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ESMAP
Energy Sector Management Assistance Program

JOB CREATION AND SKILLS DEVELOPMENT DURING THE ENERGY TRANSITION - TUNISIA

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Cover: The medieval fortress in Monastir, Tunisia.

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ACKNOWLEDGMENTS

The Energy Sector Management Assistance Program (ESMAP) is a partnership between the World Bank and 24 partner organizations 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 7 (SDG7) 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 Tunisia is one of three country case studies under phase 2 of the 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 Middle East and North Africa governments 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, Amira Klibi, Bechir Allouche, Ezzedine Khalfallah, Himdat Iqbal Bayusuf, Xiaonan Cao, and Yao Zhao.

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Acronyms and Abbreviations

AFD	Agence Française de Développement
ANETI	National Agency for Employment and Self-Employment
ANME	National Agency for Energy Management
ATFP	Tunisian Agency of Professional Training
CBF	Banking and Financial Advisory
CENAFFIF	National Center for the Training of Trainers and Training Engineering
CFPK	STEG's Kheldia Training and Development Centre
CIVP	Professional Life Integration Contract
CONECT	Confederation of Citizen Enterprises of Tunisia
CRTEn	Center for Energy Research and Technologies
ENA	National School of Administration of Tunis
ENIT	National School of Engineering of Tunis
EPNA	public institutions of a nonadministrative character
ETF	Energy Transition Fund
FRPs	federated research projects
FTE	full-time equivalent
GIZ	German Agency for International Cooperation
HVAC	heating, ventilation, and air-conditioning
IEA	International Energy Agency
ILO	International Labour Organization
IRENA	International Renewable Energy Agency
ISO	International Organization for Standardization
IT	information technology
ITCEQ	Tunisian Institute of Competitiveness and Quantitative Studies
MESRS	Ministry of Higher Education and Scientific Research
MIME	Ministry of Industry, Mines and Energy
MV	medium voltage
MW	megawatt

NDC	Nationally Determined Contribution
PV	photovoltaic
PVR	grid-connected photovoltaics
PVS	on-site photovoltaics
R&D	research and development
RES4MED	Renewable Energy Solutions for the Mediterranean
SCCs	sectoral competence councils
SMEs	small and medium enterprises
STEG	Tunisian Electricity and Gas Company
TGBC	Tunisian Green Building Council
TD	Tunisian dinar
UTICA	Tunisian Union of Industry, Commerce and Handicrafts
VSE	very small enterprise

EXECUTIVE SUMMARY

THE ENERGY TRANSITION IS A DRIVER FOR THE CREATION OF INCLUSIVE GREEN JOBS IN TUNISIA

Tunisia has chosen to embark on an ambitious energy transition to address the challenges of decarbonization, energy security, and vulnerability to volatile international energy prices. The national energy strategy, "Stratégie énergétique de la Tunsie à l'horizon 2035", i.e. Tunisia's energy strategy to 2035[1]—announced in February 2023—calls for the share of renewable energy in the primary energy mix to reach 18 percent by 2035; its share in the electricity production mix is to reach 50 percent by the same year. The country also aims to reduce primary energy intensity by at least 3.6 percent per year on average between 2021 and 2035. The new energy strategy is designed to create 70,000 jobs (direct, indirect, and induced) in all energy sectors, including biogas and hydrogen, between 2021 and 2035. If achieved, this could reduce the country's high unemployment rate, especially among youth and women. The goal is about 20 times more job creation than in 2015, when energy efficiency and renewable energy programs created nearly 3,000 direct jobs in the country (GIZ 2016).

The job creation process is part of a global transition from conventional to clean energy. New jobs specific to this clean energy transition require new skills, which will have to be acquired either through the university system or through vocational training. These new skills may also be required for existing jobs, the prerequisites of which are subject to change ("transformed jobs"). The energy transition may render some jobs in the conventional energy sector obsolete.

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

In this context, the World Bank has studied how to help countries devise and implement policies, incentive systems, infrastructure, institutions, and programs to create an enabling environment for job creation and transformation—and particularly to develop the necessary workforce for the clean energy transition. The study focuses on the renewable energy sector (ground-mounted and rooftop solar photovoltaic and onshore wind power) as well as the energy efficiency of buildings. To meet this objective, the study has drawn on the following sources of information:

- A review of relevant literature to better understand national contexts
- Eighteen in-person interviews with public and private entities involved in the energy transition
- Fourteen interviews with companies in the renewable energy and energy efficiency value chains
- An online survey to gather operational data from Tunisian renewable energy and energy efficiency companies, and to glean their perceptions of the obstacles to job recruitment
- Scans of eight job portals to extract data on job offers related to the energy transition.

[1] Here is a synthesis from the MIME : https://www.energiemines.gov.tn/fileadmin/docs-u1/synth%C3%A8se_strat%C3%A9gie_2035.pdf

HIGHER SKILLS ARE HARD TO FIND

The analysis tracks the jobs needed for each phase of the development and operation of renewable energy projects, from planning to decommissioning. The Tunisian renewable energy value chain creates the most jobs during (1) construction and commissioning; (2) operation and maintenance; and, to a lesser extent (3) equipment and assembly (RES4MED 2018). For energy efficiency, opportunities are present predominantly in the supply and installation of equipment and materials. However, given that large projects tend to be led by foreign companies, Tunisian companies, especially small and medium enterprises (SMEs), are mainly engaged in self-generation (which occurs when a user or a group of users produces energy locally using renewable energy sources) and other small-scale projects, or act as subcontractors for foreign groups.

The analysis also identified 14 strategic job profiles that are highly sought after for clean energy businesses in Tunisia. Examples include electrical engineers, architects, software engineers, thermal technicians, cable technicians, and draftsmen. Aside from specific technical skills, many so-called transversal skills cut across these profiles, ranging from the hard skills of data science, logistics, clean energy fundamentals, and language, to the soft skills of project and team management, organization, and environmental awareness.

INITIATIVES TO DEVELOP REQUIRED SKILLS REMAIN LIMITED IN SCOPE AND SCALE

Initiatives have been taken to enable companies and educators to inculcate the skills needed in the two sectors studied. Most remain limited, however, given the early stage of development of renewable energy and energy efficiency. The absence of a strategic body, such as a trade association, dedicated to the development of skills specific to the clean energy transition poses a risk of mismatch between what training programs provide and the actual skills required by companies.

The creation of specific plans has helped open the renewable energy market to the private sector and thus encouraged job creation. Nevertheless, Tunisian SMEs face challenges in participating in projects. They struggle to find workers with the skills needed to navigate administrative complexities and access finance. At present, most projects in an advanced stage of development are large projects dominated by large multinational companies and characterized by relatively low levels of local integration. At the same time, even though the Tunisian Electricity and Gas Company (STEG) is redirecting a portion of its activities toward renewable energy, its recruitment system (notably the frequency of hiring campaigns) has followed the same pace as its former activities, suggesting that the company is not responding as well as it could to the fulfillment of its skill needs. Training programs have been created to address this recruitment issue, but their implementation remains incomplete.

With respect to energy efficiency for buildings, companies perceive the lack of clear investment policies or incentives as a challenge to the development of a strong, dynamic market. For example, energy audits have been made mandatory every five years for public and private entities in the transport, industry, and building sectors (government and public buildings), but the obligation pertains only to the conduct of audits and not to the resulting efficiency measures. Companies therefore consider the market's growth prospects to be weak and do not wish to make major investments in training their employees. The low level of investment in training has the dual effect of weakening the sector's dynamism and maintaining a high rate of informal employment.

Finally, challenges to the inclusiveness of employment in the energy transition have been identified. Women play a limited role in the energy transition as they face gender barriers in training programs for low-skilled technical positions, as well as in high-skilled positions with companies. At the same time, the unemployment rate among young graduates continues to rise, even as their long-term prospects dwindle. Renewable energy and energy efficiency companies express two main concerns. First, young graduates lack practical education and skills for current jobs. Second, uncertainty about the sector's growth leads employers to prioritize versatile applicants capable of participating in the energy transition as well as working in conventional energy. Finally, for young people who have not developed the necessary skills as part of their initial training, professional retraining may be ruled out on grounds of high costs.

OPPORTUNITIES EXIST TO OPTIMIZE THE ENERGY TRANSITION'S JOB CREATION POTENTIAL

To address the abovementioned challenges, 14 key actions are recommended (table ES.1). Divided into three pillars, they can be summarized as follows:

PILLAR 1: ENHANCE COLLABORATION AMONG EDUCATORS, TRAINERS, AND COMPANIES

To mitigate the risk of skill mismatches, two sectoral competence councils specific to renewable energy and energy efficiency could be created. The councils could operate under the supervision of the Ministry of Industry, Mines and Energy, drawing inspiration from the practices of the council of postsecondary and federated research programs. The councils would be composed, respectively, of representatives of the education and training sector, and of representatives of companies operating in the relevant sectors. Within the councils, business representatives could detail their skill needs to educators, who could then adapt their curricula.

The councils would also offer an opportunity for the Ministry of Industry, Mines and Energy to adapt its renewable energy strategy and related job creation plan. In particular, the development of small-capacity renewable energy projects (projects undertaken under the self-generation scheme or projects of less than 1 megawatt) could be promoted. Such projects involve more local integration than do high-capacity projects, which are more difficult for Tunisian SMEs to access.

PILLAR 2: RAISE THE SKILLS OF THE WORKFORCE BY CREATING OR IMPROVING TRAINING PROGRAMS

The skills of the workforce can be raised by updating academic curricula and promoting continuing education and vocational training.

In the public sector, STEG's upskilling programs could be enhanced through two key measures. First, better oversight of training programs would ensure that the skills of all targeted employees are effectively improved. Second, the content of training could be based more closely on analyses of the company's prospective needs.

In the private sector, short-term vocational training facilitates effective upskilling and retraining. To ensure delivery of training of a quality that meets the needs of companies involved in the clean energy transition, the program accreditation standards of the National Agency for Energy Management (*l'Agence Nationale de Maitrise de l'Energie*, ANME) should be raised. Increasing the resources of the National Center for the Training

of Trainers and Training Engineering (CENAFFIF) could help it to prepare a larger number of trainers for the successful delivery of instructional programs for adults and recent graduates. Further, strengthening ANME's human resources would raise the quality of relevant surveys and samples and would allow the agency to ensure that certification requirements and mandatory training are aligned with market needs.

The government could intervene in two ways to help the workforce access short-term vocational training. First, it could increase (as necessary) the funding provided to training centers so that they have the resources to create new training courses or acquire licenses for access to online training. Second, with respect specifically to online courses, the government could work with training centers to facilitate payment in local currency, thereby enhancing access for local workers.

This study emphasizes two main skills that the job market currently lacks and that could be developed through short-term vocational training or initial training: (1) administrative and financial management of renewable energy projects, and (2) mastery of techniques and materials used in insulating buildings. Taking each in turn:

- Vocational courses could strengthen training in management of renewable energy projects. First, the scope of training for bank officers could be expanded to enhance understanding of the renewable energy and energy efficiency sectors. Second, specific training courses could be designed for companies operating in the sector and for postsecondary students specializing in renewable energy.

- The lack of knowledge about building insulation materials and techniques suggests a need to include them in academic curricula and to offer continuing education on these subjects. For example, curricula related to building construction and renovation could include these elements. Such curricula could be deemed equivalent to certification training if in the course of ANME's work the certification of companies and key personnel becomes mandatory for their involvement in the energy efficiency sector.

PILLAR 3: PROMOTE AN INCLUSIVE ENERGY TRANSITION THAT CREATES JOBS FOR YOUNG PEOPLE AND WOMEN

To help young graduates access employment in the sectors studied, initial training should be adapted to (1) integrate more practical learning and (2) enable students to develop versatile skills so they can participate either in the clean energy transition or in the conventional energy and building sectors, depending on where opportunities are available.

- Practical learning could be enhanced, in the short term, through partnerships between universities and training centers, allowing university students to benefit from practical training at reduced prices, to cite just one benefit. In the medium term, internships conducted during the academic year and apprenticeship programs could be better structured and more widely deployed, starting in the first years of specialized studies.

- To foster versatility, energy-related training programs could include at least one module on renewable energy and/or energy efficiency. Exposing students to these important areas would make them more versatile and adaptable in the evolving energy landscape. Such a module could take the form of a comprehensive open online course designed by the Ministry of Higher Education and Scientific Research, with content potentially defined by the sectoral competence councils. Such courses would target postsecondary students, who can access digital tools relatively easily.

Unemployed young graduates whose initial training did not prepare them for the clean energy transition could be provided specific training free of charge. The National Agency for Employment and Self-Employment could reimburse the cost of training young people if companies commit to hiring them afterward.

Finally, raising women's participation in the sectors examined here will require dismantling several gender barriers—in training, in companies, and in mindsets. Two solutions suggest themselves. First, communication campaigns could be conducted on television and through social networks to promote the idea of women working in the energy sector (including in technical and engineering positions). Such campaigns, properly funded, could play a decisive role in raising awareness about these professions among young female students and their families. Second, incentives could be devised to encourage the integration of women in training programs (for low-skilled technical positions) and in companies (for high-skilled positions). Such incentives, supported by monitoring indicators, could encourage companies and training actors to increase the share of women in the sector. The incentives could take the form of grants and mentoring sessions for female students, or benefits for companies that implement gender diversity policies.

The report's recommendations are presented by pillar in table ES.1.

Table ES.1 Summary of recommendations

Recommendation	Related challenge	Priority	Complexity
		Low: ● ○ ○ Moderate: ● ● ○ High: ● ● ●	
1 • Enhance collaboration among educators, trainers, and companies			
1.1 • Strengthen existing initiatives to identify and cultivate skills needed for the energy transition	In a few initiatives, educators and companies are already working together to identify and develop skills—for example, by co-designing academic programs, federating research programs, or forming a postsecondary council. However, these initiatives either are too narrow in scope (pilot projects) or are not specific to the clean energy transition, often resulting in a mismatch of skills.	● ● ●	● ● ●
1.2 • Encourage the development of small renewable energy projects within larger government plans to deploy renewable energy	While small projects in Tunisia involve many local companies (especially small and medium enterprises), large projects are less likely to create local jobs because of the preponderant involvement of foreign groups.	● ● ○	● ● ●
2 • Raise the skills of the workforce by creating or improving training programs			
2.1 • Strengthen STEG's upskilling programs to facilitate the company's transition to renewable energy	STEG has developed training programs to raise its employees' skills and their ability to operate in the renewable energy sector. However, these programs, which are aimed at compensating for the company's time-consuming recruitment process, suffer from flaws that hamper STEG's transition into renewable energy.	● ● ○	● ● ●
2.2 • Develop national programs to strengthen the skills of trainers working in ANME-accredited training centers	The companies interviewed for the study emphasized a need to make vocational training more rigorous, in part to help companies prevent damage to their reputation from the actions of poorly trained workers. However, ANME has insufficient human resources to thoroughly monitor the quality of training offered in its accredited training centers.	● ● ●	● ● ○
2.3 • Facilitate the workforce's access to short-term vocational training	Although short-term vocational training is effective in retraining workers, it often relies on foreign funding sources, such as development banks. The long-term sustainability of such funding is not assured. Requiring would-be trainees pay for online	● ● ●	● ● ○

	training in foreign currency often prevents them from making use of such resources.		
2.4 • Offer students of renewable energy and employees of companies in the sector training in administrative and financial management of projects	Renewable energy projects may be hindered by a shortage of administrative and financial capacity. The job market lacks applicants with skills in renewable energy as well as finance.	🔴🔴🔴	🟡🟡⚪
2.5 • Expand existing training for bank employees to cover the specific requirements of renewable energy projects	International donors (the World Bank, the German Agency for International Cooperation) and ANME have developed a program to train bank employees in the specific aspects of renewable energy. This initiative has not been extended to cover all banks, however. Meanwhile, the banking sector struggles to retain employees possessing dual technical and financial skills.	🔴🔴🔴	🟡🟡⚪
2.6 • Mandate that academic curricula include training in insulation materials and techniques used in building construction and renovation	Increasing the energy efficiency of buildings may be held back by (1) a deficit of skills in insulation materials and techniques, and (2) a lack of postsecondary programs in energy efficiency for buildings (especially with respect to building renovation).	🟡🟡⚪	🟡🟡⚪
3 • Promote an inclusive energy transition that creates jobs for young people and women			
3.1 • Enhance practical training components in academic curricula focused on renewable energy and energy efficiency	The companies interviewed for this study mentioned a lack of practical training (as opposed to theoretical training) as a major obstacle to recruiting qualified young graduates.	🔴🔴🔴	🟡🟡⚪
3.2 • Require at least one module on renewable energy and one on the energy efficiency of buildings in all energy training programs, especially those for senior technicians	Heterogeneous development of renewable energy and energy efficiency in buildings poses a dual unemployment risk for young graduates who lack versatility because they specialized either too soon or too late.	🟡🟡⚪	🟡🟡⚪
3.3 • Provide free and systematic training in renewable energy and energy efficiency of buildings to young people who are unemployed for a long period or are under CIVP contracts	Young graduates struggling to find employment may lack theoretical and practical skills specific to renewable energy and building energy efficiency. However, they often cannot afford the required training and certification.	🟡🟡⚪	🟡🟡⚪
3.4 • Create communication campaigns	Gender stereotypes and the lack of female representation and role models can	🟡🟡⚪	🟢⚪⚪

focusing on women working in the renewable energy and energy efficiency sectors, especially those in technical positions	discourage women from considering careers in renewable energy and energy efficiency for buildings, especially in technical and scientific roles.		
3.5 • Create incentive mechanisms to encourage women's participation in low-skilled technical training programs	Women's limited participation in low-skilled technical training programs means they are poorly represented in the sector and related positions.		
3.6 • Create incentive mechanisms to increase the share of women in highly qualified positions (including top management positions) in companies involved in renewable energy and energy efficiency in buildings	The low representation of women in highly qualified positions (including engineers) and top management is not explained by their low presence in the associated education systems. Instead, it can be attributed to companies lacking policies to attract and retain women.		

Note: ANME = National Agency for Energy Management; CIVP = Professional Life Integration Contract; STEG = Tunisian Electricity and Gas Company.

INTRODUCTION AND METHODOLOGY

Over the past two decades, Tunisia's energy balance deteriorated, primarily because of an increase in energy consumption in all economic sectors and a decline in national hydrocarbon production. The country's energy deficit rose from 7 percent in 2010 to 50 percent in 2019, increasing its dependence on fossil fuel imports. This dependence exerts a significant influence on the electricity generation sector, which is largely dominated by natural gas.

In response to the resulting energy security challenges and the country's vulnerability to volatile international energy prices, Tunisia has chosen to begin an energy transition process as part of its broader strategy for sustainable economic and social development. The energy transformation has two main pillars: diversifying the energy mix through greater renewable integration and increasing energy efficiency. The Tunisian Solar Plan of 2015 specified the objectives and implementation modalities resulting from this energy transition. These aimed to achieve a 30 percent share of renewables in the country's electricity mix by 2030 and 16 Mtoe (million tons of oil equivalent) in energy savings between 2015 and 2030. In February 2023, the Government of Tunisia published its 2035 energy strategy, raising its initial energy transition goals. The strategy foresees installed renewable energy capacity in the primary energy mix to increase to 18 percent and the share of renewable in the electricity production mix to increase to 50 percent in 2035. The country also aims to reduce primary energy intensity by at least 3.6 percent per year on average between 2021 and 2035.

This energy transition can generate crucial jobs for the country. The 2035 energy strategy provides for the creation of 70,000 additional jobs between 2021 and 2035.[2] This job creation represents an opportunity for social development in Tunisia, addressing concerns such as a high unemployment rate (16.8 percent in 2021), especially among young workers and graduates (40 percent and 30 percent, respectively). The unemployment rate is especially high in governorates with the greatest potential for renewable energy development, suggesting that massive deployment of renewable energy projects could contribute to regional social development.

The estimated job creation would result from increased labor utilization as the electricity sector moves away from a centralized, fossil-fuel-dependent supply chain toward augmented deployment of smaller, more privately owned renewable energy and energy efficiency infrastructure. Increased work intensity and associated technological changes can lead to job creation and transformation (changing the profile of skills required). However, the new jobs created through the energy transition will have to be weighed against the likely job losses in the conventional energy sector. Thus, effective management of the employment transition will be essential to ensure that the energy transition leads to net job creation and/or improved job quality, in turn boosting the country's economic development.

In this document, and with support from Ernst & Young and funding from the Energy Sector Management Assistance Program and the Climate Support Facility, the World Bank provides an analysis of the opportunities and challenges facing the Tunisian labor market in addressing evolving employment needs in the clean energy sector. The objective is to assist the country in formulating, adopting, and implementing appropriate policies, incentive systems, infrastructure, institutions, programs, and frameworks for human capital development in order to create an enabling environment for job creation and transformation in the context of clean energy transition.

[2] These are direct, indirect, and induced jobs in all sectors of the energy transition, including the biogas and green hydrogen sectors.

This report is structured as follows:

- Chapter 1 presents the characteristics of the labor market and the energy transition in Tunisia. It also covers the institutional framework, the national programs implemented, and the education sector's initiatives to facilitate employment creation and transitions as the world moves away from conventional energy. This chapter presents the context for the analysis provided in the next chapter.

- Chapter 2 first describes the employment impact of Tunisia's energy transition, by profile and stage of the value chain, to identify 14 strategic jobs for the sector. It then describes the skills required by the energy transition, including the fundamental skill sets needed for long-term success. Finally, these two assessments are reviewed based on the structure of detailed job descriptions summarized in this section and presented in detail in appendix 12.

- Chapter 3 provides a detailed analysis of the challenges and opportunities for job creation and transition. The analysis is linked to four elements: (1) the business environment and the structure of renewable energy and energy efficiency markets for buildings; (2) the institutional framework, national policies, and programs implemented, and the existing education system; (3) the development of a digital economy, technology, and innovation; and (4) human capital.

- Chapter 4 presents 14 recommendations to promote job creation in the context of the Tunisian energy transition. The recommendations result from a cross-analysis of the findings from chapters 3, 4, and 5.

- Chapter 5 concludes the study.

The study aims to identify the professional profiles and job skills required by the Tunisian energy transition, and suggests public policies to advance a job-enhancing clean energy transition. To this end, the jobs affected by the energy transition were analyzed, and the opportunities for and obstacles to new job creation as well as a shift away from conventional energy jobs were assessed. This research focused on the renewable energy and energy efficiency sectors, specifically (Ministry of Local Affairs and Environment 2021):

- **Renewable energy:** Photovoltaic solar energy and wind energy are the most prevalent options in the Tunisian Solar Plan (expected to constitute 85.6 percent of renewable energy installation capacities in 2030) and linked to almost all emissions reductions due to renewable energy, as outlined in the country's Nationally Determined Contribution.

- **Energy efficiency:** Improving energy efficiency in buildings over 2021–30 is expected to contribute one-quarter of Tunisia's projected emission reductions toward its Nationally Determined Contribution.

Several sources of information were chosen for this report:

- **Literature review:** A review of the available literature was conducted to better understand the national context of Tunisia's energy transition, the labor market, and the opportunities and challenges of creating and filling the requisite jobs. The literature used was identified through online searches and recommendations from local stakeholders consulted for this study. The main references used in this study are outlined in the footnotes of the relevant paragraphs.

- **Interviews with local stakeholders:** Fourteen public and private companies, 16 energy-related stakeholders, and 2 education-related organizations were interviewed (the list of interviews is presented in appendix 1). These interviews were conducted to gather stakeholders' points of view on the energy transition's employment impact. Qualitative information was obtained on the (1) jobs and skills required by the clean energy transition, (2) professional opportunities and challenges related to the transition, and (3) initiatives underway to address the identified challenges. These results were compared with those of the online survey and of scans of job portals. (Multiple job portals were scanned to collect data for a more comprehensive view of current job openings.) The interviews and scans were complemented by findings from the literature review.

- **Online survey of private companies:** An online survey was shared with Tunisian private energy efficiency and renewable energy companies between January 2023 and April 2023. The survey was shared with 626 recipients and received 127 responses (67 complete responses, 60 incomplete responses)—the typologies of the responding companies and the main results of the online survey are presented in appendix 5. Appendix 6 contains a list of the companies that consented to being contacted again by education-related stakeholders to discuss ways to align training provision with market demands. The survey yielded quantitative data to support or complement qualitative information obtained through the literature review and local stakeholder interviews. Specifically, quantitative information was obtained on the (1) challenges faced by companies to growing in their respective sectors; (2) strategic jobs and required skill sets; and (3) types of training that appear to be the most appropriate for addressing skill mismatches. This quantitative information was tested during the stakeholder interviews to ensure it was properly contextualized.

