KfW. Each center will operate a network of schools offering practical renewable energy/energy efficiency vocational training, and they expect more than 12,000 students across the country. The goal of the centers is to increase the share of dual-educational programs—in this case, Egyptian-German education—that involve companies, from day one, in quality training.

Some of the most important recent initiatives are detailed in appendix 4.

The national-level programs are not accredited since Egypt has no accrediting bodies. Usually, an awarding body would develop the course and authorize centers to deliver course content. Further, they would ensure that these centers deliver training to required standards, knowledge, and technique. The above projects and initiatives may have used external awarding bodies, but this was not investigated during the field work. It should be noted, however, that since 2018 the government has been working with GIZ, through the MoETE, to establish a Quality Assurance and Accreditation National Authority (ETQAAN). Under the authority of the prime minister, ETQAAN has the mandate to develop a national system for quality assurance and accreditation of educational and training institutions and programs, quality concepts and standards, teaching and learning methods, assessment methods, and implementation. Once ETQAAN is operational, all programs will be subject to accreditation.

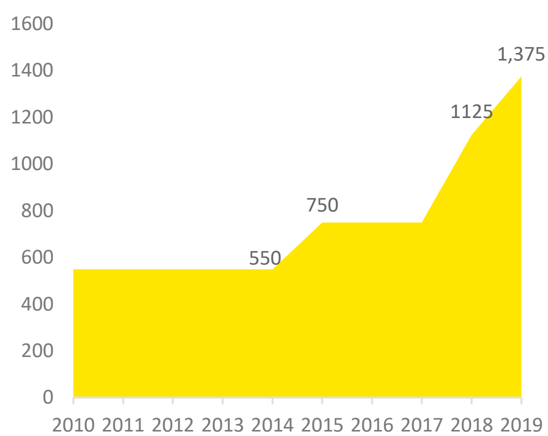
ACHIEVEMENTS IN RENEWABLE ENERGY AND ENERGY EFFICIENCY

ACHIEVEMENTS IN RENEWABLE ENERGY

The capacity building of renewable energy power plants throughout Egypt has surged since 2017, reaching 5,972 MW in 2019 (Statista 2019a), of which 23 percent is wind energy and 28 percent solar; compared with 3,503 MW in 2014 and 3,857 MW in 2017. Nonhydro renewable energy capacities reached 3,016 MW in 2021 (World Bank 2022b).

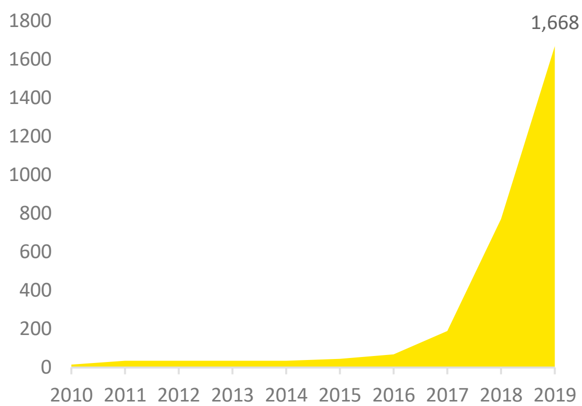
Installed wind capacity reached 1,375 MW in 2019 (figure 2.1) (International Trade Administration 2022). Since 2001, large-scale wind farms were established in cooperation with Germany (KFW), Denmark (DANIDA), Spain (Siemens Gamesa), and Japan (Japan International Cooperation Agency). The Egyptian government allocated around 7,845 square kilometers (km) in the Gulf of Suez region and along the bank of the Nile for the New and Renewable Energy Authority (NREA) to implement additional wind energy projects. The 262.5 MW Ras Ghareb wind farm near the Gulf of Suez began operation in 2019. Executed by a consortium led by the French company Engie,[5] it is the first wind energy project to follow the BOO (build-own-operate) model.

Figure 2.1 Installed wind energy capacity in Egypt, 2010–19 (MW)



Source: Statista 2019a. *Note:* MW = megawatt.

Figure 2.2 Total solar energy capacity in Egypt, 2010–19 (MW)



Source: Statista 2019c.
Note: MW = megawatt

The exploitation of solar energy is more recent in Egypt, as most of the 1,668 MW installed capacity (2019) was set up in 2016 (figure 2.2), with the majority at Benban solar park. This rise in capacity was coupled with a rush of companies into the solar energy sector: in 2021, the NREA counted more than 250 companies working on small and medium PV projects. Rising demand for solar energy is driven by plummeting prices over the past few years (from 7–8 cents/kilowatt-hours [kWh] to 2–3 cents/kWh), making solar energy more affordable.

[5] Engie 40 percent, Toyota Tsusho 40 percent, and Orascom 20 percent.

A 10 MW solar PV plant has been operating in Siwa since 2015, the largest solar power installation in Egypt at the time of its completion. In 2016, through a loan of $100 million (Construction Review 2016), Japan financed the first solar PV power plant using PV cells and modern Japanese technology. Located near the Red Sea, with a capacity of 20 MW, the plant has an information center nearby that educates the public about renewable energy (SolarQuarter 2022).

The 37 square km Benban solar park in the Western Desert was completed in 2019 with financing from the European Bank for Reconstruction and Development (EBRD), the International Finance Corporation, and other international financial institutions. Composed of 32 individual plants, each with a 2,050 MW capacity, and four substations, the park generates almost 1.5 GW of power (International Trade Administration 2022). In April 2021, the EBRD, OPEC[6] Fund, African Development Bank, Green Climate Fund, and Arab Bank signed a $114 million financing package with ACWA Power for the construction of the largest private solar plant in Egypt (Kom Ombo) less than 20 km from the Benban complex. It will have a capacity of 200 MW (OPEC Fund 2021).

In 2021, the renewable energy sector continued its growth, featuring the same dynamics seen for solar energy (marked rise in installed capacity) and wind energy (steady rise of installed capacity), as revealed in the NREA's harvest report. Indeed, renewable energy projects under development amounted to 3,570 MW in 2021, 78 percent of which was linked to solar energy projects and 22 percent to wind energy (Daily News Egypt 2022).

ACHIEVEMENTS IN ENERGY EFFICIENCY

Overall, energy efficiency in Egypt has achieved little when one considers the country's potential and its ambitions. Egypt has no clear monitoring or tracking system to measure sectoral achievements at the national level. Some achievements can, however, be highlighted (RCREEE 2017).

- The petroleum sector Modernization Project (Egypt Oil & Gas 2019) created a comprehensive database for rationalizing energy consumption. It identified 25 consumption-intensive companies accounting for nearly 92 percent of the total consumption. A number of measures were used to implement low-cost projects in 13 consumption-intensive companies, which cut consumption by around $18 million.
- The petroleum sector Modernization Project 4, still ongoing in 2023, has been strengthening institutional setups to manage energy efficiency and to develop a national energy efficiency strategy with a specialized international consultant. It has also worked to implement energy efficiency projects worth $1.45 million, organize three editions of the Egyptian Petroleum Sector Energy Efficiency Conference, and realize yearly energy savings of $35 million through the use of no-cost or low-cost energy efficiency techniques. Five technical energy efficiency audits are being conducted on Assiut Oil, Cairo Oil, Egyptian Petrochemicals, and GUPCO, all in cooperation with the European Union and the Japan International Cooperation Agency. To build capacity, the initiative offered about 72 training courses that were completed by around 1,000 trainees (MoPMR 2016). In 2019–20 five companies executed a training plan involving 68 programs, which are expected to reach 1,100 trainees. Moreover, the EBRD-financed energy efficiency projects at the Egyptian Natural Gas Company (GASCO) and the Suez Oil Processing Company, with investments of around $450 million.

[6] Organization of the Petroleum Exporting Countries.

- Technology transfer of sustainable systems to the Southern Mediterranean brought the application of 252 measures, including several pertaining to new capacitors and additional power factors involving soft starters and inverters.[7]
- Deployment of energy efficiency through the introduction of LED lamps. About 47,000 LED lamps were installed in pilot projects under a program, Improving the Energy Efficiency of Lighting and Building Appliances (2010–17) (World Bank 2022b). The objective was to provide technical support for these projects. Half the funding was dedicated to the governmental sector and 25 percent to the private sector, with a maximum of Egyptian pounds (LE) 250,000 for each pilot project. The pilot sites saw a savings of 25 to 40 percent of total electricity consumption. Large-scale transitions to energy-efficient lighting in Egypt reduced fuel consumption at power stations by 12.8 percent nationwide since 2015.
- Making home appliances more energy efficient by defining energy-efficiency standards for televisions, water pumps, adaptations, electric furnaces, fans, and dishwashers.
- Around 860 rural Egyptian households have lowered their energy consumption by around 3,000 MW per year since 2019 (Egypt Oil & Gas 2019).
- A more energy-efficient industrial sector emerged from an integrated approach of capacity building and technical assistance that imposed policies at institutional and industrial facilities. This approach includes programs like the Environment Pollution Abatement Project Phase III (2017–22), a mechanism for adopting resource-efficient technologies and management in the industry, the Industrial Energy Efficiency (IEE) Project (2013–18), and the Solar Heating in Industrial Processes (SHIP) (2014–22) (World Bank 2022b).
- The ENCPC undertook an analytical study to create a database of companies, prioritize 100 companies from the private sector, and organize workshops on energy efficiency.
- Construction of 419 buildings with a total of 10,000 housing units in Badr City, using the highest green standards and specifications. This project was led by New Urban Communities and Nile Home Italian company.

OUTLOOK AND TREND

In October 2016, ISES to 2035 was adopted by the Supreme Energy Council, which selected scenario 4-B as a reference for energy planning.[8] The scenarios were assessed based on key parameters of the Egyptian energy system (energy import rate, diversification of the primary energy supply and energy generation, CO_2 intensity, final energy savings through improved energy efficiency, and total discounted subsidies and system costs) (IRENA 2018). Tables 2.3A (cumulative installed power capacity) and 2.3B (share, by type) illustrate the energy outlook, with both installed capacity and energy generation estimations, under the selected scenario.

[7] The project ($9 million) was funded by SwitchMED and UNIDO and led by the ENCPC.

[8] Scenario 4-B was selected as reference for energy planning in Egypt.

Table 2.3A Total capacity installed under scenario 4-B of ISES to 2035

	2009–10	2014–15	2019–20	2025–26	2029–30	2034–35
			Cumulative installed power capacity (gigawatts)			
Nuclear	0	0	0	3.6	4.8	4.8
Coal	0	0	1.6	12	13.6	23.2
Oil products	1.4	1.3	0.9	1	1.3	1.3
Natural gas and dual fuel	20.4	33	55.9	54.9	55	54.8
Hydro	2.8	2.8	2.8	2.9	2.9	2.9
Wind	0.5	0.5	13.3	20.5	20.6	20.6
Photovoltaic	0	0	3	5.9	22.9	31
Concentrated solar power	0	0.1	0.1	0.1	4.1	8.1
Total renewable energy	**3.3**	**3.4**	**19.2**	**29.4**	**50.5**	**62.6**
Total	**25.1**	**37.7**	**77.6**	**100.9**	**125.2**	**146.7**

Source: IRENA 2018.
a. Coal power generation was initially canceled by the government.
Note: ISES = Integrated Sustainable Energy Strategy.

Table 2.3B Total capacity installed under the scenario 4-B of ISES to 2035

	2009/10	2014–15	2019–20	2025–26	2029–30	2034–35
			Share by type (%)			
Nuclear	0.0	0.0	0.0	3.6	3.8	3.3
Coal	0.0	0.0	2.1	11.9	10.9	15.8
Oil products	5.6	3.4	1.2	1.0	1.0	0.9
Natural gas and dual fuel	81.3	87.5	72.0	54.4	43.9	37.4
Hydro	11.2	7.4	3.6	2.9	2.3	2.0
Wind	2.0	1.3	17.1	20.3	16.5	14.0
Photovoltaic	0.0	0.0	3.9	5.8	18.3	21.1
Concentrated solar power	0.0	0.3	0.1	0.1	3.3	5.5
Total renewable energy	**13.2**	**9.0**	**24.7**	**29.1**	**40.3**	**42.7**
Total	**100**	**100**	**100**	**100**	**100**	**100**

Source: IRENA 2018.

Note: ISES = Integrated Sustainable Energy Strategy.

Under this scheme, net electricity generation is expected to rely on a 37.3 percent share of renewables by 2035, representing around 155.9 GWh (IRENA 2018).

Regarding energy efficiency, the objective of ISES to 2035 was to reach a total energy saving target of 18 percent in 2035 compared to 2015. But no other pathways were developed.

LABOR MARKET CONTEXT, ESPECIALLY IN THE GREEN ECONOMY

The jobs shall be classified according to the International Labour Organization framework:

- **"Jobs created"** (or "New jobs") are jobs created that cannot be filled by jobs lost in similar occupations from other industries in the same country or region.
- **"Jobs transformed"** (or "Jobs with new characteristics") are jobs in the same occupations that continue to exist, but their skill profiles and/or qualification requirements have changed to accommodate the new demand.
- **"Jobs substituted"** (or "Jobs destroyed and reallocatable") are jobs for which vacancies in the same occupations in other industries within the same country or region will be found.
- **"Jobs eliminated"** (or "Jobs destroyed and not reallocatable") are jobs for which vacancies in the same occupations in other industries within the same country or region will not be found.

OVERALL CONTEXT

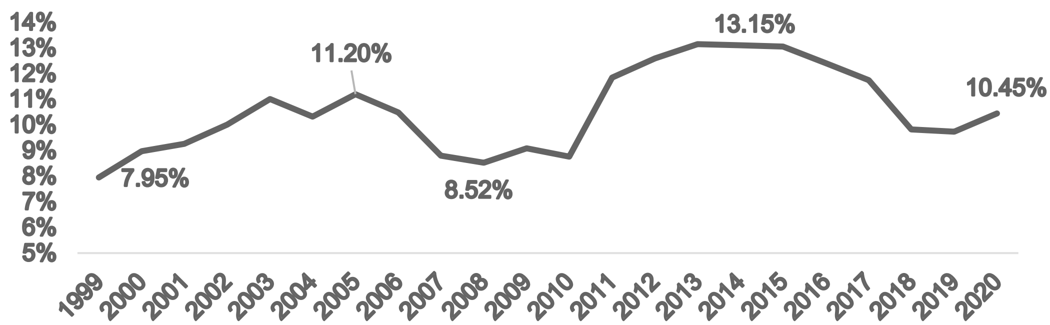
DEMOGRAPHICS AND UNEMPLOYMENT

In the mid-twentieth century, Egypt's population began to explode, rising from 20.9 million in 1950 to 104 million in 2021 (United Nations Population Fund 2021). In a zero-migration scenario, the Central Agency for Public Mobilization and Statistics forecasts that Egypt's population will exceed 200 million by 2100 (CAPMAS and IOM 2017). The working-age population saw annual increases of 3.1 percent between 2010 and 2015. In 2021, 60.7 percent of the population was working age (between 15 and 64) (United Nations Population Fund 2021).

The Egyptian working-age population is not only very young, but its average age has fallen with the entry of massive new generational cohorts into the labor force.

The national rate of unemployment increased from 9 percent in 2010 to more than 13 percent in 2015 (figure 2.3). More recent publications highlight recent declining unemployment at 7.5 percent in 2021. This rate is expected to fall to 7.2 percent by 2023 (Trading Economics 2021).

Figure 2.3 Unemployment rate in Egypt, 1999–2020



Source: Statista 2021.

Egypt's Central Agency for Public Mobilization and Statistics (CAPMAS) has stated that the economy will not have economic growth rates able to absorb the cohorts of graduates now exiting the educational/training system. In fact, the structural excess of labor with high educational levels portends not only precariously high unemployment and poverty but also social instability (CAPMAS and IOM 2017). For example, unemployed Egyptians aged 15 to 29 years reached 64.3 percent of the population in 2021 (Trading Economics 2021).

ECONOMIC ENVIRONMENT AND SKILLS REQUIREMENTS

Compounding this problem is the emergence of new technologies that are altering the nature of work. Given the tough economic climate and shifting business realities, many firms believe new technologies are fundamental to their long-term survival (PwC 2019) and that most of today's jobs will be eliminated some day. All students, and all workers, need a solid foundation of basic skills and knowledge (World Bank 2020a).

Educational outcomes (skilled, trainable employees) are currently incommensurate with labor market needs. In international surveys of graduates' skill sets, Egypt ranks 133rd out of 141 countries (Schwab 2019). Despite Egypt's persistent unemployment and notably vast informal sector, employers report that skills shortages are the key barrier to competitiveness and growth. Many feel they lack in-house talent to realize the full benefits of digital gains. Yet their investment in training is very low, and companies say they struggle to retain trained staff. Low salaries, poor work environments, a deficient human resources culture, and minimal gains in labor productivity (compared with faster-growing emerging economies) have all exacerbated this challenge (World Bank 2020a).

QUALITY OF EDUCATION

Education is one of the most powerful national instruments for building dynamic private sectors that generate growth and create and transform jobs. Yet Egypt scored 0.49 on the Human Capital Index in 2020 (World Bank 2020b), meaning a child born there today will be 49 percent as productive when grown than a child who enjoys full education and health. Worldwide, a child born in 2020 can expect, on average, to be 56 percent as productive as they could be when they grow up. Egypt's low score, mostly driven by the poor quality of education, is a great hindrance to labor productivity as well as private sector investments in the Egyptian market. For decades, Egypt's educational system has struggled to deliver the learning, skills, and competencies necessary for a healthy school-to-work transition. Limited access to good-quality early education (especially in disadvantaged areas), poor quality pre-tertiary teaching focused on rote learning, and high-stakes school exit examination and associated private tutoring that drives the system, have all contributed to poor learning outcomes. Across all education levels starting from basic to postsecondary, students are not acquiring skills that make them employable (World Bank 2020a, 2021a).

Private sector institutions could play a role by providing adaptability, efficiency, and financial sustainability. But the entry barriers deter investors from establishing new educational institutions—whether universities or vocational colleges. The laws and regulations around privately owned universities, community colleges, and technical and vocational training centers are cumbersome. Some state regulatory decisions are discretionary and might multiply the costs to investors and create uncertainty. Private postsecondary institutions are underfinanced, with few incentives for investment or ongoing support from the state, such as tuition subsidies, scholarships, tax holidays, or provision of land at no charge or a discount. Rigid admission and enrolment rules prevent expansion of the industry. Flexibility with curricula is controversial, and private institutions claim they must mirror public institutions to gain approval. Meanwhile, the Supreme Council of Private Universities states this is the primary choice of providers to get faster approval. Furthermore, the ministries involved have executive authority over different aspects of education and training. This welter of authorities produces poor coordination, market confusion, and administrative inefficiencies. In addition, the scarcity of quality-assurance rules and minimal market transparency—including no disclosure requirements—further prevent the private sector from filling implementation gaps. These entry barriers deter private investors from accessing the middle-income market or experimenting with new business models or possibly making tuition more affordable (World Bank 2020a).

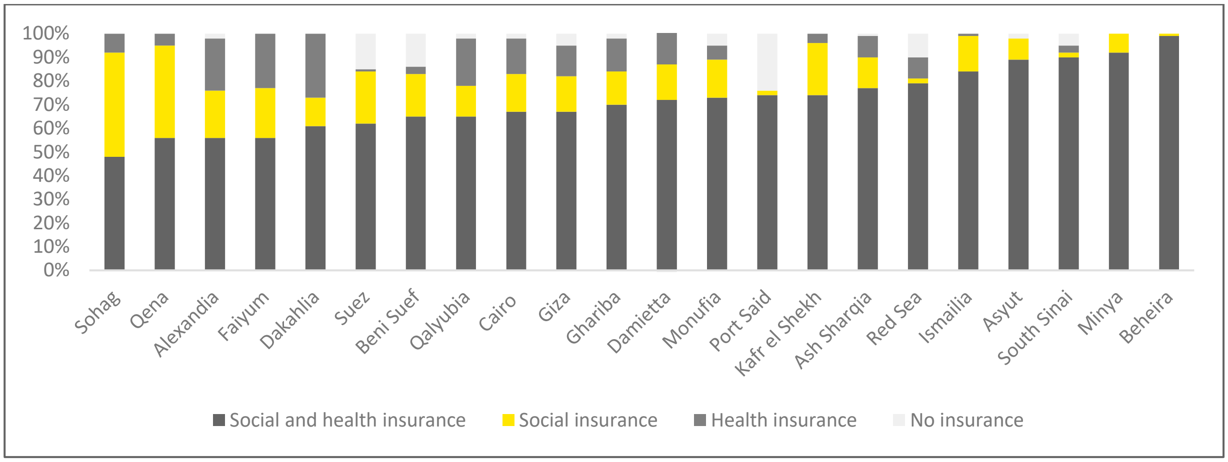
LABOR MARKET REGULATIONS AND SOCIAL PROTECTIONS

Egypt has a large informal economy estimated to represent 40 percent of GDP (PwC 2019). Comprising small businesses with minimal organization, the informal sector employed 58 percent of all private sector workers in 2019.

Meanwhile, employment security in the formal sector remains flawed. In the renewable energy sector in particular, there is a perceived discontinuity in renewable energy projects, creating job insecurity. Indeed, the current development model animating Egypt's strategic ambitions would guarantee enough jobs. But announced projects are perceived by governmental agencies as insufficient to guarantee enough secured full-time jobs, calling it a development battle. The pipelines seem unsecured, resulting in temporary projects instead of permanent contracts.

Regarding social protections and employee benefits, figure 2.4 shows a breakdown by governorate. Most governorates provide social and health insurance for workers (considering both the formal and informal labor markets). The Egyptian Center for Economic Studies and the National Bank of Egypt (ECES and NBE 2021) analysis of the job market found that, on average, 72 percent of the companies provide employees with both social and health insurance programs.

Figure 2.4 Health and social insurance for workers in Egypt's governorates

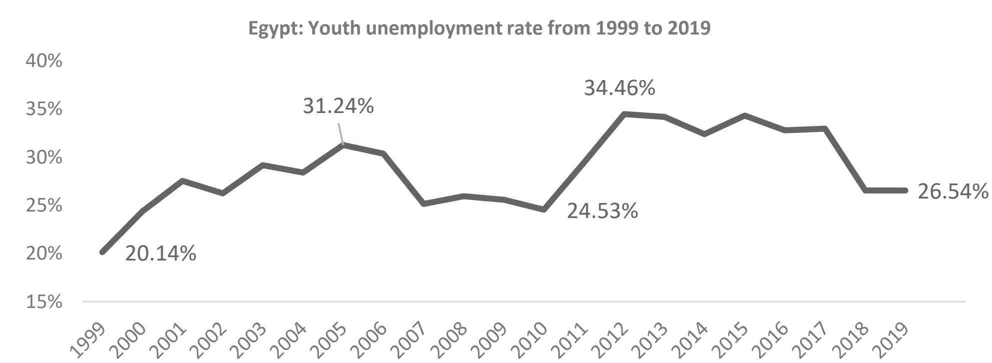


Source: ECES and NBE 2021.

INCLUSION OF WOMEN AND YOUNG WORKERS IN THE LABOR MARKET

The unemployment of young people under the age of 24 is not a negligible issue in Egypt. Its rate reached a peak of 34.46 percent in 2012, and even though it has since fallen, it remained at 26.54 percent in 2019 (figure 2.5).

Figure 2.5 Youth unemployment in Egypt, 1999–2019



Source: Statista 2019d.

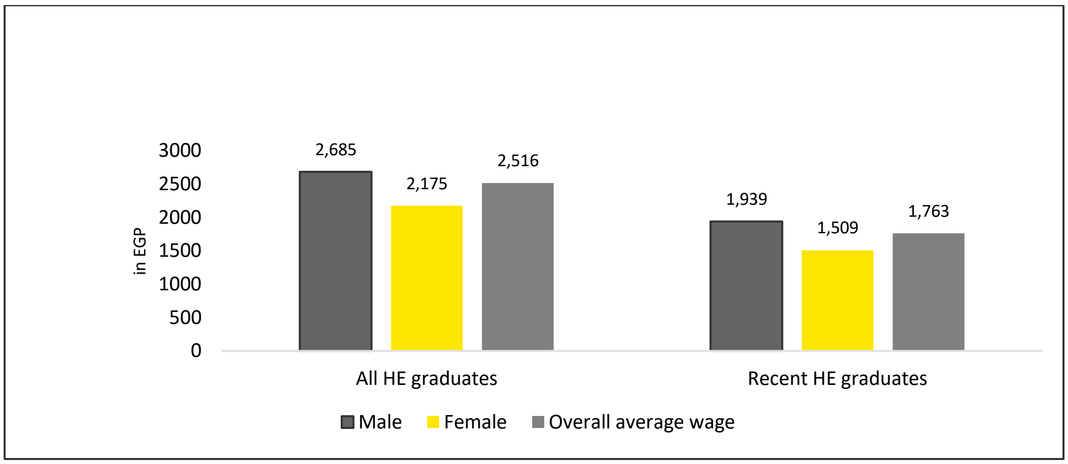
Women's employment remains a major challenge in the Egyptian labor market. Women represented around 19.97 percent of the labor force in Egypt in 2019, a declining figure compared to 20.86 percent in 2018 (CAPMAS 2022) and a maximal share of 23.6 percent reached in 2014 (World Bank 2021b). A more recent figure illustrates that in 2019 Egypt scored rather poorly in the World Economic Forum's Global Gender Gap Report (WEF 2021). Indeed, while it gained five places in the 2021 edition of the WEF's report, ranking 129 out of 156 countries, Egypt showed declining rates of women participating in the economy and rising figures for health inequality.

The unemployment rates for women and men differ markedly. In 2015, the unemployment rate for men represented 10 percent, while it reached 24 percent for women (ILO 2018). The high unemployment rate for highly qualified women (34 percent) (ILO 2018) suggests that the education system's output of skilled workers is incommensurate with market needs.

The scarcity of women in energy efficiency and renewable energy has been acknowledged, and targeted, by several governmental agencies and private actors. For example, ECO FEI leads campaigns to convince CEOs to hire more women; the campaigns receive good feedback from top managers, who appear more engaged with the issue of women's empowerment. In 2021, four workshops were conducted across sectors to raise awareness about women and their contributions toward a clean energy transition. With more than 18 industrial sectors in Egypt, more workshops may need to be held.

In addition to being relatively scarce in the labor market, women generally earn less than men, an especially noticeable phenomenon among higher education graduates (figure 2.6).[9]

Figure 2.6 Average monthly wages of all and recent higher education graduates by gender



Source: World Bank calculations of monthly wages based on LFS (2017).
Note: EGP = Egyptian pound; HE = higher education.

LABOR MARKET RESPONSE TO THE CLEAN ENERGY TRANSITION

RENEWABLE ENERGY SECTOR

Since 2015, the number of jobs supported by the renewable energy sector has doubled from 6,995 in 2015 to 14,344 in 2018. In parallel, the number of indirect jobs grew 25.27 percent in 2016 over the previous year at 2,973 jobs and reaching 6,267 jobs in 2018 (RECREE and meetMED 2020).