- **Job portal scans:** Eight job portals were scanned in January 2023, and data were extracted on all job offers related to the energy transition. These jobs were categorized and analyzed based on their type, the level of education required, years of experience required, the location of the position, and the skills required. The results of the analyses were compared with the online survey's results to identify strategic jobs and skills in the clean energy transition. They were then tested during the stakeholder interviews to validate the final results presented in this study.

- **Consultation workshops:** Two workshops were conducted with 40 key local stakeholders of the Tunisian energy transition. The stakeholders were presented with the main conclusions of the study, in which most of them had already participated (during interviews, for example). During these workshops, stakeholders were consulted on the opportunities and challenges related to a job-enhancing clean energy transition, and on both the recommendations of public policies suggested in this report, as well as their own suggestions.

Except where otherwise indicated, the information presented in this report was obtained from the interviews, surveys, scans, and consultations described above. Insights gathered from the literature review are cited in the text and footnotes.

1. COUNTRY CONTEXT

This chapter opens with a review of Tunisia's labor market before examining the status of its clean energy transition. It concludes with a close look at the programs, initiatives, and institutions that will shape the country's clean energy transition.

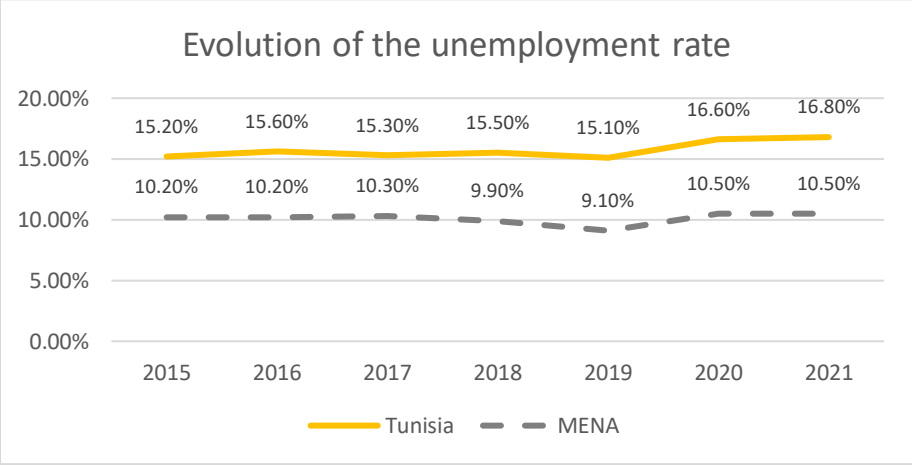
THE TUNISIAN LABOR MARKET

TRENDS IN THE LABOR FORCE AND UNEMPLOYMENT RATE

According to Tunisia's National Institute of Statistics (2021a), Tunisia had an active population (all the employed and unemployed people who would normally work and earn money) of 4.124 million at the end of 2022, or 46.5 percent of the working-age population (over 15 years old), of which 69 percent were men and 31 percent were women.

A study conducted by the Tunisian Institute of Competitiveness and Quantitative Studies (ITCEQ 2022) shows that the Tunisian economy does not generate enough jobs to absorb the growing workforce. Between 2006 and 2020, employment increased by 13.3 percent, compared to a 20.9 percent increase in the active population over the same period. This gap explains the increase of the unemployment rate, which was 16.8 percent in 2021. This rate has increased significantly following the deterioration of the country's economic situation, influenced by two main factors: the 2011 Tunisian revolution and the COVID-19 crisis, after which the unemployment rate rose from 15.2 percent to 16.8 percent (between 2019 and 2021). This rate is one of the highest in the Middle East and North Africa region (figure 1.1).

Figure 1.1 Evolution of the unemployment rate, 2015–21



Source: World Bank 2022.
Note: MENA = Middle East and North Africa.

Unemployment is also qualified as "youth unemployment," since it mainly affects the 15–24 age group: at the end of 2022, 38.8 percent of the unemployed working population belonged to the 15–24 age group (National Institute of Statistics 2022).

IMPACT OF UNEMPLOYMENT ON GRADUATES

Tunisian unemployment is also classified as "categorical" because it particularly affects postsecondary graduates, ages 20–29 years.

24 percent
of postsecondary graduates are unemployed

An ITCEQ study has shown a correlation between education and unemployment: the higher the level of education, the greater the risk of remaining unemployed. The unemployment rate for postsecondary graduates rose sharply between 2007 and 2020, reaching 26.6 percent at the end of 2020. It fluctuated slightly over the following two years, reaching 24 percent at the end of 2022. Unemployment affects 15.7 percent of male graduates and 30.8 percent of female graduates (National Institute of Statistics 2022).

The composition of the unemployed population based on qualification type shows that some training courses are not adequately aligned with the needs of the Tunisian economy. For example, people with a background in sciences account for 33.3 percent of unemployed postsecondary graduates (National Institute of Statistics 2022). In the energy sector, these courses produce graduates with generic skills, who require additional training to be able to break into the labor market.

Today, the public sector—which used to be the largest employer of graduates from these fields—is unable to absorb the growing flow of graduates. This observation also holds in the energy sector, where the Ministry of Industry, Mines and Energy (MIME) as well as the organizations under its supervision (including the Tunisian Electricity and Gas Company [STEG]) were the first employers.

On the other hand, the lack of effective technical education, the lack of appeal of vocational training for young people, and the absence of a national retraining program (ITCEQ 2022) are all factors contributing to the growth of unemployment, especially among young graduates.

IMPACT OF UNEMPLOYMENT ON WOMEN

Although women outnumber men among postsecondary students and graduates, unemployment rates by gender show a reverse trend.

The female unemployment rate is twice that of men

The female unemployment rate is twice that of men, at 20.1 percent and 12.9 percent, respectively (ITCEQ 2022). Statistically, this is explained by a structural shift in the labor force since 2006, which is reflected in an increase in the number of women in the workforce. The gradual entry of women into the workforce has raised the demand for jobs, and the low employability of women has resulted in widespread unemployment among them.

Part of this unemployment is attributable to gender discrimination in access to employment, particularly in technical fields. For example, a study by the National Agency for Energy Management (ANME) demonstrated misperceptions of women's entry and retention barriers in the renewable energy and energy efficiency sectors (ANME and GIZ 2019).

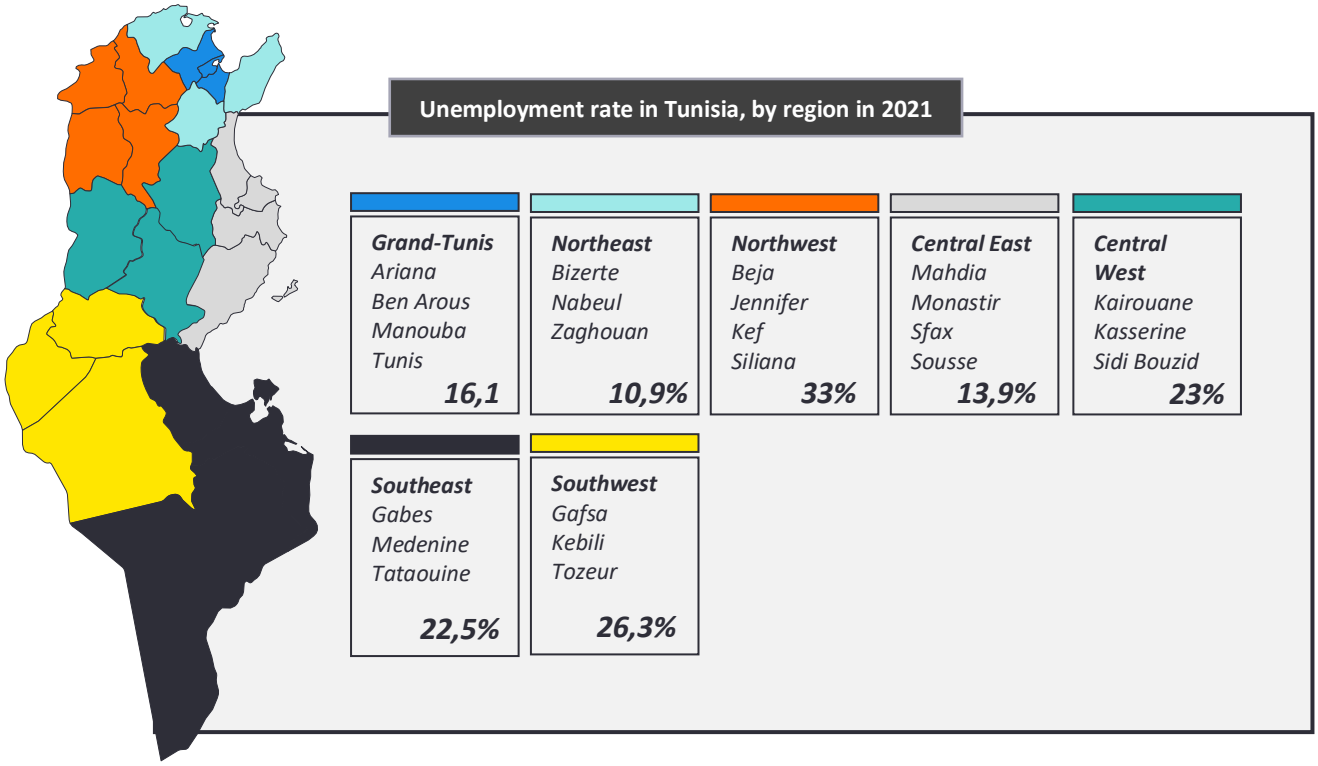
To address this issue, feminist organizations and civil society have made advocacy efforts, which resulted in a pioneering text on eliminating all forms of discrimination against women, including economic and employment,

as well as gender-based violence. This text comes in addition to the guarantees provided for by the Constitution (Article 20).

IMPACT OF UNEMPLOYMENT BY REGION

Unemployment rates vary widely across Tunisia's regions (figure 1.2). The unemployment rate is highest in the northwest and southwest, at 33 percent and 26.3 percent, respectively (National Institute of Statistics 2021b), and particularly low in greater Tunis and the coastal areas. This disparity can be explained by a lack of investment, and inadequate transport infrastructure in the central parts of the country.

Figure 1.2 Distribution of the unemployment rate by region



Source: National Institute of Statistics 2021b.
Note: Tunisia is divided into 24 units called governorates (Wilayah). The governorates, named after their capital city, are Ariana, Béja, Ben Arous, Bizerte, Gabès, Gafsa, Jendouba, Kairouan, Kasserine, Kebili, Kef, Mahdia, Manouba, Medenine, Monastir, Nabeul, Sfax, Sidi Bouzid, Siliana, Sousse, Tataouine, Tozeur, Tunis, and Zaghouan. The "regions" shown here have no formal administrative status.

The high unemployment rates in the northwest, and particularly in the Siliana governorate, also stem from unbalanced economic activity and the absence of a decentralization policy since independence (ONEQ 2015), resulting in a heterogeneous concentration of economic actors in the country. Greater Tunis is home to over 35 percent of Tunisian companies, followed by the northeast (25 percent); the southeast, the central west, and the northwest (slightly above 7 percent each); and, finally, the southwest (3.6 percent) (National Institute of Statistics 2021b).

Unemployment rates are lower in the "regions of female employment" (regions with a prevalence of seasonal sectors—such as textiles and tourism—often characterized by precarious jobs). These include the central east region (governorates of Sousse and Monastir), Cap Bon (governorate of Nabeul), and the district of Tunis. The southwest and central west regions have the highest female unemployment rates, 26–48 percent in 2019 (La Presse Tunisie 2019).

WORKING CONDITIONS

Tunisia has made considerable progress in terms of labor legislation, particularly because of the historically powerful trade union movement in the country. Since the 1970s, there has been a culture of social dialogue at the government level and within companies (with collective agreements by economic sectors). Tunisia now has rather advanced labor legislation consistent with international standards. For example:

- Tunisia is a pioneer in the region in the establishment of a social security system (since the 1960s), allowing 85 percent of its active population to have social coverage (ILO 2018).
- The Tunisian labor code offers several mechanisms for the protection of workers and the resolution of labor disputes (minimum wage, labor inspections, right to compensation, etc.). This makes it possible to attract investors concerned about their social responsibility and the compliance of their employees' working conditions with international standards and conventions.
- The work week in Tunisia is capped at 48 hours (Article 79 of the Labor Code) and can be as low as 40 hours based on the collective agreements of each sector.
- Tunisia is now a signatory to 64 International Labor Organization Conventions (including nine fundamental ones).

Tunisia has also implemented several employment incentives to support the employability of young graduates and the unemployed. The main associated programs are as follows:

- **The Professional Life Integration Contract (CIVP):** This allows young graduates to obtain a bonus and the companies that hire them to benefit from a tax exemption and social security contributions.
- **The "Dignity Contract" Program (KARAMA):** This program aims to encourage private companies to recruit first-time job seekers with postsecondary degrees and improve their supervision. It pays part of the beneficiary's salary and also makes a contribution toward the employer's social security and tax contributions.

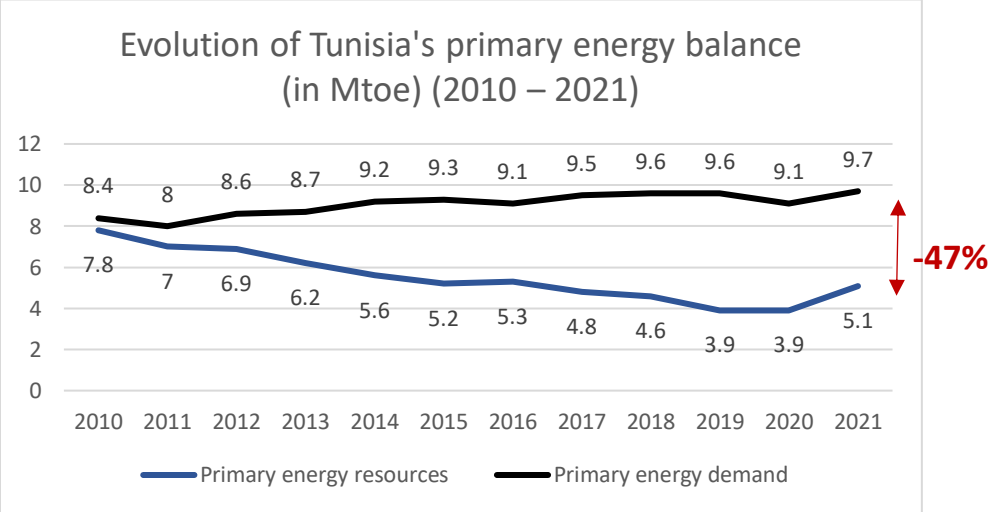
OVERVIEW OF THE TUNISIAN ENERGY MARKET

PRIMARY ENERGY BALANCE

Tunisia meets its energy needs primarily with natural gas, at 53 percent of annual demand. Natural gas is mostly consumed in electricity production, at 74 percent of annual consumption.

Tunisia's energy market is characterized by a significant decline in primary energy resources and a sharp increase in energy demand. This resulted in a deficit of 47 percent in the primary energy balance in 2021. The deterioration of the energy balance has accelerated in the years between 2010 and 2020 (figure 1.3).

Figure 1.3 Evolution of Tunisia's primary energy balance, 2010–21 (Mtoe)



Source: MIME 2022d.

Tunisia's energy balance has changed drastically over the past 20 years. Between 1990 and 2015, a decline in oil and gas resources (following the natural decline of major deposits and the absence of new discoveries) and a growth in energy demand resulted in Tunisia becoming a net energy importer instead of exporter.

Aside from limited domestic resources, the energy deficit has been compounded by other social and political factors:

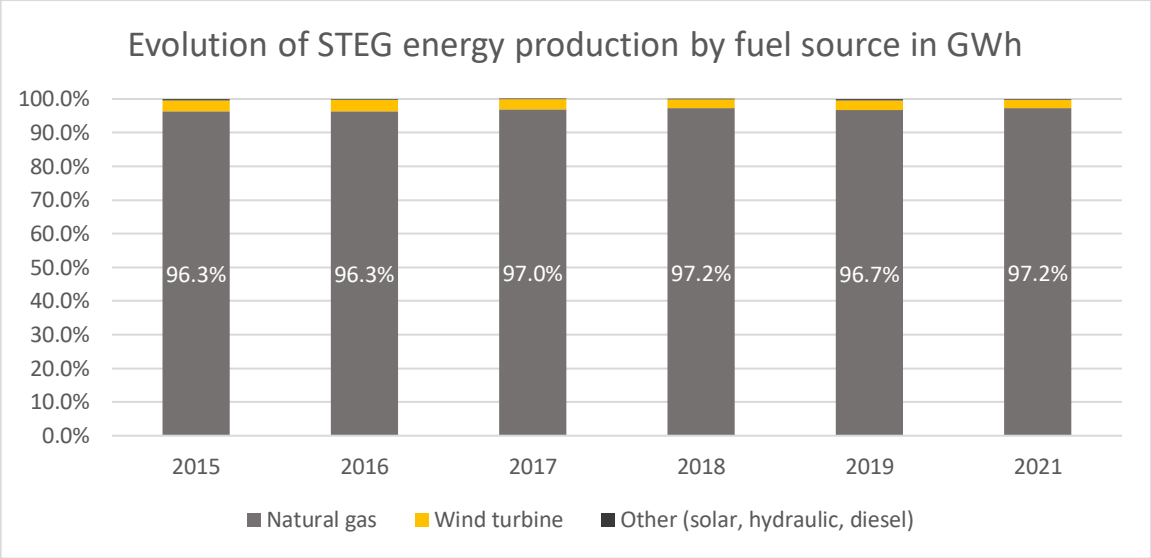
- After 2011, southern Tunisia saw several social movements, which caused significant disruptions in national energy production. Strikes and blockades of gas production in the south broke out, threatening pipelines, pumping station and production transmission circuits.
- The number of valid exploration permits has reduced significantly (52 in 2010, compared to 19 in 2021). This has led to a decline in exploration activity, and renewal of hydrocarbon reserves has come to a standstill.

ELECTRICITY SECTOR

STEG, a non-administrative public company, is the main electricity producer in Tunisia. It accounted for 84 percent of national production in 2021, compared with 15 percent among independent electricity producers.

Natural gas accounts for 97.2 percent of total electricity generation. But despite the strong potential of renewable energy, renewable sources accounted for less than 3 percent of electricity production in 2021 (2.5 percent from wind and about 0.5 percent from hydropower and solar) (figure 1.4) (STEG 2022).

Figure 1.4 Evolution of STEG's energy production by fuel source (GWh)



Source: STEG 2022.
Note: STEG = Tunisian Electricity and Gas Company.

The 2015 Law on Electricity Production from Renewable Energy Sources provided for three project implementations schemes:

- The **self-production scheme**, which aims to boost market growth by involving various actors across the renewable energy value chain, especially solar photovoltaic (PV) actors (design offices, engineering offices, equipment suppliers, unit installers, component manufacturers, etc.).
- The **authorization scheme**, which aims to prepare Tunisian entrepreneurs to develop their technical, financial, and legal skills and expertise through partnerships to be created with international developers participating in projects related to this scheme.
- The **concession scheme**, expected to ensure a significant contribution of renewable energies to the electricity mix, through the installation of high production capacities.

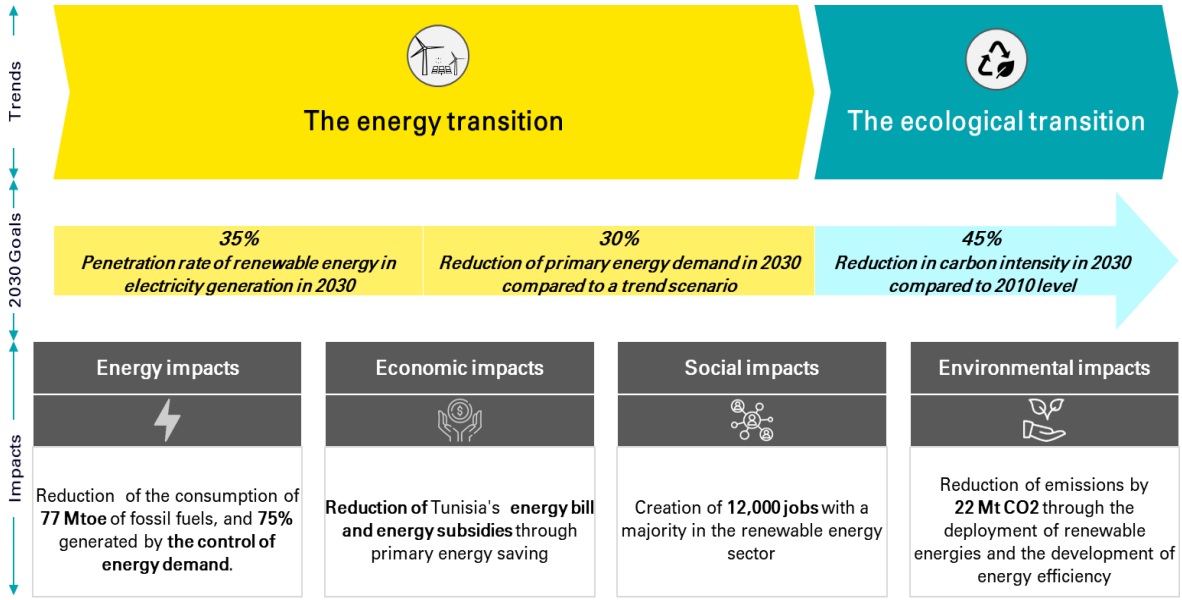
THE 2035 NATIONAL ENERGY MANAGEMENT STRATEGY

To address the energy balance deficit, a national energy management strategy was developed in 2014, and updated in 2023. The strategy mainly focuses on the rationalization of primary energy consumption and the development of renewable energies.

These strategic objectives have been translated into detailed projects focusing on technological innovations and renewable energy deployment. To ensure the success of these projects, the national energy management strategy has emphasized the need to develop skills to ensure the effective use of new technologies and strengthen research and development (R&D) activities.

The update of the national energy management strategy (figure 1.5) has revised upward the share of renewable energy types in the electricity mix (35 percent instead of 30 percent initially planned)—that is, a capacity of 4,850 megawatts (MW) in 2030 and 8,350 MW in 2035, and an investment of around Tunisian dinars (TD) 55 billion. The updated strategy is expected to create about 70,000 cumulative jobs between 2021 and 2035, mainly in renewable energy projects. This represents about 20 times more job creation than in 2015, when energy efficiency and renewable energy programs created nearly 3,000 direct jobs in the country (GIZ 2016).

Figure 1.5 Tunisia's 2035 National Energy Management Strategy



Source: MIME 2022b.
Note: $MtCO_2$ = million tons of carbon dioxide; Mtoe = million tons of oil equivalent.

MAIN ACHIEVEMENTS AND ONGOING PROJECTS IN THE CLEAN ENERGY TRANSITION

ACHIEVEMENTS AND PROJECTS IN THE RENEWABLE ENERGY SECTOR

Several ambitious programs have paved the way for the growth of renewable energy in Tunisia.

The PROSOL program, which started in 2005 and involved many stakeholders, aimed to create a sustainable market for the development of solar thermal technology in the country. The project is being supported by a financing mechanism, which combines a subsidy through the Energy Transition Fund (ETF) and a grant of credits repayable through the STEG bill over a period of seven years. In addition, a communication plan has been put in place to inform and sensitize the population to the importance of solar energy. This dynamic made it possible to attract nearly 50 solar water heater suppliers, reach more than 1,200 installers over the entire program period, and create an industrial ecosystem composed of seven local manufacturers and assemblers in 2016 (mainly microenterprises). Around 68 percent of the market was served by the local industry, with a strong competitive dynamic.

The PROSOL program has also supported the development of grid-connected PV, which began in 2010 with the "PROSOL Elec" program. The project encourages individuals, businesses, and communities connected to the low-voltage grid to install PV systems to generate electricity from solar energy. PROSOL Elec offers financial incentives in the form of grants and refundable credits to help cover the investment costs of solar PV installations. The PROSOL Elec project also offers awareness-raising programs to inform and educate the population about the benefits of solar energy and how it can be used to produce clean and renewable electricity. This program has made it possible to create an industrial ecosystem of five manufacturers and more than 200 installers (GIZ 2016).

At the ANME level (GIZ 2016), several projects have been launched with a view to implementing Smart governorates:

- A Smart City project to supply renewable energy to underserved families through several projects
- A project to implement PV panels on mosques and replace existing lamps with LED (light-emitting diode) lamps (Governorate of Tozeur)
- A project for ACTE (Alliances of Municipalities for the Energy Transition): Some municipalities have already initiated a program for PV panel installation or revision of governorates' urban plans.

At the same time, the MIME launched new renewable energy projects under three renewable energy production schemes in the period 2022–25 (figure 1.6) (MIME 2022a). As an example, in early 2023, it set up a call for tenders for a 1,700 MW project (concession scheme), which aims at creating a new dynamic in the national market and encouraging the influx of investments toward projects of this type.

Figure 1.6 Capacity goals by scheme

	Self-production regime	Authorisation scheme	Concession scheme
	500 MW	140 MW	1800 MW
Total capacity	Of which: 350 MW PV; 150 MW wind	Mainly PV	Of which: 1200 MW PV; 600 MW wind

Source: Original compilation.
Note: MW = megawatt; PV = photovoltaic.

A detailed breakdown of renewable energy projects by year is presented in appendix 8. The actual implementation of these projects has however been quite slow, due to barriers of various kinds: technical, governance, regulatory, economic, and financial. In chapter 4 of this report, recommendations are suggested to ensure stronger private sector participation and better implementation of renewable energy projects.

ACHIEVEMENTS AND PROGRAMS IN THE ENERGY EFFICIENCY OF BUILDINGS

Tunisia is developing several ambitious programs to enhance energy efficiency in buildings and achieve its objectives linked to energy management and decarbonization.

The Green Building initiative, launched by the Tunisian Green Building Council in coordination with ANME and other institutional actors, aims to support sustainable construction and planning through several measures:

- The introduction of regulations for new buildings to comply with minimum technical specifications for greater energy efficiency and reduced heating and cooling need.
- The implementation of energy audits for new and existing buildings, the latter being major energy consumers.
- The preparation of a label for buildings, in accordance with international practices (e.g., LEAD and HQE labels in France, DREAM label in England) and the establishment of a subsidy system through the FTE to financially help entrepreneurs join this program. The cost of accompaniment is covered at a rate of 70 percent, capped at TD 70,000. In other words, developers seeking to improve their building energy efficiency will benefit from subsidies at the level of the additional investment cost: the state bears 30 percent of the additional investment costs, in order to encourage investors to transition to high-energy-performance buildings. However, the cost of monitoring labels is not adapted to the types of existing buildings: they would affect only 10 percent of them.
- The obligation of demonstrating energy performance on an international scale (from 1 to 8), to encourage entrepreneurs to move toward optimal performance (close to 1) with a label.
- The Energy Certification Program for Household Appliances (initiated by ANME), which aims to introduce mandatory energy labeling of appliances, to inform households about the energy performance of the appliances they intend to buy, and to gradually eliminate energy-intensive equipment from the market (Class 4 and above).
- The creation of energy manager positions. The government has decided that all boards of directors (of public and private companies) should have someone in charge of monitoring energy efficiency. This energy manager would be responsible for monitoring energy consumption and implementing energy optimization measures. Although specific training for this position should be required, energy managers have not always benefited from the appropriate training.

JOB CREATION IN THE CONTEXT OF THE CLEAN ENERGY TRANSITION: INSTITUTIONS, PROGRAMS, AND INITIATIVES

INSTITUTIONAL AND REGULATORY FRAMEWORK FOR THE CLEAN ENERGY TRANSITION

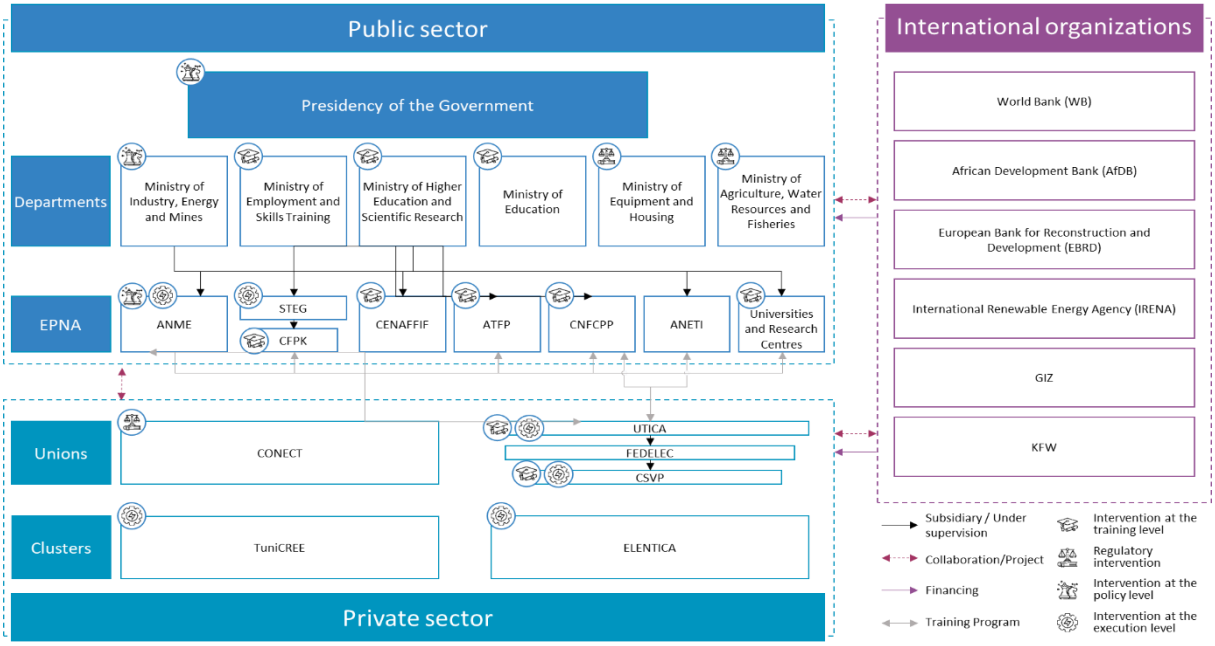
To achieve its strategic objectives, the Tunisian government has structured an institutional framework that brings together stakeholders with different roles and levels of intervention. These stakeholders are divided into three categories—the public sector, the private sector, and international organizations (figure 1.7).

Public actors are mainly ministries and public institutions of a non-administrative nature (EPNA). The driving force behind this transition is MIME, which is responsible for electricity infrastructure; planning and implementing national policies on electricity, energy efficiency, and renewable energy; and regulatory oversight.

Private sector actors are trade unions and economic clusters representing private companies operating in different parts of the energy value chain. They are the largest contributors to job creation in the energy sector.

International organizations comprise donors and other financial institutions. They provide development support to the public and private sectors through funding and support projects.

Figure 1.7 Mapping of key players in the renewable energy and energy efficiency sectors



Source: Original Compilation

Note: ANETI = National Agency for Employment and Self-Employment; ANME = National Agency for Energy Management; ATFP = Tunisian Agency of Professional Training; CENAFFIF = National Center for the Training of Trainers and Training Engineering; CFPK = STEG's Kheldia Training and Development Centre; CNFCPP = National Center for Continuing Education and Professional Promotion; CONECT = Confederation of Citizen Enterprises of Tunisia; CSVP = Trade Union Chamber of Photovoltaics of Tunisia; ELENTICA = Electronic Industries Cluster; EPNA = public institutions of a nonadministrative character; FEDELEC = National Federation of Electricity and Electronics; GIZ = German Agency for International Cooperation; STEG = Tunisian Electricity and Gas Company; TuniCREE = Tunisian Cluster for Renewable Energy and Energy Efficiency; UTICA = Tunisian Union of Industry, Commerce and Handicrafts

Collaboration among these actors can take several forms.

Public actors, including MIME, play a key role in the growth of the renewable energy and energy efficiency sectors. They are responsible for defining and implementing public policies and regulations. They also provide financial incentives and/or subsidies to encourage the installation of renewable energy systems and the implementation of energy efficiency measures.

Public actors are also in charge of cross-stakeholder coordination in the implementation and monitoring of these public policies.

The private sector includes about 25,000 industrial companies that operate in several segments of the renewable energy and energy efficiency value chains (studies, energy audits, and construction and installation of production and distribution infrastructures from different sources). The private sector is represented by economic clusters and trade unions that support renewable energy and energy efficiency strategies and programs. Private sector actors also contribute to the creation and update of training programs and curricula, especially for nonmanagers, in collaboration with public actors and international organizations. Trade unions are engaged in reshaping the legal, regulatory, and economic framework in the clean energy transition. They bring together a significant number of companies in the sector. For example, the Photovoltaic Trade Association (CSPV) currently brings together 540 companies registered by ANME. Private actors can benefit from government programs, as well as from incentives and grants from development banks to encourage investments in Tunisia's renewable energy and energy efficiency sectors.

International organizations support the growth of the renewable energy and energy efficiency sectors in several ways. They fund projects through loans and grants, offer technical advice and training services for local institutions and/or businesses, and support the establishment and/or update of policies and frameworks that encourage private investment.

Alongside its institutional framework, Tunisia has developed a legislative and regulatory framework providing laws and decrees to govern the entire energy sector. Renewable energy technologies are at the heart of this regulatory framework.

In addition to the regulatory framework, Tunisia has implemented several incentive mechanisms for investment in energy efficiency and renewable energy projects supported by notable technical and financial partners.

These laws and incentive mechanisms are detailed in appendix 7.

TRAINING IN THE ENERGY SECTOR

In Tunisia, training programs are mainly managed by:

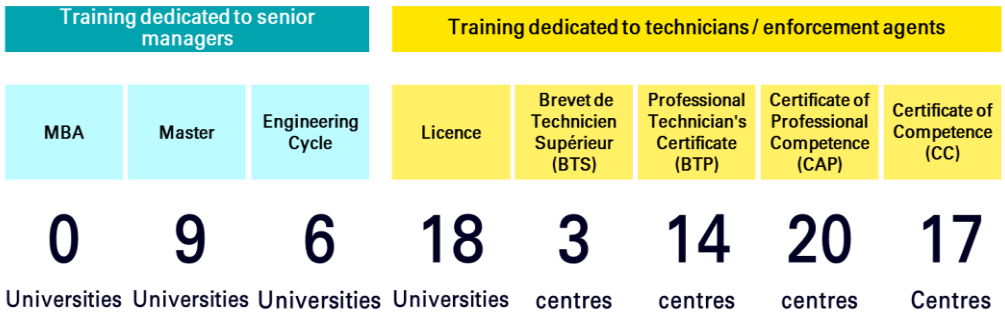
- The Ministry of Higher Education and Scientific Research, which focuses on early executive training
- The Ministry of Employment and Vocational Training, which focuses on the training of nonmanagers and vocational education.

In the energy sector, the Tunisian Union of Industry, Commerce and Handicrafts (UTICA) also contributes strongly to initial and vocational training on energy transition technologies, in particular through the following programs:

- Certifications and co-certifications between public/private actors
- Co-constructed licenses
- Programs with double or triple degrees in engineering.

Tunisia's energy sector thus benefits from a multitude of training programs targeting managers and technicians (figure 1.8).

Figure 1.8 Training opportunities in the energy sector



Source: GIZ 2011.

TRAINING AND EDUCATION SECTOR—INITIAL TRAINING

Initial training equips people with the skills and knowledge needed to work in a defined occupational sector. It is managed by mostly public institutions; only 10 percent of graduates are from private institutions.

Initial training—*managerial*. At the postsecondary level, a 2022 census by the German Agency for International Cooperation (GIZ) identified 3,605 specialties for the 2021–22 school year, which were divided between public institutions (2,814 specialties) and private institutions (791 specialties), and 126 of which relate to the renewable energy and energy efficiency sectors (GIZ 2022).

The same study included a census of national public and private institutions awarding diplomas in the fields of renewable energy and energy efficiency. The following diplomas were identified:

- Engineering degrees: 32 specialties (leading to distinct degrees) in 10 public engineering schools and 15 private schools
- Research master's degrees: 27 specialties (leading to distinct degrees) in 17 public institutions
- Professional master's degrees: 28 specialties (leading to distinct degrees) in 18 public and 5 private institutions (GIZ 2022).

Initial training—*nonmanagerial*. The Ministry of Employment and Vocational Training provides basic training for nonmanagers in 112 locations at institutions and centers under its supervision.

Relatively few training courses are dedicated to the field of energy. However, training in certain fields such as electricity and electronics; general mechanics and metal construction; buildings, public works, and appendix; and transport, operation, and maintenance of vehicles and machinery has general scientific bases that are shared with the energy sector. All graduates of these sectors represented 60 percent of the initial training graduates in 2017.

As part of the restructuring of vocational training centers, a set of specializations has been programed in the field of energy management and renewable energies:

- Senior technician in home automation at the Training and Professional Training Center of Kef
- Senior technician in solar system installation at the Training and Professional Training Center of Douz.

Within the framework of Tunisian-Swiss cooperation, two specializations have been created in the field of energy efficiency:

- Energy efficiency of industrial electrical installations, at the sectoral training center in electronic and electrical industries in Tunisia
- Energy efficiency of electrical installations of residential facilities, at the sectoral training center in construction and its subsidiaries in Ibn Sina.

Based on the number of energy-related courses in each stream, estimates made in the context of this report indicate that that there were 9,302 graduates with an energy-related specialty in 2017, or 31 percent of the total graduates in initial training.

VOCATIONAL TRAINING

Vocational training is one of the pillars of the human resource development system due to its important role in workforce upskilling from a technological and organizational point of view. In Tunisia, training is provided by institutions under the supervision of the Ministry of Employment and Vocational Training; by companies; and by several organizations such as the International Center for Technologies and Environment of Tunis (CITET), the Tunisian-German Chamber of Industry and Commerce (AHK), and ANME, which offer programs focused on renewable energy and energy efficiency.

The Ministry of Employment and Vocational Training and the institutions under its supervision have set up training centers.

Within the framework of Tunisian-German cooperation, three PV vocational training units have been created:

- Installation, operation, and maintenance of network-connected PV systems—PVR (grid-connected photovoltaics)
- Installation, operation, and maintenance of PV systems at an isolated site—PVS (on-site photovoltaics)
- Installation, operation, and maintenance of solar pumps.

The same framework supports five sectoral centers:

- Sectoral training center for electricity supply to and maintenance of biomedical equipment in Tunisia
- Sectoral energy training center in Kairouan
- Center for training and the promotion of self-employment in El Hamma
- Training and vocational training center in Kebili
- Sectoral energy training center in Djerba.

Two units have been installed within the Jendouba training center:

- Installation, operation, and maintenance of grid-connected PV installations—PVR
- Installation, operation, and maintenance of PV installations at an isolated site—PVS.

Twenty-three centers approved by ANME (in coordination with the private sector, including UTICA) are providing additional training in renewable energy and energy efficiency. According to UTICA, the training aims to train 5,000 learners, 80 percent of whom learn about low-voltage technologies.

An initiative to establish an integrated African center of excellence in renewable energy in Tunisia has been announced. This center will train and develop skills in support of the new 2035 energy strategy. The initiative is still at a preliminary stage: The proposal to launch the center was first presented at the eighth Tokyo International Conference on African Development "TICAD 8," in August 2022. This initiative was discussed again at the end of March 2023.

Tunisia aims to promote the sharing of these skills within the country as well as across the African continent, in turn becoming a hub for renewable energy training at the regional level.

Ad hoc training programs have also been created in coordination with international organizations and donors (e.g., the GIZ "Energy Manager" training module). Some examples are presented in table 1.1.

Table 1.1 Examples of training provided by support organizations.

	Formation	Outcome (affected population)
Technical cooperation	Energy Efficiency Training	~15 participants representing key stakeholders in the energy efficiency sector
	Training courses on energy management: Training Energy Manager	~50 participants
International organizations	Training of man-energy by CITET	11 trainers, 408 energy managers and 27 central energy managers.
	Formation of photovoltaic solar energy connected to the grid by the CFPK.	~100 engineers and technicians, belonging to STEG and companies in the field of renewable energies.
	Training on the different fields and activities of energy management by ANME	> 400 managers, engineers and technicians

Source: Ministry of Skills Training and Employment 2020.
Note: ANME = National Agency for Energy Management; CFPK = STEG's Kheldia Training and Development Centre; CITET = International Center for Technology and Environment of Tunis; STEG = Tunisian Electricity and Gas Company.

Box 1.1 highlights the contributions of other organizations that, while involved in R&D, are also crucial in vocational education.

Box 1.1 Case study: CRTEn

The Technopole de Borj-Cédria holds strong potential in research and development (R&D), training, and technical education. It promotes the creation or growth of innovative companies. It is at the heart of the national strategy for the promotion of renewable energies, sustainable development, and materials.

Technopole de Borj-Cédria has four R&D centers spread over 88 hectares. It brings together 450 permanent researchers as well as 600 PhDs and postdoctoral positions. The center has a substantial budget, TD 4 billion per year, which supports its techno-scientific production: it is responsible for 16 percent of scientific production in Tunisia.

The Center for Energy Research and Technologies (CRTEn) advances R&D in energy, renewable energy technologies, and energy transition, and has two objectives:

- Strengthening energy efficiency and minimizing energy expenditure in Tunisia,
- Valuing scientific production to create job-generating companies in the renewable energy sector.

The CRTEn advances R&D through, for example, its PV Laboratory (LPV), which works on enhancing the performance of photovoltaic cells through nanotechnology, and the LaNSER laboratory, which is dedicated to nanomaterials and systems for renewable energy (derived from the LPV) and conducts research on nanomaterials for photovoltaic and photocatalytic applications and sensor development for applications.

In 2023, the CRTEn decided to strengthen the technology transfer component, through the training office Energy Training & Consulting CRTEn, a laboratory dedicated to research and training in renewable energies:

- Offer: About 30 training courses, delivered by CRTEn staff, and, if necessary, external experts. Customized training can also be offered at customers' request.
- Training type by intended recipient:
    - Specialized training for design offices: Certified/accredited training on renewable energy (PV, wind, etc.). The training is necessary to obtain the design office's approval.
    - Specialized and/or additional training for employees of an existing company and for entrepreneurs wishing to set up their own projects: Undergoing training certified by the National Agency for Energy Management (ANME) is necessary to obtain the necessary assets. The training centers are authorized by ANME to conduct this training.
    - Basic training for engineers under training: Engineering schools may request training for technical students and engineers in the final year of university studies, and for students who are specialized in renewable energies (electrical engineering, renewable energies, etc.).
- Modalities: Theoretical studies, with practical examination at the end
- Duration: 2–3 weeks, with seven hours of training per day
- Most requested training courses:
    - PV installation
    - Energy management
    - Geothermal energy

- Energy recovery from waste

The CRTEn also works for the adoption and innovative application of existing technologies (such as the use of PV in agriculture in Tunisia), or the development of new technologies and a technology ecosystem (such as green hydrogen).

TRAINING OF GOVERNMENT ADMINISTRATION EXECUTIVES

The National School of Administration of Tunis (ENA) conducts initial and vocational training for senior administrative officials (ENA 2022). ENA's intervention programs can be summarized as follows:

- Initial training (graduate cycle): Equip executives with the skills to exercise leadership functions and promote capacity building. Designed for executives with a master's degree or engineers of certain specialties.
- Vocational training: Improve civil servants' skills through continuous training courses to aid in their promotion to higher grades, as well as short on-demand training courses.
- Director training (administrative leadership): Develop senior administrative managers' skills in leadership- and management-related areas.
- Good governance training: Strengthen the capabilities of administrative officials in the public and private sectors and civil society.

ENA's training programs do not consider the notions of energy and ecological transition. However, ENA has expressed its commitment to sustainable development through the launch of a project to implement an RSO/ISO 26000 approach, which addresses various aspects of corporate social responsibility (CSR). The project includes training schools' managers and raising awareness of CSR concepts among students.

2. CHARACTERISTICS OF JOBS AFFECTED BY THE CLEAN ENERGY TRANSITION

POSITIONS AFFECTED BY THE CLEAN ENERGY TRANSITION

JOB CREATION POTENTIAL IN THE RENEWABLE ENERGY SECTOR

SECTOR ANALYSIS

The growth of renewable energy has paved the way for new job opportunities in the Tunisian energy sector. Until now, the Tunisian Electricity and Gas Company (STEG) had a monopoly over the electricity sector's value chain. But with renewables' expansion, the sector can gradually decentralize, involving more local private companies in job creation, as described later in this report. The International Renewable Energy Agency estimates that the solar photovoltaic and wind sectors each created 200 direct and indirect jobs in 2021 (IRENA 2021a). The *Tunisian Solar Plan* anticipated the creation of about 12,000 jobs by 2030, and the new 2035 energy strategy (which includes aspects other than renewable energy and energy efficiency, such as green hydrogen) targets the creation of 70,000 additional jobs (direct, indirect, and induced jobs) cumulatively between 2021 and 2035. This estimate represents about 20 times more job creation compared with 2015, at the end of which the country recorded nearly 3,000 direct jobs (GIZ 2016) created by energy efficiency and renewable energy programs.

There is a strong challenge to train STEG employees working in conventional electricity on renewable energy topics.

Renewable energy expansion is not expected to significantly affect jobs in the conventional energy sector. Total electricity production is increasing in Tunisia (+2 percent per year on average between 2010 and 2021 [MIME 2022e]), and natural gas remains a major component of the national energy mix (98.1 percent in 2022, compared with 1.7 percent wind and 0.2 percent solar, considering only power plants' production (IEA, 2022). This production is also largely attributable to STEG, which—as a public company—seeks to recruit employees in renewable energy or train them on related topics, rather than reduce its workforce. Tunisia's conventional energy sector thus faces low job loss risk, although there is a strong challenge to train STEG employees working in conventional electricity to anticipate the evolution of their jobs in terms of skills.

ANALYSIS BY PROFILE

Table 2.1 presents the job profiles required within the renewable energy value chain (for solar photovoltaic and wind technologies). They were identified based on the available literature and interviews with local stakeholders.

Table 2.1 Key job profiles in the renewable energy value chain (Solar photovoltaic and wind)

Main profiles in the renewable energy value chain (solar photovoltaic and wind)

	Design and sizing	Study and planning	Equipment and assembly	Construction and commissioning	Operations and Maintenance	Transmission and distribution	Services
Highly skilled jobs	• **Engineer:** electrical, another specialty • **Expert:** marketing and communication, another specialty • **Architect** • **Regulatory professions:** lawyer, jurist, notary, accountant • **Economist** • **Financial professions:** financial controller, other	• **Engineer:** renewable energies, environment, civil engineering, other specialty • **Expert:** logistics, environment, marketing and communication, other specialty • **Regulatory professions:** lawyer, jurist, notary, accountant • **Economist** • **Financial professions:** financial controller, other	• **Engineer:** data analyst, electrical, (electro)mechanical, electronics, energy efficiency, mechatronics, computer science, other specialty • **Expert:** logistics, marketing and communication, other specialty	• **Engineer:** electrical, (electro)mechanical, electronic, mechatronics, civil engineering, other specialty • **Expert:** logistics, marketing and communication, other specialty	• **Engineer:** electrical, (electro)mechanical, electronic, mechatronics, renewable energies, computer science, data analyst, other specialty • **Expert:** marketing and communication, another specialty	• **Engineer:** electrical, another specialty • **Expert:** logistics, marketing and communication, other specialty	• **Engineer:** data analyst, computer science, other specialty • **Expert:** marketing and communication, another specialty • **Economist** • **Financial professions:** financial controller, other
Medium-skilled jobs	• **Draughtsman** • **Realtor** • **Technical sales:** purchasing (components) and negotiations (land) • **Administrative functions**	• **Financial professions:** banker, other • **Administrative functions**	• **Senior technician:** electrical, (electro)mechanical, electronic, energy efficiency, IT, mechatronics • **Draughtsman** • **Technical sales:** purchases (components) and negotiations (land), sales of products or services • **Administrative functions**	• **Senior technician:** electrical, (electro)mechanical, electronic, mechatronics, environment, civil engineering • **Technical sales:** purchasing (components) and negotiations (land) • **Administrative functions**	• **Senior technician:** electrical, (electro)mechanical, electronics, renewable energies, mechatronics, IT • **Administrative functions**	• **Administrative functions**	• Senior IT **Technician** • **Web Developer** • **Technical sales**: purchases (components) and negotiations (land), sales of products or services • **Non-technical commercial:** telemarketer, etc. • **Administrative functions**
Low-skilled jobs	• -	• **Operator** of machinery and/or heavy goods vehicles	• **Technician:** electrical, (electro)mechanical, electronic, energy efficiency, mechatronics, IT • **Operator** of machinery and/or heavy goods vehicles • **Worker**	• **Technician:** electrical, (electro)mechanical, electronic, mechatronics, civil engineering • **Operator** of machinery and/or heavy goods vehicles • **Construction worker** • **Worker**	• **Technician:** electrical, (electro)mechanical, electronics, renewable energies, mechatronics, IT • **Worker**	• **Operator** of machinery and/or heavy goods vehicles • **Worker**	• **Computer Technician** • **Non-technical commercial** : telemarketer, etc.

Note: Logistics is included in each relevant part of this value chain and is therefore not mentioned as a distinct part. IT = information technology.