- **Hydropower:** In 2018, this technology supported about 3,000 direct jobs, or nearly 40 percent of the total (compared with 78 percent in 2010). It is expected that the share of hydropower's direct jobs in renewable energy will fall to 8.83 percent by 2030.

[9] Recent higher-education graduates include individuals graduated between 2013 and 2017—World Bank calculations based on Labor Force Survey (LFS) 2017 (latest data available).

- **Solar PV:** Until 2016, PV had not exceeded 1 percent of the total number of direct jobs, but it rose 10 percent in 2018, supporting 796 direct jobs—most of them generated by utility-scale PV. Direct jobs are supported in operation and maintenance (O&M) (56 percent), procurement and manufacturing (22 percent), and installation and grid connection (17 percent). The professionals needed for these projects range from construction workers and technicians (44 percent) to factory workers (14 percent), engineers (13 percent), and quality health and safety experts (13 percent). Until 2017, the share of PV on-grid represented 10 percent of indirect jobs supported; PV off-grid did not exceed 1 percent. In 2017 the share of PV on-grid rose to 20.14 percent in sync with the development and construction of several PV projects totaling about 1.5 GW at the Benban solar park.

- **Wind power:** In 2019, wind power was expected to support 4,052 direct jobs (51 percent of the total direct jobs supported by renewable energy). In 2030, it is expected to represent 35.5 percent. Direct jobs are supported in O&M (43 percent), development and construction (30 percent), and manufacturing (17 percent). While development and construction jobs are mobilized for a short period of time (two to three years, depending on job type and technology), most those supported for O&M last throughout the lifetime of the project (25 to 30 years). For indirect jobs supported, wind power represented 14.65 percent in 2014 and 25.21 percent in 2018. On average, this technology supported 1,225 indirect jobs annually between 2016 and 2019.

- **Solar water heaters (SWHs):** SWH technology supported 2,812 direct jobs in 2017 and 2,696 direct jobs in 2018. Between 2019 and 2030, solar water heating is expected to contribute, on average, nearly 9 percent of the total direct jobs supported by renewable energy. The technology supports a small share of the total number of indirect jobs, adding 346 indirect jobs in 2018 and 333 in 2019.

The pattern of jobs created by renewable energy has changed over the past ten years. In 2010, 78 percent of direct jobs were created by hydropower, while SWHs supported 12.36 percent. In 2018, 7,629 direct jobs were created, with hydropower accounting for 39.70 percent of them and SWHs 35.35 percent (RECREE and meetMED 2020).

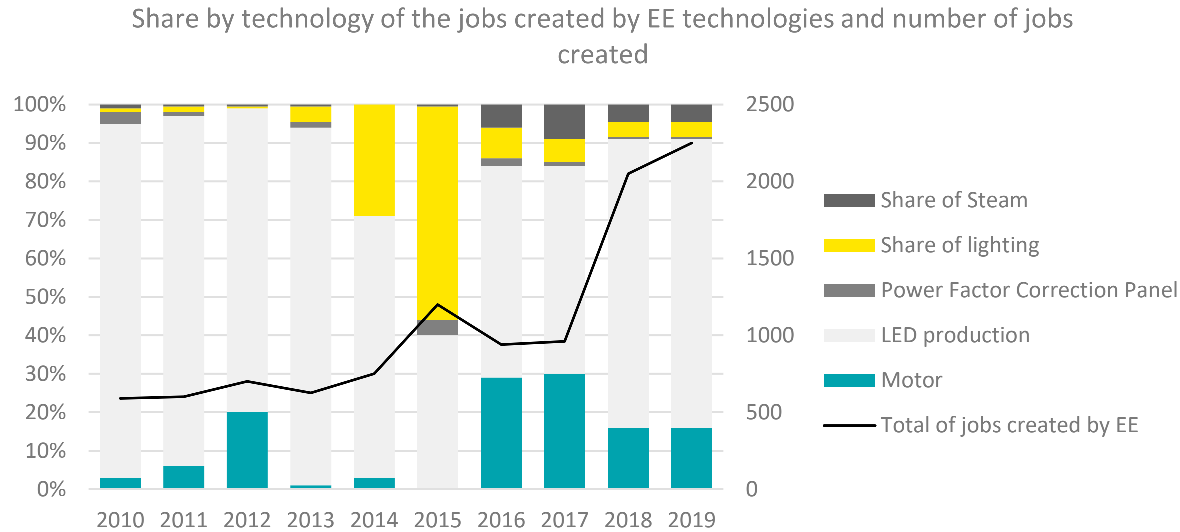
ENERGY EFFICIENCY SECTOR

After 2017 job numbers surged in the energy efficiency sector, as seen in figure 1.8. This trend began in 2015, with the advent of 1,158 jobs; between 2010 and 2014 fewer than 1,000 jobs were created. On average, most of them were generated by LED technology owing to awareness campaigns and declining investments in other energy efficiency measures.

Although in 2013 efficient lighting created only around 23 jobs, it represented in 2014 and 2015, respectively, 29 percent and 56 percent of the total jobs created. But these two years appear to have been exceptional, because this share decreased to 8 percent in 2016, and again LED technology generated most of the new jobs.

Furthermore, since 2016, motor technology represents a steady share of at least 15 percent of total jobs created due to greater investments in this sector (figure 2.7).

Figure 2.7 Share of each technology in total jobs created in the energy efficiency sector, 2010–2019



Source: RECREE and meetMED 2020.
Note: EE = energy efficiency; LED = light-emitting diode.

PROSPECTIVE ANALYSIS OF BOTH THE RENEWABLE ENERGY AND THE ENERGY EFFICIENCY SECTORS

According to analysis completed in Phase 1 of the World Bank project under which the present study was conducted, the clean energy transition should produce 2,018,000 net job-years over the period 2020–50. Net jobs are the sum of jobs created through investments plus their impact both on economic activities and on job displacement as fossil fuel electricity plants are replaced with clean technologies. As table 2.4 shows, the respective shares of the various impact mechanisms (investment, investment shift, substitution, and revenue impacts) differ by technology. Table 2.4 disaggregates the direct, indirect, and induced job-years according to these four mechanisms.

Table 2.4 Direct, indirect, and induced job creation by energy transition mechanism

	Utility PV	PV industry distributed	PV residential rooftop	Wind	Energy efficiency
Investment impact	594,000	73,000	22,000	923,000	501,000
Substitution impact	942,000	179,000	41,000	2,251,000	261,000
Revenue impact	-335,000	-41,000	-13,000	-600,000	-143,000
Investment shift impact	-842,000	-102,000	-32,000	-1,510,000	-153,000
Total by technology	359,000	109,000	19,000	1,065,000	466,000

Source: Phase 1 of this study (World Bank 2021d).
Note: PV = photovoltaic.

Most jobs grow out of energy savings (called "substitution impact"). This is not the case, however, with energy efficiency, where most new jobs come from *investment impact,* reflecting the comparatively large investments in energy efficiency while the other clean technologies incur negligible energy costs. Most of the jobs displaced through energy efficiency investment are for the construction of conventional power plants. The displacement is notable when looking at wind and utility-scale solar, signaling the degree to which their capacity is deployed. Similarly, the revenue losses to be expected by traditional energy suppliers due to wind and utility-scale solar development are greater than for other clean technologies.

3. CHARACTERISTICS OF JOBS AFFECTED BY THE CLEAN ENERGY TRANSITION

This section presents the characteristics of jobs impacted by the clean energy transition as it:

- Offers an analysis of **the types of jobs affected by both the renewable energy and energy efficiency sectors,** with a focus on the occupations that could be transformed then transferred from the conventional energy sector to the renewable energy and energy efficiency sectors.
- Reviews **the core skills companies need to operate in the renewable energy and energy efficiency sectors**, as well as the level of difficulties encountered to find applicants with such skills in the Egyptian labor market.

OCCUPATIONS

The following section maps the skills needed throughout the technology value chains pertaining to each phase for developing and operating a renewable energy or an energy efficiency project.

In the following section, employees' skill levels are classified as low, medium, and high, according to the International Standard Classification of Occupations (ISCO) 2008, as follows:

- **High-level skills**: High-skilled occupations often require higher education for a period of one to six years. Workers perform complex tasks, either technical/practical or theoretical with a decision-making capacity and a complex problem-solving dimension. Such occupations can be divided into managers, professionals, technicians, and associate professionals.
- **Midrange skills**: Medium-skilled occupations often require secondary education and involve the operation of machinery and electronic equipment, driving vehicles, maintenance and repair, or manipulation. Many occupations at this skill level require advanced literacy and numeracy and good interpersonal communication. Such occupations can be divided into clerical support workers, service and sales workers, craft and related trades workers, and plant and machine operators as assemblers,
- **Low-level skills**: Low-skilled occupations require a form of primary education or at least on-the-job training. They involve the performance of simple and routine physical or manual tasks. Many of such occupations require physical strength and endurance. For some jobs basic skills in numeracy and literacy may be required but would not be a major part of the work in that case. Such occupations include elementary occupations, laborers.

OCCUPATIONAL PROFILES IN THE RENEWABLE ENERGY VALUE CHAIN

The renewable energy value chain has four main components: project development; components manufacturing and assembly; engineering, procurement, and construction; and operations and maintenance. As table 3.1 shows, each component contains several positions requiring commensurate skills.

Table 3.1 Mapping occupations for renewable energy projects

	Project development	Components manufacturing and assembly	Engineering, procurement, construction	Operations and maintenance
High skills	- Architect - Project designer (engineer) - Market analyst - Economic/financial risk specialist - Atmospheric scientist and meteorologist - Geographer - Social impact specialist - Lawyer - Sustainability specialists (natural resource/ environmental planner, social scientist) - Planner (permit monitoring, amendment, application) - Resource assessment specialist and site evaluator - Archaeologist - Land development adviser - Land use negotiator - Lobbyist - Mediator - Public relations officer - Financial specialist - Communication specialist	- Design and conception engineer - Researcher - Modeler - Manufacturing engineer - Thermodynamics engineer - Electrical and electronical engineer - Marketing specialist	- Wind/PV/CSP system designer (electrical/mechanical/structural engineer) - Software engineer - Operations head - Project manager - Business development manager (sales manager) - Project designer (engineer) - Health and safety executive engineer - Quality assurance engineer - Grid engineer - Measurement and control engineer - Commissioning engineer (electrical) - Logistics specialist - Wind resource assessment manager	- Plant director - O&M manager - O&M engineer
Midrange skills	- Measurement expert - Data acquisition expert - Water supply expert - Plumbers - Environmental Impact Assessment specialist - Procurement professional	- Manufacturing quality assurance experts - Shift supervisor - Logistics professional - Sales personnel - Logistics expert - Electrical and electronical technician - Health, safety, and quality control expert	- Wind/PV/CSP operator and installer - Project and installation evaluator - Quality assurance specialist - Welder - Pipe fitter - Plumber specialized in solar/wind - Electrician specialized in solar/wind/PV/CSP system technician	- Mechatronics technician - Plant operation manager - Administration personnel - Production technician - Wind/PV/CSP maintenance technician - Electrical and grid maintenance operator - Electrical maintenance technician - Inspector - Storage maintenance technician
Low skills		- Manufacturing operator - Assembly operator - Logistics operator - Equipment transporter - Laborer - Machine operator - Electrical operator	- Construction worker - Transportation worker - Laborer - Machine operator - Electrical operator - Equipment transporter	- Production operator - Plant worker - Cleaning operator - Site maintenance operator - Logistics operator - Equipment transporter

Source: World Bank and EY 2021.

Note: CSP = concentrated solar power; O&M = operation and maintenance; PV = photovoltaic.

For Egypt specifically, the International Labour Organization (ILO 2018) identifies emerging sets of jobs created by the growing renewable energy sector.

For solar energy, jobs created in Egypt include (ILO 2018):

- **Solar installers:** Install, set up, maintain the solar modules, panels, or support structures and wiring that connect a solar energy system to the electrical grid in compliance with system design.
- **Solar service technicians:** Monitor, diagnose, optimize, and repair underperforming panels (quality assurance professionals).
- **Solar plant managers:** Coordinate day-to-day work (materials, time and budget constraints, coordination of engineers, system designers, and installers).

For wind energy, new jobs in Egypt include (ILO 2018):

- **Wind turbine technicians:** Install, inspect, operate, maintain, and repair wind turbines.
- **Wind plant managers:** Oversee electric power generation and distribution systems as well as operation, maintenance, repair, safety, performance, and profitability.
- **Quality engineers:** Develop processes, test procedures, and implement systems that ensure the fulfilment of quality standards and safety requirements.

In addition to the new jobs, particularly in the solar energy segment, the energy transition will require jobs to shift from conventional to renewable energy, such as (ILO 2018):

- **Electricians with solar component expertise**: Install, maintain, repair electrical wiring for equipment and fixtures for PV systems, ensure compliance with electrical and building conventional codes.
- **Plumbers with solar component expertise:** Install and repair tanks, piping, and other components of solar thermal systems, in addition to issuing permits and ensuring compliance with conventional plumbing and building codes as well as selling equipment and systems.
- **Heating, ventilation, and air-conditioning technicians:** Install, service, and repair commercial solar thermal systems.

Box 3.1 Case study—distribution of human resources along the value chain of a solar photovoltaic farm and wind farm

The needs for different occupations vary depending on their position in the value chain and the technology(ies) involved. Indeed, the study *Renewable Energy and Employment: The Experience of Egypt, Jordan, and Morocco* (KAPSARC 2019) finds that workforce requirements in the renewable energy and energy efficiency value chains vary: a 50 MW solar photovoltaic (PV) plant and a 50 MW wind farm, for example, call for varying numbers of workers.

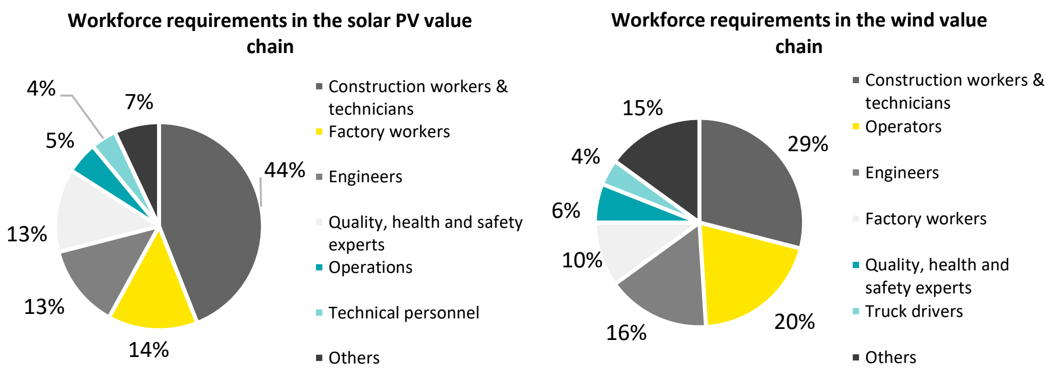
The results are illustrated in table B3.1.1.

Table B3.1.1 Tasks in renewable energy work activity (as % of the activity)

Work activity	Solar PV farm	Wind farm
Project development	1	2
Manufacture of main components	22	17
Transport	2	1
Installation and construction	17	30
Operation and maintenance	56	43
Decommissioning	2	7

Note: This table shows the distribution of human resources for both projects and not the number of jobs created. PV = photovoltaic.

Figure B3.1.1 Workforce requirements in the solar PV and wind value chains



Note: PV = photovoltaic.

The demand for semiskilled (vocational skills) and unskilled workers is greater than the demand for skilled workers (degree or diploma qualification). This follows from the relatively plentiful technicians, machine operators, drivers, and laborers available to build wind and solar PV projects.

Source: KAPSARC 2019.

OCCUPATIONAL PROFILES IN THE ENERGY EFFICIENCY VALUE CHAIN

Energy efficiency projects crisscross sectors and therefore have a broader scope for job creation than renewable energy projects (table 3.2).

Table 3.2 Energy efficiency occupations

	Project development	Components manufacturing and assembly	Engineering, procurement, construction	Operation and maintenance
High skills	- Architect - Project designer (engineer) - Energy efficiency technology development designer - Market analyst - Economic/financial/risk specialist - Public relations officer - Environmental consultant - Lawyer - Planner (permit monitoring, amendment, application) - Policy maker/legislator/politician - Educator and trainer - Researcher	- Design and conception engineer - Energy modeler - Quality insurance specialist - Logistic expert - Lifecycle cost/sustainability expert - Marketing specialist - Thermodynamic, electrical, and electrodynamical engineers	- System designer (electrical/mechanical/structural engineer) - Construction engineer - Commissioning engineer - Software engineer - Quality assurance engineer - Health and safety executive engineer - Measurement and control engineer - Industrial energy specialist - Weatherization/energy-saving possibilities expert	- Energy auditor - Building inspector - Building owner and manager - Recycling specialist - Energy manager - Maintenance, performance, and data expert
Mid-range skills	- Staff of policy makers and government office workers - Procurement professionals	- Manufacturing technician - Electrical and electronical technician - Shift supervisor - Quality assurance expert - Logistics professional - Salesperson - Wholesale and retail distributor of energy efficiency appliances	- Electrician - Plumber - Carpenter - Plasterer - Roofer - Heating, ventilation, and air conditioning, insulation, heating, windows, lighting, and water heating technician - Project/installation evaluator - Automation system installer	- Administration personnel - Facilities technician - Electrical maintenance technician - Inspector - Energy tracking and monitoring, measurement, and data acquisition technician
Low skills		- Operator for manufacturing of energy efficiency appliances, materials, and industry equipment - Craftsman - Assembly operator - Logistics operator - Equipment transporter	- Construction worker - Transportation worker - Laborer - Electrical operator - Equipment transporter	- Production operator - Maintenance and repair operator

Source: World Bank and EY 2021.

The development of energy efficiency calls for new, market-specific jobs (ILO 2018):

- **Energy efficiency auditors:** Assist industrial establishments in measuring energy consumption, assessing and identifying areas of improvements, analyzing options, and developing energy efficiency plans.

- **Energy efficiency managers:** Measure and monitor energy consumption, plan and implement energy efficiency measures within production unit.

OPPORTUNITIES TO TRANSFER OCCUPATIONS AND CAPABILITIES FROM THE CONVENTIONAL ENERGY SECTOR

Studies show that in the context of the energy transition, most jobs require only that existing qualifications be strengthened (Jagger, Foxon, and Gouldson 2014). Thus, the retraining and continuing education of former employees shifting to another sector are essential levers for developing employment in the energy transition sectors (Botta 2019). They also compensate for jobs lost in the conventional energy sector through retraining (CLER 2021).

Egypt relies heavily on the conventional energy sector: in 2016 oil and gas comprised more than 90 percent of the total energy production in the country. According to the US Energy Information Administration (EIA 2018), it is the largest non-OPEC oil producer in Africa and the third-largest dry natural gas producer on the continent, following Algeria and Nigeria.

The country's oil and gas sector relies on various local occupations and skills throughout its value chain, and development of the sector saw a range of local occupations emerge across the skills spectrum, including some that could be relevant for renewable energy and energy efficiency projects.

Still, Egypt's energy outlook for 2030–35 (IRENA 2018) suggests that these sectors will not replace conventional energy but rather emerge as a complement to meet the growing demand for energy. Figures show that the natural gas sector will shrink from 55.9 gigawatts (GW) of installed capacity in 2019–20 to 54.8 GW in 2030–35, a gradual decline that will nonetheless translate into fewer natural gas plant projects and a corresponding decline in labor demand especially in project development, component manufacturing, engineering, procurement and construction (job losses should be less severe in operation and maintenance, as the need to maintain the installed capacities will remain). In the meantime, the coal sector will grow from 1.6 GW of installed capacity in 2019–20 to 23.2 GW in 2030–35. in Egypt, the job losses from the oil and gas sector is therefore likely to be absorbed and mitigated by greater demand for labor in both the coal and renewable energy sectors.

A study for Namibia-Botswana (World Bank and EY 2021) identified the transferable skills in conventional energy to the renewable energy and the energy efficiency sectors (table 2.3).

Table 3.3 Capabilities and occupations in conventional energy that are relevant to renewable energy and energy efficiency

Project phase	Potentially transferable capabilities	Corresponding occupations		
		Low skilled	Medium skilled	High skilled
Project development	• Technical studies (geotechnical, water, etc.) • Environmental and social impact assessment • Site preparation, clearing, grubbing, etc. • Grid connection and reinforcement studies	• Laborer • Machine operator	• Measurement expert • Data acquisition expert • Work driver	• Geological expert • Water specialist • Environmental and social consultant • Naturalist expert • Grid modelling expert • Land use negotiator • Grid modelling expert
Component manufacturing	• Assembly of specific components	• Assembly operator • Cement production operator		
Engineering, procurement, and construction	• Procurement of components • Construction • Civil works	• Logistic operator • Construction worker • Transportation worker • Laborer • Machine operator	• Specialized driver • Welder • Electrician • Mechanic worker • Pipe fitter (for CSP only) • Specialized plumber (for CSP only)	
Operation and maintenance	• Basic operations • Power bloc operation • Site cleaning • Site safety management • Regular mechanical maintenance • Regular electrical maintenance • Power block maintenance	• Production operator • Plant worker • Cleaning operator • Site maintenance operator • Logistics operator • Engine driver • Site keeper	• Electrical operator • Mechanical operator • Health and safety executive/specialist • Administrative personnel	• Operations manager • Maintenance manager

Note: CSP = concentrated solar power.

Box 3.2 Case study—examples of reconversions toward a new job in the framework of the energy transition

In a 2018 study, the Organisation for Economic Co-operation and Development identified examples of retraining for new employment as part of the energy transition. These conversions are based on both transferable and new capabilities.

Table B3.2.1 Job conversions made possible by transferable and new capabilities

Country	Initial job	Initial education	Continuous education	New job
Denmark	**Industrial electrician/power technician**	Professional training diploma/engineering diploma	Knowledge of energy sources, ability to integrate energy systems, project management, energy systems integration, project management	Director in the field of renewable energy
Denmark	**Industrial worker/electrician**	Vocational diploma/bachelor's degree	Assembly and integration of pieces, use of tools	Onshore wind technician
France	**Product designer**	22 initial training courses with different specializations	Integration of environmental issues	Ecological designer

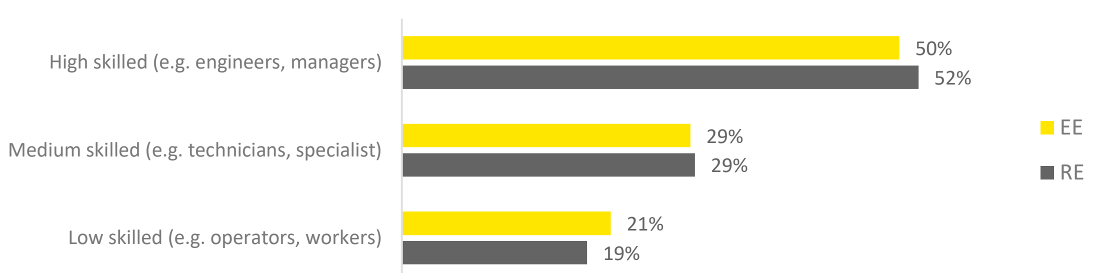
Source: OECD 2018.

REQUIRED SKILLS AND CAPABILITIES

All skills and capabilities require varying degrees of expertise, thus justifying independent analysis.

The online survey illustrates that companies mostly employ highly skilled employees in the renewable energy and energy efficiency sectors (figure 3.1). Indeed, 52 percent of the respondent's employees are highly skilled in renewable energy and 50 percent in energy efficiency, whereas medium-skilled employees such as technicians and specialists represent 29 percent of their labor force for both sectors, and low-skilled employees represent only 19 percent and 21 percent of the headcount, respectively, for renewable energy and energy efficiency.

Figure 3.1 Online survey—Skill levels in company workforces



Source: Online survey.
Note: EE = energy Efficiency; RE = renewable energy.

Eleven core competencies have been identified in the renewable energy and energy efficiency sectors (table 3.4). The online survey highlighted how scarce these skills are on the job market. Those skills crisscross both the value chains of renewable energy and energy efficiency and qualification levels—low, medium, and high. To develop a skills map for the local renewable energy and energy efficiency sectors, it would be helpful to merge the occupational labels and information from the industry survey and interviews conducted for this study with the skills classifications used by the Organisation for Economic Co-operation and Development and others.

Table 3.4 Skills classification and recruitment difficulties

Competency classification*	Competency description**	Corresponding occupation profiles	Recruitment difficulty***
Systems and risk analysis	Ability to assess and anticipate technical and natural threats to applications, systems, or networks	• Plant operations manager • Administration • Production technician • Maintenance technician • Electrical and grid maintenance operator • Electrical maintenance technician • Inspector • Storage maintenance technician	●●●●
Innovation	Ability to create and run innovative projects and/or business ventures, and address the challenges and requirements met by entrepreneurs	• Mainly concerns engineers and other highly qualified profiles in the components manufacturing segment	●●●●
Strategy and leadership	Ability to influence others to voluntarily make decisions that enhance the prospects for the organization’s long-term success while maintaining short-term financial stability	• Project designers and managers • Commissioning engineers • Business developers • Plant operations manager • Plant director	●●●●
Environmental awareness and eagerness to learn about environmental issues	Ability to use environmental knowledge to convince potential customers and to make them resilient in an environment full of counterincentives from the conventional energy interests	• All jobs along the renewable energy and energy efficiency value chain	●●●●
Coordination management and business	Ability to manage personnel and human relations, as well as to coordinate between and within units	• All high-skilled jobs along the renewable energy and energy efficiency value chain (the diversity of stakeholders involved in the energy efficiency and renewable energy sectors increasingly requires that employees have a high degree of coordination)	●●●●

Communication and negotiation	Ability to make the most out of market opportunities when they open up for renewable energy implementation	• Resource assessment specialists • Geological experts • Environmental and social consultants • Naturalist expert • Grid modeling experts • Local utility representatives • Land use negotiators • Public relations officers • Finance experts and consultants	●●●●
Marketing	Ability to create and implement techniques aiming at studying a market and at growing sales	• Marketing specialists	●●●●
Foreign language	Ability to communicate in more than one language; for Egypt, English is the most common required foreign language	• Potentially useful for semi- and high-skilled jobs, especially where local company contracts with a foreign company	●●●●
Interdisciplinary	Ability to explore content or solve a problem by integrating knowledge and experience that come from more than one field or subject	• Administration • Plant director	●●●●
Advocacy and campaigning	Ability to use advocacy tactics to enable the launch of a renewable energy or energy efficiency project	• Local utility representatives • Land use negotiators • Public relations officers	●●●●
IT (information technology)	Ability to use technological tools—IT skills are a rather wide skill set that ranges from hardware instalment and software development to troubleshooting and data analysis	• Design and conception engineer • Researchers • Modelers • Manufacturing engineers • Project designers and managers • Construction professionals • System designers • Electrical grid engineer • Commissioning engineers • Software engineer • Business developers • Plant operations manager • Administration • Plant director	●●●●

Source: * OECD 2010.
** Skills definitions have been identified based on: ILO and EC 2011; ILO 1980; Skills4Employability 2020; Wolkowicz 2023; Science Direct n.d.
*** Interviews with companies and online survey performed in the context of the study.
Legend: Level of difficulty to recruit workers with the associated skills: ●●●● – Extreme;
●●●● – High; ●●●● – Medium; ●●●● – Low; ●●●● – Minimal.

In addition to the cross-functional skills identified and analyzed through the online survey, the energy transition encompasses skills specific to the renewable energy and energy efficiency markets.

Egypt has no standardized classification for renewable energy and energy efficiency occupations or skills requirements for those specific sectors. Several initiatives have sought to bridge this gap in understanding the labor market. Two initiatives regarding renewable energy and energy efficiency (boxes 3.3 and 3.4) were broached by the Ministry of Education and Technical Education (MoETE) and the New and Renewable Energy Authority (NREA).

Box 3.3 Case study—skills classification for solar and wind technicians in Egypt

The Ministry of Education and Technical Education (MoETE) has initiated, through the WISE (Workforce Improvement and Skills Enhancement) program, an in-depth mapping of the skills and competency levels of solar and wind technicians while defining training programs for these professionals.

The methodology employed by the MoETE consisted in identifying specific skills and mapping them to the competencies required, in order to translate the competencies into knowledge (table B3.3.1). This required knowledge would then be taught in the program resulting from the initiative, as well as the indicators and success factors to measure the knowledge acquired (e.g., national and international standards). The objective of such mapping was to obtain a concrete and actionable skills identification tool that could inform courses and learning arcs.

Table B3.3.1 Solar/wind technical abilities and competencies

Abilities	Examples of competencies applying to the skill
Apply and implement occupational safety and health measures in the work environment (according to safety standards)	• Preparation of energy production systems remotely • Application of safe working practices • Identification of common first aid cases • Monitoring and review of control measures
Demonstrate full knowledge of the fundamentals of renewable energy	• Implementation of simple solar and wind power applications • Selection of the right wire/cable network systems • Extension of wire/cable networks and connection of accessories for low-voltage circuits • Testing of connections/devices • Reporting on installation activities • Connection/dismantling of common household electrical circuits • Knowledge of renewable energy transportation materials
Implement electrical circuits work according to performance standards	• Solving of low-voltage alternating current problems • Understanding of electricity sources • Maintaining power supply systems' safety
Understand and perform maintenance of solar installations	• Maintaining offline power supply systems • Solving nongrid problems in renewable energy devices and systems • Working on stand-alone renewable energy systems
Understand and perform maintenance of wind installations	• Installing and adjusting of low-voltage offline wind conversion systems • Periodically maintaining generators • Planning for inspection, maintenance of stand-alone wind turbine batteries • Testing and detection of defects in installations on different parts of a wind turbine
Conduct mechanical maintenance of wind power installations	• Equipment of the mechanical installations • Testing of the mechanical parts • Reporting and resolving of the problems
Implement and use solar heating applications	• Choosing the right heating system • Fortifying the solar heating system and optimizing functioning • Observing health and safety measures • Installing solar water heating systems in households and industrial applications (low-pressure systems)
Demonstrate understanding of theoretical mathematical notions and their application	• Performing various calculations • Problem-solving methodology • Employing scientific thinking for problem solving
Understand technical diagrams and electrical circuits according to standard terminology and symbols	• Using specific programs • Drawing diagrams and schemes

Source: USAID 2015.

Box 3.4 Case study—skills classification for energy efficiency applied to wind energy

The identification of skills for the energy efficiency sector appears more complex than it is for renewable energy, as energy efficiency covers many sectors and an array of occupations. Therefore, in Egypt, skills requirements for energy efficiency are classified by sector and job.

For energy efficiency, we consider the skills conferred through a two-week training program for wind farm engineers by the New and Renewable Energy Authority (NREA). The classroom lectures and theoretical training take place at NREA, while practical training occurs on a wind farm (Zafarana). The skills and competencies identified by NREA and addressed in this program are listed in table B3.4.1.

Table B3.4.1 Wind energy skills and competencies

Skill description	Examples of competencies applying to the skill
• Ability to prepare wind farm projects • Knowledge of wind turbine technology • Awareness of the environmental impacts of wind farms • Ability to seize opportunities to share ideas and experiences with Egyptian experts in the field of wind energy • Understanding of the operation and maintenance of the wind farms	• Wind resource assessment • Operating a clean development mechanism project • Grid connection for wind farm • Knowledge of the phases of wind farm projects • Tender documents preparation • Energy pricing • Introduction to energy conservation (principles—technologies—applications) • Energy efficiency labeling for home appliances

Source: Documentation provided by NREA (internal NREA investigation).

4. OPPORTUNITIES AND CHALLENGES IN THE JOB TRANSITION

This section presents an analysis of labor opportunities and challenges in the context of the clean energy transition in Egypt as it:

- Provides an analysis of the current Egyptian business environment in order to understand the business drivers and barriers on a macroeconomic level, and an analysis of both the renewable energy and energy efficiency markets dynamics.
- Considers the challenges and opportunities linked to policies, institutional frameworks, national programs, and the education system.
- Addresses the **challenges and opportunities of the digital economy**, technology, and innovation with regards to renewable energy and energy efficiency in Egypt.
- Touches on human capital–related challenges and opportunities.
- Lists **the key factors what would facilitate the job transition** in Egypt.

In a report on designing active labor market policies for recovery, the Organisation for Economic Co-operation and Development (OECD 2021) recalls the main levers for job creation, particularly in developing countries. The report stresses that new jobs are created when industries expand, and new businesses start and grow. Indeed, net job creation is typically led by a small number of start-ups. New firms are highly dependent on the local economic contexts in which they emerge, with most high-growth firms typically developing in densely populated localities with high levels of tertiary education. Policy makers play a major role in job creation, as they can support this process by helping to make technology, capital, affordable space, and start-up financing available, as well as promoting business networking. Also, labor market policy plays a central role in supporting job creation by ensuring that businesses have access to people with the right skills to help them start and grow. In addition, flexible training, education, and employment services are needed to address potential skills gaps that can act as obstacles to business growth and expansion.

OVERALL BUSINESS ENVIRONMENT

The overall business environment is favorable for the development of renewable energy and energy efficiency in Egypt. The demand for electricity, including from renewable sources, is expected to grow rapidly, supported by economic improvements due to structural reforms (Enterprise 2021). Consequently, Egypt's renewable energy market is expected to register a +10 percent compound annual growth rate (CAGR) during the 2022–27 period (Mordor Intelligence 2021).

The Egyptian economy has now started to recover from the COVID-19 pandemic impact. The country benefitted from 7.7 percent growth in 2021, compared with a 1.7 percent contraction the previous year (World Bank 2021c), partly due to a resumption of economic activity and international travel and trade. However, the Economist Intelligence Unit (Enterprise 2021) considers that the global economic contraction caused by the pandemic will remain a central risk in the medium term for Egypt.

Overall, recent macroeconomic reforms have helped stabilize the Egyptian economy these past few years, driving growth and demand, boosting electricity supply, and opening the energy market for private activity and investments, despite the COVID-19 pandemic. As an example, the activation of the Renewable Energy Law (Law

203, 2014), which allows a gradual shift from state-administered projects to privately financed projects in order to encourage the private sector to produce electricity from renewable energy sources, helped the renewable energy sector to continue attracting investments.

The steady appeal of the renewable energy sector, despite COVID-19 and its disruptions, is confirmed by Egypt ranking 19th in the Renewable Energy Country Attractiveness Index (EY 2021) by the end of 2021, moving up from one position in the first semester of 2021. This continued appeal of the sector was not guaranteed, since the pandemic drove a downward revision of Egypt's gross domestic product from 5.5 percent in 2019 to 2 percent in 2020, especially due to the sharp slowdown in other sectors such as tourism and supporting industries as well as manufacturing, real estate, and trade.

The government could encourage private actors to expand even more in the renewable energy and energy efficiency sectors by simplifying routine administrative tasks. In the renewable energy sector, for example, companies say it can take months to sign a contract with a utility company and to connect a power plant to the national grid. In addition to the administration fees and a murky process, administrative delays will likely inhibit development of new renewable energy projects.

Having a favorable business environment for the growth of the renewable energy and energy efficiency sectors is a key factor for job creation, since an increase in the number of projects implies an increased need for workers, and consequently more jobs created. However, the growth of these sectors also has an impact beyond the industry itself. Indeed, the development of renewable energy projects (both mega and small regional projects) as well as energy efficiency measures confers indirect socioeconomic benefits by bringing additional income to regions where the projects are located, allowing them to develop and grow. The direct and indirect benefits of growing renewable energy and energy efficiency sectors therefore highlight the need to foster a favorable business environments for renewable energy and energy efficiency projects.

Box 4.1 illustrates the indirect socioeconomic benefits of a small-scale renewable project in a small town in Morocco.

Box 4.1 Case study—impact of renewable energy development on socioeconomic growth

In Aïn Beni Mathar, a rural village near the Algerian border, an integrated, combined-cycle thermosolar power plant was constructed with a maximum capacity of 472 megawatts (MW), of which 20 MW was solar.

For the construction of the site, 500 workers were hired for the project, including 250 jobs for residents of the village of Aïn Beni Mathar. Housing and food services were set up for the workers, stimulating the local economy and creating indirect jobs in food, transportation, and housing. In addition, the income generated from the sale of land for plant construction has produced three country roads and four schools.

Before the project, the rainy season meant impassable roads. The project has thus facilitated access to social services and schools for the inhabitants of nearby villages by linking them to the area where the power plant is located. Also, the use of this system saved 12,000 tons of fuel oil per year and avoided the emission of 1,000 tonnes of carbon dioxide per year compared to a gas-only plant. Therefore, it contributed to better energy efficiency in the area (in addition to greenhouse gas reductions), through the reduction in fuel consumption due to the availability of shorter, more optimal routes.

Source: World Future Council 2016.

SECTOR STRUCTURE AND MARKET

RENEWABLE ENERGY MARKET

Although Egypt's renewable energy market is characterized by a strong growth potential (+10 percent CAGR expected for the 2022–27 period) (Mordor Intelligence 2021), it is tough competing with conventional energy. From the investors' side, a certain degree of resistance is observed due to a perceived lack of contracts for renewable energy projects. In addition, fuel subsidies discourage private investors because subsidies hamper the ability of renewable energy to financially compete with fossil fuel energy.

In addition to this resistance from investors, private companies may hesitate to expand into renewable energy owing to the long-standing predominance of the public sector. Indeed, historically, generation, transmission, and distribution assets were fully state owned and operated under the supervision of the Egyptian Electricity Authority, now known as the Egyptian Electricity Holding Company (EEHC). The power generation sector began moving toward private sector participation in the late 1990s, although it did not become prevalent until 2001 (IRENA 2018). The current Egyptian electricity market is mainly composed of state-owned utilities: six for generation, one for transmission, and nine for distribution services. All are operating under EEHC. EEHC's monopoly has begun to make way for limited competition from private distribution companies. Major companies in the power generation sector include EEHC, Edra Power Holdings, and the New and Renewable Energy Authority (NREA). The Egyptian Electricity Transmission Company (EETC) is affiliated with EEHC, which owns the national grid. The electricity transmission sector is a monopoly, whereby EETC is responsible for only transmission, maintenance, operation, and new development of the country's high- and extra-high-voltage transmission network (Global Data 2022).

In addition to the barriers mentioned above, other structural barriers prevent companies from growing in the renewable energy sector: For instance, the current exchange rate of the Egyptian currency constrains international funding opportunities, as it sets high costs for international inputs (for example, for the application of photovoltaic [PV] systems). In addition, business loan interest rates for small and medium enterprises (SMEs) are considered high, soaring to 18 percent in 2021. This may discourage SMEs from investing in the renewable energy sector (Salman and Hosny 2021). It also hinders the creation of renewable energy projects as well as competition between large and small-scale businesses. Even though a lot of SMEs still manage to enter the market (especially in the solar PV sector, in which more than 250 companies operate), these financial challenges and the consequent difficulties of raising capital prevent companies from ensuring the continuity of their renewable energy projects; these businesses remain unable to obtain regular contracts that ensure steady growth. Consequently, companies tend not to invest enough in building capacity among their employees, and therefore do not leverage the experience employees acquire from one project to another. This makes it difficult to compete with large-scale projects.

To compensate, the government is highly involved in promoting renewable energy and encouraging private investments in the sector. For example, no conventional energy projects are intended to be deployed by EEHC after 2027. This shift forces the company, as well as its partners and subcontractors, to restructure themselves and to provide training to their employees so they can work on renewable energy projects.

On the consumer side (households), the government could do more to encourage the use of renewable energy, by promoting self-consumption via net metering. Indeed, self-consumption rates are low because installing solar panels and connecting them to the grid is seen as very expensive by households. Some 80 percent of the solar market consists of off-grid projects that for the most part connect directly to water pumps in areas without electricity coverage. These produce solar energy for limited self-consumption and don't sell excess production back to the government—and are mainly in rural areas (Enterprise 2022). Another reason for consumers' reluctance to invest in net-metered solar panels is the perceived unprofitability in case of surplus energy production due to low electricity prices. But the potential surplus could be exported to neighboring countries, bringing benefits both to the households injecting electricity into the grid and to the government, which could charge for its contribution to the needed infrastructure and orchestrate the exports. A first step is to raise consumers' awareness of the potential benefits.

Another alternative is for the government to counter underinvestment in the sector by encouraging the private sector to develop a strong, competitive market for renewables. By providing a suitable regulatory environment, the government would lessen the market's need for governmental financial support. The government is therefore working to develop the right auction mechanisms to obtain attractive renewable energy costs. These should entice investors to invest more in the renewable energy sector and encourage the private sector to join in.

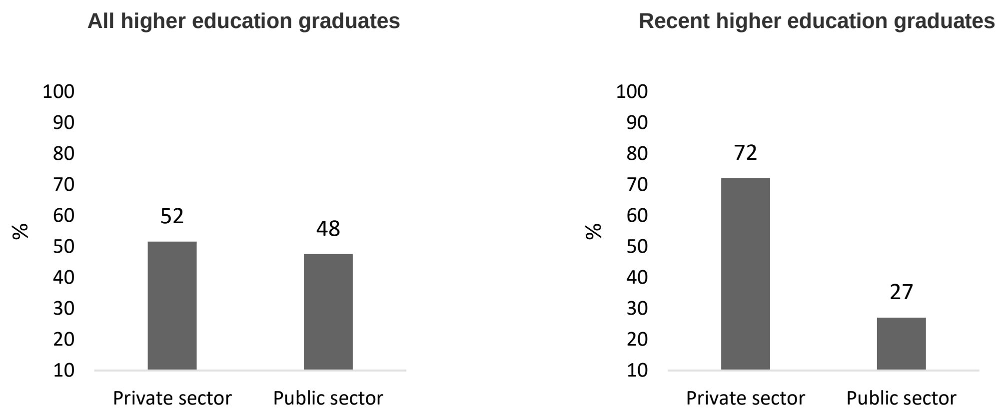
COMPETITION BETWEEN THE PUBLIC AND THE PRIVATE SECTOR TO ATTRACT AND RETAIN TALENT IN RENEWABLE ENERGY

Although the government is encouraging the development of private initiatives, the public and private sectors appear to be increasingly in competition, especially to attract and retain talent. Indeed, although the public sector has dominated the renewable energy sector, the private sector has increased its market share in the past few years (thanks to the policies and programs detailed in appendix 2), therefore gaining in attractivity for labor. In addition, the public sector is being reconstructed, especially due to the creation of new capital, which gives new graduates and skilled labor less visibility on their career path development. Therefore, the public sector increasingly struggles to attract and retain employees that could work on renewable energy projects.

This trend relates not only to the energy sector but also to Egypt as a whole: employment in the public sector decreased from 26 percent in 2014 to 22 percent in 2018. In 1994, 80 percent of graduates were employed by the public sector; in 2018, less than 30 percent of higher education graduates obtained public sector jobs, partly due to the surge in graduates' overall numbers (Assaad 2019). Another way to show this notable shift is to compare the sector, public or private, of recent graduates with that of all higher-education graduates (figure 4.1).[10]

[10] Individuals who graduated between 2013 and 2017 are considered recent higher-education graduates—World Bank calculations based on LFS 2017 (latest data available).

Figure 4.1 First job of all and recent graduates, by type of sector



Source: World Bank's public/private employment estimates based on LFS (2017).
Note: Recent higher education graduates include individuals who graduated between 2013 and 2017.

This shift to private sector employment occurs even though, on average, graduates working in the public sector earn higher monthly wages, across all types of work.[11]

Therefore, as the public sector struggles to attract and retain talent and the private sector gains importance, the former may not be able to stem the shift of skilled labor from conventional energy to renewable energy. Given that the electricity sector in Egypt is mainly led by the public sector, this might soon become an issue.

ENERGY EFFICIENCY MARKET

Several initiatives highlight a growing public sector interest in spreading practices and training related to energy efficiency. But the energy efficiency market is not driven by local companies (whether public or private): most of the major energy efficiency actions and initiatives recognized by the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE) are initiated and funded by international organizations and development banks (World Bank, United Nations Industrial Development Organization, European Bank for Reconstruction and Development, African Development Bank, Transformation Fund for the Middle East and North Africa). Perhaps this is because most national actors assume that energy efficiency implies high initial costs (owing to the purchase of energy efficiency applications) and does not necessarily enable the promising energy and cost savings resulting from its implementation. In addition, it seems that the general unfamiliarity with different energy efficiency technologies dampens private sector interest and repels potential investors (Sameh and Kamel 2017).

However, the Egyptian energy efficiency market benefits from its strong growth potential. As an example, the Egyptian residential sector is the most energy-consuming sector from the demand side (representing around 47 percent of power consumption in 2017) (Sameh and Kamel 2017): this high-energy consumption represents a strong opportunity for the development of energy efficiency in the country. It would be possible to not only deploy energy efficiency applications in the residential sector but also to model a successful implementation of energy efficiency applications, which could address some of the reluctance mentioned above.

[11] Egypt Higher Education, World Bank. https://www.worldbank.org/en/news/feature/2010/03/25/review-egypts-higher-education

As of the date of this report, little information has been offered by national institutions or agencies on the energy efficiency sector of Egypt. But the MoERE has conducted a study on energy efficiency projects in Egypt that should give the government as well as companies and investors a better overview of the sector and its potential.

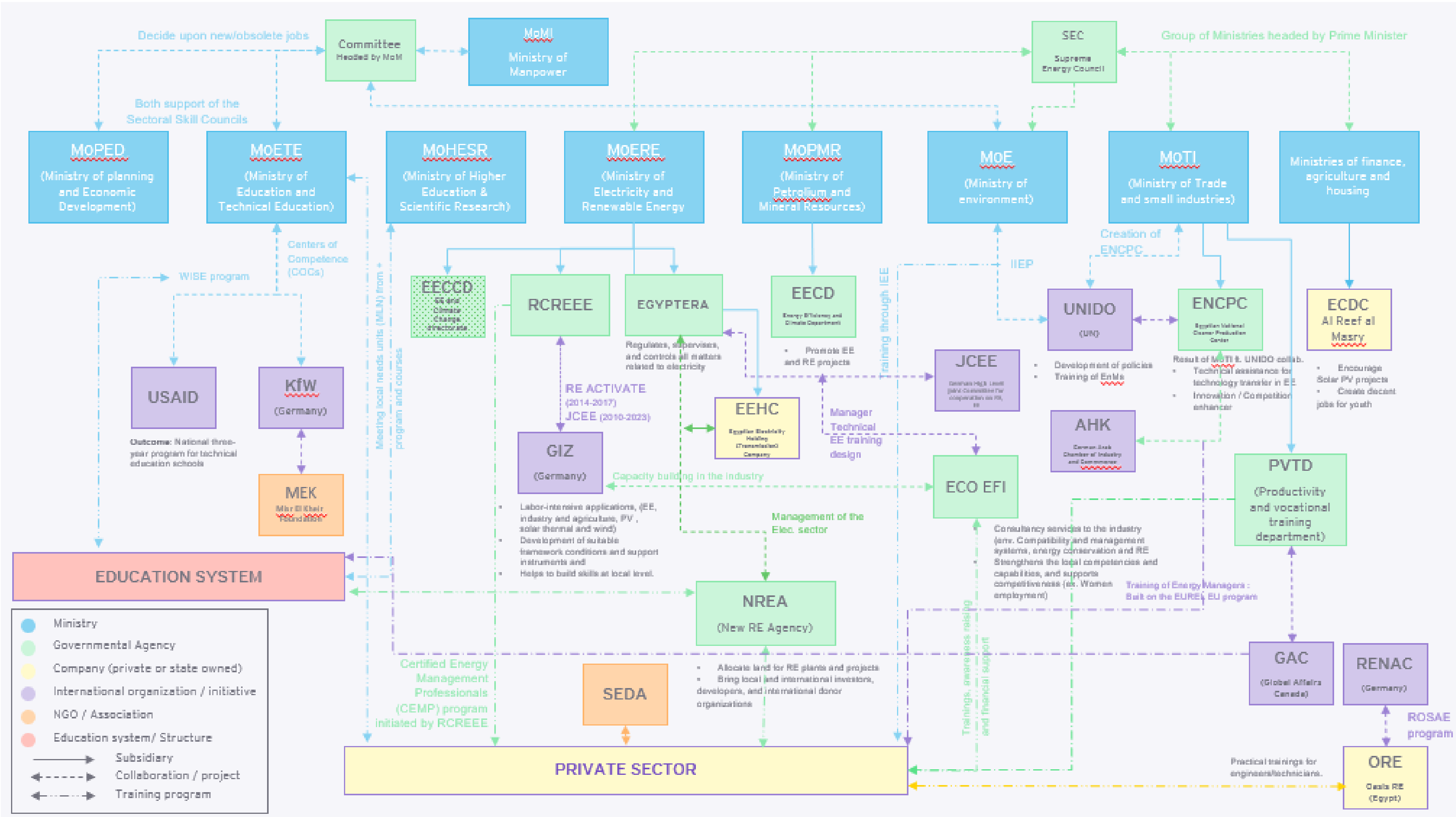
INSTITUTIONAL FRAMEWORK, NATIONAL POLICIES AND PROGRAMS, AND EDUCATIONAL SYSTEM

INSTITUTIONAL FRAMEWORK

In order to be successful and achieve its targets and goals, the energy transition needs to be backed by institutions and institutional programs that define a clear pathway to structure the transition, through explicit milestones and measurable targets and key performance indicators. Yet the overall orchestration of programs and initiatives in Egypt remains unclear. In the hydrogen sector, for example, multiple national initiatives rely mostly on short-term programs, with multiple short-term objectives. In these initiatives, ministries and governmental institutions address training (in the education system and labor market) at the very last stages. The initiatives are thus out of touch with the reality of market needs, or the practices of the education system. Instead, the market and education system should first be analyzed in depth; only then can programs and training be designed according to the needs and challenges identified.

Figure 4.2 illustrates the complexity of the energy efficiency and renewable energy institutional frameworks.

Figure 4.2 Institutional frameworks of Egypt's renewable energy and energy efficiency sectors



Source: Based on interviews with Egyptian institutions and stakeholders.

Note: ECDC = Egyptian Countryside Development Company; ECO FEI = Environmental Compliance and Sustainable Development Office within the Federation of Egyptian Industries; EE = energy efficiency; EgyptERA = Egyptian Electricity Utility and Consumer Protection Agency; GIZ = German Agency for International Cooperation; IIEP = International Institute for Educational Planning; JCEE = Joint Committee of Renewable Energy, Energy Efficiency, and Environmental Protection; KfW = German investment and development bank; NGO = nongovernmental organization; PV = photovoltaic; RENAC = Renewables Academy; RCREEE = Regional Center for Renewable Energy and Energy Efficiency; RE = renewable energy; SEDA = Sustainable Energy Development Association; UNIDO = United Nations Industrial Development Organization; USAID = United States Agency for International Development; WISE = Workforce Improvement and Skills Enhancement.

THE INSTITUTIONAL FRAMEWORK OF RENEWABLE ENERGY

Recognizing the need for a clean energy transition, the Egyptian government established several institutions in the 2010–16 period. Among them are the Supreme Energy Council (SEC), set up by Prime Ministerial Decree 317 in 2014 (ILO 2018). It reviews the national energy strategies and approves investment policies and regulations. Another institution is the Egyptian Electricity Utility and Consumer Protection Agency (EgyptERA), which supervises the coordination among electricity producers, transmitters, distributors, and end users (CMS 2019).

Several decrees[12] eased the orchestration of the initiatives on renewable energy development. The NREA[13] was made responsible for allocating land for renewable energy plants and projects (e.g., Red Sea, Aswan, South Sinai, Cairo, Giza). It also brings local and international investors, developers, and international donor organizations to bear on initiatives such as Benban (Aswan) and Giza (SIWA) for solar energy plants and the Red Sea for wind plants. The NREA was believed to have been the national renewable energy coordinator. It was empowered to be a one-stop shop to expedite processes under any renewable energy development scheme, enhancing the private sector's contribution to renewable energy deployment and reinforcing its role as a facilitator rather than a project developer (IRENA 2018). However, given the multiple and varying degrees of granularity seen in the sector's initiatives, it appears the NREA has not been playing its intended role of orchestra conductor.

The Ministry of Planning and Economic Development, working closely with Ministry of Education and other stakeholders, is taking a leading role in establishing and sustaining sectoral skills councils (SSCs). These sector-specific organizations have a skills-development mandate to move education and training systems from an emphasis on supply to demand, requiring these systems to meet the needs of the labor market and of employers. The initiative is at an early stage, mainly focused on selecting the first batch of sectors for which SSCs will be established, as well as establishing the legal status and governance of SSCs.

Once deployed, the councils will oversee the clean energy job transition. This initiative follows the creation of a committee comprising the ministry of manpower (which heads the group) along with the ministries of planning and economic development, education and technical education, and environment. The councils will weigh in on jobs—new, obsolescent, obsolete—across all sectors. Meanwhile, the Productivity and Vocational Training Department (PVTD), ensconced at the Ministry of Trade and Industry, will determine the skills levels for industrial actors, undertaking the market research and field investigations because of its closer relationship to the labor market. Overall coordination remains fairly ad hoc, initiated only for specific needs or projects.

This was not the case in previous years, where coordination of the labor market took place within the Supreme Council for Human Resources Development. But this council was replaced in 2014 by three committees: human resources, TVET, and skills development. The shift to three coordinating committees followed the announcement of decrees 705/2014, 706/2014, and 707/2014. Until the decrees are activated, however, the three committees cannot announce labor market information.

[12] For example: Presidential Decree 203 in 2010, Presidential Decree 135 in 2014.

[13] New and Renewable Energy Agency (NREA): http://www.nrea.gov.eg/.