The end of life of infrastructure phase (dismantling, recycling, etc.) is an emerging market that is expected to create few jobs by 2035. Given the long life span of renewable energy infrastructure, and the need to build most of it soon to achieve the country's energy transition objectives, companies lack clarity on the job and skill requirements to operate in this part of the value chain.

The renewable energy value chain also indirectly involves banking and financial stakeholders, which support renewable energy companies with structuring and financing. The main jobs involved in this context are small and medium enterprise managers, credit and risk analysts, internal auditors, debt collectors, and lawyers.

ANALYSIS BY VALUE CHAIN SEGMENT

The highest number of jobs are created by construction and commissioning, and operation and maintenance, followed by equipment and assembly, to a lesser extent (RES4MED 2018). The jobs created by equipment and assembly, and construction and commissioning last for the projects' duration. This means jobs may be intermittent in the absence of adequate renewable energy projects. Operation and maintenance jobs are considered permanent, given the long life span of renewable energy infrastructure.

Smaller renewable energy projects tend to generate relatively more jobs than larger projects.

However, job creation depends on the size of renewable energy projects. While small to medium projects involve many Tunisian companies (especially small and medium enterprises), large projects favor the involvement of foreign groups, resulting in limited job creation in Tunisia. While a few Tunisian companies act as developers in projects of 10 megawatt and above, and in projects under the concession scheme, most act as subcontractors. Yet, Tunisian companies do participate in small solar projects of 1 megawatt under the self-production and authorization schemes.

The above findings—shared by the stakeholders consulted for this study—highlight how large foreign groups leverage economies of scale, credentials, and financing for a competitive advantage in winning tenders for developing renewable energy projects. These groups typically operate in the form of consortia, with Tunisian companies as subcontractors. This subcontracting can benefit Tunisian companies through a knowledge transfer from the more experienced foreign groups.

Appendix 9 contains a more detailed description of job creation and transition by value chain part and project size.

Even if jobs are created in Tunisia, their geographical distribution among governorates is not homogenous. This necessitates regionalizing employment promotion policies.

JOB CREATION POTENTIAL IN ENERGY EFFICIENCY IN BUILDINGS

SECTOR ANALYSIS

Energy efficiency development in buildings creates new employment opportunities for both subcategories of this sector:

- **The building envelope**, which is the use of construction or renovation techniques and materials to reduce buildings' energy bills (especially by reducing heat loss in winter and heat gain in summer). In Tunisia, this mainly includes wall and roof insulation materials, the surface and nature of glazing, architectural studies for building design, and economic and feasibility studies for energy efficiency projects (World Bank 2015).
- **Equipment used in buildings**, which in Tunisia mainly includes heating and air-conditioning equipment, household appliances (refrigerators, washing machines, ovens), and energy-efficient lamps (World Bank 2015).

ANALYSIS BY PROFILE

The above two subcategories are closely linked within the same value chain and require the involvement of the job profiles presented in table 2.2. These profiles were identified based on the available literature and interviews with local stakeholders.

Table 2.2 Key job profiles in the value chain for energy efficiency of buildings

Key profiles in the energy efficiency value chain for buildings

	Development of solutions and equipment	Study and development	Implementation of energy efficiency projects	Control and follow-up	Services
Highly skilled jobs	• **Engineer:** data analyst, electrical, (electro)mechanical, electronics, energy efficiency, mechatronics, computer science, other specialty • **Expert:** logistics, marketing and communication, other specialty • **Economist** • **Financial professions:** financial controller, other	• **Engineer** : electrical, electronics, energy efficiency, environment, civil engineering, HVAC engineering, other specialty • **Expert:** environment, marketing and communication, other specialty • **Architect** • **Regulatory professions:** lawyer, jurist, notary, accountant • **Economist** • **Financial professions:** financial controller, other	• **Engineer:** electrical, (electro)mechanical, electronics, energy efficiency, civil engineering, HVAC / thermodynamic engineering, mechatronics, other specialty • **Expert:** logistics, marketing and communication, other specialty • **Regulatory professions:** lawyer • **Financial professions:** financial controller, other	• **Engineer:** data analyst, electrical, (electro)mechanical, electronics, energy efficiency, HVAC / thermodynamic engineering, computer science, mechatronics, other specialty • **Expert:** marketing and communication, another specialty • **Regulatory professions:** lawyer • **Financial professions:** financial controller, other	• **Engineer:** energy efficiency, IT, other specialty • **Expert:** marketing and communication, another specialty • **Economist** • **Financial professions:** financial controller, other
Medium-skilled jobs	• **Senior Energy Efficiency Technician** • **Draughtsman** • **Technical salesperson:** sales of products or services • **Administrative functions**	• **Administrative functions**	• **Senior technician:** electrical, (electro)mechanical, electronics, environment, civil engineering, HVAC / thermodynamic engineering, mechatronics, energy efficiency • **Realtor** • **Technical sales:** purchasing (components) and negotiations (land) • **Administrative functions**	• **Senior technician:** electrical, (electro)mechanical, electronics, energy efficiency, HVAC / thermodynamic engineering, computer science, mechatronics • **Administrative functions**	• **Senior Technician:** Energy Efficiency, IT • **Web Developer** • **Technical sales:** purchases (components) and negotiations (land), sales of products or services • **Non-technical commercial:** telemarketer, etc. • **Administrative functions**
Low-skilled jobs	• **Energy Efficiency Technician** • **Driver** of machinery / heavy goods vehicles • **Worker**	• -	• **Technician:** electrical, (electro)mechanical, electronics, energy efficiency, civil engineering, HVAC / thermodynamics, mechatronics • **Construction worker** • **Worker**	• **Technician:** electrical, (electro)mechanical, electronics, energy efficiency, HVAC / thermodynamic engineering, computer science, mechatronics	• **Technician:** energy efficiency, IT

Note: HVAC = heating, ventilation, and air-conditioning; IT = information technology.

ANALYSIS BY VALUE CHAIN SEGMENT

In Tunisia, enhancing energy efficiency in buildings creates jobs primarily for project implementation and developing solutions and equipment-related services (RES4MED 2018). In 2015, the Tunisian buildings sector created 65 percent of jobs for the supply and installation of equipment and materials, compared with 27 percent for equipment manufacturing, 7 percent for trials and tests, and 2 percent for studies and development.

Material purchases. Companies should reassess their supply of building or renovation materials, especially regarding insulation. Traditional materials like brick and cement, commonly used in the past, lack adequate insulation properties. The employment impact will depend on the materials used and their origin. While reliance on locally produced materials (e.g., plaster, which is 2.4 times more insulating than terracotta brick) will affect local-material-supply-based jobs (for bricks, for example), material import (e.g., of rock wool, which is 24 times more insulating than terracotta brick) will render such jobs obsolete. Thus, the switch to insulation materials will either create employment opportunities (with a modification of existing jobs) or lead to job losses, depending on the materials chosen.

Construction of buildings. To promote energy-efficient buildings, Tunisian regulations now mandate a minimum thermal performance for the building envelope of new construction and extensions. The National Agency for Energy Management (ANME) coordinated the regulation's implementation based on an experimental anticipation process adapted to Tunisia's climatic, economic, institutional, and sociocultural context and a participatory approach that involved key buildings sector stakeholders. The project enhanced the existing regulatory framework through several implementing texts and the institutional framework through the establishment of a thermal and buildings energy laboratory that is crucial in regulating and controlling product quality. The project has had a positive economic, energy, and environmental impact by transforming the construction market, in turn reducing energy consumption.

The thermal regulation of buildings aims to reduce heating and cooling needs at an acceptable cost, which is below 10 percent of a building's cost. This can be achieved using materials, techniques, and architectural design adapted to a region's unique climatic conditions. Building permits require compliance with the minimum technical requirements specific to each building type. This regulation already covers office buildings and collective residential use, and a regulation for health and tourist buildings is under preparation. The government has mandated prior consultation in the form of an Energy Audit Plan to ensure energy efficiency in new buildings and energy-efficient design and construction. This applies to large energy consumers (estimated total annual consumption exceeding 200 tons of oil equivalent), for which a consulting architect-engineer duo typically conducts energy audits.

Growth of the building energy efficiency sector thus creates a need for companies to train their employees in upcoming construction standards. Without such training, companies may no longer be selected by individuals or firms seeking to have buildings labeled and/or with low energy bills. The training need is pronounced for low- and medium-skilled workers (such as masons and painters) to use new insulation materials to remain relevant to this market.

Building renovation. The market for building renovation is expanding and is not expected to compete with other markets. As for energy-efficient building construction, the challenge remains to train low- and medium-skilled workers to meet the growing energy renovation needs. Inadequate training could only undermine market dynamics, but does not lead to job loss.

Building renovation could generate significant employment since it is one of the most-labor-intensive energy efficiency activities (the International Energy Agency estimates that 60 percent of the expenditure for housing energy renovation is returned to employees) (IEA 2020).

Equipment. Tunisia has a well-developed equipment/appliance market and continues to promote their energy efficiency through energy certification, which creates a process of testing, labeling, and control as per enforced regulations. Considering the Tunisian equipment/appliance market is expanding, and already has most energy-efficiency-related equipment, the focus now shifts to job creation to meet the growing market demands. This pertains to both testing and manufacturing, and is contingent on the effective enforcement of regulations.

Other value chain parts. Energy efficiency in buildings enables energy auditors to emerge in a cross-cutting role, considering ANME has mandated energy audits for all energy-intensive buildings.

STRATEGIC JOB PROFILES FOR THE TUNISIAN CLEAN ENERGY TRANSITION

An analysis of potential job creation along Tunisia's renewable energy value chain identified certain job profiles that are essential to successfully implement renewable energy projects. The companies interviewed for this study—through interviews or online surveys—highlighted the limited availability of some of these profiles in the labor market. This cross-research led to the identification of 14 strategic profiles for Tunisia's clean energy transition. Adequate availability of applicants with these profiles will be crucial for the unhindered development of new renewable energy and greater energy efficiency in buildings. Table 2.3 summarizes these profiles, which are described in appendix 10 and further detailed in the job descriptions in appendix 12.

Table 2.3 Strategic job profiles in the energy efficiency of buildings and renewable energy sectors

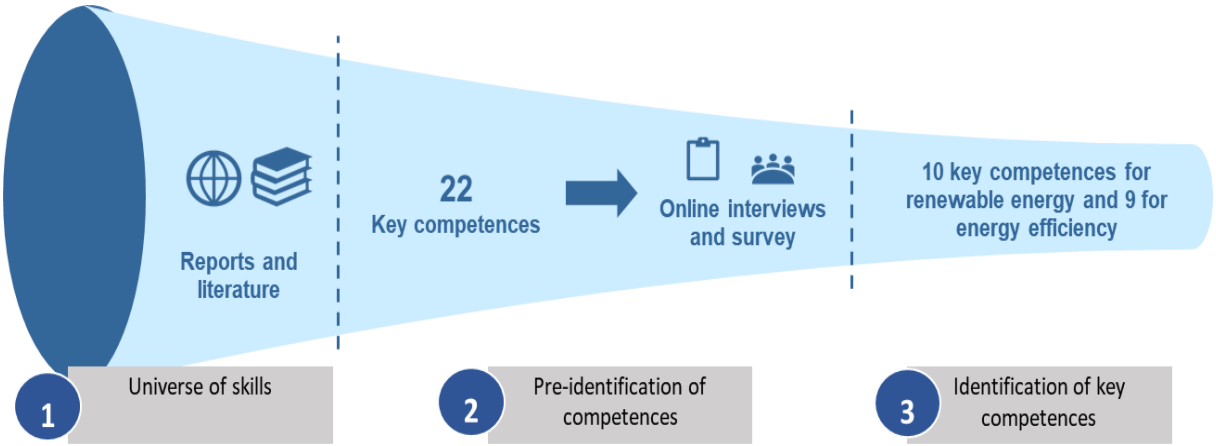
	Highly skilled profile	Medium-skilled profile	Low-skilled profile
Renewable energy	• Electrical engineer specialized in renewable energy • Engineer skilled in renewable energy and finance • Civil engineer specialized in renewable energy	• Senior electrical technician specialized in renewable energy	• Cable technician
Energy efficiency of buildings	• Architect • Energy engineer (thermal and electrical) • Heating, ventilation, and air-conditioning engineer	• Senior electrical and thermal technician (heating and air-conditioning)	• Mason • Insulation technician
Transversal to both sectors	• Software engineer	• Draughtsman • Sales	-

SKILLS REQUIRED IN THE CONTEXT OF THE TRANSITION

STRATEGIC SKILLS IN RENEWABLE ENERGY AND THE ENERGY EFFICIENCY OF BUILDINGS

Strategic skills in the Tunisian renewable energy and energy efficiency of buildings sectors were identified following the methodology illustrated in figure 2.1 and described below.

Figure 2.1 Methodology for identifying key competences



First, a literature review identified 22 skills specific to the renewable energy and energy efficiency of building sectors. Next, 10 strategic skills for the renewable energy sector and nine strategic skills for the energy efficiency of buildings sector (including 7 common skills for both sectors) were identified via online interviews and the results of the online survey (shared with Tunisian companies as part of this study).

Following this methodology, the key skills identified in the two sectors are categorized as hard skills (which are related more to technical competences) and soft skills (which are related more to behavior and interaction with teams). These skills are presented in table 2.4.

Table 2.4 Key skills identified in the energy efficiency of buildings and renewable energy sectors

	Hard skills	Soft skills
Technical skills	• Data science • Specific skills (topography, cartography, map projections) • Mastery of logistics • Mastery of energy fundamentals (electricity, networks, storage, etc.) • Mastery of the application of the energy fundamentals to renewable energy (studies, installation, commissioning, connection, operation and maintenance, etc.) • Mastery of the application of the energy fundamentals to energy efficiency • Mastery of instrumentation and connected accessories (smart meters, Internet of Things, etc.) • Mastery of the materials, methods, and tools used for constructing or renovating structures	• Project or team management (includes several skills, such as communication, team coordination, leadership, interdisciplinarity, etc.) • Organization • Environmental awareness and curiosity

	• Mastery of risk analysis methods
Digital skills	• Mastery of cybersecurity • Mastery of computer programming languages (Java, Python, C/C++, SQL, etc.) • Mastery of MS Office • Mastery of specific software
Languages	• Proficiency in foreign languages (French, English)
Economic and regulatory	• Mastery of legal and contractual frameworks • Mastery of financial and economic skills (realization of profitability analyses, financing requests...) • Mastery of environmental, energy efficiency, and renewable energy standards and regulations (e.g., the ISO 50001 standard)
Transverse	• Marketing, sales, negotiation, and communication skills • Ability to synthesize and analyze information (including writing skills)

Legend: In green: The three most important strategic skills for the renewable energy sector only; In blue: The two most important strategic skills for the energy efficiency of buildings sector only; In purple: The seven most important strategic skills for both sectors.
Note: ISO = International Organization for Standardization.

Appendix 11 contains detailed descriptions of the strategic skills for the renewable energy and energy efficiency trades.

FUTURE SKILLS NEED TO RESPOND TO THE DIGITALIZATION OF KEY SECTORS

Efforts to promote renewable energy and energy efficiency in buildings are facing economic trends that will change future skill needs:

- The two sectors are set to be increasingly digitalized (as described in the section "Digital economy, technology, and innovation" in chapter 3). This implies a need to develop digital skills.
- The opening of the renewable energy sector to private companies increases the skill need for product and services marketing in the sector.

In the context of digitalization and privatization of the two studied sectors, the consulted companies have identified several skills as "highly likely to be in demand in the future." The following skills were highlighted:

Instrumentation and connected accessories (smart meters, Internet of Things, etc.). This skill will become crucial as technologies advance toward increasingly connected and intelligent devices. Workers will need to develop the knowledge and skills to work with state-of-the-art technologies (monitoring, maintenance, etc.).

Digital models. This skill relates to a novel approach to developing, implementing, and monitoring construction projects. The approach allows project stakeholders—including designers and others stakeholders (e.g., administrators, developers, implementing companies, and control and certification institutions)—to collaboratively make and validate decisions for each discipline involved (such as architecture, finishing work, civil engineering, green spaces, plumbing, etc.) within a virtual environment.

Cybersecurity. Modern energy systems will increasingly be connected to the internet and other networks. Energy efficiency and renewable energy professionals will have to build cybersecurity-related knowledge and skills to understand the associated risks and implement relevant security measures. The related skills include network surveillance, access and identity management, malware protection, prevention of denial-of-service attacks, and disaster recovery planning.

Computer programming languages (Java, Python, C/C++, SQL, etc.) and automation. Automation and programming will be increasingly important in the energy efficiency and renewable energy sectors. Efficient project management in these sectors will require professionals to have familiarity with these technologies.

Data science. Data analytics will be crucial for energy efficiency and renewable energy. Professionals in these sectors should be capable of analyzing data to understand energy performance and assess project impact.

Marketing. With the opening of the energy market to private companies, the survival of renewable energy and energy efficiency firms in an increasingly competitive environment will depend on the skills to effectively market energy solutions and services to customers and investors.

CROSS-ANALYSIS OF STRATEGIC JOBS AND SKILLS FOR THE TUNISIAN CLEAN ENERGY TRANSITION

The skill needs of the 14 strategic jobs due to the clean energy transition (identified in Table 2.3) were identified based on a cross-analysis of the jobs and the key skills (identified in Table 2.4) required for the transition.

To that end, appendix 12 contains detailed descriptions specific to each strategic job, while tables 2.5 and 2.6 present the expected skill levels for all of them. An additional assessment regarding occupations and training programs conducted by the World Bank was provided in the context of the current case study (appendix 15).

Table 2.5 Strategic jobs and associated skill levels: Renewable energy sector

	Mastery of the application of energy fundamentals to renewable energies	Mastery of the legal and contractual framework	Mastery of financial and economic skills	Mastery of energy fundamentals (networks, storage, etc.)	Mastery of standards and regulations on the environment, energy efficiency and renewable energies	Mastery of foreign languages	Organization	Project or team management	Mastery of specific software	Analytical and synthesis skills (including writing skills)
Electrical engineer, specialized in renewable energies										
Engineer with skills in renewable energy and finance										
Senior electrical technicians, specialized in renewable energies										
Civil engineer specialized in renewable energies										
Cable technician										
Computer Engineer										
Draughtsman										
Sales										

Note: ISO = International Organization for Standardization.

Table 2.6 Strategic jobs and associated skill levels: Buildings' energy efficiency sector

	Mastery of the application of energy fundamentals to energy efficiency	Mastery of materials, methods and tools involved in the construction or renovation of structures	Mastery of energy fundamentals (networks, storage, etc.)	Mastery of standards and regulations on the environment, energy efficiency and renewable energies	Mastery of foreign languages	Organization	Project or team management	Mastery of specific software	Analytical and synthesis skills (including: writing skills)
Architect									
Energy Efficiency Engineer									
HVAC engineer									
Mason									
Senior Electrical and Thermal Technician									
Insulation technician									
Computer Engineer									
Draughtsman									
Sales									

Legend: Green indicates a low expected skill level; orange indicates a medium expected skill level; and red indicates a high expected skill level.
Note: HVAC = heating, ventilation, and air-conditioning; ISO = International Organization for Standardization.

3. OPPORTUNITIES AND CHALLENGES FOR CAREER TRANSITION

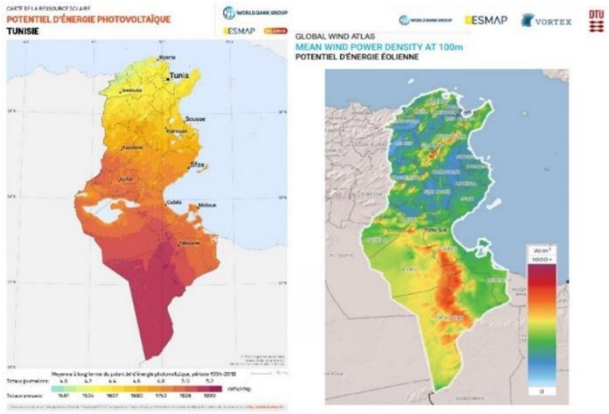
BUSINESS ENVIRONMENT AND MARKET STRUCTURE FOR RENEWABLE ENERGY AND ENERGY EFFICIENCY

Efforts to decarbonize and decentralize the energy sector amid a growing energy deficit are driving forces for the deployment of renewable energy. To develop its energy sector and thus create jobs, Tunisia can capitalize on its high renewable potential and the growing number of upcoming projects. However, the country must remove several obstacles impeding not only the sector's development but also recruitment and training by companies.

OPPORTUNITIES FOR DEVELOPING A BUSINESS ENVIRONMENT THAT PROMOTES JOB CREATION IN TUNISIA

Tunisia's geographic location and favorable climate conditions give it significant solar and wind energy potential (figure 3.1). The country receives high solar irradiation owing to sunshine of more than 3,000 hours on average annually. This generates very high productivity from the installed solar photovoltaic (PV) systems (annual electricity production between 1,450 kilowatt-hours per kilowatt-peak [kWh/kWp] in the northwest region and 1,830 kWh/kWp in the extreme southeast) (IRENA 2023). The country also has significant wind potential, especially in the coastal and mountainous regions, where winds are stronger and more constant. As estimated by the National Agency for Energy Management (ANME), the sites favorable for wind farm establishment have 10 gigawatts energy potential (ANME 2015).

Figure 3.1 Maps of solar and wind energy potential in Tunisia



In terms of market structure, the Tunisian renewable energy sector has historically been monopolized by the state-owned company, the Tunisian Electricity and Gas Company (STEG), which holds a significance place in the country's energy sector since it produces, transmits, and distributes electricity nationwide. Aside from its core activities, STEG also acts as an energy market regulator and oversees concession contracts for large-scale power generation projects involving private investors. Employment in renewable energy has thus been concentrated in the public sector to date.

Nevertheless, the renewable energy market is gradually welcoming private sector involvement due to the Tunisian Solar Plan's requirement to allocate a portion of renewable energy projects to the private sector. The private sector has been allocated a part of the government-planned capacity, while STEG has been allocated only one-third of projects. This represents an opportunity for market growth followed by job creation in the private sector.

While the deployed projects fall short of achieving the government's objectives, there is a substantial pipeline of future projects, which represent an opportunity for job creation in the years to come. Further, a sufficient number of projects would ensure continuity of employment in project-related jobs a (e.g., construction jobs). Furthermore, job creation will be influenced by the type of projects favored as part of the sector's development: an increase in small renewable energy projects will be beneficial for local job creation in the sector. However, diversity remains essential in distributing project size to ensure the related benefits: while small projects promote job creation, large projects reduce costs through economies of scale.

The projects currently identified are spread across nearly 40 companies, both Tunisian and foreign. They are evenly distributed between the companies, occasionally involving local business groups, with a slight majority being international companies. Large-capacity projects[3] are mostly in renewable energy deployment (table 3.1), resulting in suboptimal local job creation.

Table 3.1 Wind and solar projects identified at the end of 2022

Regime	Level of project implementation	Small-capacity projects[a]	Large-capacity projects[b]
Self-production—photovoltaic (low voltage)	Installed capacity (MW)	160	-
Self-production—photovoltaic (medium and high voltage)	Number of authorizations	-	300
	Power (MW)	-	68
Authorizations—photovoltaic	Number of agreements in principle	34	24
	Power (MW)	34	240
Authorizations—wind energy	Number of agreements in principle	-	4
	Power (MW)	-	120[c]
Concessions—photovoltaic	Power launched (MW)	-	1,300[d]
Concessions—wind energy	Power launched (MW)		900[e]
STEG—photovoltaic	Number of projects commissioned	2	-
	Commissioned capacity (MW)	20	-
STEG—wind	Number of projects commissioned	-	2
	Commissioned capacity (MW)	-	245
	Productive (GWh/year)	-	425[f]

Source: Ministry of Energy and Mines 2022.

[3] This report defines large-capacity projects as projects with a capacity greater than 1 MW for the authorization and concession schemes, and high- and medium-voltage projects for the self-generation scheme.

Note: GWh = gigawatt-hour; MW = megawatt; STEG = Tunisian Electricity and Gas Company.
a. Small-capacity projects include those below 1 MW capacity.
b. Projects with above 1 MW capacity for the authorization and concession schemes, and high- and medium-voltage projects for the self-generation scheme.
c. This power includes the second call for tenders.
d. The first call for tenders carries 500 MW, and the second call carries 800 MW.
e. The first call for tenders carries 600 MW, and the second call carries 300 MW.
f. Data as of 2021.

Solar PV. Solar PV projects are spread throughout the country. They are predominantly located across the central-west and southeast regions, and have unemployment rates of 23 percent and 22.5 percent, respectively (see figure 3.2, again presented to facilitate analysis). This represents an opportunity to reduce unemployment rates in these regions, which are among the highest in the country. By contrast, the northwest region—where the unemployment rate is 33 percent (the highest of all regions)—has had only one project of 1 megawatt (MW) announced to date. The 40 projects, totaling 940 MW of allocated capacity, whose production regions have not yet been determined represent an opportunity to develop local employment in the northwest region. Although northwest Tunisia has lower PV energy potential than the central and southern regions, the abundant sunshine received across the country helps keep the levels high, at approximately 1,800 kilowatt-hours per square meter per year (see figure 3.1). Unemployment in the northwest and other such regions (with high unemployment rates) would be reduced through promoting project development in these areas and those with sufficient solar potential.