THE INSTITUTIONAL FRAMEWORK FOR ENERGY EFFICIENCY

In the energy efficiency sector, the institutional framework bases initiatives on industry competencies and practices.

In 2005 the Egyptian government established the Egypt National Cleaner Production Centre (ENCPC), an initiative of the Ministry of Trade and Industry that aimed at sustaining and coordinating the initiatives addressing cleaner production and energy efficiency. The ENCPC has since become a fully operational unit with a long-term vision to "become a center of excellence for Green Industries & Resource Efficiency and Cleaner Production" in Egypt.[14] It provides technical assistance for technology transfer in the fields of resource efficiency, industrial waste valorization, as well as energy efficiency and renewable energy applications.

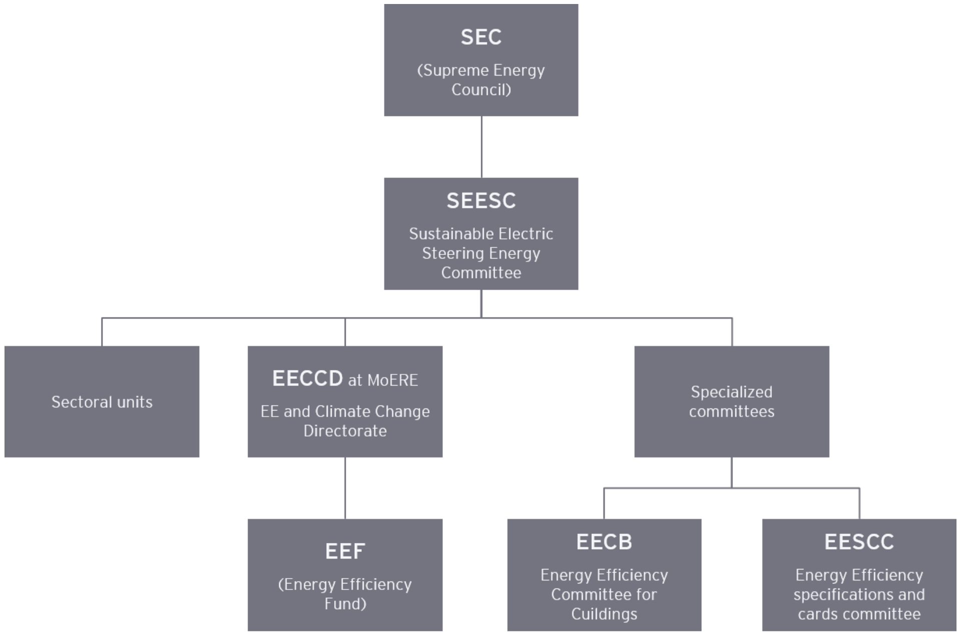
The ENCPC is strengthening the labor market during the clean energy transition through an accredited training program called European Energy Managers for Egypt. It qualified 200 local Egyptian experts as energy managers, basing the project on a successful European Union model called EURO-Energy Managers (EUREM). EUREM began in 4 countries and is being implemented across 12 countries (Supreme Energy Council 2018).

The RCREEE was initiated in 2010 by the United Nations Development Programme. Supported by a number of countries and organizations, such as the MoERE, RCREE presents a genuine opportunity to develop energy efficiency as it merges Egypt's effort with a league of 17 Arab member countries to develop common policies and strategies.

The alignment of the policy decisions and regulatory requirements (especially among governmental institutions) on the job trends and skills in clean energy might be taken up by the Energy Efficiency Committee, established by the prime minister. On the one hand, this committee has a mandate for transition to clean energy and energy efficiency. On the other, the government is also thinking about restructuring the institutional framework for energy efficiency. Figure 4.3 illustrates the institutional framework, not yet operational, for energy efficiency as suggested by the second Egyptian National Energy Efficiency Action Plan (NEEAP) (2018/19–2021/22) (Supreme Energy Council 2018). In this configuration, the Sustainable Electric Energy Steering Committee (SEESC), headed by the first undersecretary of MoERE, would supervise energy efficiency activities at the ministry. The SEESC would supervise the Energy Efficiency and Climate Change Directorate at MoERE, with an energy efficiency fund and specialized committees (energy efficiency code committee for buildings and energy efficiency specifications and cards committee).

[14] ENCPC: https://encpc.org/.

Figure 4.3 Energy efficiency institutional framework



Source: Supreme Energy Council 2018.
Note: MoERE = Ministry of Electricity and Renewable Energy.

Evidence of coordination among the institutions remains unclear, however. This highlights a salient feature of the new framework: complexity. The framework has a highly complex ecosystem and a great many independent initiatives. Complexity, in turn, calls for a highly coordinated institutional framework aligned with government objectives.

NATIONAL POLICIES AND PROGRAMS

The National Egyptian Renewable Energy Strategy, the Sustainable Development Strategy (SDS): Egypt Vision 2030, the Integrated Sustainable Energy Strategy (ISES) to 2035, and the Egypt National Climate Change Strategy 2050 have influenced (and will influence) the direction and development of specific Egyptian energy policies. Through these strategic papers, the government acknowledges that a more diverse energy mix is a more secure energy mix. Diversifying resources would make the country less vulnerable to fluctuations in the availability of fuel, while energy efficiency will generate both financing and energy savings. Although these several strategies manifest Egypt's interest in the clean energy transition, their multiplicity (and therefore array of targets) may create confusion among the actors.

But announcing an initiative does make it materialize. For example, the promulgation of a decree—giving an official order the force of law—and its activation occur in two separate phases, perplexing actors in the renewable energy and energy efficiency sectors. In fact, the government has issued several decrees to align national initiatives with institutions and committees (e.g., energy efficiency, human resources, TVET, and skills development for renewable energy), but with the committees not yet activated, uncertainty sets in. Some stakeholders say the decrees demonstrate national coordination. Others observe that nearly a decade has passed since their formation in 2014 (e.g., decree nos. 705/2014, 706/2014, and 707/2014).

Collaboration remains ad hoc. Inept program design creates overlapping outcomes and undetected and therefore unmet challenges. The renewable energy sector has the Ministry of Higher Education and Scientific Research's (MoHESR's) Meeting Local Needs units imbedded in the technological universities. The Centers of Competences is helping with a Labor Market Information System. PVTD is designing educational programs with Global Affairs Canada. Better coordination of these policies and programs could help actors capitalize on the work of other institutions, permitting them to address identified challenges.

EDUCATIONAL AND TRAINING PROGRAMS AND PROJECTS

A panel of academics and professionals are identifying the skills needed in the renewable energy and energy efficiency sectors so companies can expand their operations.

EDUCATIONAL AND TRAINING PROGRAMS AND PROJECTS DEDICATED TO RENEWABLE ENERGY

Technological universities (TUs) present a notable opportunity to enhance jobs during the clean energy transition. Created in 2018 (Law 72/2019) to absorb draw students to a technical track, TUs offer a two-year program for an advanced certificate, four-year program for the bachelor's degree, and masters and PhDs in various technologies. There offer applied studies (60 percent) and theoretical studies (40 percent) in disciplines considered most relevant to the labor market. In 2021, three TUs had already been established (New Cairo, Delta Region, and Upper Egypt) and five more are expected. The New Cairo TU offers a renewable energy technology degree.

TUs place employability and technical knowledge at the core of their strategic orientation. Graduates will have acquired skills commensurate with local, regional, and national labor market needs. In addition, TUs recruit an academic staff heavy on technical expertise, making industry experience a priority over credentials like a PhD. Industry experts also bring professional connections to facilitate networking.

But despite the opportunity presented by TUs, two challenges arise from the educational and training programs dedicated to the renewable energy sector:

- The programs focus mainly on solar technologies (especially PV); training programs lack diversity.
- Geographic distribution is sparse, with larger governorates tending to offer more courses on renewables (Cairo, Ain Chams University),[15] with extended offers of renewable mechanical or electrical engineering. Fewer of those courses are, however, offered in other governorates, where the universities still lack incentive from the market demand.

[15] The following two links present the specific renewable energy courses offered by the Ain Chams University and University of Cairo: https://eng.asu.edu.eg/education/PG/GESR/subsection1; https://cu.edu.eg/Cairo-University-News-12032.html.

EDUCATIONAL AND TRAINING PROGRAMS AND PROJECTS DEDICATED TO ENERGY EFFICIENCY OR BOTH RENEWABLE ENERGY AND ENERGY EFFICIENCY

The educational programs offering programs for energy efficiency and renewable energy/energy efficiency technicians seem unable meet market demand. Indeed, in contrast with the MoHESR's nationwide initiative on technological universities, the measures that address market needs for energy efficiency and energy efficiency/renewable energy technicians are not institutionalized, nor are they sponsored by donors or national agencies. Without a labor market information system (LMIS), surveyed institutions cannot explain what is not there. The emerging competency centers described in chapter 1 are perhaps one way to bridge the market shortfall in renewable energy and energy efficiency technicians. More broadly, and quite apart from possible solutions, most agree that Egypt needs a unified institutional framework for its educational programs. Egypt could then shape a renewable energy and energy efficiency workforce commensurate with its labor force needs.

Box 4.2 Case study—the TVET system

The technical and vocational education and training (TVET) system, which accommodates around 2 million students, of whom 650,000 graduate every year (TVET Egypt n.d.), has struggled with an inefficient labor market. Unable to respond to drastic market shifts, the TVET system fomented high turnover and low productivity. As a result, labor market conditions are deteriorating for employees. Mindful of the need to hone its workers' market-driven skills, and to streamline communications among all stakeholders, Egypt has established several work-based education programs over the past few years; most of these programs are evaluated and receive approval. As a work-based initiative, the TVET program saw a need to expand. This was especially clear after the Ministry of Education and Technical Education (MoETE) saw from 2016 data that only 2 percent (35,000 students in 2016) of its student population was enrolled in work-based secondary education. The MoETE set a new enrolment target of 50 percent: by 2025, 100,000 students would enroll in work-based learning every year (European Training Foundation 2020).

The anemic response of the TVET system to market requirements, and lackluster enrolment rates, caused the government to undertake an ambitious reform. Technical Education 2.0 has established the following pillars for technical education. These pillars support the (European Training Foundation 2020):

- The relevance of technical education by shifting to competency-based curricula,
- Teachers through training and qualifications,
- Schools through employer engagement and work-based learning, and
- The perceptions of technical education through awareness-raising campaigns.

In this context, the Government of Egypt, in cooperation with the European Union, funded the TVET II program, which supports education-related stakeholders in the renewable energy sector (nine technical secondary schools, three productivity and vocational training departments, and one technical institute affiliated with the Ministry of Higher Education), connecting these institutions (and their initiatives) to coordinated national action.

Quality assurance through accreditation and certification is expected to play a central role in this reform strategy. A national entity will be established to ensure TVET quality at the national level, while the MoETE will establish a quality assurance unit.

The Egyptian government has supported a more cohesive and granular TVET with the National Human Resources Development Council, which was introduced in 2014 and includes two executive councils, one for TVET and another for workforce skills, along with governorate-level human resource councils (European Training Foundation 2020). Industry leaders and education providers are preparing to collaborate on sector skill councils. Although not yet active, these councils will help coordinate the Labor Market Information System since the TVET system is administered on different levels. Several ministries administer the TVET provision, while the directorates operate at the governorate and regional levels, administering central decisions and requirements (European Training Foundation 2020).

DIGITAL ECONOMY, TECHNOLOGY, AND INNOVATION

The development of new technologies for clean energy transition (for instance, green hydrogen or energy storage solutions [e.g., batteries]) is an opportunity to maximize the share of renewable energy on a large scale. To reach their potential, these technologies must be available to many Egyptian companies, which must be able to afford them. Investment in research and development (R&D) will be key to mastering these new technologies while lowering their costs.

Egypt has begun to explore green hydrogen. Drawing on pertinent ministries and other entities, the Cabinet of Ministries formed a committee and tasked it with preparing a national hydrogen strategy, whose objective is to help plan how Egypt can produce and export hydrogen, explore financing schemes, and integrate hydrogen into the plans under Integrated Sustainable Energy Strategy to 2035.

The European Bank for Reconstruction and Development (EBRD) and the Government of Egypt are together drafting the technical, legal, and financial requirements for hydrogen projects in Egypt. A number of funding opportunities are available from development institutions such as the EBRD and the EU Innovation Fund and Climate Fund. The government had announced a $40 billion hydrogen strategy (Energy & Utilities 2022), along with a plan for a production capacity of 1.4 gigawatts by 2030. Egypt's Sovereign Fund announced that the country's first green hydrogen production plant would be operational by November 2022 (Arab News 2021). Hydrogen from renewable sources would be a second phase of hydrogen sector development (2030–50). The first phase is blue hydrogen generation from gas (by 2030).

Besides storage technologies, the development of services surrounding renewable energy and energy efficiency (for example, PV monitoring and optimization, solar pumping, and energy optimization solutions [e.g., better street lighting]) constitutes a major opportunity for the renewable energy and energy efficiency sectors throughout their value chains. Numerous projects and start-ups have emerged that support the digital economy of the renewable energy and energy efficiency sectors and facilitate the country's entrepreneurial culture.

The development of electric vehicles (EVs) and the *Egyptian Strategy for Electric Vehicles*[16] represent another opportunity for Egypt's energy efficiency sector, especially in transportation. EVs benefit from not only energy efficiency but also a regenerative braking system, which generates electricity and stores it in the EV's battery. Regenerative braking can generate up to 20 percent energy savings for EVs. The EV market is expected to expand,

[16] In June 2018, the Ministry of State-owned Enterprises of Egypt embarked on a reform program for the entire eight holdings and 118 subsidiaries. This reform put in motion the development of an Egyptian strategy for EVs, as one of sectors addressed by the reform.

as the cost of short-range and hybrid EVs is expected fall below the prices for fossil fuel–powered vehicles by 2025 (RCREEE 2020). As an indirect impact of the clean energy transition, this e-mobility transformation could disrupt the transportation sector and create jobs in Egypt (Climate Nexus 2019). To realize the job creation potential, however, start-ups will have to tackle the formidable accessibility challenges now facing Egyptian consumers. First, affordable EVs, and, second, charging stations distributed throughout the country.

An entrepreneurial culture is key since the country will need a great many projects and businesses to generate jobs for the many Egyptians seeking work. Egypt has favorable figures on entrepreneurship. The Egypt National Report (Ismail et al. 2019) shows that in 2020, 74 percent of Egyptians perceived entrepreneurship as a good career choice. And Egypt ranked 10th among the GEM countries. In 2020, 65.7 percent of the population aged between 18 and 64 saw good business opportunities where they lived. Although these figures cover all sectors of the economy, entrepreneurship is highlighted by the educational system geared toward the renewable energy and energy efficiency sectors, especially through the national incubators affiliated with universities. Soft finance and low-interest-rate financing can be obtained either through these incubators or through the Green Economy and Green Bank of Egypt; this financing will enable young entrepreneurs to start businesses in these green sectors.

An entrepreneurial culture in the green economy confers a number of benefits. Two successful Egyptian companies are discussed in the case studies presented in boxes 4.3 and 4.4.

Box 4.3 Case study—benefits of entrepreneurship for the energy efficiency market: Tagaddod

Tagaddod (Arabic for “renewal”) is a pioneering renewable energy and waste management company. It is an Egyptian company, established in 2013 in Cairo.

Tagaddod operates in an International Sustainability and Carbon Certification (ISCC)-certified production facility, and it produces biodiesel (green fuel) from used cooking oil (UCOME). Biodiesel is used in conventional diesel engines and can therefore directly substitute for or extend the supplies of traditional petroleum diesel. The company developed its activity over the years; it provides its customers with tech-enabled waste oil and fat collection, besides feedstock trading.

Tagaddod is leveraging data, technology, and networks for sustainable energy security and waste removal. Its revenues add up to $23 million, and it employs 97 people currently.

Box 4.4 Case study—entrepreneurship and its benefits for the renewable energy market: KarmSolar

KarmSolar, founded in 2011, was among the first private companies in Egypt that were licensed to distribute solar electricity. It also provides microgrid solutions, which enable setting up off-grid solar power plants on site in remote locations. The company claims to have installed 31.4 megawatts of renewable energy, offsetting 10,000 tons of carbon dioxide and saving 2.3 million liters of diesel annually.

KarmSolar’s operations started a decade ago with $11,000 in funding. The company has since attracted over $48 million from a network of 61 investors. Today, it employs over 54 staff, serves around 600 customers, and its revenues have quadrupled since January 2019, according to its chief executive officer. KarmSolar’s portfolio includes 12 operational solar stations ranging from 100 kilowatts peak to 16.8 megawatts peak.

KarmSolar is now putting plans in place for an initial public offering. In September 2021, it launched its water solutions division, KarmWater, with a solar-powered desalination project in Marsa Alam.

Both sectors benefit from technology and innovation through digitalization and automation.

Workers supporting digital infrastructure need specialized ICT (information and communication technology) skills such as coding and cybersecurity. Across the energy sector, all workers will need generic ICT skills to operate digital technologies. Complementary soft skills (leadership, communication, and teamwork) will also be required if ICT-enabled collaborative work is to expand (IEA 2017).

While digitalization may reduce labor intensity across energy systems, this would depend on the sectors (and value chain segments) that are affected. For example, in the life cycle of a power plant, digitalization will lower labor intensity especially with respect to equipment and its manufacture, siting, and operation and maintenance (O&M). In renewable energy, robots clean solar panels and drones monitor wind turbines; hence, some jobs will be eliminated. In equipment manufacturing, the risk of automation, which yields operational benefits (including safety and productivity) but also spells job losses for low-skilled workers, is higher for repetitive and physically demanding jobs. Yet the introduction of data, sensors, and 3D printing creates new jobs in advanced manufacturing (IEA 2017).

In energy-efficient buildings, almost all jobs are up-front (e.g., construction and refurbishment). Equipment for energy efficiency of buildings creates fewer jobs once installed. That said, those involved in O&M for energy-efficient buildings will require skills to operate new technologies; a skill gap will hinder energy efficiency (IEA 2017).

Digitalization also impacts the oil and gas sector, especially the upstream value chain, where much employment is devoted to field development. The use of 3D seismic analysis has reduced drilling needs, but created new jobs in ICT and data science roles, which require different skill sets and are often located far from drilling operations (IEA 2017).

HUMAN CAPITAL

CROSS-SECTORAL CHALLENGES AND OPPORTUNITIES FOR THE EGYPTIAN LABOR MARKET

Egypt ranks among the most populous Arab countries. It has a population of over 100 million, which grows at an annual rate of 2.6 percent. The population has a high percentage of youth, growing by 1.8 percent a year. The Egyptian workforce represents approximately 25 percent of the total labor force in the Arab world and is considered highly skilled (Egypt has registered over 500,000 engineers over the past few years). It is estimated that the Egyptian education and training system adds 700,000–800,000 new entrants to the labor force every year, while the Egyptian labor market absorbs (people hired and who found a job) 460,000 people on average.

Egypt is constrained, however, in its ability to integrate its young people into the labor market. It has long struggled to assimilate new entrants into the workforce, even during periods of high economic growth. Between 2010 and 2015, for example, 460,000 people on average entered Egypt's labor supply per year, but employment growth was much lower—about 200,000 jobs per year. Consequently, many people of working age (especially young workers, women, and the educated, both men and women) have remained inactive or chosen to emigrate. The 2017 labor force participation rate was only 45 percent (European Training Foundation 2020).

At work here are several factors:

- An overall decrease in the employment rate;
- Dwindling public sector employment, the traditional employer for most new entrants (cf. section 5.2), combined with a gradual rise in formal, private sector employment, mostly in SMEs;
- A recent surge of employment in the informal economy; and
- The declining job quantity and quality.

The low labor force participation implies a large pool of potential workers, and as such presents an opportunity for economic development in Egypt. The right training would produce workers qualified for the renewable energy and energy efficiency sectors.

The low labor force participation is also an indication of insufficient job opportunities for workers. Overall employment growth has not kept pace with the growth of the working-age population, and the employment rate fell from 40.2 percent in 2015 to 39.0 percent in 2018 (World Bank 2019a). The likely of unemployment is even higher for educated workers. Unemployment levels among poorly educated and illiterate Egyptians are 4.8 and 4.6 percent, respectively, while much higher unemployment rates are recorded among those with technical intermediate (technical secondary) and university education and above (31.2 and 43.1 percent, respectively). In 2015, 20 percent of the highly educated working-age population (aged between 15 and 64) was unemployed (CAPMAS and IOM 2017). Workers with less education will generally be engaged in the informal economy with its subsistence, casual, and household tasks. High unemployment among educated workers is a strong indication of the mismatch between employers and training and education providers.

Lack of opportunities also appears to rely on location, since most jobs are found in only a handful of governorates. If the economywide job distribution in 2021 is considered, then almost 80 percent of jobs were concentrated in three governorates: more than half of the jobs were in Cairo (52.9 percent), while 19.2 percent and 6.41 percent, respectively, were in Giza and Alexandria (ECES and NBE 2021). Only 21 percent of the jobs in were in the remaining 23 governorates.

INCLUSION OF FEMALE WORKERS

Women are less represented than men in the labor workforce. In 2017, the female labor market participation rate was 22 percent, one-third of the male participation rate (66.9 percent), and the female unemployment rate was 23 percent, almost thrice as much as the rate for men (8.2 percent). This is especially true for highly skilled women: 34 percent of highly educated women were unemployed (compared with 24 percent for all women), whereas 15 percent of highly educated men were unemployed (compared with 10 percent for all men).

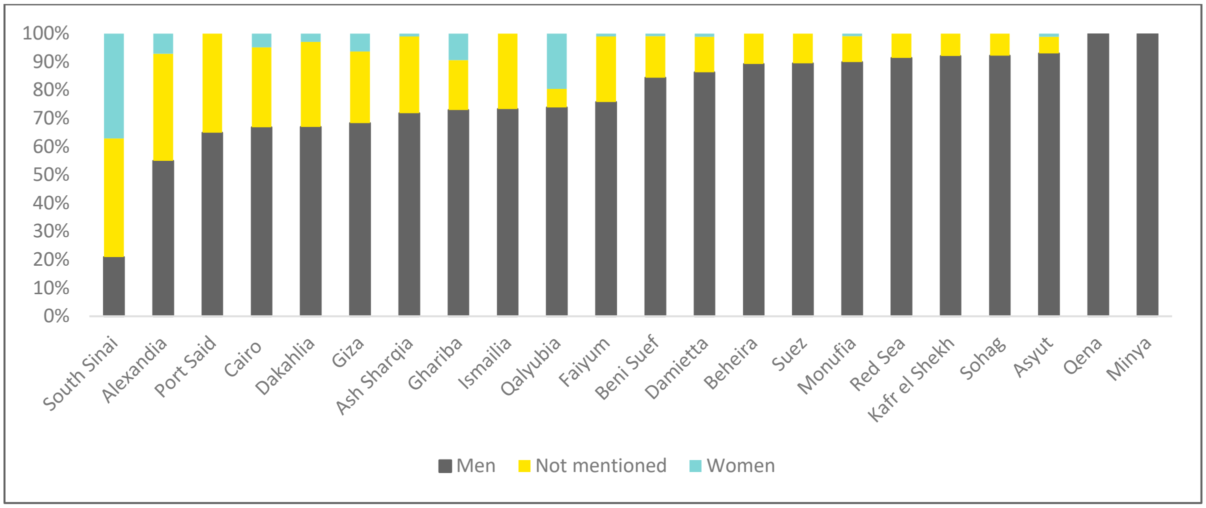
The labor force participation rate among women with higher education degrees is much higher than in any other group of women, at 66 percent; this is rated nevertheless much less than that for men with higher education degrees, at 89 percent.[17] This is due to several reasons, listed below:

- Higher education degrees do not necessarily help women obtain jobs, since nearly 31 percent of women with university degrees are unemployed due to a mismatch between field of study and labor market needs.
- Traditional social norms and lack of childcare, difficulty in finding safe and affordable transportation, and workplace safety, etc., discourage women from seeking employment opportunities (CAPMAS 2019).

In terms of awareness raising around women's employment, a detailed analysis of job offers and demand in different governorates conducted by the Egyptian Center for Economic Studies and the National Bank of Egypt (ECES and NBE 2021) illustrates that in most governorates, advertising for women barely exists. Figure 4.4 illustrates the percentage of job advertising that targets men, women, or is gender neutral.

[17] World Bank calculations based on LFS (2017).

Figure 4.4 Job advertisement by target in Egypt

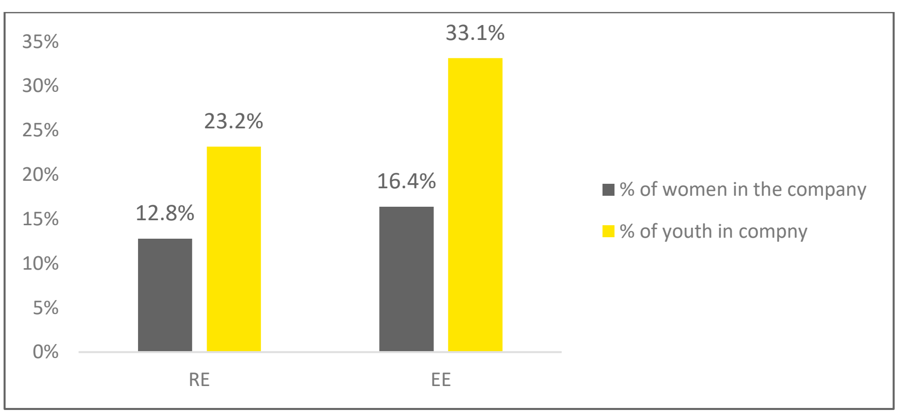


Source: ECES and NBE 2021.

Noninclusive workforces pervade the energy sector. Since the jobs involve fieldwork and travel, traditional Egyptians perceived the work as unsuitable for women. Women represent only 10 percent of Egypt's oil and gas workforce (Egypt Oil & Gas 2018). The MoHESR estimates that women constitute a 10–15 percent share of the renewable energy workforce. These figures are confirmed by the results of the online survey. Companies operating in the renewable energy and energy efficiency sectors declared that, on average, only 14 percent of their employees are women.

Different degrees of inclusion are noted, which vary by sector and the qualifications for the jobs. More women are employed for high-skilled positions (such as engineers and architects) than for low-skilled positions. Consequently, women view the energy efficiency sector as more appealing than renewable energy since the energy efficiency sector demands more high-skilled profiles. The lack of inclusivity is thus particularly visible for the technical positions in renewable energy (figure 4.5).

Figure 4.5 Inclusivity of women and young workers in the renewable energy and energy efficiency sectors



Source: Online survey results for inclusivity (women and youth).

Note: EE = energy efficiency; RE = renewable energy.