However, the territorial distribution of companies depends on the concerned value chain segment. Design offices (where value chain study and design are conducted) are based mainly in the capital, thus concentrating employment related to this segment in the Tunis governorate. Nevertheless, companies of this type can intervene in all governorates in view of the nature of their work (which can be carried out remotely).

Works and civil engineering are sourced locally (project area/region). This value chain segment is awarded through competition between local companies and skills. Electrical components of projects are generally sourced based on wider nationwide consultation, since there are fewer manufacturers and assemblers at the national level.

Wind. Tunisia has very few wind projects. The large-scale projects are concentrated in the three windy regions, Bizerte, Kébili, and Nabeul, which have the lowest unemployment rates (figure 3.2; table 3.2). The 840 MW of allocated wind capacity, the location of which is still to be determined, therefore represents an important job creation opportunity for the higher-unemployment regions, which also have very high wind energy potential. This includes the Siliana governorate in northwestern Tunisia, where the unemployment is 33 percent and wind energy production potential is one of the highest in the country. Similarly, Tataouine in the southeast (22.5 percent unemployment) and Tozeur (26.3 percent unemployment) in the southwest offer high wind energy potential. Promoting wind project development in these areas would reduce the unemployment rate.

In terms of companies' location, the online survey conducted under this study saw participation by the handful of wind energy companies in Tunisia. The responding companies are based in Tunis, with projects in the governorates of Gabes, Gafsa, Kairouan, Kasserine, and Kébili, and in Nabeul, Sidi Bouzid, and Siliana.

Figure 3.2 Unemployment rate by region, 2021

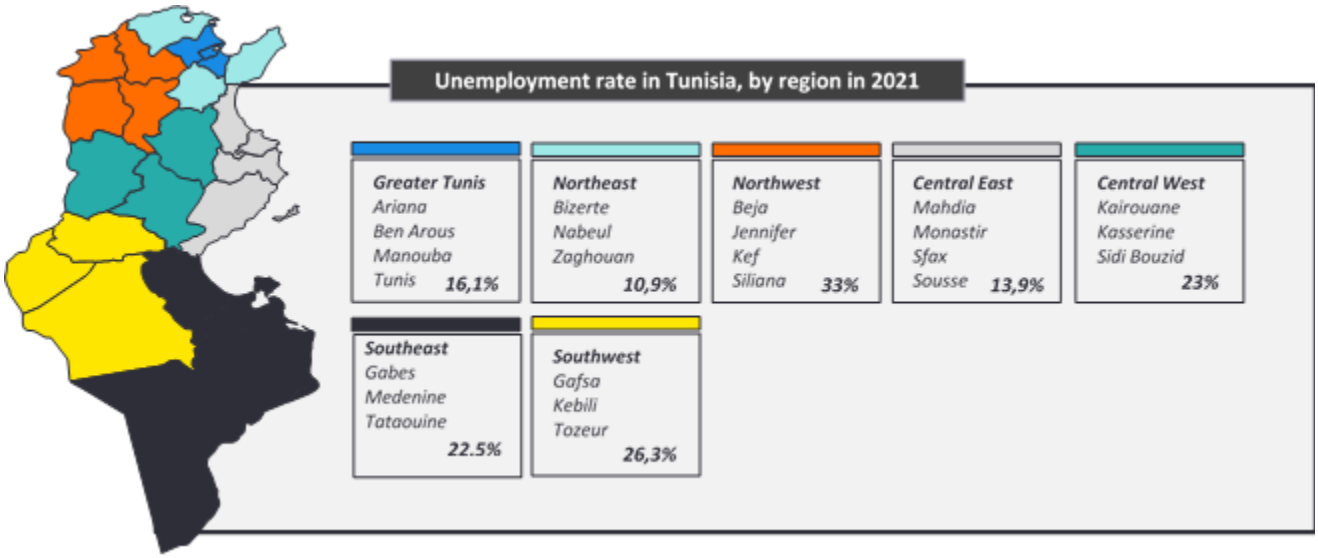


Table 3.2 Number and total capacity of projects identified at the end of 2022 by governorate (wind and solar PV—all schemes)

	Wind		Solar PV	
Governorates	**Total capacity (MW)**	**Number of projects**	**Total capacity (MW)**	**Number of projects**
Greater Tunis *(Ariana, Ben Arous, Manouba, Tunis)*				
Ben Arous	30	1		
Northeast *(Bizerte, Nabeul, Zaghouan)*				
Bizerte	90	3		
Nabeul	200	1		
Northwest *(Beja, Jendouba, Kef, Siliana)*				
Beja			1	1
Central East *(Mahdia, Monastir, Sfax, Sousse)*				
Sfax			12	3
Sousse			1	1
Central West *(Kairouan, Kasserine, Sidi Bouzid)*				
Kairouan			111	3
Kasserine			30	3
Sidi Bouzid			71	5
Southeast *(Gabes, Medenine, Tataouine)*				
Gabes			21	4
Medenine			24	6
Tataouine			212	4
Southwest *(Gafsa, Kébili, Tozeur)*				
Gafsa			101	2
Kébili	100	1		
Tozeur			70	3
Not determined				
Not determined	840	10	940	40

Source: Ministry of Energy and Mines 2022.
Note: MW = megawatt; PV = photovoltaic.

OBSTACLES TO THE DEVELOPMENT OF A BUSINESS ENVIRONMENT THAT PROMOTES JOB CREATION IN TUNISIA

The development of the renewable energy market, and in turn the consequent job creation, is hampered by three factors—(1) regulations and administrative complexity, (2) difficulties in financing projects, and (3) limited market size and limited competitiveness—which hinder recruitment by companies and reduce provisions for financing workforce training and upskilling.

REGULATION, PUBLIC POLICY, AND ADMINISTRATIVE COMPLEXITY

Historically, the Tunisian energy sector primarily consisted of fossil fuel projects with intricate and technically complex transaction structures, such as oil or natural gas projects. The renewable energy sector has inherited the specific and complex legal and financial solutions of the conventional energy sector, resulting in extended project development deadlines. This regulatory and structural legacy hinders growth especially in the number of small and medium renewable energy projects, de facto hindering job creation in Tunisia's private renewable energy sector (IRENA 2021b).

Nevertheless, the government, accompanied by the World Bank and German Agency for International Cooperation (GIZ) in particular, has implemented many simplification measures to remove existing administrative obstacles and promote job creation in the private sector. Hence, from November 2022, the Ministry of Industry, Mines and Energy (MIME) agreement is not mandatory for renewables-based electricity self-production projects connected to high- and medium-voltage grids and with power below 1 MW. However, they require connection authorization of the STEG. This administrative reduction allows companies to develop more projects and in turn have an interest in recruiting and training more workers.

While regulatory obstacles related to administrative aspects are being alleviated, other regulatory obstacles, elaborated on next, still hinder the development of renewable energy projects. These barriers depend on the technology studied.

Solar PV. Some companies, including small businesses interviewed for this study, experience difficulties in awarding government tenders for renewable energy projects. Indeed, the calls for tenders issued for the realization of these projects generally include as a selection criterion the submission of references such as the projects in question. Some Tunisian small and medium enterprises (SMEs) then enter a "*vicious circle: since they do not have these references, they are not selected under these AOs, and therefore do not acquire the desired references.*"[4] Lack of benchmarks hinders workforce growth and skill development for these companies, thus limiting the upskilling of the local workforce. Tunisian SMEs, however, can collaborate with more experienced companies (international companies, for example) within consortia to expand skills and expertise and gain autonomy for future calls for tenders.

At the same time, companies and investors lack confidence in the sector's short- to medium-term growth, especially given the uncertain evolution of budgets and associated projects. This deters private investment in the sector and effectively prevents workforce specialization in the solar PV sector. Indeed, the interviews conducted

[4] Quote from a local stakeholder's interview.

under this study revealed several companies' reluctance to establish dedicated and specialized renewable energy project teams (especially solar PV), for fear of a lack of continuity and sequencing of projects.

Wind. Limited private sector investment in this activity stems from the limited number of state-validated projects. Businesses lack confidence in the expansion of the national project portfolio due to multiple project cancellations in recent years. These reasons, coupled with uncertain political decisions concerning the validation of wind energy projects, dissuade companies from investing in the development of wind energy activities, especially in the recruitment of people specialized in wind energy. In fact, few jobs have yet been created in the sector, and companies are reluctant to hire specialized people. Some companies interviewed for this study even mentioned that a surplus of young graduates specializing in wind energy eventually retrain due to lack of opportunities.

FUNDING AND FUNDRAISING CHALLENGES

Tunisian companies, especially SMEs, show limited project participation and labor recruitment owing to challenges in obtaining financing, which prevents them from developing their activities. The companies interviewed for the study mentioned three components that explain this: (1) a "*lack of employees able to write the requests for financing and support with the expected elements and structure so that banking and financial actors can analyze them correctly*"[5]; this is coupled with a lack of the skills identified by the banking sector to analyze the transmitted files; (2) a lack of availability of and a lack of adaptability in instruments promoting the eventual recurrent projects; and (3) dissuasive economic instability for local and foreign investments.

Development of the renewable energy sector is hindered by a lack of applicants with skills in renewable energy and finance.

The interviews conducted under this study appeared to indicate that banks lack skills, and an understanding of projects and their risks. This hinders the management of loan files. In general, the local financial sector shows little involvement in financing wind and solar projects. This limited involvement stems from a lack of know-how in "project finance." Further, the processing of loan files by banks is hindered by the skill shortage for financial modeling related to companies' renewable energy projects. In short, the lack of applicants with renewable energy and finance skills hinders the sector's development.

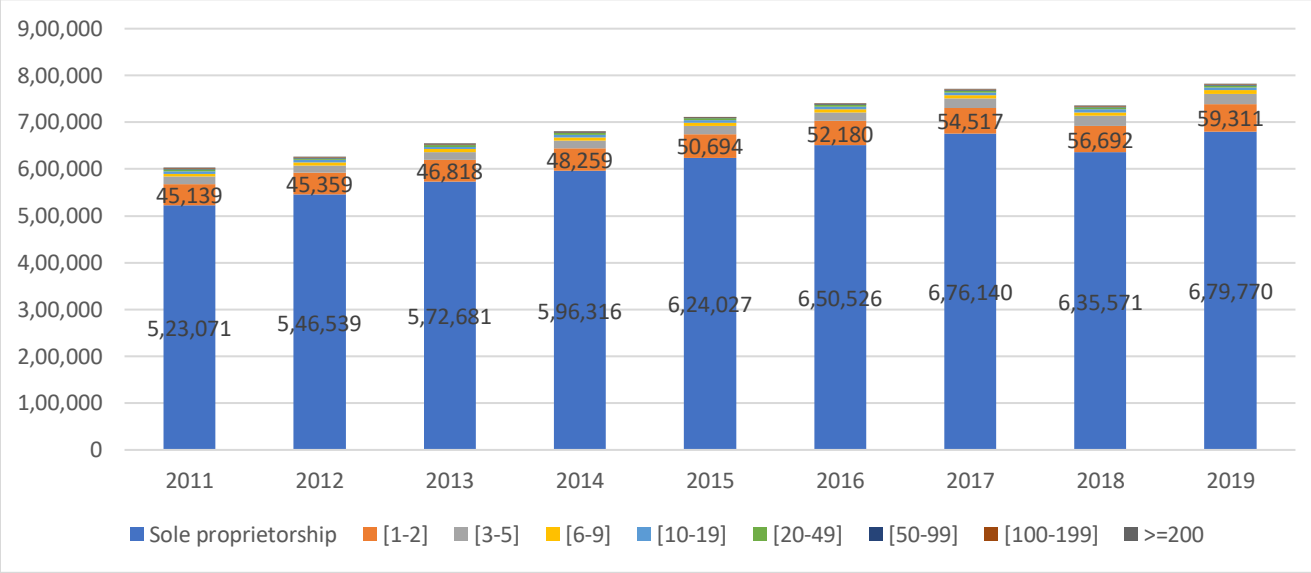
MARKET/SUPPLY CHAIN SIZE AND SECTOR COMPETITIVENESS

A SMALL MARKET SIZE REFLECTED IN THE COMPANIES IN THE SECTOR

The private sector is dominated by microenterprises that have limited growth capacity. Renewable energy companies in Tunisia, like other companies in the country, are microenterprises with low growth (private microenterprises dominate the panorama of Tunisian companies). In 2019, about 87 percent of more than 780,000 companies registered with the tax authorities were single-member businesses (figure 3.3), that is, self-employed individuals or microproduction units without formal employees.

[5] Quote from a local stakeholder's interview.

Figure 3.3 Evolution of number of companies by employee number in Tunisia



Source: National Institute of Statistics 2021b.

While Tunisian SMEs can participate in the development of small to medium renewable energy projects, which can generate more jobs, they are hindered by the market's limited size. The resulting obstacles (described below) explain a lack of dynamism in the recruitment of staff specialized in renewable energies. A larger market, and a more developed national supply chain, would promote increased job creation in the sector.

Solar PV. New solar power plant projects in Tunisia see sluggish development due to a lack of competent and affordable service providers meeting STEG's connection specifications. While finding external service providers at reasonable prices is a challenge for the companies in this sector, staff shortage at STEG leads it to subcontract connections to external service providers but at prices deemed excessive by the companies. Delays in the connection phase lead to a reluctance of companies to hire, and many planned hires ultimately do not materialize.

The Tunisian solar PV sector sees limited growth due to a lack of large-scale national projects. This leads certain private companies in the sector, those involved in developing such types of projects, to reduce their activities, which also reduces their manpower need. For solar PV, the Tunisian Union of Industry, Commerce and Handicrafts (UTICA) had identified more than 500 active companies, a figure that fell below 200 after the COVID-19 pandemic due to lack of activity. Tunisian companies are turning to the international market to increase their turnover, but this dynamic only benefits the highly qualified workforce, whereas local technicians and installers are privileged to ensure the profitability of projects. This discourages the recruitment of medium- and low-skilled labor.

Finally, the solar PV sector sees limited growth due to the prolonged duration of subsidies. The surveyed solar PV companies mentioned a need to remove solar PV subsidies to increase market efficiency. According to them, subsidy removal encourages market competitiveness, motivating more players toward competitiveness, in turn promoting efficiency and skill development. The companies see subsidies as a tool to trigger market dynamics, which, however, must be removed at the right time to let the market self-regulate. Removing this brake would create stronger market dynamics, in turn creating more private sector jobs.

Wind. Job creation in wind energy could be promoted by addressing the issue of inadequate wind project development, which is caused due to three factors: (1) the substantial financial investments to be made, (2) the perceived lack of appeal of the authorization scheme in a context of lack of market visibility among investors, and (3) the concerns raised by wind projects.

Aside from the above development obstacles to solar PV projects, wind energy development is hampered by the substantial financial investments required by companies, especially for producing wind turbine components and assembling the turbines. Companies that are discouraged from investing significantly, due to their lack of visibility on the sector's development, therefore, launch few wind projects. This limits job creation in the private sector.

On the other hand, the authorization scheme is unattractive for investors. Indeed, the authorization scheme for wind energy is based on irregular and small calls for projects (below 30 MW). This does not attract quality developers and investors, and, therefore, does not create jobs (ANME 2020).

Finally, at the national level, concerns about wind energy have historically constrained project development. The reasons cited are several, including possible disruptions to communication lines and air travel near wind farms, as well as potential tensions related to conflicts over agricultural land. No public land reserve for wind energy concession projects is therefore currently available (ANME 2020).

LIMITED COMPETITIVENESS OF THE SECTOR

Finally, the companies surveyed noted the solar PV sector's lack of competitiveness. The wind sector faces a virtual lack of a competitive environment due to the low number of wind energy companies. Nevertheless, the wind energy market is not very accessible due to the very high costs to enter the sector, due to the significant expected investments.

Solar PV. Companies perceive the historical presence of STEG's monopoly as a hindrance to the development of competition.

Although many businesses are created, they mostly have a single member or are small in size. Indeed, companies with one to two employees represented 58 percent of Tunisian companies in 2019, and their number grows by an average of 4 percent annually, compared with a 2 percent increase for medium-sized companies.

Further, the local workforce can sometimes be mobilized by dividing calls for tenders that require, for example, at least 20 percent participation of Tunisian companies (useful for integrating installers, local builders, etc.). For the authorization scheme for 1–10 MW projects, 20–30 percent local participation is mandatory.

Finally, the consulting firms interviewed explain that the market for energy studies is no longer interesting in Tunisia, for several reasons. One of them is the general crisis in engineering, causing offices to lower prices to remain competitive. Another reason is that 80–90 percent of self-employed workers and microenterprises are working from home. Small and medium-sized enterprises are no longer competitive with the self-employed who has become mainstream because the SMEs have cost items that the self-employed does not have, while the self-employed works from home and only needs their cars, computers, and phones).

BUSINESS ENVIRONMENT AND MARKET STRUCTURE FOR ENERGY EFFICIENCY IN BUILDINGS

SECTOR DYNAMICS

Tunisian companies are seeing limited development of construction- and renovation-related activities for energy efficiency in buildings. Construction has so far utilized non-energy-efficient materials (cement, bricks), which are carbon intensive upstream of their production and also provide little insulation. Companies' reluctance to purchase other materials stems from their requirement to adapt their construction processes, which they have no interest in doing, considering the costs for purchasing raw materials (stone wool, for example, which is more expensive considering it is necessarily imported), employee training, among other activities (no dynamic market identified).

Despite numerous attempts to use locally available higher-efficiency materials, these have not been conclusive. Indeed, the use of and the construction of buildings with these materials (various building materials, thermal paints) requires a workforce trained in their use. This requires a substantial training program for masons, installers, and other construction trades. Considering employment informality is very high in the sector, companies show very limited commitment to finance workers' training, without any guarantee of long-term collaboration.

COMPETITIVE ENVIRONMENT

In terms of a competitive environment, companies responding to the online survey identified market and supply chain size as a primary obstacle to their business development. The market shows weak growth prospects, due to a very limited national supply chain (especially regarding the supply of insulation materials for construction or renovation). Competitive dynamics are also hindered due to a lack of appropriate regulations, investment policies, or incentives.

Finally, firms identify high market entry costs due to limited bargaining power and a threat of substitution of services.

The above obstacles complicate and accentuate the sector's use of informal labor, leading to the limited availability of sufficiently qualified workers and high costs for local labor (again limiting competitiveness).

DISTRIBUTION OF ENTERPRISES ON THE TERRITORY

The companies responding to the online survey are spread over several Tunisian governorates (Tunis, Gabes, La Manouba, Sousse, Ben Arous, Sfax). Their projects are spread wider, over almost the entire Tunisian territory.

INSTITUTIONAL FRAMEWORK, NATIONAL POLICIES AND PROGRAMS, AND EDUCATION SYSTEM

INSTITUTIONAL FRAMEWORK

The actors involved in Tunisia's energy transition are in the public or private sector, or are international organizations:

- Public actors are mainly ministries and public institutions of a nonadministrative nature (*établissements publics à caractère non administrative*, EPNA). The ministry at the heart of this transition is MIME.
- Private sector actors are trade unions and economic clusters representing private sector companies present across the different links of the energy value chain. They are the largest contributors to job creation in the energy sector.
- International organizations comprise donors and other financial institutions. They provide development support to the public and private sectors through funding and support projects.

Despite its contribution to renewable energy and energy efficiency development in Tunisia, the multitude of actors and initiatives also presents several challenges (elaborated on next), which limit companies' visibility in these sectors' development. This poses several barriers to job creation in these sectors:

- Companies are cautious about hiring individuals specializing in renewable energy or energy efficiency.
- Companies are reluctant to invest in training their employees to help them develop skills in renewable energy or energy efficiency.
- Companies find it difficult to project themselves in these sectors and identify their job and skill needs precisely and in a manner that they can be quantified.

The last point especially makes discussions between energy and education sector actors difficult. The education sector struggles to anticipate expected changes to existing curricula to ensure alignment with the expectations of the companies in the studied sectors.

Finally, while discussions have begun among education, employment, and renewable energy and energy efficiency actors, the renewable energy and energy efficiency actors are only in pilot projects, not at a national and strategic scale. Indeed, although these actors have partnered—as described below—they could gain depth and scope to collectively determine how to adapt education and employment policies to changes in the energy transition.

RENEWABLE ENERGY SECTOR GOVERNANCE

To achieve its ambitious goals, the Tunisian government has established mechanisms dedicated to renewable energy. However, the governance of the electricity sector poses challenges to renewable energy development, despite efforts to establish an effective organizational structure. The factors listed below limit the appeal of the renewable energy sector for companies, which lack incentive to invest in workforce upskilling and create renewable energy jobs:

- **The multitude of institutional actors.** Although MIME remains the main actor in this sector, a range of institutions responsible for land, agriculture, financial planning, and the environment are indirectly involved, as well as several commissions, such as ministries responsible for monitoring protected and restricted areas, authorities issuing building permits, and those responsible for financial and fiscal incentives. For example, at the departmental level:

    - The Ministry of Agriculture approves access to land eligible for renewable energy production. The ministry hinders access to some of these lands (e.g., on the Sahel side, in the east of the country) as they are cultivable. Further, "*changing one's vocation is a time-consuming and complex process*."[6]

    - The Ministry of Defense has expressed apprehensions about the potential impact of Tunisia's wind energy development on national security. Both the defense ministry and other ministries have had these concerns since 2017. This slows down project authorization in some cases.

- **Lack of coordination among stakeholders in Tunisia.** The multitude of actors involved in the sector occasionally leads to conflicting roles in the absence of clear and transparent definitions of each institution's responsibilities (IRENA 2021b). For example, MIME could be more involved in promoting employment, alongside the Ministry of Vocational Training and Employment. This dynamic is also observed at the public-private level and reflected through a low visibility of the private sector on the government's ambitions and a "*lack of confidence in the realization of communicated programs*."[7]

- **Political instability.** Regular changes in ministries since 2011 (the Arab Spring revolution) have inevitably led to changes in scope, budgets, and governance. This rapid change of interlocutors has created confusion among market participants. The last change dates to 2020, through the merger of two ministries—the Ministry of Energy, Mines and Energy Transition, and the Ministry of Industry—to create the Ministry of Industry, Mines and Energy (MIME). This issue has been accentuated by two factors:

    - Frequent change of government, which has hindered the progress of several strategic projects, whose objectives could not be updated.

    - Change in the parliament's role in the new constitution of 2022. The parliament's role and degree of involvement in the energy sector is not yet clear.

- **STEG's monopoly.** The Tunisian Electricity and Gas Company (STEG)—being under MIME's supervision—has a profound influence on the electricity market. Indeed, STEG's unagile processes for renewable energy development stem from its status as a public company and internal regulatory system inherited from the conventional electricity sector. Further, the stakeholders consulted believe that STEG's union is slowing down the implementation of certain renewable energy installations by blocking connection to its electricity grid:

[6] Quote from a local stakeholder's interview.
[7] Quote from a local stakeholder's interview.

- A reluctance on the part of trade unions appears to be slowing down the application of the Transversal Law for the Improvement of the Business Climate, adopted on April 23, 2019. Indeed, this law amended the provisions of Law No. 2015-12 on projects subject to the self-consumption scheme, whose objective is limited to the production and sale of electricity from renewable energies.

- **Absence of an independent regulator.** The energy sector does not have an independent regulator as MIME has taken over this function. It conducts regulatory monitoring through dedicated departments and public sector bodies such as:

  - The Directorate-General for Electricity and Energy Transition, which is responsible for the state policy's implementation in the renewable energy sector and the examination of applications for renewables-based private production of electricity and its self-consumption.

  - Representatives of public institutions/enterprises, for example, STEG, the Tunisian Petroleum Company (ETAP), and the National Oil Distribution Company (SNDP).

The absence of an independent regulator raises the issue of a conflict of interest, since MIME does not oppose STEG's monopoly and deadline extension for grid connection of power plants. This directly hinders increasing renewables integration into the energy mix and job creation. Recently, MIME prepared a draft decree on the creation of a regulatory body for the electricity sector and published the same on its website for public consultation. These elements directly impact companies' appetite to develop renewable energy activities, and, consequently, job creation as well as investment in workforce training and specialization in renewable energies.