Women are underrepresented in technical positions for what appear to be three reasons:

- Women have few role models in these sectors—indicating a need for greater awareness around inclusive hiring.
- Traditional social and cultural beliefs regarding the jobs women should hold: parents are reluctant to their daughters being involved in physically demanding jobs, for example, at a solar farm. School career counselors, too, may guide women toward jobs considered "more suitable" for their gender.
- Employers prefer to employ men than women because (1) field jobs are viewed as unsuitable for women and (2) these job sectors require business travel and men are thought to be more flexible. (Women's roles managing the household are often cited.) Employers will need to learn about the benefits of (or the absence of disadvantages in) employing a woman.

The low employability of women limits any gains they realize from the education system for the renewable energy and energy efficiency sectors. Despite proper training, women will work in these sectors only if they overcome conservative social norms, parents' disapproval, lack of workplace/transportation safety, and inadequate childcare.

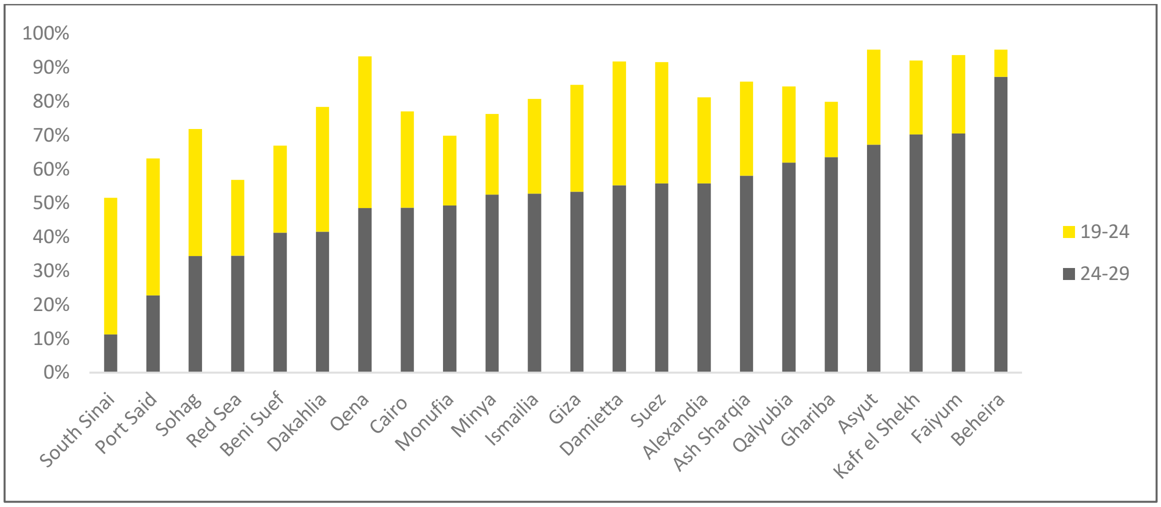
To balance the low female participation in renewable energy, the United States Agency for International Development implemented a program that supported an Aswan-based girls' school from where more than 300 girls graduated from a renewable energy program. Whether these graduates find jobs in the sector, will depend largely on employers—and the will of the graduates themselves.

INCLUSION OF YOUNG WORKERS

Egypt has quite a young population. Over half of the population is under the age of 24 years. Unfortunately, unemployment is high for people under 25, especially for new entrants who have intermediate and higher education (KAPSARC 2019). Every year between 2018 and 2022, about 700,000 youth entered Egypt's labor market; many of them faced or will face unemployment or underemployment (World Bank 2019b).

The Egyptian Center for Economic Studies and the National Bank of Egypt (ECES and NBE 2021) analyzed the job market and found that most of the country's job seekers had little or no professional experience and were between the ages of 24 and 29. Across the 22 studied governorates, the 24–29 age range represented 52 percent of the job seekers on average (ECES and NBE 202). In the three most populous governorates with the greatest employment opportunities, the trend tracked the national average: 49 percent of the job seekers were between 24 and 29 years old in Cairo, 53 percent in Giza, and 56 percent in Alexandria (figure 4.6).

Figure 4.6 Percentage of youth among job seekers in Egypt



Source: ECES and NBE 2021.

The companies responding to the online survey said only 21 percent of their workforce was under the age of 25.

The high unemployment among and low labor force share of youth can be explained by the complexity of the education programs. Meanwhile, does coursework supply the skills needed by the labor market? And the graduates' labor market outcomes are not monitored. What little data are collected—either from surveys, administrative-based employment monitoring systems, or other job portals—should be used to hone education/training programs with market needs in mind, and for each level of qualification (bachelors, masters, TVET, TU certifications). Job skills and profiles do not always match the market's needs upon graduation.

In the renewable energy and energy efficiency sectors specifically, ministries in charge of secondary, technical, and tertiary education cannot quite name the required competencies and thus struggle to provide training commensurate with the needs of the labor market. This situation is exacerbated by the disconnect between companies and training centers. Secondary and higher-education programs have no core coursework in energy efficiency; there are optional courses. But if access to energy efficiency coursework is irregular, few young people will gravitate to energy efficiency after graduation.

High unemployment can also be traced to Egypt's long-drawn-out school-to-work transition, a lengthy shift amplified by the outsized achievements of newer entrants and their lofty expectations. Many jobs that young workers find are low paid and/or low skilled, when what they seek are positions for engineers and experts, especially in view of the wages.

SKILL SHORTAGES

About 19 percent of employers in Egypt say that the surfeit of workers without the needed skills hinders competitiveness and growth (World Bank 2016). With its high unemployment rate and modest formal economic sector, Egypt still has employers that are straining to hire workers with the required skill profiles, even for basic jobs (World Bank 2016; Assaad, Krafft, and Salehi-Isfahani 2018). The country's labor productivity has grown only minimally over the past 15 years, from $32,630 in 2009 to $41,603 in 2019. Compare these gains with faster-growing economies like South Korea, where output per worker mushroomed from $2,441 in 2009 to $71,122 in 2019 (ILOSTAT data).

Despite gains in educational attainment, Egypt's workforce ranked 99th out of 141 countries on the Global Competitiveness Index (GCI) in 2019.[18] In terms of skills, Egypt's future workforce ranked even lower, at 133 out of 141 countries.[19] Except for digital skills among the economically active population (rank 44), Egypt is behind in all other subindices—vocational training (rank 129) and critical thinking in teaching (rank 123). Egypt's score on digital skills is 4.7 out of 7, below the Middle East and North Africa (MENA) average.

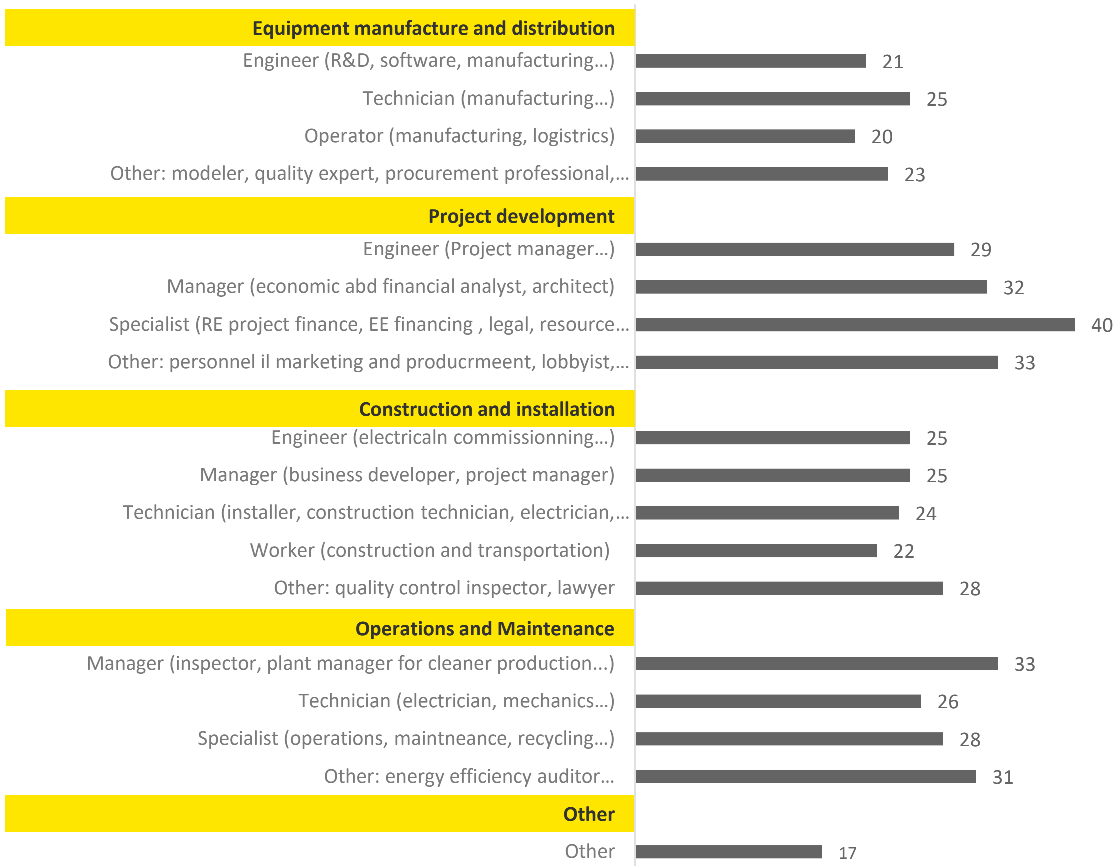
These figures align with feedback from Egyptian firms, 19 percent of which identified an inadequately educated workforce as a major or severe constraint. In addition, employers reported dissatisfaction with job candidates' technical and soft skills, including those of higher education graduates; they said they might opt to recruit foreign workers in some sectors (based on anecdotal evidence, for example, in ready-made garment manufacture).

This mismatch also appears in the renewable energy and energy efficiency sectors (ILO 2018), where companies struggle to find applicants that suit their requirements. The results of the online survey conducted for this study illustrate that the difficulties to fill certain positions vary across the value chain (figure 4.7). For equipment manufacture and distribution, technician appears to be the position that companies find the hardest to fill. In project development, specialists (e.g., renewable energy project finance specialists, as well as legal, resource, and assessment specialists) appear harder to find on the labor market. In construction and installation, quality control inspectors and lawyers, that is, more specific positions, are harder to fill. Finally, managerial positions are the hardest to fill in O&M, and companies struggle the most in finding skilled inspectors and managers for cleaner production.

[18] The following indicators are aggregated into a composite score to measure current workforce skills: (1) extent of staff training, (2) quality of vocational training, (3) graduates' skill set, (4) digital skills among the active population, and (5) ease of finding skilled employees. Some of the indicators are based on official statistics; others from WEF's Executive Opinion Survey (see WEF 2019).

[19] The GCI is the product of an aggregation of 103 simple indicators, which are derived based on data from international organizations as well as the WEF's Executive Opinion Survey. The indicators are organized into 12 pillars: institutions, infrastructure, ICT adoption, macroeconomic stability, health, skills, product market, labor market, financial system, market size, business dynamism, and innovation capability. The 2019 edition covers 141 economies (see WEF 2019).

Figure 4.7 Online survey—difficulties faced by companies in finding applicants for specific positions



Note: EE = energy efficiency; R&D = research and development; RE = renewable energy

In the same way, companies say they struggle to find applicants with the right skills on the job market. Indeed, companies have on average considered all 11 core skills identified as essential for renewable energy and energy efficiency jobs (described in the section 4 of this report) as hard to find on the job market. On a scale of 1 to 3 (3 being the most difficult to find on the market), skills have been graded 1.6–2.5. This highlights the fact that the training provided by the educational system and by companies may not be in line with companies' expectations.

To compensate for these difficulties, the WISE (Workforce Improvement and Skills Enhancement) program has started to identify, with the support of the Ministry of Education and Technical Education (MoETE), skill shortages in the renewable energy and energy efficiency sectors. These shortages can be broken down into two types: (1) a specific occupational shortage of technicians (especially outside Alexandria and Cairo) because the work has a "flawed appeal" among youth (hard work, low pay), and (2) general shortages of recruits with soft skills. However, an initiative of the type of the WISE program, which specifically targets renewable energy skills in Egypt, is not common.

SPECIFIC OPPORTUNITIES AND CHALLENGES FOR THE LABOR MARKET OPERATING IN THE RENEWABLE ENERGY AND ENERGY EFFICIENCY SECTORS

Besides these cross-sector opportunities and challenges for the development of the clean energy transition, Egypt faces three main challenges specific to the renewable energy and energy efficiency sectors:

- Lack of technicians,
- Lack of investment in capacity building from companies, and
- Slow absorption of young graduates with little professional experience.

LACK OF TECHNICIANS

The energy sector lacks technicians. Although this trend can also be observed in the conventional energy sector, it is remarkable in the renewable energy and energy efficiency sectors. A 2014 study by the IECD predicted that in 2027, about 50,000 technicians would be needed for the construction and installation phases of wind, PV, concentrated solar power, and solar thermal projects, while another 5,000 would be needed for their O&M phase.

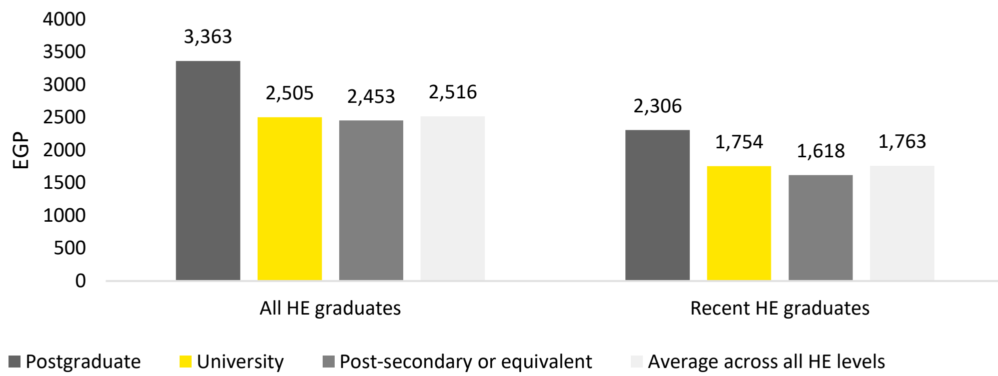
The need for well-trained technicians is clear from a glance at the staff composition of the wind farms in Egypt (Zafarana and Hurghada). The Zafarana-based wind farm, for example, operates with 59 engineers and 88 technicians, whereas the standard engineer–technician ratio is 1:5. Reportedly, one reason for the many engineers at this wind farm is that the manuals are all in English, a language the technicians have not mastered. When considering Egypt's ambitious renewable energy expansion plans, the graduation of technicians with high skills, including proficiency in English, becomes a key development factor.

To compensate for the dearth of technicians, the renewable energy sector's recruitment process targets (among others) youth with education that qualifies them for intermediate technicians. In addition, training and specific academic institutions (e.g., technological universities) have been developed rapidly enough to boost this occupation's appeal among young graduates. To strengthen recruitment, the MENA Enterprise Survey found that working in young, innovative firms reduces youth's reluctance to hold low-skilled occupations in the renewable energy sector.

Even though the technician shortage is easing, young workers hesitate to take up these jobs because wages are quite low (figure 4.8).[20]

[20] Recent higher education graduates include individuals who graduated between 2013 and 2017—World Bank calculations based on LFS (2017) (latest data available).

Figure 4.8 Average monthly wages: All and recent higher education graduates by type of program



Source: World Bank calculations of monthly wages based on LFS (2017) (latest data available).
Note: EGP = Egyptian pounds; HE = higher education.

Two other challenges may prevent companies from finding applicants for technician positions. One is the potential decrease or loss of income linked to relocation and training fees. Indeed, in these two sectors, companies want to hire workers with experience, at minimum in the conventional energy sector, but preferably in the renewable energy or energy efficiency sectors (or else with knowledge of such sectors). This is observed among technicians especially, whose required skills may depend on their chosen technology. Workers who want to change their sector (by choice or due to circumstances) therefore need to be re/upskilled to get hired in such sectors. These workers may have to find training outside their companies. But to benefit from training, they would need to reduce their working hours or altogether quit jobs, resulting in a decrease or loss of income. The prospect of poverty may discourage workers from proactively shifting to green sectors, even though skilled technicians are in demand. It may also prevent skilled workers who lost their jobs from looking for work in the renewable energy/energy efficiency sectors.

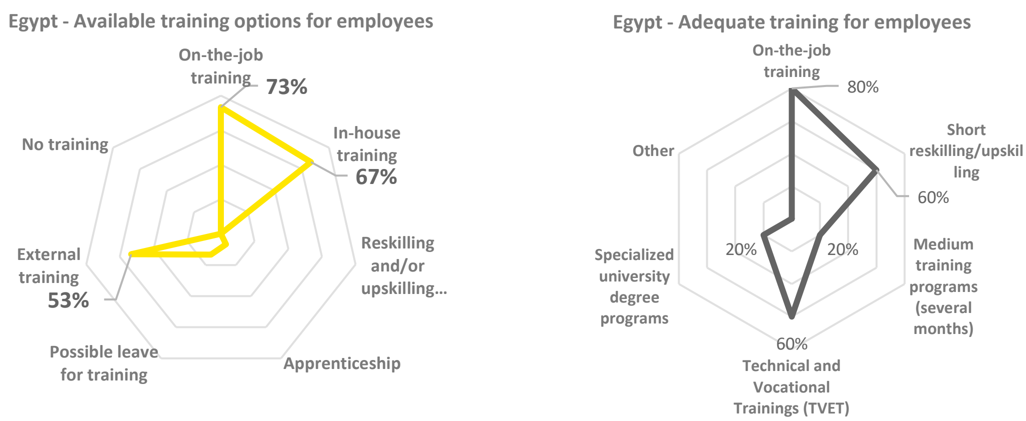
The other challenge is regional mobility. Indeed, for the renewable energy and energy efficiency sectors, the market demand is not homogeneous throughout Egypt: most projects are located in the three largest governorates. Because such projects often require workers to be on site, job seekers often have to relocate. Some workers want to work in the renewable energy/energy efficiency sector but live in regions with little market demand. The high relocation fees may discourage skilled workers from looking for jobs. Meanwhile, the new sectors miss out on talent that could have filled renewable energy/energy efficiency positions.

LACK OF PROPER INVESTMENT IN CAPACITY BUILDING FROM COMPANIES

In contrast to workers in the conventional energy sector, most workers engaged in renewable energy or energy efficiency projects can be involved in a few project phases—design, construction, O&M, and decommissioning. This is because the qualifications and skills for a job correspond to the phase. Further, most companies operating in the renewable energy and energy efficiency sectors manage only a few large-scale projects at a time (instead of many small projects): consequently, once a project ends, employees with temporary contracts must transfer to another green company or return to the conventional energy sector. Employers thus come to regard such workers as stopgap help on a project, not as long-term assets. This reality inhibits investments in training, which in turn hinders workers from building capacity so that they can continue working in the renewable energy/energy efficiency sector.

The online survey revealed that the respondents think workers should receive at least one type of training; 73 percent of them, however, report on-the-job training as the only available alternative during the workday (figure 4.9). Yet the option is merely an outgrowth of work, not an investment of company resources in actual training. The employees of only 67 percent of the companies receive in-house training, and 53 percent receive external training.

Figure 4.9 Available training for workers vs. adequate training accorded by companies

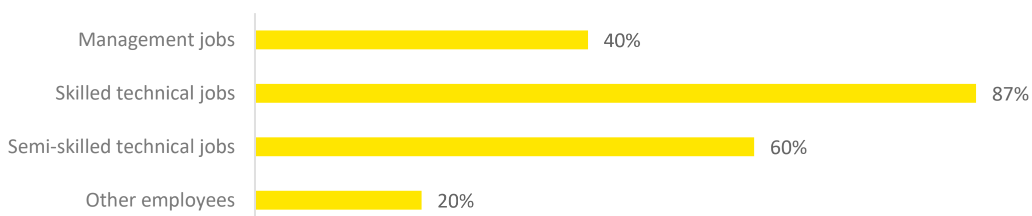


Source: Online survey.

The types of training provided by companies differ from the training they consider adequate for their employees to acquire sufficient skills to be involved in renewable energy and energy efficiency projects. Indeed, although 60 percent of the respondents consider short reskilling and upskilling training as adequate, no company has said that they provide such training. This highlights the gap between what companies consider adequate to invest in their employees' capacity building and what they offer.

Further, it appears that training does not relate to all occupations (figure 4.10). Skilled technical employees (engineers, project designers/developers) receive the most training, at 87 percent, followed by those on semiskilled technical jobs (technicians, installers), who receive 60 percent training.

Figure 4.10 Training in companies, by occupation



Source: Online survey.

SLOW ABSORPTION OF YOUNG GRADUATES DUE TO A LACK OF PROFESSIONAL EXPERIENCE

Egypt's labor market absorbs young graduates very slowly, and this is especially true for the renewable energy and energy efficiency sectors. It is a truism that students lack professional experience just as they graduate from school. Yet higher and technical educational systems could help by developing practical courses on a large scale; in fact, they have, for example, with the Centers of Competence developed by MoETE, and the practical courses at TUs. Those initiatives remain insufficient, however, in the face of overwhelming need.

As companies require an experienced workforce and appear reluctant to hire unexperienced workers for efficiency and safety reasons (e.g., high-voltage settings, complex tools, knowledge of technology), youth often struggle to find their first jobs.

A number of initiatives have been put forward to counter the gap between companies' expectations for experienced recruits and unexperienced young graduates:

- **Private training centers and online certification programs.** These programs include practical training and provide certifications that can help qualify young graduates for employment. But these programs cost money and are out of reach of most unemployed youth.

- **International initiatives.** Launched as collaborations between international development actors and Egyptian public institutions, they come with donors' financial support, which targets companies and their employees rather than new graduates looking for work. Still, such initiatives might counter companies' reluctance to hire young job seekers, as they benefit from capacity building programs. An example of such an initiative is presented in the case study in box 3.5.

- **Independent private sector initiatives.** Some companies develop initiatives and training programs for youth. These include apprenticeships, internships, and programs that target new graduates looking for their first jobs (box 4.6). Such programs have long served to bridge the labor market gap and ease the transition from school for job-seeking youth. Egypt is also rolling out formal schemes, among them industrial apprenticeships in vocational training centers. There are also "training stations" in the PVTD, and a dual system—applied technology schools and the "school in factory" scheme—under the MoETE. These are promising ventures but are mostly unnoticed.

These programs are important for not only young graduates but also companies in the renewable energy and energy sectors, which need young workers who are willing to relocate or travel to project sites.

Box 4.5 Case study—capacity building and quality infrastructure for rooftop photovoltaics

Renewables Academy (RENAC), a Berlin-based international provider of renewable energy/energy efficiency-related training and capacity building, was asked to train Egyptian photovoltaic installers with practical courses on solar energy. It collaborated with the German Agency for International Cooperation (GIZ). RENAC's coursework satisfies the industry demand for expertise and also expertise in solar energy more specifically, with support from Egypt's financial institutions and policy-setting bodies in green energy markets. RENAC has thus observed the skill gaps in Egypt.

In 2019, GIZ sponsored the Egyptian-German Joint Committee for Renewable Energy, Energy Efficiency, and Environmental Protection (JCEE), hosted by the New and Renewable Energy Authority as a bilateral measure crafted by the Ministry of Electricity and Renewable Energy and the Federal German Ministry for Development and International Cooperation (BMZ). **The program offered courses for Egyptian companies supplying, installing, and operating and maintaining rooftop photovoltaic systems (below 500 kilowatts peak).** The trainees receive RENAC certification, and then certifications from NREA and GIZ separately. Eligible companies sent one candidate to participate in the free training (GIZ/JCEE covered the fees).

The program covered theoretical as well as practical knowledge.

Table B.4.5.1 Theoretical vs practical knowledge

Theoretical knowledge	Practical knowledge
• Technical knowledge about photovoltaic (PV) on-grid systems and their single components • General knowledge about the overall conditions for installing PV rooftop systems, such as connection regulations, safety measures, and weather requirements • Theoretical knowledge on the design, calculation for, and sizing of PV rooftop systems (orientation of panel, shading) • Exchange and discussions on potential technical issues while installing PV systems	• Analysis of installed PV systems and their potential sources of error • Correct wiring and installation of mounting systems of PV plants • Connection of a small-scale PV system to the grid according to the grid code • Detection of failure source and its repair based on knowledge from several years' experience of the renewables academy's experts • Installation of a PV system with a 5 kilowatts peak total capacity. The system will be installed on the roof of the premises of the New and Renewable Energy Authority or on similar roofs nearby that are owned by the North Cairo Distribution Company

Box 4.6 Case study—an internal academy dedicated to practical training

EPECO, a firm active in electronics since the 1980s, has for the past five years been developing an **internal academy dedicated to practical training** in the field of renewable energy (solar photovoltaics [PV]) for recent graduates (engineers as well as technicians). The objective is to provide these young graduates with practical training that confers enough experience to make them employable for companies looking for experienced staff only. The free classes depend on the company's employees volunteering their time.

Although graduates with all certification levels take the same theoretical courses on solar PV, each student must pass an on-site practical test on their profile. After graduates have passed this final test, the company helps them find work by sending them to larger plants and ongoing projects in other companies and providing specific in-depth training to help them further develop their skills. To do so, the company can count on its large portfolio of suppliers and developers.

For now, every class is made up of 5–6 young graduates, and nearly 2,000 graduates have benefited from EPECO's training. The company now plans on constructing two large classrooms with roof-mounted solar PV panels, which students can use to familiarize themselves with the technology.

However, several reasons are hindering the program's expansion, despite growing interest in improving the quality of education to help graduates succeed in the labor market:

- **Scant funding from the relevant parties.** EPCO needs to invest in appropriate infrastructure (classrooms, solar panels for practice) to expand its initiative; it is unable to do so on its own while focusing on its primary business.

- **Strong competition with private institutions providing practical training and certification.** Even though their goal is also to help young graduates become competent and find a job, they remain for-profit endeavors, which do not support the development of free courses, which could compete with their business.

In the future, EPCO would like to ask industry professionals to contribute one hour per week to the project, so that young graduates receive improved training and the offering can be expanded.

SUMMARY OF THE KEY ENABLING FACTORS FOR SECTOR DEVELOPMENT

Several enabling factors bear on the development of renewable energy/energy efficiency and the job transition. They are discussed below.

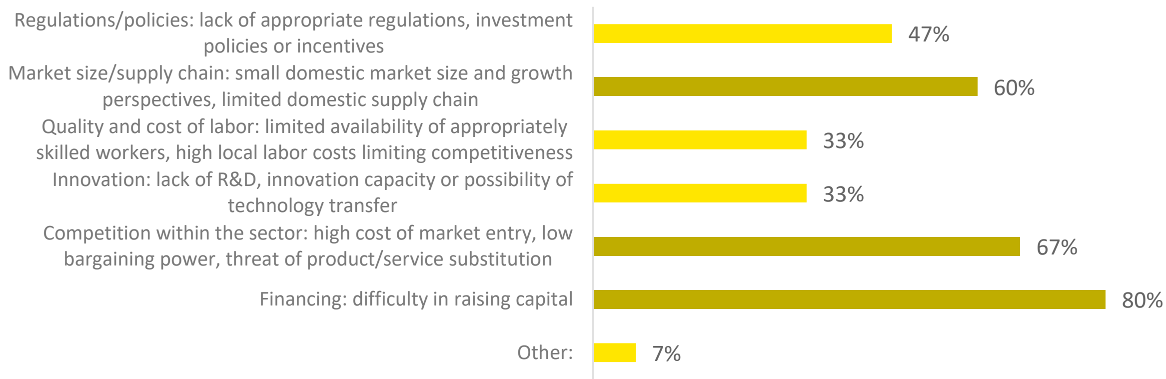
ABUNDANCE OF RENEWABLE ENERGY RESOURCES

Egypt possesses abundant renewable energy resources in the form of solar. It receives average daily sunshine of 9–11 hours, and **direct solar radiation intensity**, which generates 2,000–3,200 kilowatt-hours per square kilometer per year. The country has rich wind resources, with average annual speeds of 8–10 meters per second (m/s) by the coast of the Red Sea; wind speeds are measured at 6–8 m/s along the southwest Nile banks and in the south of the Western Desert. Abundant solar and wind resources lower any investment risks and should boost private sector interest.

AN ENABLING MARKET ENVIRONMENT (AVAILABLE CAPITAL, FAIR COMPETITION)

In responding to the online survey for this study, companies pointed to obstacles to market development. The removal of those obstacles constitutes enabling conditions (figure 4.11).

Figure 4.11 Main obstacles for clean energies' development



Source: Online survey.
Note: R&D = research and development.

Available financing is a key enabler for a strong green sector. However, high interest rates for business loans for SMEs prevent these enterprises from competing with large players, which have the power and capital needed for negotiation. This disparity is evident in the online survey's results: 80 percent of the respondents mentioned capital as one of the three main obstacles inhibiting clean energies' development.

Fair competition among the actors in these green sectors, especially between small and large businesses, will benefit sector growth. SMEs should be able to compete for larger projects to upskill their capabilities and sustain growth. Large companies are meanwhile aggregating larger projects, whereas small companies take on smaller projects, which tend to require and acquire fewer qualifications over time. The online survey's results support this idea: 67 percent of the respondents identified competition as one of the three main challenges to clean energies' development.

Further, the competing companies, regardless of their size, require **a market environment that enables renewable energy to compete with conventional energies**. But because fuel subsidies create market distortions, Egypt's highly subsidized energy prices will inhibit growth in the sector. Note, too, that Egypt is unaccountable for externalities in planning development for renewable energy. Its small domestic market and prospective growth for both renewable energy and energy efficiency have limited the domestic supply chain. Sixty percent of the survey respondents pinpointed market size as a top challenge to sector development.

COORDINATING PUBLIC INSTITUTIONS WITH A CENTRALIZED INFORMATION SYSTEM

Coordinated collaboration among clean energy actors would be a key enabler for sector development. Coordination would allow strategies to align on the design to improve skills. However, the key stakeholders in Egypt's energy transition are unable to evaluate the national initiatives. Meanwhile, skills (educational outcomes) remain incommensurate with market needs.

Another key enabler would be a centralized information system that tracks renewable energy/energy efficiency initiatives and projects. It would enable companies to leverage individual initiatives or projects so they can prevent overlapping outcomes while addressing the identified challenges. However, the green sectors are cobbled together from fragmented job transition initiatives. A working information system would centralize institutional initiatives and decisions, private sector efforts, and the educational system's targets and programs.

AVAILABILITY OF TRAINING AND EDUCATION PROGRAMS THAT ALIGN WITH THE MARKET'S NEEDS

Education programs and training in renewable energy/energy efficiency skills equip workers and sustain sectoral development. They should be accessible throughout the country across all governorates. All graduates should be able to train in these sectors. Meanwhile, training initiatives are predominantly carried out in four governorates: Alexandria, Cairo, Aswan, and Red Sea. Greater market opportunities in the rest of Egypt might encourage all universities to offer these courses.

Educational and training outcomes commensurate with the needs (skill needs) of renewable energy/energy efficiency companies would be a key enabler. Otherwise, graduates cannot meet expectations, fewer young workers are hired, and companies struggle to fill positions. For example, the dearth of technical programs has created a concomitant shortage of technicians. By way of contrast, the renewable energy sector is awash in engineers because master's and engineering degree programs are filled with students.

A centralized information system on educational and training programs would improve the clean energy transition. No such system exists in Egypt. To identify new graduates with skills suitable for green sector jobs, employers would have to consult with the government (through an LMIS, for example) so that educational and training programs can respond timely.

RAISING AWARENESS REGARDING ENERGY EFFICIENCY AND INCLUSIVE HIRING

Greater awareness about the benefits of inclusive hiring (women employees) would open up new positions and create jobs for women. Companies operating in the renewable energy/energy efficiency sectors would profit from the broader talent pool, especially for technical positions in office settings.

By the same token, greater awareness about existing energy efficiency technologies and their implementation costs will play a key role in the sector's development. Despite the availability of mature technologies and their cost savings, misconceptions and even ignorance continue to hobble the energy efficiency sector, which should be thriving. The development of R&D for energy efficiency boosts energy efficiency service providers (Sameh and Kamel 2017).

5. RECOMMENDATIONS FOR A JOB-ENHANCING CLEAN ENERGY TRANSITION

A job-enhancing clean energy transition rests on two pillars:

- **Clear institutional frameworks** capable of attracting more investment in business and creating more jobs
- **The hiring of local graduates and workers.**

A focus on fairness is paramount, especially for young people and working-age women.

Both sectors—renewable energy and energy efficiency—must **reinforce institutional frameworks and simplify roles**. To reach the country's renewable energy and energy efficiency targets, the sectors need a conducive job transition environment.

The sector skills councils (SSCs) should be connecting the ministries and organizations devoted to energy, jobs, and skills and giving them a skills-development mandate. That mandate should direct the training and education programs to meet the needs of businesses. Such skills councils would curb overlapping programs and address identified and emergent challenges.

At the same time, simpler frameworks and roles would shore up the trust that companies and investors have in Egypt's clean energy transition market. More trust creates larger private investment and greater job creation. The need for financial investments and visibility is especially evident for the energy efficiency sector, given its market potential in Egypt. To realize this potential, companies need to overcome their bias and capture the economic value that could result from investing in the sector.

To ensure that local graduates and workers fill the newer renewable energy/energy efficiency jobs, **the authorities need to assess** the labor market vis-à-vis available skills and occupations; **identified shortages must be tackled**. Prospective deficits in skills and occupations, similarly, must also be anticipated.

After identifying skills gaps, the government should **encourage companies to invest in workforce training**, **especially for young hires**, who generally have no practical experience.

In addition, the government should **ensure that workers in the renewable energy or energy efficiency sectors have the opportunity both to gain needed skills and to relocate to regions** showing strong market demand and to do so without risking loss of income. An **assistance fund would** compensate workers who incur loss of income to train or relocate. An assistance fund could attract conventional sector workers to shift to renewable energy/energy efficiency sectors or attract workers who lost their jobs because of the clean energy transition.

For now, the shortage is caused by a critical need for skilled technicians. To face this challenge:

- **Create training programs for secondary school students** and present them as what they are: alternative, desirable pathways to a degree and rewarding work. Expanded TVET (Technical and Vocational Education and Training) programs is one possible way, or programs at technological universities. Dispersed geographical locations and diverse programs would also help.

- **Empower women to study and work as technicians** in these sectors to boost the number of potential recruits.

Future gaps grow out of present mismatches between educational outcomes and business needs and expectations. Simpler institutional frameworks should therefore name those in charge (like the SSCs) of two vital information systems:

- **A labor market information system** (LMIS) that collects data and provides analysis on market needs, especially occupations and skills

- **An education management information system** (EMIS) that collects data and provides analysis on the educational programs and professional outcomes for students.

The information obtained through merging the LMIS and the EMIS data would enable authorities to compare market needs with available skills. Skills and occupational shortages could then be detected, which would in turn enable providers to hone their instructional content accordingly.

Apprenticeship programs constitute a vital interface between the worlds of school and work. **They would benefit from more structure and a nationwide deployment.** Apprentices could funnel their own learning and work accounts into the LMIS and EMIS, permitting the SSCs to test the premises of these systems. While some apprenticeship programs already exist, they have negligible visibility. Better structuring is recommended to help young graduates gain the experience they need at the end of their studies. Otherwise their payments for additional practical training would be out of pocket. As a bonus, the involvement of employers in shaping coursework would foster helpful linkages between education and industry.

The recommendations are summarized in table 5.1 according to their category and their level of priority and complexity. Each of the 10 recommendations is further explained after the table. The degrees of complexity are explained in appendix 6.

Table 5.1 Ways to support a job-enhancing clean energy transition—key recommendations

Recommendation	Challenge addressed	Priority	Complexity
Recommendations to favor the growth of the renewable energy and energy efficiency sectors			
1. Create structured and coordinated institutional frameworks for both renewable energy and energy efficiency	Lack of coordination among the institutional frameworks, leading to the creation of programs with overlapping outcomes as well as to the omission of some challenges	●●●	●●●
2. Pursue the establishment of sectoral skills councils dedicated to renewable energy and energy efficiency	Limited employer engagement in the shaping of education and training programs, hence the persistent gap between skills needed and skills generated Lack of project-based/donor-funded initiatives to deliver needed skills in renewable energy and energy efficiency	●●●	●●○

3. Make companies aware of the economic value that could result from investing in energy efficiency	Underinvestment in energy efficiency throughout Egypt	🟡🟡⚪	🟢⚪⚪
Recommendations to ensure that available jobs are occupied by local graduates and workers			
4. Create and implement a Labor Market Information System (LMIS)	Lack of up-to-date labor market information that would otherwise help to identify skills needs and shortages	🔴🔴🔴	🔴🔴🔴
5. Create and implement an Education Management Information System (EMIS)	Lack of information on professional outcomes hinders upgrades of educational and training programs	🔴🔴🔴	🔴🔴🔴
6. Deploy a more structured apprenticeship program dedicated to renewable energy and energy efficiency	Mismatch of market needs and educational/training outcomes slows absorption of new entrants into the labor market Companies are unaware of existing apprenticeship programs/schemes	🔴🔴🔴	🟡🟡⚪
7. Create an assistance fund for workers who need to pay for training or relocation expenses	Risk of income loss for workers in need of training and relocation fees for jobs in other governorates	🟡🟡⚪	🔴🔴🔴
8. Dedicate training programs to technicians and promote them as alternative pathways to higher education	Few training programs dedicated to technicians throughout Egypt (not only in a few governorates), and for technologies besides solar	🟡🟡⚪	🟡🟡⚪
9. Raise awareness among companies and families regarding the inclusion of women in the renewable energy and energy efficiency sectors	Lack of inclusion of women in the renewable energy and energy efficiency sectors, where they could be recruits for technician positions	🟡🟡⚪	🟢⚪⚪
10. Make companies aware of the importance of investing in their employees' training	Lack of investment by employers in their employees' training, while this could prevent or reduce identified skills shortages	🟡🟡⚪	🟢⚪⚪

Note: Legend—Low: 🟢⚪⚪; Medium: 🟡🟡⚪; High: 🔴🔴🔴.

1. Create structured and coordinated institutional frameworks for both renewable energy and energy efficiency	

Current situation	• Maps of existing institutional frameworks for renewable energy and energy efficiency illustrate the many actors and their **independent initiatives** (programs, training, educational programs).
	• Coordination is **orchestrated in an ad hoc fashion** and **initiated for specific needs or projects**. Three prime ministerial decrees (nos. 705, 706, and 707) were issued in 2014 to promote coordination and collaboration among various educational and training stakeholders, employers, and employers' organizations. This included a National Committee for Human Resource Development, with two executive committees (an executive technical and vocational education and training [TVET] committee and an executive skills development committee) in addition to regional TVET committees at the governorate levels. Although these committees are the only platforms formulated to coordinate education and train stakeholders, they remain inactive. In addition, although the prime ministerial decrees have named many stakeholders (ministries, authorities, federations, etc.), several authorities closely concerned with the renewable energy or energy efficiency sectors were not included (e.g., Ministry of Environment, New and Renewable Energy Authority).
	• Initiatives to improve coordination of these institutional frameworks include:
	  o For renewable energy: The Ministry of Education and Technical Education and the Ministry of Planning are supporting sectoral skills councils to coordinate the several actors.
	  o For energy efficiency: The Energy Efficiency Committee will work on aligning policy decisions and regulatory requirements (especially among governmental institutions); it has the mandate to oversee the transition to clean energy and energy efficiency.

Limitations	• **Companies say they do not know who is in charge of** the programs and institutions involved in expanding renewable energy and energy efficiency or creating a conducive environment for job transition. • No **framework** for correlating national and international initiatives. • Poorly coordinated and designed initiatives result in **overlapping outcomes** and undetected (and therefore unmet) **challenges**.
Recommendations	• Clarify roles and responsibilities so actors can implement **actions** in coordination with sets of **aligned objectives** that (1) achieve renewable energy and energy efficiency targets and (2) support the job transition. • Establish a **dedicated committee** to discuss and centralize the initiatives of the various national actors. The committee would act as a hub with visibility on renewable energy and energy efficiency in Egypt, distribute the projects across ministries, and align the road maps. • This committee should head the **Labor Market Information System** and the **Education Information System**, described in recommendation nos. 2 and 3. It would centralize and merge the information collected by the two systems and translate them into action plans to be rolled out by the pertinent member ministries.

Governance	• An interministerial committee would coordinate the activities of the following ministries: o Manpower o Education and Technical Education o Higher Education and Scientific Research o Environment o Electricity and Renewable Energy o Petroleum and Mineral Resources o Trade and Industry o Planning and Economic Development o Investment and International Cooperation

2. Pursue the establishment of sectoral skills councils dedicated to renewable energy and energy efficiency	
Current situation	• Limited engagement of employers and employers' organizations in the formulation and provision of education and training programs. The last initiative for employers' participation in the development of curriculum for renewable energy for technical secondary schools took place in 2017, within the framework of implementing the Workforce Improvement and Skills Enhancement (WISE) project (funded by the United States Agency for International Development). • Most of the initiatives undertaken to address skills needs for renewable energy and energy efficiency are project based and usually funded by donors. Therefore, they tend to slow down or cease to exist once the funding is finished. • Since early 2022, the Ministry of Planning and Economic Development has launched and is leading an initiative to establish and sustain sectoral skills councils (SSCs), where each council will include several employers (from the same sector) and representatives from education and training providers. The purpose is to allow employers to take a leading role in formulating and influencing education and training programs, so the programs become more demand driven, of higher quality, and more relevant to the labor market needs. The initiative is currently in its very early stages, and mainly focused on selecting the first batch of sectors for which an SSC will be developed, and the legal status and governance of such councils.
Limitations	• Limited engagement of employers in the formulation of education and training programs, and hence the prevailing gap between skills needed and skills generated by the existing education and training programs. • Absence of project-based/donor-funded initiatives to boost skills in the renewable energy and energy efficiency sectors.
Recommendations	• SSCs are sector-specific organizations with a skills development mandate able to move education and training systems from supply to demand, requiring systems to meet the needs of the labor market/employers. Accordingly, the

2. Pursue the establishment of sectoral skills councils dedicated to renewable energy and energy efficiency	
	establishment of a Renewable Energy SSC can have a long-term institutional impact on skills for renewable energy and energy efficiency. • A collaborative approach among employers, supported by the Federation of Egyptian Industries, working with the Ministry of Planning and Economic Development to establish and support an SSC for renewable energy, in addition to emphasizing that energy efficiency is a visible priority for sector-specific energy efficiency skills. • Therefore, the SSC should head the **Labor Market Information System** and the **Education Information System**, described in recommendations nos. 2 and 3. It would centralize and combine the information collected by the two systems and translate them into action plans to be rolled out by the pertinent member ministries. • The SSCs should support the development of qualifications and programs that meet the needs of employers. This can be achieved at the preuniversity as well as university level, using Meeting Local Needs units to introduce courses, learning modules, or learning tools, supported by Centers of Competence for renewable energy and energy efficiency. • It is also crucial that renewable energy SSCs and other SSCs are aware of the need to promote and strengthen women's integration and participation in their sectors.
Governance	• Ministry of Planning and Economic Development • Federation of Egyptian Industries • Employers for renewable energy and energy efficiency • Ministry of Education and Technical Education • Ministry of Higher Education • Ministry of Trade and Industry (for the Ministry of Productivity and Vocational Training Department) • Ministry of Environment • Ministry of Electricity and Renewable Energy • Ministry of Petroleum and Mineral Resources • Representatives of School-to-Work Transition Units • Representatives of the Centers of Competences for renewable energy and energy efficiency

<table>
<tr><th colspan="2">3. Make companies aware of the economic value that could result from investing in energy efficiency</th></tr>
<tr><td>Current situation</td><td>The energy efficiency market is driven not by local companies (public or private) but by international organizations and development banks. Most national actors assume that energy efficiency implies high initial costs and do not necessarily enable the promising energy and cost savings resulting from implementation. In addition, actors appear unaware of the different energy efficiency technologies.
The energy efficiency market in Egypt benefits from strong growth potential.
National institutions or agencies have produced little information on the energy efficiency sector of Egypt. The Ministry of Electricity and Renewable Energy (MoERE) has, however, conducted a study on the energy efficiency projects in Egypt.</td></tr>
<tr><td>Limitations</td><td>Egyptian companies lack knowledge about the energy efficiency sector, and their biases inhibit development of energy efficiency projects. As a consequence, some companies do not operate in the sector, curtailing employment.
In addition, because little information exists on the market, institutional actors, companies, and investors struggle to relay achievements and development potential. As a consequence, companies find it difficult to anticipate what occupations and skills they will need.</td></tr>
<tr><td>Recommendations</td><td>Communicate the MoERE report to reassure investors that projects have recently been launched, so there is a low risk in investing in the market, and to reassure companies that energy efficiency provides positive environmental and economic outcomes.
Organize workshops with companies from several sectors to demonstrate the economic and environmental value of implementing energy efficiency projects.</td></tr>
<tr><td>Governance</td><td>MoERE to communicate via a regular report.
The Federation of Egyptian Industries to organize and facilitate the awareness-raising workshops.</td></tr>
</table>

<table>
<tr><th colspan="2">4. Create and implement a Labor Market Information System (LMIS)</th></tr>
<tr><td>Current situation</td><td>Labor market information is collected independently by several actors, without being centralized. Hence, it is not exhaustive or regularly updated, and does not reflect labor market needs.
The Technical and Vocational Education and Training (TVET) II project (funded by the European Union) has a mandate to develop an LMIS. Recent progress indicates that the Ministry of Planning and Economic Development is taking a</td></tr>
</table>

	leading role in coordinating the efforts of all relevant stakeholders who are active in collecting, analyzing, disseminating, and using labor market information in Egypt (Ministry of Manpower, Central Agency for Public Mobilization and Statistics, Information and Decision Support Centre, Ministry of Education and Technical Education, Ministry of Trade and Industry). But this initiative was launched at the beginning of 2022 and has not yet materialized.
Limitations	• Inefficiently gathered labor market information obscures the true gaps between labor market needs (demand) and labor market characteristics (supply). • The lack of a centralized and efficient LMIS also affects education and training **programs**, which are not being shaped by precise, timely, relevant, and market-based information about skills needs and shortages. • Imprecise and outdated labor market information **prevents stakeholders (education and training providers) from measuring the outcomes of their initiatives** on a national level and from **adapting their programs** to support a clean energy transition.
Recommendations	• Develop an LMIS that **efficiently collects, analyzes, and disseminates labor market information**: key indicators (unemployment rate, labor workforce participation rate), and market needs in terms of occupations and skills and qualifications. The LMIS would be in charge of: o Collecting and analyzing labor **market data** (needs and forecasts). These data can be obtained from relevant ministries and authorities, the main job portals (as it provides real-time information on job offers and associated expected skills), tracer studies, and interviews with companies. o The investigation of **gaps between workforce skills and the expected levels of qualifications** by the labor market. o The identification of available professional training and certifications that employers can use to work-qualify their employees.
Governance	• **Sectoral skills councils** as defined in recommendation no. 2: Specific unit in charge of the centralization and management of the data collected and managed by representatives from relevant ministries (Ministry of Petroleum and Mineral Resources, Ministry of Electricity and Renewable Energy, Ministry of Manpower, Ministry of Environment). • Close collaboration with entities that have visibility and close access to market information such as the: o Regional Center for Renewable Energy and Energy Efficiency o New and Renewable Energy Authority o Federation of Egyptian Industries

5. Create and implement an Education Management Information System (EMIS)	
Current situation	• The educational system does not **track the labor market outcomes** of its graduates (especially in higher education), nor does it **provide a clear and exhaustive list of its programs**.
Limitations	• Without tracking, providers of educational/ training programs cannot know if or how their programs **supply the labor market**. • Without tracking, authorities cannot observe how **job seekers (and especially women) find employment upon graduation** in the renewable energy and energy efficiency sectors; **they also cannot set** quantified objectives for inclusive hiring. • The education system (secondary, technical, and higher education) provides few high-visibility role models. Schools struggle to design programs that suit the labor market and rarely shut down obsolete programs. • Unclear listings for educational programs create uncertainty for **students on possible educational and follow-on** career pathways.
Recommendations	• The EMIS would **centralize information** on careers and educational program availabilities. The EMIS would be in charge of: ○ **Listing all available education programs** in renewable energy and energy efficiency in Egypt, ○ **Collecting data** via an administrative-based monitoring system to track hiring, among other data sources such as labor force surveys. Regular and systematic tracking identifies hired graduates, how hard it was to find work, and if their occupation/industry is aligned with their coursework.
Governance	• **Sectoral skills councils** as defined in recommendation no. 2: Specific unit in charge of centralizing and analyzing the data collected and managed by relevant ministry personnel (Ministry of Education and Technical Education and Ministry of Higher Education and Scientific Research). • Collaborate with training and educational program providers: universities, technological universities. • School-to-work units (such as Meeting Local Needs units).

6. Deploy a more structured and formal apprenticeship program dedicated to renewable energy and energy efficiency	
Current situation	• A prevailing gap between skills needed by companies and skills generated by the existing education and training systems • Apprenticeship programs have long served to fill the gaps between the labor market needs and the outcome of the education and training systems, as well as enhance the school-to-work transition for youth. Egypt is also rolling out formal apprenticeship schemes, among them, industrial apprenticeships in vocational training centers, "training stations" in the Productivity and Vocational Training Department (PVTD), and a dual system—applied technology schools and the "school in factory" scheme—under the Ministry of Education and Technical Education. These promising apprenticeships are, however, not widely known and need to be more visible.
Limitations	• Mismatch between the market needs in terms of skills and the educational/training programs that slow absorption of new entrants in the labor market. • Existing apprenticeship programs/schemes are unknown by companies. • Limited working relation between employers and education and training providers, and therefore limited engagement in provision of apprenticeship opportunities.
Recommendations	• Development of a well-structured, quality assured apprenticeship program that allows students from technical and vocational schools and technological universities to acquire work-based experience in renewable energy and energy efficiency, is a crucial measure that can bridge the gap between the skills required by the companies and the outcomes of the education and training systems. • Promote the involvement of employers in the definition of education content of such programs to foster linkages between the education system and industry. • Set objectives on the share of women benefiting from apprenticeship programs. • Enhance the creation of such structures in areas with lower market demand to boost local growth of the renewable energy and energy efficiency sectors and to enable a just job transition.
Governance	• Federation of Egyptian Industries • Ministry of Education and Technical Education • Ministry of Trade and Industry (for the PVTD) • The relevant sectoral skills councils as defined in recommendation no. 2 (when and if it is established)

7. Create a monetary assistance fund for workers who need help with training and relocation fees	
Current situation	• In the renewable energy and energy efficiency sectors, **companies want to hire workers with experience**, at a minimum in the conventional energy sector, but preferably in the renewable energy/energy efficiency sectors (or with knowledge in these sectors). This is especially important for technicians, whose required skills may depend on the technology they are working on. Therefore, **workers who want to change their sector** (by choice or through job loss) **need to be re-/upskilled** to get a job in the desired sector. There is, however, no monetary fund that helps workers get training for jobs in the renewable energy and energy efficiency sectors. • For the renewable energy and energy efficiency sectors, **the market demand is not homogeneous throughout Egypt**: most projects are located in the three biggest governorates. Because such projects often require on-site activity, **workers wanting work in such sectors but living outside the largest governorates often need to move**. There is no dedicated monetary assistance to help these workers relocate.

Limitations	• Workers who need to be re-/upskilled to occupy a position in the renewable energy/energy efficiency sectors are likely to need outside training. **To benefit from such training, workers risk a loss of income because they are cutting hours or quitting altogether. A loss of income can:**
	  o Discourage workers from proactively shifting their sector of activity to work in the renewable energy/energy efficiency sector, though such sectors need more skilled workers.
	  o Prevent workers who lost their jobs due to the clean energy transition from finding new jobs in the renewable energy/energy efficiency sectors, though they are likely to have valuable skills.
	• Workers want to work in the green sectors but live in places without strong market demand. They may not get **jobs in the renewable energy/energy efficiency sectors because relocation costs are so high**. This results in a loss of talent for the sectors, which could have helped supply more skilled technicians, for example.

Recommendations	• **Create a dedicated monetary assistance fund** to help workers find a job in the renewable energy/energy efficiency sector. This fund could be based on the workers' revenues to integrate the notion of fairness in the DNA of this assistance. Two types of workers would be eligible for such assistance:
	  o Workers who want to benefit from training so their applications can be considered by companies operating in the renewable energy/energy efficiency sectors.
	  o Workers who find a position in a firm operating in the renewable energy/energy efficiency sectors, and who need to relocate.