GOVERNANCE OF THE ENERGY EFFICIENCY SECTOR

Regarding energy efficiency, the Tunisian government has established an institutional framework comprising public and private actors. Each actor contributes to the objectives' achievement within their designated scope. Despite the efforts made, some challenges have been faced:

- **Lack of coordination between organizations.** The buildings sector includes a multitude of stakeholders (e.g., the Ministry of Energy, Ministry of the Environment, Ministry of Vocational Training, and Ministry of Equipment and Housing). This implies a lack of coordination for project implementation. Work for stakeholder coordination is, nevertheless, underway in collaboration with the Technical Center for Building Materials, Ceramics and Glass (CTMCCV), the Tunisian Green Building Council (box 3.1), the Order of Tunisian Architects and the Order of Tunisian Engineers, and the new Green Building cluster.

- **The multiplication of labels.** The multitude of stakeholders and organizations in the sector has led to a multiplication of energy efficiency labels. Meanwhile, the different bodies must coordinate toward a common label to ensure easier skill alignment with expected skill levels for energy sector jobs.

- **ANME's bureaucracy.** The National Agency for Energy Management (ANME), a key player, has a small workforce, with which it manages a large number of projects. The small staff strength means it is slow to design and implement programs under its aegis, which in turn affects coordination with the private sector. Also, ANME often aims for grant approval for programs, which is, however, sluggish. The private sector has repeatedly expressed its willingness to forego this aid for faster program launch and thus streamline companies' activities, allowing them to have more visibility on their trajectory, and improved recruitment.

Box 3.1 Case study: Work on public-private coordination in the energy efficiency sector

As part of work to establish the Green Building cluster within the Borj Cédria technopole, the Tunisian Green Building Council is facilitating coordination among all public bodies (the Ministry of Equipment and Housing, the National Office of Mines [ONM], technical centers, and research centers) and private organizations (innovative building materials manufacturers, public and private developers, designers, and technical inspectors) with a view to:

- Promote the results of the ONM, which has developed a mapping of useful substances available in Tunisia that can be recovered into materials and can be used with local construction techniques to comply with the thermal regulations established jointly by the National Agency for Energy Management (ANME) and the Ministry of Equipment for new buildings.
- Create jobs in disadvantaged regions through technical support to new promoters via building materials sector technical centers. Support spans project concept to realization, analysis of raw materials identified by new promoters, and validating that finished products comply with international standards.
- Developing a procedure guide for validating innovative products and processes in the construction sector. This guide will direct manufacturers and new developers to the inspection and certification bodies for their products.
- Integrate the thermophysical characteristics of insulation and low-energy production materials into technical specifications and simulation tools so that building project designers can use them to design more cost-effective variants for real estate developers, which can make the right decisions.
- Develop guides to assist promoters to follow sustainable public procurement practices in Tunisia.

NATIONAL POLICIES AND PROGRAMS

Public subsidies are an effective tool to boost the Tunisian renewable energy sector (e.g., through the Tunisian Solar Program, PROSOL). They facilitate market development, which creates employment. However, the absence of a clear limit on subsidy programs discourages companies from prioritizing efficiency ramp-up. Thus, while subsidies incentivize recruitment through their creation, they can dampen market dynamism, causing a job creation slump.

NATIONAL RENEWABLE ENERGY POLICIES AND PROGRAMS

Substantial private investment is required to generate the installed renewable energy capacity for meeting the targets set out in the Tunisian Solar Plan (IRENA 2021b). In response, the Tunisian government, in 2015, adopted regulatory reforms through a new law (Law No. 2015-12) on renewables-based electricity production. The reforms aim to establish a legal framework conducive to private sector investment in renewable energy generation through two new regulatory schemes:

- The self-production/consumption scheme, which makes it possible to connect an installation to a low-voltage network.

- Concession and authorization schemes, which are intended for the independent electricity production for local consumption and make it possible to connect installations to medium- and high-voltage networks.

Despite their important contribution in encouraging renewable energy use, and to a lesser extent energy efficiency, these schemes also present certain challenges:

- **Limited access to finance.** Companies seeking to develop renewable energy projects may struggle to find project financing, including for staff increase. This is because financial institutions are not sufficiently equipped to conduct risk analysis to adequately support potential investors, and/or potential clients are not capable of presenting strong financial cases, despite their eligibility.

- **Cumbersome bureaucratic processes.** The process of applying for a permit to install renewable energy projects can be long and complicated, with many administrative steps. This can discourage potential investors and slow down project development (mandatory passage through STEG). Indeed, many investors could not access finance because of long delays in obtaining the required authorizations, which in some cases amounted to a year and a half. This slows down the development of the existing work material, aside from impeding capacity development.

- **Dependence on subsidies.** Subsidies could create long-term dependence on government support, which may not always be available. Indeed, "*the cancellation of grant budgets in 2015 was a blow to companies in the sector*,"[8] which are occasionally compelled to reduce their workforce.

- **Disparity in regional development.** Fiscal and financial incentives are designed to boost the development of marginalized regions, which are home to most renewable energy projects. However, an analysis of companies eligible for installing solar panels under the PROSOL Elec project (for self-production purposes) reveals that only 10 percent of them are based in the targeted regions, most spread between Tunis and Sfax. This indicates that the sector's development benefits the more developed regions, especially in terms of job creation and profits, at the expense of regions in need of greater local integration and unemployment reduction (Tunisian Observatory of the Economy 2022).

NATIONAL ENERGY EFFICIENCY POLICIES AND PROGRAMS

Tunisia is seeing the development of several ambitious energy efficiency programs in response to the energy management and carbon reduction objectives. Nevertheless, some challenges were observed, despite achievements in energy efficiency:

[8] Quote from a local stakeholder's interview.

- **Noncompliance with international standards.** Older buildings are far more energy efficient than new buildings compliant with energy efficiency standards. Newly trained individuals struggle to achieve energy balance for new buildings based on modern standards. This mismatch between training and on-ground reality also hinders the development of recommendations to remedy these buildings' energy suboptimality, following international standards.

- **Lack of individuals trained in using high-performance materials and materials for insulation.** Buildings in Tunisia lack energy efficiency primarily due to the building envelope, which is made of bricks and cement (80 percent limestone and 20 percent clay), which do not provide insulation. Several attempts to introduce new, more efficient materials have failed due to a lack of training for masons, a workforce that often has little or no qualification.

- **No obligation to implement energy efficiency optimization.** Although experts have been approved to conduct mandatory energy audits every five years for entities in the transport, industry, and buildings sectors, the obligation remains limited to conducting the audits, not to ensuring energy efficiency. An audit is typically followed by a program contract between an institution that undertakes to execute its energy efficiency program and ANME, which undertakes to grant the premiums related to this program. Thus, there is little potential for the creation of jobs in the implementation of energy efficiency programs.

EDUCATION AND TRAINING PROGRAMS AND PROJECTS IN THE ENERGY SECTOR

Training programs are primarily managed by the Ministry of Higher Education and Scientific Research (which focuses on executive training) and the Ministry of Employment and Vocational Training (which focuses on the training of nonmanagers).

Also, UTICA and ANME are making a strong contribution to training in energy transition technologies through initial and continuing training:

- Public/private certifications and co-certifications,

- Co-constructed license, and

- Programs with double and triple degrees in engineering.

Given the necessity of further training to advance renewable energy and energy efficiency skills, the related activities involve multiple actors. These include the Ministry of Employment and Vocational Training and the institutions under its supervision, which provide training via training centers, ANME, and donors and international organizations.

Although the Tunisian training sector offers diverse and versatile training, it faces certain challenges due to the needs of the energy transition:

Lack of specific initial training. The versatility of initial training in Tunisia implies a lack of skills specific to the energy transition among young graduates. Additional training is thus a necessity, since initial training does not equip employees sufficiently. Several actors have developed accreditation training to meet this need. Some have

developed specific mechanisms to ensure skill development for specific professions and technologies. For example, in the field of complementary and vocational training:

- ANME has—at the private sector's request—developed training modules for technical sales representatives to develop their skills.
- STEG conducts mandatory training within its "Kheldia Training and Development Centre (CFPK)" for the skill development of new recruits.

Cost of further training. Although skill development requires further training, the persistent high costs of training by training centers discourages the unemployed and very small businesses, who cannot afford it. The National Agency for Employment and Self-Employment (ANETI) offers training support programs, which are integrated with professional programs, where companies undertake to recruit the people trained. Further, development banks now offer short-term training courses to help professionals in the conventional energy and buildings sectors shift to jobs in renewable energy and energy efficiency in buildings. ANETI considers this training useful, which indicates that these programs indeed make professional retraining possible at relatively low costs. However, these initiatives rely on donor funding, considering the lack of adequate mechanisms to sustain them.

Lack of coordination between training and employment actors. Although the labor market and training actors do communicate, it is not sufficient for regular update of programs. Federated research projects were initiated but were intended to test the collaboration between academia and industry on pilot projects only (reduced scope) and were not deployed on a large scale.

Sectoral technical commissions have been established within the National Center for the Training of Trainers and Training Engineering (CENAFIF) to promote industry–education sector coordination. However, this system fell short of achieving the expected effectiveness, especially for the energy sector, due to the industry's low committee representation and infrequent occurrence of exchanges.

Inadequacy of certain vocational training programs. Some companies interviewed under this study indicate that certain training programs of ANME-accredited centers could include a requirement for stronger and more homogeneous workforce upskilling, which could make the sector more dynamic. These training courses could become more demanding either in terms of the acquired technical expertise (trainers' hard skills) or in the way the courses are delivered (trainers' soft skills). However, a hiring freeze has limited ANME's human resources, which are inadequate to support the necessary skill building.

Case studies (boxes 3.2–3.4) show that some challenges can be overcome through the establishment of win-win partnerships between different actors.

Box 3.2 Case study: Perenco

The company Perenco needed to recruit young individuals locally to optimize the costs of building a solar power plant. The work was to include civil engineering (earthworks, roofing, foundations, panel supports, gutters, etc.) and electrical engineering. Since these young individuals are not trained in renewable energies, Perenco is financing their training.

Initially, selection criteria were defined, such as the minimum level of academic training (Certificate of Professional Competence, CAP), relevant academic training (civil/electrical engineering), and the minimum unemployment duration. In a second step, the local community collected applications and 10–12 individuals were trained and certified with funding from Perenco. They worked over the project's duration.

Following the project closure, some of the trainees started their own photovoltaic panel installation companies and were registered on the National Agency for Energy Management (ANME) installer roster. Others chose to find employment, which was facilitated by the experience they gained.

Box 3.3 Case study: STEG's partnership with ENIT, SUP'COM, and ENSTAB

For a successful energy transition and to ensure achievement of specific objectives, the Tunisian Electricity and Gas Company (STEG) has set up the STEG Talents 2030 program in coordination with the European Bank for Reconstruction and Development. The program, which began in 2021 with a road map up to 2030, aims to equip STEG with the trades and skills required to face the three transitions: energy, ecological, and digital.

The program has facilitated STEG's partnerships with university actors to adapt vocational training and develop vocational training programs on behalf of STEG's employees. Figure B3.3.1 details the scope of the partner programs. A vocational training plan, with over 30 planned training sessions, has been designed for the year 2023. Up to the first half of 2023, STEG employees benefited from three vocational training sessions with the National School of Engineering of Tunis (ENIT) for 30 employees, of whom 50 percent are women.

Figure B3.3.1 Partnership programs with STEG

Partners	Description and composition of scenarios
• National School of Engineers of Tunis - **ENIT** • **QehnA** Laboratory	• **Initial training:** Update of the IMPRESA-TEAM Master by adding an optional semester focused on STEG issues. • **Continuing education:** Construction of a Smart Grid training catalog through the QehnA lab platform. • **Research & Development:** Collaboration of ENIT & QehnA PhD students with STEG for the treatment of subjects and problems in the field.
• Higher School of Communications of Tunis - **SUPCOM**	• **Initial training:** Update of the engineering cycle via the reinforcement of E-Energy modules and the addition of optional modules in Smart Grid. • **Continuing education:** Construction of a qualifying training cycle for STEG Smart Grid engineers. • **Research & Development:** Involvement of STEG in the SInERT project, aimed at developing innovative solutions for renewable energy management in Tunisia and Italy.
• National School of Advanced Sciences and Technologies of Borj Cédria	• **Initial training:** Co-construction of the REMO (Energy Technologies and E-mobility) master's degree. • **Continuing education:** Construction of a Smart Grid training catalog by capitalizing on the LARINA lab platform. • **Research & Development:** Involvement of STEG in the REMO project, in collaboration with Germany and Morocco and focusing on R&D in E-Mobility.

Note: ENIT = National School of Engineering of Tunis; ENSTAB = National School of Advanced Sciences and Technologies of Borj Cédria; R&D = research and development; STEG = Tunisian Electricity and Gas Company; SUP'COM = Superior School of Communication of Tunis.

Box 3.4 Case study: coordination between the TGBC and the doctoral school "Architectural Sciences and Engineering"

The Tunisian Green Building Council (TGBC) is coordinating with the doctoral school "Architectural Sciences and Engineering" under the National School of Architecture and Urbanism (ENAU), which will develop knowledge related to new information and communication technologies as part of a university training course, "Energy BIM." All buildings sector actors in Tunisia can acquire a master's degree through this course.

Training of these actors in Building Information Modeling will ensure expedited support to the Tunisian construction sector toward the national energy transition, which is the challenge to be met as part of the degree.

The TGBC is coordinating with the Order of Tunisian Architects (OAT), the Order of Tunisian Engineers (OIT), and proficient private sector actors in this field, as well as the construction sector and the Ministry of Equipment, to extend training to all these actors and formulate technical specifications for the universal application of this process to all new constructions.

DIGITAL ECONOMY, TECHNOLOGY, AND INNOVATION

Digitalization is a driver of the energy transition (EY 2020). Digital technology appears to serve as a solution to address difficulties encountered in different phases of projects (Renewable Energy Union 2022):

- Development and design phase: Monitoring, data access, simulation and modeling tools, and so on
- Installation and construction phase: Optimization of organization and controls on construction sites
- Operation and maintenance phase: System optimization.

Digitalization implies the use of new technologies and requires adapting the regulatory framework (industry performance standards, technical requirements, codes of practice) (EY 2020), and the jobs and skills in the value chain. Although digital technologies have indeed made numerous contributions, their use in the energy sector requires regulations, data interoperability among different actors, and data security (Renewable Energy Union 2022). This requires expanding the workforce's skills on these topics. The development of new technologies and the evolution of the related regulatory framework thus create jobs adaptation of existing jobs based on the demand for new skills.

JOB CREATION

The information technology (IT) and digital sectors are at the forefront of job creation driven by the development of the digital economy and technologies, and innovation within the energy transition.

Tunisia has many trained computer engineers, who are in high demand for creating software and applications for local and international companies. The number of software used is only going to increase, and will have to be created. Such software includes:

- Energy simulation software, to model the energy performance of a building, a production system, or an energy network; and

- Energy monitoring software, to monitor energy consumption in real time, identify sources of energy savings, and monitor equipment to detect possible malfunctions (e.g., in the context of energy audits, for the operation and maintenance of infrastructure for energy efficiency in buildings).

Thus, the creation of these digital solutions, the training of future users, and the resolution of related technical issues will create job and skill requirements within IT companies.

Aside from resolving technical issues, companies would need technical support to maintain their IT infrastructure and network in general (including the above software). IT support services are also in high demand in Tunisia.

Tunisia's energy sector will also need a variety of data science professionals to effectively manage energy production and consumption data, optimize energy production and reduce costs, and help companies make strategic decisions, especially in projects' design phases. Companies will have a growing need for *data scientists* and *energy modeling engineers*, among other skill profiles.

Finally, the development of other sectors (through innovation) should facilitate demand growth and, in turn, growth of renewable energy projects (e.g., electric vehicles and green hydrogen through electrolysis and battery storage). The emergence of these technologies should thus stimulate job creation in the respective sectors (research and development, construction, maintenance, trade, technical advice, after-sales service, etc.) as well as in the renewable energy sector, which will see greater growth as technologies develop.

JOB CHANGES

Apart from the job creation mentioned above, many professions will have to evolve to adapt to this technological evolution. For example, *smart grids* require advanced skills in electrical and electronic engineering as well as telecommunication. This requires the substantial development of new skills and competences (RES4MED 2018).

Energy engineers will play a key role in the energy transition and will be crucial in articulating these values by guiding the workforce to manage changes. The use of new technologies will require revised industry performance standards, technical requirements, and codes of practice. To establish policies and regulations in these areas, energy engineers will need to understand the fundamentals of the energy transition as well as familiarity with regulators' new requirements (EY 2020). Following are the related key skills and competencies:

- Development of a policy and regulatory framework for technology advancement
- Energy strategy planning and governance
- Public health and safety management.

Cybersecurity will also become a growing concern from the increasing use of digital technology to manage and connect electrical engineering systems. Companies must be capable of minimizing vulnerability through establishing adequate measures (EY 2020). Following are the related key skills and competencies:

- Application of a cybersecurity framework
- Cyber incident management

- Cyber risk detection and monitoring
- Security audits for operational technology
- Security management for operational technology.

The use of digital models (Building Information Modeling) is a growing expectation among Tunisian buildings sector professionals. However, there is a shortage of training on the subject for private sector designers (architects, engineers, and control offices) and controllers in the public sector (administration and certification bodies).

The smart buildings sector (which involves smart grid development) is also a future market for optimizing energy efficiency in buildings. New professions are emerging in this sector, especially in the field of consulting, for example, energy advisors and energy managers. Thermal renovation targets call for more skilled labor, more new materials, innovation, and project and site management skills. Renovating residential housing to control energy consumption will reduce thermal use and create qualified jobs, alongside the renovation of tertiary buildings[9].

Finally, there is substantial job potential in customer relations roles in the labor market. With consumers becoming an active element in smart grids (box 3.5), direct customer interaction with them is strengthened, in turn creating a demand for managerial, relational, and commercial skills.

Box 3.5 Case study on the job-creation potential of smart grids

Smart grids are electricity networks that enable optimal electricity flow management in real time between suppliers and consumers. They make electricity networks energy efficient by minimizing losses. Smart grids are a component of the smart city concept and help mitigate greenhouse gases. They form part of an approach to decentralize electricity production by bringing closer production and consumption points (RES4MED 2018).

In October 2016, Tunisia began an experiment with 154 smart meters, which were installed in the districts of Ezzahra and El Kram. At the end of the experiment, the Tunisian Electricity and Gas Company (STEG), on December 3, 2020, launched an international call for tenders for acquiring new smart meters. Over 50 companies participated in the call for tenders, including a third of Tunisian origin. It will take 8–15 years to convert all the meters (3.6 million of them) into smart meters. Tunisia aims to have only smart meters by 2029.

The above project comprises two phases: the first phase (2022–25), financed by Agence Française de Développement (AFD), will involve the deployment of smart meters in three areas covering the largest consumers, Sfax city and Kerkennah, Sousse city and Sidi Bouzid, and Le Kram and Beja. The second phase (2026–30) will involve the infrastructure's deployment in the rest of the territory. This first phase involves equipping the above three areas with approximately 510,000 electric and low-voltage/low-pressure gas smart meters.

The project will also deploy 26,000 medium-voltage smart meters for large consumers across Tunisia. This project will enable STEG to improve service quality, control the electricity demand, and promote renewables' penetration in the electricity mix.

The project was structured in six lots and selected five international and national companies, which entered into partnerships.

[9] Tertiary sector buildings include all of the infrastructure occupied by public authorities, associations and companies providing services.

As a follow-up to this initiative, the Chinese multinational Huawei and the Industrial Company of Electrical Equipment and Equipment (SIAME) signed a technology partnership agreement to develop an integrated smart metering solution that is dedicated to STEG and will subsequently be adapted to other customers in Africa and the Middle East.

Smart grid deployment involves a variety of technologies and requires the support of multiple actors:

- **Electrical and digital equipment manufacturers.** They manage and install equipment that ensures network security and operation. They are the major technical players in smart grid development.
- **Traditional players.** Electricity producers (STEG, Enel, EDF) supply electricity transmission networks and must be able to respond to demand in real time. Smart grid development allows connecting decentralized producers of small capacities (e.g., wind turbines or photovoltaic panels belonging to individuals). It also involves transmission and distribution system operators.
- **Telecommunications players.** Microsoft, Cisco, IBM, Atos, or Google, and processor and computer system managers, such as InfoVista, Intel, or Cisco Systems, develop the information technology essential for smart grids' operation.
- Finally, smart grid development also involves new players (aggregators, demand response managers, downstream service providers, electric vehicle charge manager, etc.), new services (demand management), and new technologies (advanced decision-support interfaces, user applications [e.g., meters, displays, energy managers]).

Sources: RES4MED 2018; TN24 2020.

HUMAN CAPITAL

Tunisia's job market is characterized by low labor-force participation of women (39 percent, compared with 61 percent of men at the end of 2022), a high youth unemployment rate (38.8 percent of the unemployed were aged 15–24 at the end of 2022), and a significant share of informally employed workers (National Institute of Statistics 2022).

The high unemployment rate across the various skill levels required to realize the projects in question (unskilled labor, technicians, engineers, etc.) presents companies with an opportunity to find the required labor when executing projects (National Institute of Statistics 2022). However, several studies show a correlation between educational attainment and unemployment. This stems from a mismatch between enterprises' qualification requirements and the qualifications acquired during the study (ITCEQ 2022). Thus, Tunisia indeed has available labor, provided by higher levels of education (master's degree) to correct the mismatch between the skills acquired and those required by companies.

Women's and young individuals' low labor market participation represents an opportunity for the energy transition, considering they constitute an important pool of workers who can be qualified for renewable energy and energy efficiency professions. Their participation would increase companies' chances of finding suitable candidates and allow Tunisia to make the energy transition a source of socioeconomic benefits for the country. It is, therefore, a question of successfully implementing actions to promote increased integration of women and young individuals into the renewable energy and energy efficiency sectors.

INTEGRATING WOMEN INTO THE ENERGY TRANSITION

Tunisia's renewable energy and energy efficiency sectors continue to see limited representation of women—merely 28 percent of these sectors' workforce. When they are present, they primarily occupy administrative positions: women occupy 54 percent of the administrative positions in these sectors, compared with only 22 percent of technical positions and 6 percent of management positions (ANME and GIZ 2018).

Regarding technical positions with low qualification requirements, women's low representation can be explained by their low presence in vocational training (12 percent) (MIME 2021). For example, ANME trained 1,230 PV system installers and maintainers between 2017 and 2022, of whom "*only 13 percent were women*."[10] The challenge, therefore, is to encourage women to enroll in training of this type.

For managerial and top management positions (including engineers), women's low representation is not explained by their low presence in the associated education systems—since they represent 58 percent of university students (MIME 2021). The challenge, therefore, is to ensure (1) these students get a job in the renewable energy and energy efficiency sectors, and (2) that they remain employed in these sectors, for nonadministrative professions.

These results appear to be consistent with the online survey's results: women represent, on average, only 31 percent of the employees in the companies that responded to the online survey.

Several challenges, primarily cultural challenges, explain the low female workforce representation. First, gender stereotypes and the lack of female representation and role models in the renewable energy and energy efficiency sectors can discourage women from considering careers in these sectors, especially for technical and scientific positions.

Also, women may struggle to reconcile their professional lives with family responsibilities, which can prevent them from pursuing a career in renewable energy. Lack of encouragement and support may also hinder women from pursuing careers in these sectors.

According to the International Renewable Energy Agency (IRENA 2019), 60 percent of men perceive no gender barriers for women to work in the renewable energy sector, compared with 25 percent of women. This perception gap suggests that affirmative action policies favoring women are unlikely, given men's predominant presence in top management.

INTEGRATING YOUNG PEOPLE INTO THE ENERGY TRANSITION

Tunisia has very high unemployment rate among young individuals, especially young graduates: between 2007 and 2020, the unemployment rate for postsecondary graduates increased. It reached 26.6 percent at the end of 2020 and slightly decreased to 24 percent in 2022. In the companies responding to the online survey, only 23 percent of employees are below 25 years, on average.

At the same time, the number of graduates trained each year in the energy sector stagnates or even declines depending on the training level (STEG and EY Tunis 2022):

[10] Quote from a local stakeholder' interview.

- Bachelor's degrees comprise the majority of postsecondary graduates, yet the annual count of such graduates has been declining: the number of graduates with a bachelor's degree with an energy-related specialization declined by -4 percent on average over 2015–19. In 2019, 20 percent of graduates with a bachelor's degree had skills related to the energy sector.

- The number of employees in the energy engineering sector decreased slightly between 2015 and 2019 (-1 percent, with an increase in 2015–17 and a decrease in 2017–19). In 2019, 60 percent of engineers had skills related to the energy sector. Training offers in energy efficiency are poorly diversified, predominantly comprising modules in other specialties.

- Enrolment in master's programs increased slightly between 2015 and 2019 (+1 percent, with a decrease in 2015–18 and an increase in 2018–19). In 2019, 20 percent of master's students had energy-related skills. The private sector has marginal contribution to training offers at the master's level.

Despite minimal or no changes in the number of graduates entering the market each year, youth unemployment is on the rise, potentially attributable to the modest growth of the renewable energy and energy efficiency sectors. Greater dynamism would be the first element to bolster youth's employment prospects.

Youth's integration into the labor market would be hindered by several elements even if we assumed that the state's renewable energy and energy efficiency objectives would be achieved, causing increased dynamism in these sectoral markets.

First, those involved in training and education struggle to perceive the real skill needs of enterprises, especially because companies themselves struggle to identify their future needs in view of the market's weak dynamism. Market growth would require constant communication among education actors and companies to adapt courses, with dedicated governance for such communication.

Further, the interviews revealed that young graduates often lack on-field experience related to the positions and missions they are applying for, discouraging companies from hiring them. Indeed, companies often have limited manpower and want to recruit qualified individuals to compensate for their low staff strength and the lack of means to train young recruits. This is especially for calls for tenders, for which they must demonstrate their ability to perform the requested tasks despite their small size. Boosting practical learning (internships, apprenticeships, etc.) among young students could enable them to enter the labor market with more practical knowledge.

At the same time, young individuals without a degree but with experience are occasionally not hired by companies which specifically consider their lack of theoretical knowledge in renewable energy or energy efficiency. Imparting theoretical knowledge to them would increase their employability for renewable energy or energy efficiency companies. Youth find it more difficult to obtain or gather the funds necessary to register for and pursue existing renewable energy and energy efficiency certifications.

Finally, the unequal distribution of energy transition projects, especially renewable energy projects, on the Tunisian territory creates employment barriers for youth. The challenges are worse for those living in regions where only a handful of energy companies are located. They are compelled to move to other governorates, where the job demand is higher.

EMPLOYMENT INFORMALITY IN THE ENERGY TRANSITION

Tunisia has high employment informality. According to data from the Labor Force Survey, in general, nearly 520,000 informal own-account workers were estimated to be active in 2019. However, there is no information on the number of companies operating without registration with tax authorities. Nearly half the private sector's workforce is employed informally. In 2019, 1.55 million of nearly 2.80 million private sector employees were informal, with an average informality rate of 43.9 percent. Informality is considerably higher among the self-employed (87.7 percent) than among salaried workers (29 percent).

The interviews revealed multiple reasons for employment informality. For the renewable energy and energy efficiency sectors, the lack of market dynamism is deterring companies from formally employing people for primarily low-skilled jobs since they fear that "the market will not develop eventually and that they will need to lay off employees afterwards."[11]

The private renewable energy companies interviewed for this study attribute this phenomenon to their lack of confidence in the future development of this sector's activity. Companies are more interested in hiring informally for specific project durations, rather than hiring with open-ended contracts, at the risk of having no current or future projects but with salaries to pay. For the renewable energy sector specifically, administrative complexities received multiple mentions during interviews (e.g., related to electricity grid connections), implying that companies are more reluctant to hire on permanent contracts, and therefore "prefer to promote informal employment."[12]

Similarly, the interviewed companies stated that changes in state decisions (especially due to frequent changes of government) regarding solar PV or wind project authorization and implementation affected the visibility on potential future projects, and thus future human capacity needs. For example, companies are unsure whether renewable energy development will mainly involve developing a few large projects (with low local integration) or the development of multiple small projects (with strong local integration). This lack of long-term visibility "pushes companies to not recruit sustainably."[13]

Finally, companies mentioned connection issues as an obstacle to investing in renewable energy development (at the risk of working on slowed down, halted projects, etc.).

This creates social issues for the engaged workers, who cannot benefit from social protection (health insurance, country leave, etc.), and struggle to access finance, which could allow them to access new opportunities (including training that would let them find long-term formal work in the renewable energy and energy efficiency labor markets).

This also hinders skill development in the renewable energy and energy efficiency markets. Since workers face an uncertain situation and lack easy access to finance, they struggle to access certification training on their own since it is generally paid. Also, companies hiring informally do not see any incentive to pay for their certification training since they view these employees as "temporary." This lack of upskilling for low-skilled employees reinforces the weak market dynamics and the skill shortage identified in the market (e.g., for energy efficiency masons).

[11] Quote from a local stakeholder's interview.
[12] Quote from a local stakeholder's interview.
[13] Quote from a local stakeholder's interview.

Employment informality could be countered if private companies have better market visibility and are obligated to conduct medium- or long-term certification training to enable employees to find renewable energy and energy efficiency jobs. This will boost the market and promote greater workforce upskilling.

This is not an issue in the public sector, however, since STEG is subject to the public administration's recruitment-related rules and regulations.

EVOLUTION OF PUBLIC SECTOR EMPLOYMENT DYNAMICS IN THE ENERGY TRANSITION

STEG has over 13,000 employees, of which over 3,000 are reservists (former STEG employees), who can be called upon any time. It is the largest employer in the electricity sector.

STEG recruits through competitions held every three years on average. Upon the publication of the decree related to the competitions for entry into public energy companies, thousands of applications are received, granting these companies ample options for expertise and skills.

However, STEG's recruitment system does not necessarily ensure companies have the right skills at the right time. Indeed, it takes three years on average to actually hire the people with the right skills after STEG directors have identified the skills. However, the renewable energy sector is evolving very rapidly, creating a very high risk of a mismatch between STEG's needs and its employees' skills. Further, although reservists can be mobilized to fill this skill gap, their skills are not tracked, and it is highly likely that they have not acquired the skills STEG seeks today.

Finally, there are recruitment flows from the public sector (from STEG in particular) to private companies, especially in experienced roles.

DEPARTURE OF QUALIFIED AND EXPERIENCED EMPLOYEES ABROAD

Companies (private and public) are facing a growing challenge of highly qualified employees, especially engineers, moving abroad (especially to Europe and the United States).

These departures are due to three reasons:

- More lucrative salaries abroad
- Lack of perceived opportunities, due to a high unemployment rate, especially for the most highly educated
- Lack of dynamism of renewable energy and energy efficiency markets and lack of market visibility for companies—leading employees to be unable to anticipate future improvements.

Essentially, renewable energy and energy efficiency businesses are facing increasing challenges to finding highly skilled and experienced personnel, who are crucial for the development of energy transition projects. These departures are particularly observed for certain roles:

- Project management engineers (including electrical engineers, with at least five years of desired experience) in charge of seamless project execution
- Engineers or senior technicians working as site managers, in charge of smooth site operations
- Electrical engineers, specifically involved in the entire renewable energy value chain
- IT engineers in charge of developing connected networks
- Data analysis engineers in charge of climate, economic, and financial modeling.

This brain drain is a risk for companies in the renewable energy and energy efficiency sectors. Indeed, any increase in this trend would compel these companies to continuously train new employees, without being able to capitalize on the skills already transferred during previous training. This would imply an additional cost for the company (over the cost incurred due to recruitment) and a barrier to companywide skill expansion and know-how increase.

4. RECOMMENDATIONS TO PROMOTE THE ENERGY TRANSITION'S CREATION OF JOBS

The main recommendations of this study are to:

- Enhance collaboration between education- and training-related stakeholders and the companies involved in the clean energy transition;
- Facilitate workforce upskilling through the creation of training programs or improvement of existing training programs; and
- Promote an inclusive energy transition that can create jobs for youth and women.

Each recommendation is elaborated on below. Table 4.1 summarizes the recommendations, with subrecommendations. Additional details are provided in appendix 14, including the suggested governance for each of these recommendations.

RECOMMENDATION AREA 1: ENHANCE COLLABORATION AMONG EDUCATORS, TRAINERS, AND COMPANIES

The renewable energy sector has both the Tunisian Electricity and Gas Company (STEG) and private companies. Private companies are mostly small, with limited growth potential, and struggle to anticipate sector dynamics, in turn investing minimally in employee training. They tend to prefer hiring trained individuals experienced in either conventional energy or renewable energy, depending on the specific role. Similarly, the sector focused on building energy efficiency predominantly includes small companies with limited visibility on the sector's development. They hire a limited number of energy efficiency specialists, which in turn creates a vicious cycle that hampers sector growth and workforce upskilling.

Companies' limited visibility of the growth of the renewable energy and building energy efficiency sectors hinders them from identifying their job requirements, including the number of jobs and in-demand skills, even when they consider potential sectoral growth. This results in the education and training sectors struggling to anticipate companies' needs and adapt curriculum content accordingly. Although educational institutions and companies do collaborate, especially in codeveloping academic programs, these interactions remain infrequent and lack strategic coordination. Examples of such collaborations include federated research projects, which facilitate skill development projects and are jointly governed by education- and energy-related stakeholders. However, federated research projects have only resulted in limited pilot projects and have not been implemented on a large scale. Similarly, a postsecondary council has recently been established to issue recommendations in the fields of education, teaching, scientific research, vocational training, and employment (Jurist Tunisia 2022). However, despite its broad scope, this council does not specifically address the sectors examined in this report, and its recommendations are updated at an unknown frequency. The absence of a dedicated strategic body for energy-transition-related skill development, thus, poses a risk of skill mismatch.

To overcome this difficulty, the existing mechanisms for skill identification and development in the clean energy transition's context could be strengthened, through the creation of two sectoral competence councils (SCCs) (recommendation no. 1.1)—one each for renewable energy and energy efficiency in buildings. These councils

would be linked to the Ministry of Industry, Mines and Energy (MIME) and could be established based on the postsecondary council, which constitute cross-governance bodies between education and business actors. The SCCs would comprise representatives of the education and training sectors (including vocational training), as well as representatives of the companies in the relevant sectors, and would primarily aim to strengthen strategic and sustainable collaboration between these two types of actors, toward skill development specifically in the relevant sectors. Representatives of existing bodies (including the postsecondary council mentioned above) could share their work and conclusions within the SCCs. The objective would be to set up programs and actions to match training offers with the needs of the companies operating in renewable energy and energy efficiency in buildings. This collaboration would also allow the education and training sectors to shift from a skill-supply-based approach to a skill-demand-based approach.

Alongside skill identification and development efforts, the government's energy transition objectives must align with the aim of maximizing job creation through project development. This will ensure that project implementation becomes an optimal employment creation driver. Efforts should thus be directed toward encouraging the development of small-size renewable energy projects (recommendation no. 1.2). In Tunisia, small- to medium-size projects involve many local companies (especially small and medium enterprises, SMEs), whereas large projects promote the involvement of foreign groups, allowing more limited local job creation. Small-size projects could thus be given more prominence in the government's objectives. For this, the government could include in its renewable energy development strategy a specific target for the proportion of small-size projects that will contribute to the overall generation capacity goal. Setting this target could allow the government to prioritize the development of smaller-scale projects and ensure they make significant contributions to achieving the desired renewable energy generation capacity. In particular, the ministry could promote project development under the self-generation scheme and encourage the creation of projects of 1 megawatt or less under the authorization scheme. However, there must be diversity in the distribution of project sizes to ensure the related benefits (the largest projects allowing a cost reduction, for example).

Table 4.1 Summary of recommendations

Recommendation	Related challenge	Priority	Complexity
		Low: ●○○ High: ●●●	Moderate: ●●○
1 • Enhance collaboration among educators, trainers, and companies			
1.1 • Strengthen existing initiatives to identify and cultivate skills needed for the energy transition	In a few initiatives, educators and companies are already working together to identify and develop skills—for example, by co-designing academic programs, federating research programs, or forming a postsecondary council. However, these initiatives either are too narrow in scope (pilot projects) or are not specific to the clean energy transition, often resulting in a mismatch of skills.	●●●	●●●
1.2 • Encourage the development of small renewable energy projects within larger government plans to deploy renewable energy	While small projects in Tunisia involve many local companies (especially small and medium enterprises), large projects are less likely to create local jobs because of the preponderant involvement of foreign groups.	●●○	●●●
2 • Raise the skills of the workforce by creating or improving training programs			
2.1 • Strengthen STEG's upskilling programs to facilitate the company's transition to renewable energy	STEG has developed training programs to raise its employees' skills and their ability to operate in the renewable energy sector. However, these programs, which are aimed at compensating for the company's time-consuming recruitment process, suffer from flaws that hamper STEG's transition into renewable energy.	●●○	●●●
2.2 • Develop national programs to strengthen the skills of trainers working in ANME-accredited training centers	The companies interviewed for the study emphasized a need to make vocational training more rigorous, in part to help companies prevent damage to their reputation from the actions of poorly trained workers. However, ANME has insufficient human resources to thoroughly monitor the quality of training offered in its accredited training centers.	●●●	●●○
2.3 • Facilitate the workforce's access to short-term vocational training	Although short-term vocational training is effective in retraining workers, it often relies on foreign funding sources, such as development banks. The long-term sustainability of such funding is not assured. Requiring would-be trainees pay for online training in foreign currency often prevents them from making use of such resources.	●●●	●●○
2.4 • Offer students of renewable energy and employees of companies in the sector training in administrative and financial management of projects	Renewable energy projects may be hindered by a shortage of administrative and financial capacity. The job market lacks applicants with skills in renewable energy as well as finance.	●●●	●●○
2.5 • Expand existing training for bank employees to cover the specific requirements of renewable energy projects	International donors (the World Bank, the German Agency for International Cooperation) and ANME have developed a program to train bank employees in the specific aspects of renewable energy. This initiative has not been extended to cover all banks, however. Meanwhile, the banking sector struggles to retain employees possessing with dual technical and financial skills.	●●●	●●○
2.6 • Mandate that academic curricula include training in insulation materials and	Increasing the energy efficiency of buildings may be held back by (1) a deficit of skills in insulation materials and techniques, and (2) a lack of	●●○	●●○

techniques used in building construction and renovation	postsecondary programs in energy efficiency for buildings (especially with respect to building renovation).		
3 • Promote an inclusive energy transition that creates jobs for young people and women			
3.1 • Enhance practical training components in academic curricula focused on renewable energy and energy efficiency	The companies interviewed for this study mentioned a lack of practical training (as opposed to theoretical training) as a major obstacle to recruiting qualified young graduates.	●●●	●●○
3.2 • Require at least one module on renewable energy and one on the energy efficiency of buildings in all energy training programs, especially those for senior technicians	Heterogeneous development of renewable energy and energy efficiency in buildings poses a dual unemployment risk for young graduates who lack versatility because they specialized either too soon or too late.	●●○	●●○
3.3 • Provide free and systematic training in renewable energy and energy efficiency of buildings to young people who are unemployed for a long period or are under CIVP contracts	Young graduates struggling to find employment may lack theoretical and practical skills specific to renewable energy and building energy efficiency. However, they often cannot afford the required training and certification.	●●○	●●○
3.4 • Create communication campaigns focusing on women working in the renewable energy and energy efficiency sectors, especially those in technical positions	Gender stereotypes and the lack of female representation and role models can discourage women from considering careers in renewable energy and energy efficiency for buildings, especially in technical and scientific roles.	●●○	●○○
3.5 • Create incentive mechanisms to encourage women's participation in low-skilled technical training programs	Women's limited participation in low-skilled technical training programs means they are poorly represented in the sector and related positions.	●○○	●●●
3.6 • Create incentive mechanisms to increase the share of women in highly qualified positions (including top management positions) in companies involved in renewable energy and energy efficiency in buildings	The low representation of women in highly qualified positions (including engineers) and top management is not explained by their low presence in the associated education systems. Instead, it can be attributed to companies lacking policies to attract and retain women.	●○○	●●●

Note: ANME = National Agency for Energy Management; CIVP = Professional Life Integration Contract; STEG = Tunisian Electricity and Gas Company.

RECOMMENDATION AREA 2: RAISE THE SKILLS OF THE WORKFORCE BY CREATING OR IMPROVING TRAINING PROGRAMS

Steps can be taken urgently to facilitate upskilling of the current workforce and young graduates. The resulting skill development requires improving existing training programs and creating additional programs to develop the skills not present in the labor market.

For STEG, hiring applicants takes on average about three years from the identification of jobs and the related skills requirements. Considering the renewable energy sector evolves rapidly, STEG runs a high risk of a mismatch between its skill requirements and its employees' skills. While STEG includes a capacity-building component in all calls for tenders, it alone is not sufficient to address the skill development deficit. The component falls short in two aspects: first, it does not provide training for all staff members in need of training, and second, it does not cover all the required skills in the sector. For instance, while training is conducted for smart grid technicians,

other employees should also benefit from it. By contrast, these training programs of STEG do not cover certain essential skills, such as the management of users' personal data.

To overcome this challenge, STEG has launched projects that are led by its training department. These projects include, for example, those cocreated with universities, as well as an e-learning platform that is available for all employees. However, these projects are only partially implemented and are not based on an analysis of STEG's future skill and job needs. STEG's employee upskilling programs could thus be improved to facilitate its renewable energy transition (recommendation no. 2.1). These programs could be improved in two ways. First, program implementation oversight could be improved to ensure effective skill enhancement for all targeted employees. Second, the training content could be defined based on prospective analyses of the company's needs. This training could be conducted either by STEG employees or by external trainers if needed. Practical training could also be included. These programs would allow STEG to gain agility in obtaining skills specific to renewable energy, to compensate for its time-consuming recruitment process.

In the private sector, workforce upskilling requires vocational training programs, offered by ANME-accredited centers. To enhance workforce training and improve skills, it would be ideal to establish national programs for the skill enhancement of trainers in ANME-accredited training centers (recommendation no. 2.2). The companies consulted for this study highlighted that some certification programs could be more rigorous (more pedagogical trainers, better quality teaching, etc.) to help renewable energy and energy efficiency companies prevent reputational issues. This is based on past experience with companies with inadequately trained individuals. Raising trainers' skill levels makes training more rigorous and helps ensure that those with certification are sufficiently qualified to work on renewable energy or energy efficiency projects. This would facilitate the sector's growth and allow companies to reduce their training need for new employees as well as training costs, and become more efficient.

Trainers' skills could be strengthened through the implementation of two measures. First, the National Center for the Training of Trainers and Training Engineering (CENAFFIF) could have better resources to train any trainer in pedagogy and andragogy (adult training), in turn ensuring they have the skills to pedagogically deliver their technical knowledge. Second, ANME could have better human resources to conduct more surveys on the quality of the trainers in its training centers. For example, it could conduct quality surveys with companies, universities, and so on. To ensure an impartial and consistent evaluation of the trainees at the national level, examinations in question should be relocated to a location different from the training centers. The objective is not to standardize training, but to ensure trainers have the right hard and soft skills. It should be possible to adapt ANME's controls and CENAFFIF's training over time to avoid training being deemed "archaic."

At the same time, strengthening ANME's human resources would allow the agency to assess whether certification training should be made mandatory. The question arises particularly for training related to insulation materials and insulation techniques (as these are needed to enhance energy efficiency in buildings) since companies consider these skills crucial, yet the job market has a scarcity of them. The objective is to ensure the workforce is sufficiently qualified to provide quality services, thus contributing to sectoral growth and the promotion of construction workers' retraining.

Considering short-term vocational training programs have high success rates, as reported by the National Agency for Employment and Self-Employment (ANETI), it becomes even more important to further enhance and improve these programs, which are relatively inexpensive for workers, owing to their limited duration. Longer training

programs exist but are less affordable since workers need access to finance and suffer a significant income loss due to prolonged absence from work. However, short-term vocational training is usually funded on an ad hoc basis by international stakeholders (e.g., international donors). This funding is thus not considered sustainable and could end abruptly.

Thus, workers' retraining should be facilitated by further promoting access to short-term vocational programs (recommendation no. 2.3). The government could increase its funding for relevant training centers (1) to allow them to benefit from sustainable funding and (2) to allow the development and creation of more classroom-based or online short-term training if necessary (according to the conclusions of ANME's work, as described under recommendation no. 2.2). Training should enable the beneficiaries to obtain diplomas, which they can use to obtain funding if they wish to start their own businesses.

These training programs will leverage pilot actions of international stakeholders, which have demonstrated notable success in terms of professional reconversion. International stakeholders wishing to finance training of this type could either continue to fund projects as executed today or finance a training-related fund to be cocreated by the Ministry of Employment and Skills Training (MEFP) and MIME. Stakeholders will need to coordinate with relevant institutional and private actors (e.g., Tunisian Agency of Professional Training [ATFP]/ Tunisian Union of Industry, Commerce and Handicrafts [UTICA]) to launch these training programs in other centers and update them regularly.

Online retraining courses are considered expensive. The government could help remove this obstacle by funding training centers—potentially allowing them to purchase online training licenses through foreign currency payment—and collaborating with them could ensure the training programs are offered in local currency. The government could also consider other facilitation mechanisms. Considering energy transition technologies and the related market are evolving rapidly, workers could benefit from having access to a multitude of online and especially international training courses.

The companies consulted for this study also indicated that it is difficult to recruit workers with in-depth knowledge of both renewable energy and finance. Students of renewable energy and the companies in this sector should be offered training in administrative and financial management (recommendation no. 2.4). Administrative skills will be especially in demand by two actors: (1) SMEs, which must be able to set up administrative files and obtain the necessary authorization to put their projects into operation, and (2) actors specialized in supporting SMEs for realizing these administrative procedures. Financial skills will be mainly required by two actors: (1) SMEs, which must be able to furnish viable financing files to banking and financial actors; and (2) actors specializing in supporting SMEs in the financial structuring of their projects.

Skills for the administrative and financial management of renewable energy projects could be developed in two ways:

- **In the education sector.** Optional courses could be offered to engineers studying in the energy sector, especially to those wishing to work in renewable energy. This would enable them to obtain dual competences in renewable energy and finance.

- **In the vocational training sector.** Renewable energy companies could be offered training, delivered by ANME-accredited training centers, with their content probably created by external experts (such as the Banking and Financial Advisory [CBF], which represents the national banking and financial sector).

Before that, it will be necessary to conduct a study on the specific skills to be developed, to adapt the training content. Next, the training content should be sent to accredited training centers so that they can assess whether they have the right qualified trainers to conduct the training.

Similarly, current training programs for bank employees should be expanded, with an aim to develop administrative and financial skills specific to renewable energy and energy efficiency in buildings (recommendation no. 2.5). This training is essential to equip bank employees with the necessary knowledge and expertise to effectively support and finance projects in these sectors. This training is especially crucial considering the labor market scarcity of employees with in-depth knowledge in both renewable energy and finance. People with these dual skills are needed to evaluate and critically review the financing requests submitted by Tunisian renewable energy companies, especially SMEs, which at times struggle to submit complete and viable financing files.

International donors (World Bank, the German Agency for International Cooperation [GIZ]), and ANME have developed a program to train bank employees on renewable energy topics. The programs have, however, not been sufficiently scaled up and disseminated among all banks. Thus, there exist training programs as well as qualified trainers. The number of beneficiaries can be increased through continued and intensified efforts in this direction, including, for example, adding more trainers, using the banking sector's internal communication channels (through the CBF), and providing special offers to encourage banks to register for training (this may include discounts for early adopters or reduced rates).

The banking sector also struggles to retain professionals with dual technical and financial skills. This obstacle could be overcome by conducting a comprehensive study to identify positions suitable for these professionals and assessing the working conditions offered by employers. Insights into the prevailing conditions and requirements can help banks suitably modify their working conditions and requirements for these critical positions, in turn increasing their appeal. This would aid in employee retention.

Regarding the energy efficiency of buildings, the companies consulted during the study highlighted that the current workforce specifically lacks knowledge of insulation materials and techniques, and there is a lack of training on the use of Building Information Modeling for designers (architects, engineers, and controllers in the private sector, and controllers in the public sector). The resulting skill gap can hinder the development of certain projects due to a lack of manpower or create negative experiences for their customers, resulting in reputational issues and weaker market dynamics. Academic curricula related to buildings' construction and renovation could be mandated to include training on insulation materials and techniques (recommendation no. 2.6). This recommendation could be accompanied by a requirement that applicants complete postsecondary training programs in the energy renovation of buildings. This would benefit young graduates, who would be able to participate either in the conventional buildings sector or in that focused on energy efficiency in buildings, depending on the latter's growth. Making certification training on this subject mandatory for participation in efforts to promote the energy efficiency of buildings (following ANME's work; described under recommendation no. 2.2) could help students to obtain a degree that is equivalent to ANME's certification training.

RECOMMENDATION 3: PROMOTE AN INCLUSIVE ENERGY TRANSITION THAT CREATES JOBS FOR YOUNG PEOPLE AND WOMEN

SUPPORTING THE INTEGRATION OF YOUNG GRADUATES IN THE RENEWABLE ENERGY AND ENERGY EFFICIENCY SECTORS

Although the skills developed by education-related stakeholders are not entirely misaligned with companies' skill requirements, the unemployment rate among young graduates remains very high. This is mainly due to (1) a lack of practical training of young graduates and (2) a specialization that may be inconsistent with the sector's growth level.