	• **Communicate information about this monetary assistance** so workers from different sectors are aware of its existence.
Governance	• The Ministry of Manpower and Ministry of Electricity and Renewable Energy. • The Federation of Egyptian Industries largely to communicate assistance within several industries.
8. Create training programs dedicated to technicians, as alternative pathways to higher education	
Current situation	• Close to 3 million students in 2019 were enrolled in higher education institutions, up from 2.7 million in 2015, because of a growth of the school-age population and an increase in access to secondary education, and a corresponding increase in the completion of secondary education. • Managing and channeling the flow of these students into public higher education institutions and other tertiary education institutions are crucial to maintain the equilibrium between market demand in terms of workers and education output. • Currently, the renewable energy and energy efficiency labor markets **lack technicians**, while an abundance of engineers is observed, due to the greater attractiveness of this qualification (higher wages, social recognition, and job security).
Limitations	• A **slow market absorption** rate is leading to **high unemployment** among young graduates. • Many more high-skilled workers (e.g., engineers) in the renewable energy and energy efficiency sectors than **technicians and medium-skilled workers, who are in short supply**. This leads to disproportional engineer-to-technician ratios in renewable energy projects, creating a financial impact on projects.
Recommendations	• Encourage alternative pathways by: o Expanding technical and vocational education and training and raising its profile, along changing admissions criteria o Developing renewable energy and energy efficiency programs in technological universities o Designing programs that focus on mid- to high-level vocational/technical skills. • Promote technical education among secondary-school students before they engage in higher education.
Governance	• The Education Management Information System as defined in recommendation no. 5. • Relevant ministries: o Education and Technical Education o Higher Education and Scientific Research

9. Raise awareness about inclusive hiring among companies and families so that more women will work in the renewable energy and energy efficiency sectors	

Current situation	• The inclusivity issue is mainly linked to technician positions in the renewable energy sector (the problem is less salient for a high-skilled workforce and for the energy efficiency sector in general).
	• The **low participation of women** in the renewable energy and energy efficiency sectors is linked mainly to:
	  ○ The mentality of business owners, who may prefer employing men.
	  ○ The mentality of women: There are few role models working in these sectors (especially for technical positions), so women might see themselves as less capable than men.
	  ○ The mentality of women's families, who may consider these sectors as "not suitable" because of the field work (especially for technicians in the renewable energy sector).
	  ○ The education system itself that does not necessarily encourage women to pursue studies or careers in these sectors.
	• The absence of **quantified targets** for women's participation in these sectors inhibits girls from pertinent schoolwork; lectures and presentations at the beginning of the school year could encourage girls to choose a renewable-energy-focused curriculum.
	• More girls are observed pursuing energy efficiency than renewable energy: Energy efficiency appeals to more women because it is perceived as less physically demanding and offering more office jobs, which are seen as more appropriate for women.

Limitations	• Social perceptions regarding "suitable" jobs for women discourage them from choosing from among the entire range of career paths. • The **lack of inclusivity in the labor market** impacts the efficiency of the education system (women who study until graduation end up unemployed or not employed in the sectors they initially wanted to work in). Those women, if trained and encouraged to work, can fill the occupation gaps (e.g., technicians). • Enlarging the presence of women in the labor market is not only a question of social equity. Men and women have the same potentialities, so their unequal participation in the labor market hinders productivity. It is in the general interest of the country to reach a more equitable distribution of jobs between men and women.

Recommendations	• Promote technician positions for women among employers by organizing **awareness-raising campaigns** with chief executive officers and business owners. These campaigns would aim to demonstrate the benefits (or the absence of disadvantages) of employing a woman compared to a man. The creation of new jobs for women would reduce the **skill shortages** currently observed in technician positions.
	• Promote technician positions for women among students and their families by:
	  ○ Promoting women's employment as technicians in school orientation events.
	  ○ Involving companies in promoting women's employment (e.g., involve company representatives in orientation events).
	  ○ Involving women who are active in these sectors in promotion campaigns, so they can be role models for students.
	  ○ Increasing the presence of women in ads that promote technician positions in the renewable energy and energy efficiency sectors.
	• Sensitize teachers not to influence female students in their career paths based on their gender.

Governance	• Relevant ministries:
	  ○ Education and Technical Education
	  ○ Higher Education and Scientific Research
	• Collaboration with the Federation of Egyptian Industries, which can relay information and organize campaigns with companies and businesses.
	• Sector skills councils as defined in recommendation no. 2

10. Make companies aware of the importance of investing in their employees' training	
Current situation	• The renewable energy market is characterized by discontinuity in projects. For example, workers with low- and midrange skills can be hired for the construction phase of a renewable energy plant with a temporary contract and unemployed after completion, obliging them either to work for another company in the renewable energy/energy efficiency sector, or return to the conventional energy sector. • Companies tend not to consider employees as **long-term investments** in capacity and experience, and thus do not invest in training and qualifying human resources. • The reskilling and upskilling of the workforce from the conventional energy sector is key in the acquisition of adequate skills and capabilities for developing renewable energy and energy efficiency, especially for the public sector that struggles to attract young graduates.

	• Large companies implement large-scale projects and attract the skilled workers they require with little need for training, while smaller companies have smaller-scale projects and usually employ people with fewer skills.
Limitations	• Employees do not benefit enough from **training** to keep working in sequential projects in the renewable energy and energy efficiency sectors. These workers will as a result shuttle **to and from the conventional and clean energy** sectors. • As a vicious circle, small and medium enterprises remain less attractive to workers with the right mix of skills, which makes them less and less competitive with large-scale projects.
Recommendations	• Raise awareness in companies (e.g., through campaigns, workshops) about the **importance of training employees over the long term**. • Share during the awareness campaigns information on the available sources of training (upskilling programs, reskilling programs), both internal (share of good practices implemented in other companies) and external (share of organizations providing adequate training).
Governance	• Federation of Egyptian Industries • Close collaboration with the Labor Management Information System and the Education Management Information System, which would oversee the identification of training options for professionals as well as desirable skills for companies to focus on.

6. CONCLUSION

The Egyptian government has set ambitious goals for the growth of the renewable energy and energy efficiency sectors, especially through its Integrated Sustainable Energy Strategy to 2035 and its Sustainable Development Strategy: Egypt Vision 2030. A range of public agencies, institutions, and international development banks are therefore active in helping the sectors expand, as well as in ensuring that this growth enables a just job transition.

Indeed, the expansion of the renewable energy and energy efficiency sectors is an opportunity for the creation of jobs (such as plant managers, quality engineers, energy efficiency auditors, or energy efficiency managers). This expansion also portends, however, the decline of conventional energy with concomitant shifts in, and elimination of, jobs. Ensuring a just job transition means jobs for affected workers (electricians, plumbers, and technicians) in the green sector. A just transition also means diversity and inclusion in the workforce.

Several difficulties, however, threaten to thwart a just job transition. To develop these sectors, there is a clear need to clarify roles and reinforce coordination among actors in the institutional frameworks, to optimize resource allocation among them, and to help companies and investors gain in confidence and increase private investments to grow more jobs. The need for financial investments and therefore visibility is paramount in the energy efficiency sector. Companies need to better understand the economic and environmental value of energy efficiency projects.

To ensure that all available jobs in these sectors are filled, there is a need to assess and then bridge current and anticipated gaps between the labor market's characteristics and the green sector's skills and occupations needs. Gaps can be bridged if companies develop greater awareness about the need for employees' training, especially for new graduates. In addition, the government should provide monetary assistance to workers who want to take a training course or who need to relocate to regions with strong market demand for their skills. With the shortage of skilled technicians, training programs for technicians should become a priority in all Egyptian governorates, along with women's empowerment to study and work as technicians. Future gaps between the labor market's characteristics and the market needs may appear where there are mismatches between existing educational programs and companies' needs and expectations. Consequently, the clarified institutional frameworks should identify the actor(s) in charge of creating and implementing a Labor Market Information System (LMIS) and an Education Management Information System (EMIS). Merging the information obtained through both the LMIS and the EMIS should help identify shortages in skills and occupations, enabling providers of educational and training programs to adapt their programs. The Meeting Local Needs units and the Centers of Competences should be deployed nationally, at the same time, so information can be transferred into the LMIS and the EMIS and to implement and test their conclusions.

For the above recommendations to be efficiently implemented, cooperation and communication among the main stakeholders, both public and private, will be paramount. Cooperation will optimize the use of time in implementing these recommendations, while fluid communication will ensure that well-trained students and workers will saturate the labor market with the skills companies need to expand. The Egyptian government has ambitious goals for the renewable energy and energy efficiency sectors, and since their expansion represents a true opportunity for job creation and transition. It is therefore essential for these recommendations to be implemented as quickly as possible, with the assistance of all relevant actors.

REFERENCES

[1] Arab News. 2021. "Egypt to Open Its First Green Hydrogen Plant in November 2022." Arab News, December 16, 2021. https://www.arabnews.com/node/1987996/business-economy.

[2] Assaad. 2019.

[3] Assaad, R., C. Krafft, and D. Salehi-Isfahani. 2018. "Does the Type of Higher Education Affect Labor Market Outcomes? Evidence from Egypt and Jordan." *Higher Education* 75 (6): 945–95.

[4] Botta, E. 2019. "A Review of 'Transition Management' Strategies: Lessons for Advancing the Green Low-Carbon Transition." OECD Green Growth Papers 2019/04, OECD Publishing, Paris. https://www.oecd-ilibrary.org/environment/a-review-of-transition-management-strategies_4617a02b-en.

[5] CAPMAS (Central Agency for Public Mobilization and Statistics). 2022. "Figures 2022 for Labor."

[6] CAPMAS. 2019. CAPMAS Survey 2019.

[7] CAPMAS and IOM (International Organization for Migration). 2017. *Egypt Labor Market Report: Demographic Trends, Labour Market Evolution and Scenarios for the Period 2015–2030*. Cairo: IOM.

[8] CLER. 2021. Transition énergétique: Le défi de l'emploi. CLER, 2021.

[9] Climate Nexus. 2019. "Job Impacts from the Shift to Electric Cars and Trucks." https://climatenexus.org/climate-issues/energy/ev-job-impacts/.

[10] CMS. 2019. "Renewable Energy Law and Regulation in Egypt." https://cms.law/en/int/expert-guides/cms-expert-guide-to-renewable-energy/egypt.

[11] Construction Review. 2016. "Japan to Fund Construction of Solar Power Plant in Egypt." Construction Review, January 7, 2016. https://constructionreviewonline.com/news/egypt/japan-to-fund-construction-of-solar-power-plant-in-egypt/.

[12] Daily News Egypt. 2022. "Egypt's Renewable Energy in 2021 Amounts to 24,000 GW/h." Daily News Egypt, January 19, 2022. https://dailynewsegypt.com/2022/01/19/egypts-renewable-energy-in-2021-amounts-to-24000-gw-h/.

[13] ECES (Egyptian Center for Economic Studies) and NBE (National Bank of Egypt). 2021. "Detailed Analysis of Demand in Different Governorates."

[14] EcomNews Med. 2022. "Egypt Wants to Increase the Share of Renewables in Its Energy Mix to 20% by 2022, then to 42% by 2035." EcomNews Med, January 21, 2022. https://www.ecomnewsmed.com/en/2022/01/21/egypt-wants-to-increase-the-share-of-renewables-in-its-energy-mix-to-20-by-2022-then-to-42-by-2035/.

[15] Egypt Oil & Gas. 2018. "Tracking the Gender Gap in Egypt's Petroleum Sector from Academia to Field." Egypt Oil & Gas, May 1, 2018. https://egyptoil-gas.com/features/tracking-the-gender-gap-in-egypts-petroleum-sector-from-academia-to-field/.

[16] Egypt Oil & Gas. 2019. "Egypt Reveals Progress in Energy Efficiency During EPEEC 2019." Egypt Oil & Gas, May 13, 2019. https://egyptoil-gas.com/features/egypt-reveals-progress-in-energy-efficiency-during-epeec-2019/.

[17] EgyptERA (Egyptian Electric Utility & Consumer Protection Regulatory Agency). 2022. "Circular No. 5 on EV Regulation." http://egyptera.org/ar/Download/journal/2022/5_2022.pdf.

[18] EIA (Energy Information Administration). 2018. "Country Analysis Brief: Egypt."

[19] Energy & Utilities. 2022. "Egypt to Launch $40bn Hydrogen Strategy before June 2022." Energy & Utilities, January 31, 2022. https://energy-utilities.com/egypt-to-launch-40bn-hydrogen-strategy-before-news116149.html.

[20] Enterprise. 2021. "Investing in Egypt's Renewables Sector: Risks and Returns." Enterprise, June 30, 2021. https://enterprise.press/hardhats/nvesting-egypts-renewables-sector-risks-returns/.

[21] Enterprise. 2022. "EgyptERA Is Packaging Incentives for Solar Producers ahead of COP27." Enterprise, March 1, 2022. https://enterprise.press/greeneconomys/egyptera-packaging-incentives-solar-producers-ahead-cop27/.

[22] European Training Foundation. 2020. "Quality Assurance in Vocational Education and Training in Egypt." https://www.etf.europa.eu/sites/default/files/2021-01/quality_assurance_in_vet_egypt.pdf.

[23] EY (Ernst & Young). 2021. "Renewable Energy Attractiveness Index (RECAI)." https://www.ey.com/en_in/recai.

[24] Friedrich Ebert Stifung. 2021. *Sustainable Transformation of Egypt's Energy System*. Cairo: Friedrich Ebert Stifung.

[25] Global Data. 2022. *Egypt Power Market Size and Trends by Installed Capacity, Generation, Transmission, Distribution, and Technology, Regulations, Key Players and Forecast, 2022–2035*. London: Global Data. https://www.globaldata.com/store/report/egypt-power-market-analysis/#:~:text=The%20total%20installed%20capacity%20in,2%25%20during%202021%2D2035.

[26] Global Project Partner. N.d. "European Energy Manager—Licensed for Egypt." https://global-project-partners.de/european-energy-manager-licensed-for-egypt.

[27] IEA (International Energy Agency). 2017. *Digitalization and Energy*. Paris: IEA.

[28] IEA. 2019. "Egypt Outlook." https://www.iea.org/countries/egypt.

[29] ILO (International Labour Organization). 1980. *Directing and Co-Ordinating Work; Modular Programme for Supervisory Development, Module Ii-04*. Geneva: ILO. https://labordoc.ilo.org/discovery/fulldisplay?vid=41ILO_INST:41ILO_V2&search_scope=ALL_ILO&tab=ALL_ILO&docid=alma992031693402676&lang=en&context=L&adaptor=Local%20Search%20Engine&query=creator,exact,International%20Labour%20Office.%20Library.&facet=creator,exact,International%20Labour%20Office.%20Library.

[30] ILO (International Labour Organization). 2018. *Skills for Green Jobs in Egypt*. Geneva: ILO.

[31] ILO and (European Commission). 2011. *Skills and Occupational Needs in Renewable Energy*. Geneva: ILO. https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_166823.pdf.

[32] International Trade Administration. 2022. "Electricity and Renewable Energy." In *Egypt—Country Commercial Guide*. Washington, DC: International Trade Administration. https://www.trade.gov/country-commercial-guides/egypt-electricity-and-renewable-energy.

[33] IRENA (International Renewable Energy Agency). 2017. *Rethinking Energy 2017.* Abu Dhabi: IRENA.

[34] IRENA. 2018. *Renewable Energy Outlook Egypt*. Abu Dhabi: IRENA.

[35] Ismail, A., A. Tolba, Sh. Barakat, H. Meshreki, and S. Ghalwash. 2019. *Egypt National Report 2018/2019*. Global Entrepreneurship Monitor. Cairo: The American University in Cairo.

[36] Jagger, Nick, Timothy Foxon, and Andy Gouldson. 2014. "Licensing and Certification to Increase Skills Provision and Utilization amongst Low Carbon SMEs." In *Greener Skills and Jobs*, 119–33. Paris: OECD Publishing.

[37] KAPSARC (King Abdullah Petroleum Studies and Research Center). 2019. "Renewable Energy and Employment: The Experience of Egypt, Jordan and Morocco." KAPSARC, Riyadh, Saudi Arabia. https://www.kapsarc.org/research/publications/renewable-energy-and-employment-the-experience-of-e-egypt-jordan-and-morocco/.

[38] Mazghouny. 2022. "Special Investment Incentives for Green Projects in Egypt." Mazghouny, January 15, 2022. https://mazghouny.com/road-to-cop27-1-special-investment-incentives-for-green-projects/#:~:text=A%20new%20Prime%20Ministerial%20Decree,2310%2F2017.

[39] MoERE (Ministry of Electricity and Renewable Energy). 2022. "EV Tariff Structure." MoERE, Cairo, Egypt. http://egyptera.org/ar/download/pdf/DecNo14_2022.pdf.

[40] MoP (Ministry of Petroleum). 2015. "Sustainable Development Strategy (SDS): Egypt Vision 2030." MOP, Cairo, Egypt. http://www.cairo.gov.eg/en/GovernorsCVs/sds_egypt_vision_2030.pdf.

[41] MoPMR (Ministry of Petroleum and Mineral Resources). 2016. "Program 4: Downstream Performance." MOPMR, Cairo, Egypt. https://www.petroleum.gov.eg/en/update-project/programs/Pages/program4.aspx.

[42] Mordor Intelligence. 2021. *Egypt Renewable Energy Market—Growth, Trends, COVID-19 Impact, and Forecasts (2022–2027)*. Hyderabad, India: Mordor Intelligence. https://www.mordorintelligence.com/industry-reports/egypt-renewable-energy-market.

[43] OECD (Organisation for Economic Co-operation and Development). 2010. *Greening Jobs and Skills*. Paris: OECD. https://www.oecd.org/cfe/leed/45484420.pdf.

[44] OECD. 2018. "Inclusive Solutions for the Green Transition." https://www.oecd.org/greengrowth/GGSD2018%20SaveTheDate.pdf.

[45] OECD. 2021. "Designing Active Labour Market Policies for the Recovery." OECD, Paris, July 15, 2021. https://read.oecd-ilibrary.org/view/?ref=1100_1100299-wthqhe00pu&title=Designing-active-labour-market-policies-for-the-recovery.

[46] OPEC (Organization of the Petroleum Exporting Countries) Fund. 2021. "Egypt's Largest Solar Plant, Kom Ombo, Receives US$114 Million Financing Package." Press release, April 22, 2021. https://opecfund.org/media-center/press-releases/2021/egypt-s-largest-solar-plant-kom-ombo-receives-us-114-million-financing-package.

[47] PwC (PricewaterhouseCoopers). 2019. "Shedding Light on Egypt's Shadow Economy." https://www.pwc.com/m1/en/publications/shedding-light-on-egypts-shadow-economy.pdf.

[48] Renewables Now. 2022. "Egypt's Renewables Capacity to Reach 10 GW by 2023." Renewables Now, February 10, 2022. https://renewablesnow.com/news/egypts-renewables-capacity-to-reach-10-gw-by-2023-772801/.

[49] RCREEE (Regional Center for Renewable Energy and Energy Efficiency). 2017. *Key Energy Efficiency Actions and Initiatives in Egypt*. Cairo, Egypt: RCREEE.

[50] RCREEE. 2020. *Electric Mobility Opportunities and Challenges: A Case Study on Cairo—Egypt*. Cairo, Egypt: RCREEE.

[51] RCREEE and GIZ (German Agency for International Cooperation). 2017. *The Socio-Economic Impacts of Renewable Energy and Energy Efficiency in Egypt—Local Value Employment*. Eschborn, Germany: GIZ.

[52] RECREE and meetMED (Mitigation Enabling Energy Transition in the Mediterranean). 2020. *Mapping EE and RES Market Potential Areas with Higher Impact on Local Economy and Job Creation: Tunisia, Egypt and Lebanon*. Brussels: meetMED.

[53] Riad & Riad Law Firm. 2021 "Electricity and Renewable Energy Regulations in Egypt." Riad & Riad Law Firm, January 18, 2021. https://riad-riad.com/electricity-and-renewable-energy-regulations-egypt-update/.

[54] Salman, Doaa, and Nadine Amr Hosny. 2021. "The Nexus between Egyptian Renewable Energy Resources and Economic Growth for Achieving Sustainable Development Goals." *Future Business Journal* 7 (1): 47.

[55] Sameh, S. H., and B. Kamel. 2017. "A Framework to Promote Energy Efficiency as a Solution to the Energy Problem in Egypt." *Energy and Power Engineering* 9 (3): 187–15.

[56] Schwab. 2019.

[57] Science Direct. N.d. "System Risk Assessment." https://www.sciencedirect.com/topics/computer-science/system-risk-assessment.

[58] Skills4Employability. 2020. https://skills4employability.eu/2020/11/30/interdisciplinary-skills-to-combine-knowledge-analyse-and-think-critically/#:~:text=Interdisciplinary%20skills%20refer%20to%20the,than%20one%20field%20or%20subject.

[59] SolarQuarter. 2022. "Egypt Invites Bids For 20 MW Hurghada Photovoltaic Plant." SolarQuarter, December 5, 2022. https://solarquarter.com/2022/12/05/egypt-invites-bids-for-20-mw-hurghada-photovoltaic-plant/.

[60] Statista. 2019a. "Total Renewable Energy Capacity in Egypt 2010–2019."

[61] Statista. 2019b. "Total Wind Energy Capacity in Egypt from 2010 to 2019 (MW)."

[62] Statista. 2019c "Total Solar Energy Capacity in Egypt from 2010 to 2019 (MW)."

[63] Statista. 2019d. "Youth Employment in Egypt between 1999 and 2019."

[64] Statista. 2021. "Global Unemployment in Egypt between 1999 and 2020."

[65] Supreme Energy Council. 2018. "National Energy Efficiency Action Plan (NEEAP) (2018/19–2021/22)." https://climate-laws.org/document/national-energy-efficiency-action-plan-2018-19-2021-22_a27e.

[66] Trading Economics. 2021. "Egypt Unemployment Rate." https://tradingeconomics.com/egypt/unemployment-rate.

[67] TVET Egypt. N.d. https://tvetegypt.org/tvet/.

[68] UNIDO (United Nations Industrial Development Organization). 2014. "Egypt National Cleaner Production Centre." https://www.unido.org/sites/default/files/2014-02/Egypt_National_Cleaner_Production_Centre_0.pdf.

[69] UNIDO. 2016. *UNIDO Activities in Egypt 2015–16*. Vienna: UNIDO. https://www.unido.org/sites/default/files/2016-04/UNIDO_Egy_2015-2016__web__0.pdf.

[70] United Nations Population Fund. 2021. "World Population Dashboard." https://www.unfpa.org/data/world-population-dashboard.

[71] USAID (United States Agency for International Development). 2015. "Workforce Improvement and Skills Enhancement." https://2017-2020.usaid.gov/egypt/fact-sheets/workforce-improvement-and-skills-enhancement-wise.

[72] WEF (World Economic Forum). 2019. *The Global Competitiveness Report 2019*. Geneva: WEF. http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf.

[73] WEF. 2021. *Global Gender Gap Report 2021*. Geneva: WEF.

[74] WFC (World Future Council). 2016. *Roadmap for 100% Renewable Energy in Morocco*. Hamburg, Germany: WFC.

[75] Wolkowicz, Oliwia. 2023. "IT Skills for Your Resume [45+ Skills in Demand]." Zety (blog), November 24, 2023. https://zety.com/blog/it-skills.

[76] World Bank. 2016. Enterprise Survey.

[77] World Bank. 2019a. *Understanding Poverty and Inequality in Egypt*. Washington, DC: World Bank.

[78] World Bank. 2019b. *Performance and Learning Review of the Country Partnership Framework for the Arab Republic of Egypt for the Period FY15-FY19*. Washington, DC: World Bank.

[79] World Bank. 2020a. *Creating Markets in Egypt: Realizing the Full Potential of a Productive Private Sector*. Country Private Sector Diagnostic. Washington, DC: World Bank.

[80] World Bank. 2020b. "Human Capital Index 2020: Arab Republic of Egypt." World Bank Data Bank. https://databankfiles.worldbank.org/public/ddpext_download/hci/HCI_2pager_EGY.pdf.

[81] World Bank. 2021a. "Egypt Higher Education Employability Policy Note."

[82] World Bank. 2021b. "Labor Force, Female (% of total Labor Force)—Egypt, Arab Rep." https://data.worldbank.org/indicator/SL.TLF.TOTL.FE.ZS?locations=EG.

[83] World Bank. 2021c. The World Bank in Egypt.

[84] World Bank. 2021d. Phase 1 of the study.

[85] World Bank. 2022a. *The Employment Benefits of an Energy Transition in Morocco*. Disruptive Energy Transition and the Opportunities for Job Creation in the Middle East and North Africa. Washington, DC: World Bank.

[86] World Bank. 2022b. *Egypt Country Climate and Development Report, 2022*. Washington, DC: World Bank.

[87] World Bank and EY. 2021. *Analysis of Socio-Economic Benefits and Contractual Model Options for Renewable Energy Development*. Washington, DC: World Bank.

[88] World Energy Council. 2018. "World Energy Trilemma Index 2018." https://www.worldenergy.org/publications/entry/world-energy-trilemma-index-2018.

APPENDIX 1 INTERVIEW GUIDE FOR PUBLIC STAKEHOLDERS' CONSULTATION

A1.1 CONTEXT AND OBJECTIVES OF THE ACTIVITY

The clean energy transition and associated innovations in technology can promote job creation and shift the skills profiles for occupations. Early evidence for the Middle East and North Africa is positive regarding jobs, but rigorous evidence in the region is still scarce. In this context, the World Bank is conducting a study, financed by the Energy Sector Management Assistance Program (ESMAP), to build evidence on both the potential of job creation and the challenges of meeting employment as it shifts. The goal is to help countries formulate, adopt, and implement appropriate strategies, policies, regulations, incentive schemes, programs, and human capital development frameworks for a job transition. As part of the first phase of the study, the World Bank assessed the net direct, indirect, and induced job impact of disruptive clean energy transition in Egypt, Morocco, and Yemen.

The World Bank has hired EY to undertake the second phase of the study, which will deepen the Phase 1 analysis through a country case study for Egypt, which will include:

- Country-specific deep-dive analyses on the opportunities and challenges of job creation and transformation, focusing on sectors that offer the most significant employment opportunities, in particular, the renewable energy and energy efficiency sectors and associated value chains (e.g., manufacturing, finance, support sectors); and

- Recommendations of policies to maximize the opportunities and address the challenges identified.

This activity has focused on the following renewable energy and energy efficiency technologies:

- Solar (concentrated solar power, utility-scale photovoltaic, industrial-sector distributed photovoltaic, residential rooftop solar) and wind (utility scale);

- Commercial building energy efficiency;

- And the activity may be expanded to include additional clean energy technologies such as electric vehicles and battery energy storage.

As part of Phase 2, data and information are being collected from actors linked to the energy and the jobs/education sectors in Egypt, to complete the knowledge obtained through existing literature review. EY will first conduct face-to-face or phone interviews with such stakeholders and then send an online survey to companies in the renewable energy and energy efficiency sectors in order to verify some of the interview findings.

EY will conduct interviews with four types of actors, asking each specific questions according to their expertise. In this interview guide, each group of questions is thus assigned to one or several types of actors, according to the following code (table A1.1):

Table A1.1 Actor codes

Code	Type of actor interviewed
A	Energy public institutions as well as public and private agencies
B	Energy trade associations and energy companies
C	Jobs/education public institutions as well as public and private agencies
D	Development finance institutions

A1.2 QUESTIONS

- **1. Clean energy achievements, trends, and labor market context (A, B)**
  - ***1.a)*** What are the current governmental objectives for the renewable energy and energy efficiency sectors in terms of capacity and job creation?
  - ***1.b)*** How have the renewable energy technologies (solar and wind) evolved?
    - Which technologies have been most deployed in the past 5 to 10 years (in terms of cumulated and annual installed capacity)? To what extent (cumulated installed capacity and annual capacity additions in megawatts)?
    - On which segments of the value chain are local actors positioned (installation, operation and maintenance [O&M], manufacturing, project development)? In other words: which parts of the value chain are local, and which parts are imported? Is there any available study on this subject?
    - What evolutions do you expect in the next 5 to 10 years (annual growth rate and share in total installed capacity, as well as the evolution in the local content in relation with projected growth rate and projected growth in share in overall installed capacity)?
  - ***1.c)*** How has the demand-side commercial buildings energy efficiency sector evolved?
    - Which technologies have been most deployed in the past 5 to 10 years (in terms of annual investments in energy efficiency technologies and of savings that could be achieved in commercial buildings as a result)? To what extent (annual growth in market volume, number of commercial building energy efficiency retrofit projects)?
    - On which segments of the value chain are local actors positioned (construction, installation, O&M, manufacturing, project development, design)?
    - What evolutions do you expect in the next 5 to 10 years (in terms of investment volume, share of buildings, local content)?

- ***1.d)*** For both renewable energy and energy efficiency sectors and the green economy overall, how many people are employed (direct employment—full and part time) along the entire value chain, in the country? How many are domestic vs. foreign workers? Through which channels are workers recruited?

- **2. Impact of the clean energy transition on jobs and required skills (A, B, C, D)**
  - ***2.a)*** What skills are required for existing jobs in the renewable energy and energy efficiency sectors in the different segments of the value chain, for technologies mentioned above: manufacturing, import, project development, distribution, design and engineering, construction, installation, O&M?
  - ***2.b)*** How have these skills evolved over time? Are skills required for new jobs created in the renewable energy and energy efficiency sectors different from the skills required in existing jobs in the renewable energy and energy efficiency sectors? If so, in which segment(s) and why?
  - ***2.c)*** What are the challenges to job quality for these new jobs (education and training, high skilled vs semiskilled vs low skilled, wages, type of employment [full-time vs part-time], security of employment, benefits)? Are there opportunities or challenges to inclusiveness for minorities, women, and young workers?
  - ***2.d)*** Have skills shortages already been identified in the renewable energy and energy efficiency sectors, and by whom (for direct and indirect jobs, both technical and nontechnical skills)? If so, what are the identified skills shortages? How were the needed skills developed?
    - At what occupational level were these shortages identified (low-skilled jobs such as O&M, medium-skilled jobs such as solar installers and wind turbine operators, high-skilled jobs such as engineers and architects)?
    - Were these shortages identified for technical jobs (engineers) or nontechnical occupations (green financing experts)?
    - What are the characteristics of these missing skills (technical, language, IT/digital, project management, soft skills such as teamwork and communication)?
  - ***2.e)*** Were some jobs transformed by the clean energy transition, (i.e., existing occupations whose skills profiles/qualification requirements shifted to meet demand of the renewable energy and energy efficiency sectors)? If so, how were they transformed in the renewable energy and energy efficiency sectors?
  - ***2.f)*** How has the development of the renewable energy and energy efficiency sectors affected jobs requirements in the conventional energy sector? How many jobs were eliminated? What are the characteristics of these jobs (occupations, skills)? Will they change over time?
  - ***2.g)*** What opportunities do you see for employment and skills transfer from the conventional energy sector to energy efficiency and renewable energy sectors? In your opinion, will workers losing their job in the conventional energy sector be able to fill vacancies in the same occupations in the energy efficiency and renewable energy sectors (“jobs substituted”)? Do you have a quantitative estimate of the number of such workers?

- ***2.h)*** In your opinion, how may the clean energy transition indirectly impact employment in the country, by creating or displacing manufacturing or service jobs in industries associated with conventional energy, renewable energy, and energy efficiency (e.g., industries that supply intermediate goods for building retrofits, such as steel, transportation)?
    - How do you expect jobs in these industries (and required skills) to evolve in the next 5 to 10 years?
    - Is the development of the renewable energy and energy efficiency sectors the sole driver of these evolutions, or do they also depend on other trends (such as cost reductions, increasing automation and digitization, etc.)?

- **3. Opportunities and challenges for job transition (A, B, C, D)**
  - ***3.a)*** What might prevent young graduates entering the job market (or students in school aiming to get into the renewable energy/energy efficiency occupations) from occupying positions newly created in the renewable energy and energy efficiency sectors?
  - ***3.b)*** What might prevent existing workers from having the required skills to occupy positions in the renewable energy and energy efficiency sectors?
  - ***3.c)*** What are the challenges to ensure that workers losing their jobs in the conventional energy sector obtain the required skills to occupy new positions in the renewable energy and energy efficiency sectors?
  - ***3.d)*** For workers whose jobs will be altered in the clean energy transition (i.e., jobs in the same occupation persist, but the skills profiles and/or qualification requirements change), what challenges would prevent them from acquiring the required skills to adapt to their new jobs? Which opportunities can be seized to maximize their chances of adapting?
  - ***3.e)*** To answer these questions, we will analyze a set of factors facilitating or hindering the job transition. Table A1.2 provides examples but is neither exhaustive nor restricting.

Table A1.2 Factors and components

Examples of factors	Components
Overall business environment	Macroeconomic stability, governance, regulations, investment policies, incentives, etc.
Enabling factors for sector development	Access to financial services and infrastructure, local financing capacity, ease of access to inputs, regional comparative advantage (cost of labor, raw material, inputs), etc.
Sector structure and market	Barriers to entry, competition within the sector, regional and international competition, dominance of public sector, private sector participation, market size, etc.
Digital economy, technology, and innovation	Connectivity, technology adoption, time of experience with the technology, the possibility of technology transfer, research and development, and innovation capacity, etc.
Labor market regulations and social protections	Labor costs, prevalence of formality, labor protection, etc.
Human capital	Labor force and demography, presence of industrial actors with relevant skills, availability of skilled workers, training needs and opportunity to develop or "green" workforce, etc.

- **4. Enablers of a job-enhancing clean energy transition (A, C)**
  - ***4.a)*** Institutional framework (A, C)
    - What public authorities are involved in the policy-making process related to clean energy jobs and skills development? What are their mandates/powers with respect to the policy-making process?
    - What are the institutional arrangements for skills identification and development? Who is responsible for collecting and analyzing information on skills needs and skills development? What is the frequency for updating this analysis?
    - What is the level of coordination of efforts between line ministries and other governmental agencies? How do public authorities coordinate with industries on employment and skills issues related to clean energy? Are there any joint working groups or joint initiatives between different entities?

- How do different line ministries and other governmental agencies manage to align their policy decisions and regulatory requirements with clean energy jobs trends and skills demand?
- In your opinion, is there a gap between the needed institutional frameworks and existing ones, and why?

- ***4.b)*** Enabling policies and programs (A, C, D)
  - What are the key national strategies/policy documents related to clean energy jobs and skills? Are they available online? If not, would be it be possible to get a copy?
  - What is the level of coherence between energy, labor, social protection, education, and skills policies?
  - What are the existing policies and programs to support private sector development and investments in clean energy? Are you aware of any plans to develop new policies and programs?
  - What are the existing policies and programs to promote localization and creation of local value chains? Are you aware of any plans to develop new policies and programs?
  - What are the existing educational and skills policies to facilitate the development of human capital for energy transition?
  - What are the existing policies and programs to strengthen labor market and social protection systems? What are the policies and programs aimed at enhancing minority, women, and young workers inclusion? Are you aware of any plans to develop new or update policies and programs?
  - Are you aware of any specific policies and programs to mitigate negative impacts from job substitution and elimination?
  - What additional policies and programs could be implemented or strengthened to maximize the job potential of the clean energy transition?
- ***4.c)*** Educational and training programs/projects* (B, C)
  - What are the existing educational and training programs/projects aimed at developing the new skills required as a result of the clean energy transition? Are these programs part of formal education? Who developed/supported these programs? Are these nationwide programs or pilot programs? If it is a pilot program, is there an opportunity to scale it up?
  - Are there any data on program outcomes (i.e., number of people trained)?
  - Are you aware of any new programs that will be developed in the future?
  - In your opinion, is there a gap between the needed educational/training programs and existing ones, and why? What policies could fill in this gap?
  - Are there any certification/accreditation systems for the new skills required by the clean energy transition?

* These programs and projects include different levels of education and training programs: postsecondary (formal TVET [technical and vocational education and training] and university), but also short-term training modules and on-the-job, industry, and employer-provided training and upskilling.

APPENDIX 2 KEY NATIONAL POLICIES, LAWS, AND DECREES SINCE 2008 TO ENABLE THE GROWTH OF THE RENEWABLE ENERGY AND ENERGY EFFICIENCY SECTORS

The following key policies, laws, and decrees have been adopted since 2008.

A.2.1 FOR THE DEVELOPMENT OF THE RENEWABLE ENERGY SECTOR

- *New National Egyptian Renewable Energy Strategy* (2008), which updates the targets and strategy regarding the renewable energy sector, including the definition of capacities to be implemented by the public and private sectors.
- *Egyptian solar pla*n (2012), which is a strategy targeting 3,500 megawatts (MW) of solar power plants installed by 2027 (2,800 MW of concentrated solar power and 700 MW of photovoltaic [PV]) (IEA 2019).
- Egyptian constitution (Article 32 of the 2014 Constitution), which states the government's commitment to "make the best use of the renewable energy sources, motivate investment therein, and encourage relevant scientific research" (IEA 2019).
- *Feed-in tariffs* for wind and solar PV projects (2014 for round 1 through the Cabinet Decree No. 1947, and 2016 for round 2 through the Cabinet Decree no. 2532) (Riad & Riad Law Firm 2021) launched to support wind and solar PV projects with a capacity lower than 50 MW, which aims at boosting renewable energy production in Egypt and to reach 4.3 gigawatts of renewable energy (2,300 MW of PV capacity and 2,000 MW of wind capacity).
- *Renewable energy custom tax reduction for renewable equipment* (2014), which enables a reduction of 2 percent in customs on new and renewable energy equipment (IEA 2019).
- *Egypt Renewable Energy Law—Decree No 203/2014* (2014), which encourages the generation of renewable electricity from private entities, providing several options for supporting renewable energy projects (competitive bids, feed-in tariffs, independent power producer scheme, etc.) and allowing a gradual shift away from state-administered projects to privately financed projects.
- *Egypt Renewable Energy Tax Incentives—Presidential Decree No 17/2015* (2015), which aims at attracting energy investments in Egypt, including trimming sales tax to 5 percent from as high as 10 percent, and setting customs duties on equipment used for production at 2 percent.
- *Egypt Renewable Energy Tenders (build-own-operate [BOO] contracts)* (2015), which defines the applicable renewable energy auction mechanism for the procurement of future renewable energy projects in Egypt.
- *"Gas Law"—Law no. 196 (Gas Regulatory Authority)* (2017), which creates and governs a new clear legal and regulatory framework aimed at creating a liberalized gas market with the opportunity for competition in the downstream segments amongst potential market players.

- *Prime Ministerial decree 104*/2022 (January 2022), which encourages local manufacturing of renewable energy equipment in Egypt. Investment projects established after the entry into force of the law will benefit from a "special investment incentive" through a deduction from their net taxable income (50 percent deduction from the investment of *Sector A* projects). (Mazghouny 2022).[21]

- Updated *Net metering circular 2/2020* (February 2022), which encourages PV net metering installations.

A.2.2 FOR THE DEVELOPMENT OF THE ENERGY EFFICIENCY SECTOR

- *Air Conditioners Energy Efficiency Standard No. 3795* (2013) and *standard No. 3795-1* (2016), which establishes label requirements for room air conditioners (both window and split) with fixed capacity and fixed compressor.

- *2013/3795 energy efficiency label requirement* for room air conditioners—window-split (2017).

- *New Electricity Law* (2015), *Art. 48*, which makes it mandatory for organizations with more than 500 kilowatts of contracted capacity to nominate an energy efficiency manager.

- *Nonducted air conditioners and heat pumps testing and rating for performance (standard 4814/2018)*, activated in 2019, which establishes the minimum energy performance standard and appliance testing standards of nonducted air conditioners and heat pumps.

A.2.3 FOR THE DEVELOPMENT OF BOTH THE RENEWABLE ENERGY AND THE ENERGY EFFICIENCY SECTORS

- *Sustainable Development Strategy (SDS): Egypt Vision 2030* (2015), a roadmap for maximizing competitive advantage and achieving a dignified and decent life for Egyptians through three main dimensions: economic, social, and environmental.

- *Integrated Sustainable Energy Strategy (ISES) to 2035* (2015), which sets objectives for the renewable energy and the energy efficiency sectors at the national level from 2015 to 2035.

A.2.4 FOR THE DEVELOPMENT OF THE ELECTRIC VEHICLES SECTOR

- *Ministerial decree 14/2022* of the Ministry of Energy and Renewable Energy (MoERE 2022), which creates an electric vehicle tariff structure.

- Circular of EgyptERA (2022), which regulates electric vehicles charging.

---

[21] Sector A includes among other industrial projects: feeder industries for new and renewable energy projects, such as solar panels and their components, and solar power plants' components (including inverters and fiber optic cells); green hydrogen projects' inputs and green fuel derivatives; green hydrogen electrolyzers; and wind farm equipment. It also encompasses engineering, mineral, and extractive industries, including wastewater treatment, sustainable seawater desalination, and new technologies in general, and well as water desalination equipment.

APPENDIX 3 KEY INSTITUTIONS THAT ACHIEVE OR SUPPORT RENEWABLE ENERGY AND ENERGY EFFICIENCY TARGETS

Category	Organization	Mandate	Objective 1	Objective 2
Ministry	Ministry of Electricity and Renewable Energy (MoERE) (including the Energy Efficiency and Climate Change unit)	The MoERE is in charge of managing and regulating the generation, transmission, and distribution of electricity in Egypt through its subsidy, the Egyptian Electricity Holding Company (EEHC). The Energy Efficiency and Climate Change unit is a dedicated unit established within the ministry to promote energy efficiency and renewable energy projects as well as its affiliated agencies and companies.	✓	
Ministry	Ministry of Petroleum and Mineral Resources (MoPMR) (including the Energy Efficiency and Climate Department)	The MoPMR is in charge of meeting the demands of the domestic market for petroleum, petrochemical products, and mineral resources as well as achieving the target of the national economy growth rates. One of its strategic objectives includes maintaining environmental standards and sustainable development. The Energy Efficiency and Climate Department Is a dedicated unit established within the ministry to promote energy efficiency and renewable energy projects as well as its affiliated agencies and companies.	✓	
Ministry	Ministry of Environment (MoE)	The MoE works in collaboration with national and international development partners on defining environmental policies, setting priorities, and implementing initiatives within a context of sustainable development. The MoE has issued an executive summary of the Egypt National Climate Change Strategy 2050, which is expected to be public in the next few months.	✓	
Ministry	Ministry of Trade and Industry (including the Productivity and Vocational Training Department, PVTD)	The ministry's mission is to provide an adequate environment for a sustainable and inclusive economy, based on enhancing competitiveness, diversity, knowledge, and innovation, and on generating decent and productive job opportunities. Affiliated to the Ministry of Trade and Industry, the PVTD qualifies technical labor at various skill levels required by the industrial labor market.	✓	✓

Category	Organization	Mandate	Objective 1	Objective 2
Ministry	Ministry of Education and Technical Education (MoETE)	It is a key stakeholder in developing training programs for renewable energy and energy efficiency.		✓
Ministry	Ministry of Higher Education and Scientific Research (MoHESR)	It is responsible for the development of higher education programs, and of the technological universities.		✓
Public institution	Supreme Energy Council (SEC)	It is responsible for the review of national energy strategies and roadmaps, for monitoring the energy sector performance and prices, and for approving investment policies and regulations. It is headed by the Prime Minister and includes relevant ministries: the MoERE, the MoPMR, the MoE, the Ministry of Trade and Industry, as well as the ministries of finance, agriculture, and housing.	✓	
Public agency	Egyptian Electricity Utility and Consumer Protection Regulatory Agency (EgyptERA)	Affiliated to the MoERE, it regulates, supervises, and controls all matters related to electricity in coordination and consultation with the EEHC and the New and Renewable Energy Authority (presented below).	✓	
Public agency	New and Renewable Energy Authority (NREA)	The NREA acts as the national focal point for expanding efforts to develop and introduce renewable energy technologies to Egypt on a commercial scale, together with implementation of related energy conservation programs.	✓	✓
Public agency	Egyptian National Cleaner Production center (ENCPC)	Supported by the German Arab Chamber of Industry and Commerce (AHK), it is in charge of the development of an accredited training program, the "European Energy Managers for Egypt."	✓	✓
Trade association	Federation of Egyptian Industries	The Federation of Egyptian Industries is one of the country's largest employers' associations, with 19 active industrial chambers as members, representing over 102,000 industrial enterprises out of which more than 90 percent belong to the private sector, accounting for more than 2 million workers and 18 percent of the national economy. The chambers work closely with their members and provide technical assistance to enhance growth of their affiliated enterprises, including those operating in renewable energy and energy efficiency.	✓	✓

Category	Organization	Mandate	Objective 1	Objective 2
Regional nonprofit organization	Regional Center for Renewable Energy and Energy Efficiency (RCREEE)	It ”s an intergovernmental organization with diplomatic status, operating under the Arab League with 17 Arab member countries to facilitate and increase the adoption of renewable energy and energy efficiency practices in the Arab region. RCREEE teams up with regional governments and global organizations to initiate and lead clean energy policy dialogue, strategies, technologies, and capacity development with a view to increasing the Arab States' share of tomorrow's energy. Therefore, its objective is to build and strengthen Arab qualifications, competencies, and expertise in the renewable energy and energy efficiency sectors (for the whole value chain).	✓	✓

APPENDIX 4 INDEPENDENT INITIATIVES FOR CAPACITY BUILDING AND SKILLS REINFORCEMENT RELEVANT TO RENEWABLE ENERGY AND ENERGY EFFICIENCY

In addition to the initiatives supervised by the national education system, other independent initiatives for capacity building and skills reinforcement relevant to renewable energy and energy efficiency, mostly for the labor market, have been implemented. Some of the most important recent initiatives are detailed in the following list.

- **Short-term training programs** offered by the New and Renewable Energy Authority (NREA) through its two training facilities (one- or two-week general training programs focus on renewable energy sources and applications, specialized programs directed at engineers and technicians working on field, theoretical and practice training visits to training sites, and internal training programs to empower the NREA staff and improve their professional skills). Up to 2021, those programs had enabled over 300 people to receive training on photovoltaic (PV) and PV project management or receive specific courses on wind energy. Most of the 250+ companies working for small and medium solar PV projects took certificates and courses offered by the NREA.

- **Short-term training programs** offered by the Solar Energy Development Association[22] on PV grid-connected (on-grid) systems, solar water pumping, and comprehensive PV system training.

- **Practical, short training courses (two to three days)** offered by ROSAE[23] for engineers, installers, technicians, and investors in solar electricity on solar thermal energy (introductory courses on solar energy, PV on- and off-grid design, solar pumping, solar thermal technology). More than 500 beneficiaries took part in the training.

- **Capacity building in the industry** enhanced by the Federation of Egyptian Industries in cooperation with the German Agency for International Cooperation (GIZ) to enhance capabilities of people to manage funds deployment and usage in the renewable energy and energy efficiency sectors.

- **Certified continuous training courses** provided through the Certified Energy Management Professionals program initiated by the Regional Center for Renewable Energy and Energy Efficiency (RCREEE). The program consists of a standardized in-depth professional certification program for energy managers. The training aims to assist energy efficiency policy makers and program administrators in planning and implementing energy efficiency plans and related measures. The training encompasses an optional preparatory training and a mandatory written exam (70 percent or more passing requirement) to be renewed every two years.

[22] SEDA is the Solar Energy Development Association, a non-profit organization advocating the development of the solar energy (heat and power) in Egypt through the development of competencies, the introduction of innovative solutions for market development, and offering guarantees of supply quality.

[23] ROSAE, a partnership between the German Renewables Academy (RENAC) and the Egyptian Oasis Renewable Energy (ORE), trains professionals in renewable energy.

- **Training industry representatives** in cement, metallurgy, ceramics, paper, chemicals, and fertilizer sectors, as well as governmental agency agents through the Industrial Energy Efficiency project, conducted by the Ministry of State for Environmental Affairs and supported by UNIDO. The project has trained up to 400 beneficiaries.

- **Manager Technical Energy Efficiency,** a training program held by the Environmental Compliance Office of the Federation of Egyptian Industries (ECO FEI), is the output of close cooperation between the Egyptian-German Joint Committee on Renewable Energy, Energy Efficiency, and Environmental Protection (JCEE); the Egyptian Electricity Utility and Consumer Protection Agency (EgyptERA); and TÜV Rheinland. The program trained over 216 engineers to become energy auditors, including training of trainers for 60+ engineers. Cadres were trained at EDCs on energy management and auditing, in addition to training of trainers. EDCs held seminars at schools led by energy savings engineers who received training-of-trainers courses delivered by EgyptERA and GIZ in cooperation with the EDCs, to raise awareness among students on energy saving.

- **European Energy Managers for Egypt**, an accredited training program under development at the Egyptian Countryside Development Company (ECDC), aims at building up capacity among 200 local Egyptian experts through qualifying them as energy managers. The project is built on the European Union project, EURO-Energy Managers (EUREM), which started in 4 European countries and is now being rolled out in 12 countries. The program qualifies specialists in energy efficiency (Global Project Partner n.d.). The program was initiated by Global Project Partners e.V., a Berlin-based nonprofit association, and the Chamber of Industry and Commerce (IHK) Nuremberg.

- **Capacity development programs** by RCREEE, offering training in renewable energy and energy efficiency covering the entire renewable energy value chain, such as energy pricing and trading, large-scale renewable energy project management, grid integration, energy audit, certification and standards, and energy management software tools.

APPENDIX 5 DETAILED INFORMATION ON TECHNICAL AND VOCATIONAL EDUCATION AND TRAINING

Technical and vocational education and training (TVET) is going through a major restructuring—changes that might create development opportunities for renewable energy and energy efficiency jobs in a context of energy transition.

Egypt has two main TVET programs.

- **Technical education:** An alternative track to traditional academic learning in Egypt (Thanaweya Amma), technical education comes after the completion of their preparatory education and focuses on occupational learning. Theme-based academies for the skilled trades, applied sciences, technologies, and other disciplines provide a practical learning experience for students, giving them the opportunity to gain career-oriented work experience. More recently, technological universities have been introduced for the same purpose.
- **Vocational training**: As a complement to technical education, vocational training, offered by several ministries and agencies, allows students and graduates to enroll in specialized courses to further develop their skills. Lasting from 45 days to 6 months, the learning experiences span career tracks from culinary arts, automotive technology, construction, plumbing, electrical contracting, agriculture, and garment making, among others.

APPENDIX 6 JUSTIFICATION FOR THE PRIORITY AND COMPLEXITY LEVELS IN THE RECOMMENDATIONS

Table A6.1 To develop the renewable energy and energy efficiency sectors

Recommendation	Challenge addressed	Priority	Complexity	Justification
1. Create structured and coordinated institutional frameworks for both renewable energy and energy efficiency	Little coordination among institutional frameworks, programs with overlapping outcomes and unmet challenges.	●●●	●●●	**Priority**: The lack of coordination between institutions and initiatives emerged as the main challenge in the renewable energy and energy efficiency sectors. **Complexity**: Implementation complexity stems from a complicated ecosystem (multiple ministries and institutions, multiple granular initiatives and actions, and decision-making divided among a host of different ministries).
2. Pursue the establishment of sectoral skills councils dedicated to renewable energy and energy efficiency	Low engagement among employers in formulating education and training programs creates persistent gaps between skills needed and skills generated by existing programs. Few initiatives are project based/donor funded to supply skills needed in renewable energy and energy efficiency.	●●●	●●○	**Priority**: The priority of the current recommendation results from recommendation no. 1. The sectoral skills councils aim to coordinate between the institutional framework and the economic sectors, that is, to tackle the key challenge identified. **Complexity**: The implementation of the recommendation has a medium complexity level as it is already being considered by the government.
3. Alert companies to economic value gained from investments in energy efficiency	Lack of investments in energy efficiency throughout Egypt.	●●○	●○○	**Priority**: The recommendation involves medium- to long-term sets of actions after implementation of recommendation nos. 1 and 2. **Complexity**: Industry associations would organize workshops and awareness sessions—these associations would conduct such workshops.

Table A6.2 • To ensure that available jobs are filled

Recommendation	Challenge addressed	Priority	Complexity	Justification
1. Create and implement a labor market information system (LMIS)	Outdated labor market information on skills needs and shortages	●●●	●●●	**Priority**: Established in recommendation no. 1. The LMIS would help transmit information between government and economic sectors. **Complexity**: Implementation requires a high involvement of both parties.
2. Create and implement an education management information system (EMIS)	Untracked job outcomes for graduates; tracking permits educational/training program providers to reshape coursework to match the market's needs	●●●	●●●	**Priority**: Established by recommendation no. 1. The EMIS would help to transmit accurate, timely information between the government and educational system. **Complexity**: Implementation requires high involvement of both information seekers and universities/schools.
3. Deploy more structured apprenticeships dedicated to renewable energy and energy efficiency	Mismatch of skills with market needs will slow the integration of new entrants in the labor market Existing apprenticeship programs/schemes unfamiliar to hiring companies	●●●	●●○	**Priority:** Apprenticeship programs serve to fill the gaps between the labor market needs and existing education programs' content. Their deployment is key to enable companies find the right applicants while ensuring that graduates find a job. **Complexity**: Apprenticeship programs are already developed—they need to be improved, structured, and communicated about.
4. Create an assistance fund that will pay for training or relocation for workers who want to find jobs in renewable energy and energy efficiency	Income loss for workers in need of training and relocation to jobs outside their governorates	●●○	●●●	**Priority**: Monetary subsidies and assistance require a longer implementation time and would be more effective after implementing recommendation nos. 1 and 2. **Complexity**: Monetary assistance requires complex validation processes that should be covered by the government's expenditure plans.

Table A6.2 To ensure that available jobs are filled (cont'd)

Recommendation	Challenge addressed	Priority	Complexity	Justification
5. Create training programs for technicians as alternative pathways to higher education and jobs	Lack of training programs dedicated to technicians throughout Egypt (not only in a few governorates), and for all the technologies (not only solar)	●●○	●●○	**Priority:** The current recommendation would be more effective after implementing recommendation nos. 4 and 5, to better design these training programs and ensure they meet the companies' skills needs. **Complexity:** The creation of specific programs is expected to be eased by the information collected by the LMIS and the EMIS.
6. Raise awareness about inclusive hiring practices in the renewable energy and energy efficiency sectors	Noninclusive hiring at renewable energy and energy efficiency companies; women are suitable recruits for technician (office job) positions	●●○	●○○	**Priority**: The current recommendation is made of a medium to a long timescale set of actions, since it is linked to a long-term cultural change. **Complexity**: The implementation lies in the organization of workshops and awareness sessions by industry associations—these associations are used to conduct such workshops.
9. Make companies aware of the importance of investing in their employees' training	Employers underinvest in training that could address skills shortages	●●○	●○○	**Priority**: Medium to long term, linked to cultural change. **Complexity**: Implementation through workshops and awareness-raising sessions by industry associations.


THE WORLD BANK
ESMAP
Energy Sector Management Assistance Program