The companies interviewed for this study mentioned a lack of practical training (as opposed to theoretical training) among young graduates as a major obstacle to their hiring. Hiring young graduates without practical training creates training needs that the companies in these sectors (usually SMEs) cannot or are not willing to provide. This is true for all skill levels and explains why some young graduates prefer to relocate and work abroad after completing their studies. Simultaneously, the consulted companies indicated that the labor market has a scarcity of experienced workers, especially for highly skilled positions, such as engineers, which demonstrates a growing trend of relocation and working abroad.

Including more practical training in academic curricula (recommendation no. 3.1) could equip young graduates to better meet companies' expectations in terms of professional experience and increase the number of suitable applicants. It could also make young graduates more loyal to their companies, in turn helping to retain experienced people. In the short term, partnerships between universities and ANME-accredited training centers could be further developed to allow students to benefit from training (including practical training) at a reduced price, for example. In the medium term, more structured nationwide initiatives, such as in-year internships and apprenticeship programs, can bridge the gap between academia and the professional realm for early-stage postsecondary students.

Currently, student internships are mainly in summer, when economic activity is relatively low. Internships could (1) change the corporate culture in terms of welcoming young learners and graduates and defining their role, (2) help young learners gain practical experience, and (3) promote the deployment of apprenticeship programs.

Further, companies appear unaware of apprenticeship programs. Apprenticeship programs could help address several of the challenges identified in this study. They: (1) aid in the successful implementation of the SCCs' recommendations by being a means to test the recommendations; (2) help young graduates acquire the necessary experience to be employable at the end of their studies, without having to pay for additional training; and (3) promote employer involvement in defining the content of education and thus foster links between educational institutions and industry.

The heterogeneous growth of the renewable energy and building energy efficiency sectors (depending on the implementation of projects relating to these sectors) poses a dual employment risk for young graduates, whose specialization may be either too premature (potentially putting them at risk of not finding enough job offers) and or too late (potentially putting them at risk of seeing the market saturated with job demand). It is thus important to enable them to build versatile job profiles, allowing them to work in the conventional energy and buildings sectors while being available to meet the future demand in renewable energy and energy efficiency in

buildings. Mandatory inclusion of at least one module on renewable energy or the energy efficiency of buildings in all energy training (recommendation no. 3.2) would allow young graduates to acquire the versatility expected today on the job market.

Although all young graduates wishing to be involved in the clean energy transition should develop this versatility, the related measure should target senior technicians as a priority. The companies consulted for this study indicated that the difficulty of workforce upskilling varied based on the qualification level. While companies consider it relatively difficult to requalify engineers (who have strong adaptability) and technicians (who can benefit from short-term training), it is more difficult for them to retrain senior technicians. Individuals in these roles are in charge of technical implementation of projects and must thoroughly understand their design-related and practical aspects. For this reason, it is important to provide all future senior technicians (such as students) with specific training in renewable energy or energy efficiency in buildings (depending on their original training) to help them build versatility, eventually aiding their professional retraining.

Young graduates without the specific skills demanded by renewable energy and energy efficiency companies may need to undergo dedicated training programs to develop these essential skills. However, young graduates—especially those who are unemployed—may find these training programs expensive. To facilitate upskilling and employment access, specific training in the skills demanded by renewable energy and building energy efficiency companies (provided by ANME-accredited training centers) could be offered systematically and free of cost to young graduates who are unemployed for a long time and youth under Professional Life Integration Contracts (CIVPs) (recommendation no. 3.3). This recommendation will build on existing ANETI mechanisms and will rely on the companies' initial commitment to hiring youth. Indeed, ANETI could reimburse the cost of training youth during preemployment or under CIVP contracts if companies commit to hiring them afterwards.

PROMOTING WOMEN'S PARTICIPATION IN THE RENEWABLE ENERGY AND ENERGY EFFICIENCY SECTORS

Communication campaigns on women working in renewable energy and energy efficiency in buildings — especially those in technical positions (recommendation no. 3.4)—could be created and disseminated (via television, social networks). The goal is to enhance women's capacity to envision themselves in the fields of renewable energy and energy efficiency, while also breaking down gender stereotypes in these sectors.

Women's participation in technical studies is currently low. This low participation is reflected in the sector, where few women are seen in low-skilled technical jobs. The goal is to encourage greater female participation in low-skilled technical training programs in a nonbinding manner, creating a pathway for increased representation in these training programs as well as subsequently within companies. To this end, training programs for low-skilled technical jobs in renewable energy and energy efficiency in buildings could include incentives for participation (recommendation no. 3.5). Especially as apprenticeships are being expanded nationally, implementing mechanisms like scholarships or grants for women could further promote their participation. Women under training could be provided mentoring sessions delivered by women in the sector.

Meanwhile, the small share of women in qualified and/or managerial positions cannot be attributed to their low rate of participation in the related training programs, since many women do participate in such programs. For these positions, the objective is to directly increase female representation. To this end, companies could implement incentives for qualified positions (engineers in particular) and managerial positions

(recommendation no. 3.6). For example, companies that justify the implementation of gender diversity policies could be favored in the context of responses to calls for projects. Companies could organize awareness workshops for employees to communicate the benefits of gender equality in the workplace. This could help create a more inclusive work environment. Companies could also offer flexible work policies, maternity leave, and parental leave to help women balance their professional and personal lives. This could encourage women to pursue long-term careers and take up leadership positions.

5. CONCLUSION

The Tunisian government has set ambitious targets for the growth of the renewable energy and energy efficiency sectors, notably through the February 2023 energy strategy. Several public, private, and international development banks have shown involvement in the sectors' growth, as well as to ensure that they create jobs in the country.

Renewable energy and energy efficiency expansion presents an opportunity for the creation of jobs (e.g., solar panel installers, energy management engineers, or building insulation technicians). The Tunisian energy transition does not necessarily imply job loss in the conventional energy sector, given the historical dominance of the public sector, which tends to prioritize internal employee retraining. Ensuring a just job transition mainly involves skill development for workers to participate in these sectors and the implementation of accompanying measures to facilitate retraining. It also requires assessing and then addressing current and future mismatches between labor market characteristics and the skill and occupation needs of these sectors. These changes offer an opportunity for the energy transition sectors to be more diverse, through greater inclusion of women and young workers.

This report highlights the challenges and opportunities related to job creation in renewable energy and buildings energy efficiency in Tunisia. It highlights the importance of ensuring a fair and inclusive career transition to these sectors and presents a set of short- to long-term measures to close the gaps between skill and job needs and the labor market.

The proposed recommendations include as the main measures the creation of sectoral competence councils, the establishment of national programs for skill enhancement of trainers in the National Agency for Energy Management (ANME)-accredited training centers, the integration of administrative and financial management training for students of renewable energy and the companies in this sector, and including more practical training in academic curricula related to renewable energy and energy efficiency of buildings. Implementing these recommendations requires cooperation and effective communication among all actors related to energy, employment, and education, both public and private.

This report can facilitate communication between companies and academic and university actors, to initiate discussions on aligning training provision with the current and prospective needs of enterprises. For this purpose, appendix 6 of the report contains a list of the companies that participated in the online survey shared as part of this study and agreed to make their contact available to academic actors.

Further, the conclusions of this report can enrich discussions between international development banks and the Tunisian government, with the aim of orchestrating large-scale programs to promote a fair transition of employment to the renewable energy and energy efficiency sectors and coordinate all the initiatives identified in this report.

Finally, the analyses in this report leave room for further studies to deepen some of the findings mentioned. The socioeconomic benefits of the energy transition could be evaluated quantitatively, as well as the possibility to relocate value chains across the Tunisian territory. Similar studies could also be conducted for other energy transition sectors, such as green hydrogen. These additional studies would complement the current road maps to ensure the transition and evolution of employment in Tunisia as part of the energy transition.

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APPENDIX 1 STAKEHOLDER INTERVIEWS CONDUCTED FOR THIS STUDY

Type	Name of company or organization	Date
Public		
Ministry	Ministry of Industry, Mines and Energy (MIME)	10/02/2023
	Ministry of Higher Education and Scientific Research (MESRS)	15/02/2023
	Ministry of Employment and Skills Training (MEFP)	23/12/2022
Nonadministrative institution	National Agency for Energy Management (ANME, 2 interviews)	21/12/2022 13/04/2023
Trade union	Tunisian Union of Industry, Commerce and Handicrafts (UTICA)	19/12/2022
	Trade Union Chamber of Photovoltaics of Tunisia (CSVP)	19/12/2022
	Confederation of Citizen Enterprises of Tunisia (CONECT)	21/12/2022
Cluster	TuniCREEE (2 interviews)	27/01/2023 15/02/2023
Research and development center	Center for Energy Research and Technology (CRTEn)	15/02/2023
Nongovernmental organization	Tunisian Green Building Council (TGBC)	31/01/2023
Association	Tunisian Professional Association of Banks and Financial Institutions (APTBEF)	24/02/2023
Nonadministrative institution	National Center for the Training of Trainers and Training Engineering (CENAFFIF)	17/04/2023
	Regional Training Center for Energy Management Professions	13/04/2023
	National Agency for Employment and Self-Employment (ANETI)	19/04/2023
Consultant	Sector Expert (Expert in Training Engineering)	20/12/2022
Consultant	Sector Expert (Renewable Energies)	01/02/2023
University	National School of Engineers of Monastir (ENIM)	15/02/2023
University	National School of Engineers of Tunis (ENIT)	24/02/2023
Private		
Enterprise	Tunisian Electricity and Gas Company (STEG, 2 interviews)	03/02/2023 28/02/2023
Enterprise	AMEA	03/03/2023
Enterprise	AURASOL	16/02/2023
Enterprise	CAMI Engineering	15/02/2023
Enterprise	Technical Center for Mechanical and Electrical Industries (CETIME)	09/03/2023
Enterprise	Mazarine	01/03/2023
Enterprise	Poulina Group	27/02/2023
Enterprise	Qair	23/02/2023
Enterprise	SCATEC	01/03/2023
Enterprise	SPECTRA	28/02/2023
Enterprise	BACK PV	08/03/2023
Enterprise	SNDP - AGIL	22/02/2023
Enterprise	Smart Energies	07/03/2023
Enterprise	TuNur	08/03/2023

APPENDIX 2 NATIONAL PUBLIC AND PRIVATE INSTITUTIONS AWARDING DEGREES IN FIELDS RELATED TO RENEWABLE ENERGY AND ENERGY EFFICIENCY

Tunisian institutions awarding an engineering degree in renewable energy and energy efficiency, or in related fields, are listed below.

Engineering degree		
No.	**Diploma**	**Institution**
1.	Electrical engineering	ENIT
2.	Electrical-automatic engineering	ENSIT
3.	Infotronics systems engineering: Renewable energy systems	ENI Carthage
4.	Energy systems and clean technologies (EETS)	UNSTABLE
5.	Industrial systems and competitiveness (CIS)	UNSTABLE
6.	Advanced electronics and nanotechnology (EAN)	UNSTABLE
7.	Instrumentation and industrial maintenance (IMI)	INSAT
8.	Industrial computer engineering: Supervision of energy systems	ENET Com Sfax
9.	Electrical engineering	ENIM
10.	Energy engineering: Thermal fluids	ENIM
11.	Energy engineering: Renewable energy	ENIM
12.	Energy engineering: Energy and environment	ENIM
13.	Energy engineering: Energy efficiency	ENIM
14.	Energy engineering: Electrical conversion of renewable energies	ENIS
15.	Energy engineering and environmental technology	ENI Gafsa
16.	Electrical-automatic engineering	ENIG
17.	Energy saving and sustainable development	Private Higher School of Technology and Management of Tunis (SUPTECH)
18.	Electrical engineering	Private Higher School of Engineers and Technological Studies of Tunis (UAS)
19.	Electrical engineering	Private Higher School of Engineering of Tunis (ESPRIT)
20.	Renewable energy engineering	Mediterranean Private Higher Institute of Technology
21.	Energy engineering	Institut Supérieur Privé Polytechnique, Université Libre de Tunis (ULT-ISP)
22.	Energy engineering: Thermal systems	Ecole Centrale Supérieure Privée Polytechnique de Tunis (UC-Polytech)
23.	Energy engineering: Energy and environment	Ecole Centrale Supérieure Privée Polytechnique de Tunis (UC-Polytech)
24.	Electrical engineering	Private Higher School of Engineers and Applied Technology Sousse (ESPITA)
25.	Electrical-automatic engineering	Polytec Sousse

26.	Electrical engineering	Private International Polytechnic School of Sousse
27.	Electrical engineering	Private Higher School of Engineering and Applied Technology/Sousse
28.	Industrial engineering: Air-conditioning and cooling	Private Higher School of Engineering of Monastir (ESPRIM)
29.	Electrical engineering	Private Polytechnic School of Monastir (Polytech Monastir)
30.	Electrical engineering	Private Higher Polytechnic Institute of Advanced Sciences of the South—Sfax (UPSAS)
31.	Energy engineer	Polytechnic of Advanced Sciences Sfax
32.	Electrical engineering	Private Higher School of Applied Sciences and Technology of Gabès

Tunisian institutions awarding a research master's degree in renewable energy and energy efficiency, or related fields, are listed below.

Research master's degree		
No.	**Diploma**	**Institution**
1.	Modeling in hydraulics and environment	ENIT
2.	Fluid and transfer physics	TSPS
3.	Nanophysics and nanotechnology	TSPS
4.	Soft matter physics	TSPS
5.	Condensed matter physics	TSPS
6.	Electrical engineering: Conversion and treatment of electrical energy	ENSIT
7.	Physics of materials	ENSIT
8.	Materials physics and applications	FSB
9.	Energy and processes	ISSTE
10.	Microsystems and embedded electronics: Sustainable mobility and clean energy	ISSAT Sousse
11.	Physics of materials of energies	Higher School of Science and Technology of Hammam Sousse
12.	Physics of materials	Higher School of Science and Technology of Hammam Sousse
13.	Renewable energy and energy efficiency for Middle East and North Africa (REMENA)	ENIM
14.	Energy engineering: Energy management	ENIM
15.	Physics of nanostructures and applications	WSF
16.	Electrical engineering	ISSAT of Kairouan
17.	Condensed media physics: Materials physics	FSS
18.	Condensed media physics: Nanostructure physics	FSS
19.	Electrical systems: Renewable energy	ENIS
20.	Mechanical engineering: Energetics	ENIS
21.	Innovative materials physics and energy management	FS Gafsa
22.	Energetic	FS Gafsa
23.	Mechanical and energy engineering	ISSAT Gafsa
24.	Energy: Sustainable energy and entrepreneurship	ENIG
25.	Electrical engineering: Smart systems and renewable energy	ENIG
26.	Physics of materials and nanomaterials	FS Gabes
27.	Process engineering: Energy and environment	ISSAT Gabes

Tunisian institutions awarding a professional master's degree in renewable energy and energy efficiency, or in related fields, are listed below.

Professional master's degree		
No.	**Diploma**	**Institution**
1.	International Master's Program on Renewable Energy Systems for Africa: Technology and Management (IMPRESA-TEAM)	ENIT
2.	Renewable energies, ERTA technologies and applications	TSPS
3.	Wind energy sciences and technologies (WESET)	ENI Carthage
4.	Energy	ISSTE
5.	Solar energy	ISSTE
6.	Integration of electronic systems dedicated to renewable energies	FSB
7.	HVAC engineering and energy management	FSB
8.	Energy efficiency of buildings	Higher School of Science and Technology of Hammam Sousse
9.	Energy engineering	ISSAT of Sousse
10.	Advanced instrumentation and application: Instrumentation for renewable energy	WSF
11.	Energy	FSS
12.	Electrical engineering	FSS
13.	Physics of materials	FSS
14.	Energy Economics and Sustainable Development (2E2D)	Higher Institute of Business Administration of Sfax
15.	Energy/energy engineering	Higher Institute of Biotechnology of Sfax
16.	Electricity system and renewable energy	ISSAT of Kasserine
17.	Energy systems engineering and energy management	FS Gafsa
18.	Energy management	FS Gafsa
19.	Electrical engineering	FS Gabes
20.	Electrical engineering	Higher Institute of Industrial Systems of Gabes
21.	Professional master in process engineering: New and renewable energies	ISET Gabes
22.	Professional master in electrical engineering	ISET Gabes
23.	Professional master in mechanical engineering: New and renewable energies	ISET Tozeur
24.	Energy engineering and renewable energies	Free University of Tunis (ULT)
25.	Energy and renewable energies	Institut Supérieur Privé Polytechnique, Université Libre de Tunis (ULT-ISP)
26.	Energetics/electrical engineering	Private Higher School of Engineers, Sciences and Technologies of Sousse (UPS)
27.	Energy saving and sustainable development	Private International Higher School of Sfax (EPISPS)
28.	Co-constructed in quality, safety, environment, and energy management	Private Higher School of Applied Sciences and Technology of Gabès

Note: HVAC = heating, ventilation, and air-conditioning.

Tunisian institutions awarding a bachelor's degree in renewable energy and energy efficiency, or in related fields, are listed below.

License degree (bachelor)		
No.	**Diploma**	**Institution**
1.	LPh physics	TSPS
2.	Physics and energy LPhE	TSPS
3.	Electronics, electrical engineering, and automatic LEEA	TSPS
4.	Energy engineering	ISSTE
5.	Co-building in energy engineering	ISSTE
6.	Master LMD research EEA, course: WESET: Wind Energy Sciences and Technologies	ENI-Carthage
7.	Electrical engineering: Safety of electrical systems	ISET Rades
8.	Electrical engineering: Maintenance of electrical systems	ISET Rades
9.	Mechanical engineering: Energetics	ISET Nabeul
10.	Physics and energy	FSB
11.	Physics of materials: Composite and advanced materials	FSB
12.	Electronics, electrical engineering, and automation	WSF
13.	Physics and energy	WSF
14.	Electronics, electrical engineering, and automation	WSF
15.	Physics and energy	Higher School of Science and Technology of Hammam Sousse
16.	Electronics, electrical engineering, and automation: Renewable energies	Higher School of Science and Technology of Hammam Sousse
17.	Energy engineering	ISSAT of Sousse
18.	Physics	ISSAT of Mahdia
19.	Physics of materials	ISSAT of Mahdia
20.	Electrical engineering	ISET Ksar Helal
21.	Electronics, electrical engineering, and automation	ISSAT of Kasserine
22.	Electrical engineering	ISSAT of Kairouan
23.	Physics and energy	FSS
24.	Electronics, electrical engineering, and automation	FSS
25.	Physics of materials	FSS
26.	Electrical engineering	ISET Sidi Bouzid
27.	Electrical engineering	ISET Kasserine
28.	Mechanical engineering: Energetics	ISET Tataouine
29.	Thermal and renewable energies	ISET Tataouine
30.	Distance learning: bachelor's degree in electronics, electrical engineering, and automation	ISSAT Gafsa
31.	Electronics, electrical engineering, and automation	ISSAT Gafsa
32.	Energy engineering	FS Gafsa
33.	Physics and energy	FS Gafsa
34.	Physics	FS Gabes
35.	Physics of materials	FS Gabes
36.	Energy engineering	ISSAT Gabes
37.	Materials engineering	ISSAT Gabes
38.	Electronics, electrical engineering, and automation: Renewable electrical energies	Higher Institute of Industrial Systems of Gabes
39.	Energy engineering	Institut Supérieur Privé Polytechnique, Université Libre de Tunis (ULT-ISP)

APPENDIX 3 STAGES OF THE RENEWABLE ENERGY VALUE CHAIN (SOLAR PHOTOVOLTAIC AND WIND)

Value chain stage	Description
Design and sizing	This phase consists of designing the renewable energy system according to the specific needs of the user. This involves designing components such as solar panels, wind turbines, hydroelectric turbines, etc., as well as sizing the system to ensure efficient and reliable power generation.
Study and planning	This phase consists of carrying out technical and economic studies to assess the feasibility of the project. Studies include environmental assessments and feasibility studies to determine if the project is viable, as well as operational plans to ensure long-term profitable operation.
Equipment and assembly	This phase involves the manufacture and assembly of system components, such as solar panels, wind turbines, turbines, inverters, etc.
Construction and commissioning	This phase involves the construction of the renewable energy facility, including the installation of components, connection to the power grid, and testing to ensure the system is operational.
Operation and maintenance	This phase involves the day-to-day management of the renewable energy facility, including regular maintenance to ensure efficient and safe operation, as well as incident and outage management.
Transmission and distribution	This phase involves transporting the energy produced by the renewable installation to consumers. It may involve the construction and operation of transmission and distribution lines to deliver energy to final consumers.
Services	This phase includes advisory services, financing services, insurance services, and other related services that may be required to support the development, construction, and operation of renewable energy facilities.

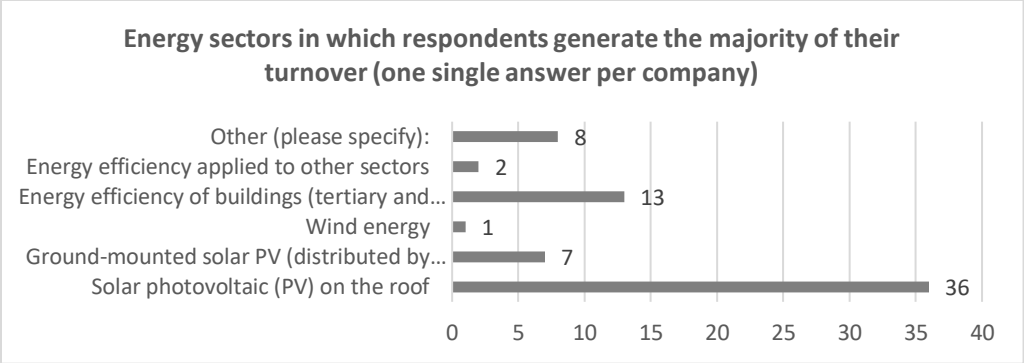
APPENDIX 4 STEPS IN THE VALUE CHAIN FOR ENERGY EFFICIENCY IN BUILDINGS

Value chain stage	Description
Development of solutions and equipment	This part of the value chain involves the research and development of innovative technologies and solutions to improve the energy efficiency of buildings. This may include the design and manufacture of heating, ventilation, air-conditioning, lighting, and other systems to reduce the energy consumption of buildings.
Study and development	This step involves collecting data on the energy consumption of buildings and analyzing these data to identify opportunities to improve energy efficiency. This may involve energy audits, analyses of the performance of building systems, feasibility studies for energy efficiency projects, and other research activities.
Implementation of energy efficiency projects	This step involves the implementation of the solutions and technologies identified in the previous phase to improve the energy efficiency of buildings. This may include installing new equipment, upgrading existing systems, implementing energy-saving measures, and other interventions to reduce energy consumption.
Control and follow-up	This step involves monitoring and analyzing the performance of building systems to ensure that they are performing optimally and achieving desired levels of energy efficiency. This may include collecting data on energy consumption, analyzing these data to identify deviations from energy efficiency targets, and implementing corrective measures to improve system performance.
Services	This part of the value chain includes all the support and maintenance activities necessary to ensure the proper functioning of building systems and maintain their energy efficiency. This may include preventive maintenance services, for example.

APPENDIX 5 COMPANIES RESPONDING TO THE ONLINE SURVEY—AND KEY SURVEY RESULTS

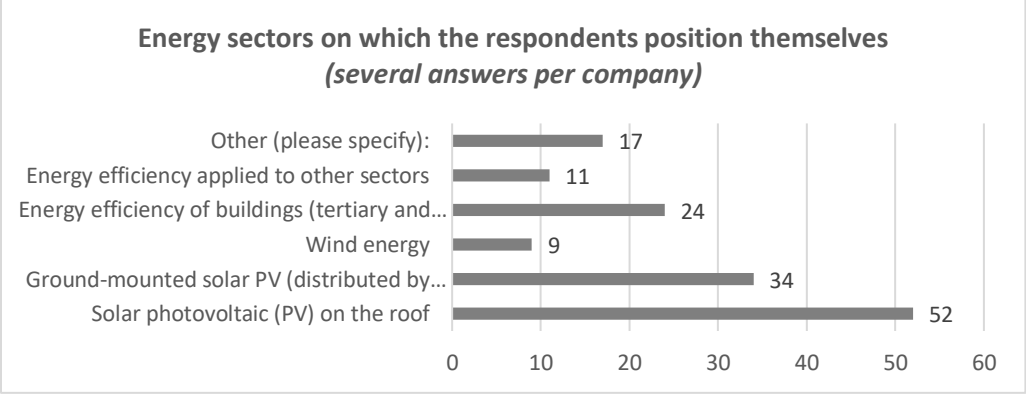
PROFILE OF COMPANIES THAT RESPONDED TO THE ONLINE SURVEY

SECTORS WHERE RESPONDING COMPANIES GENERATE THE MAJORITY OF THEIR REVENUE



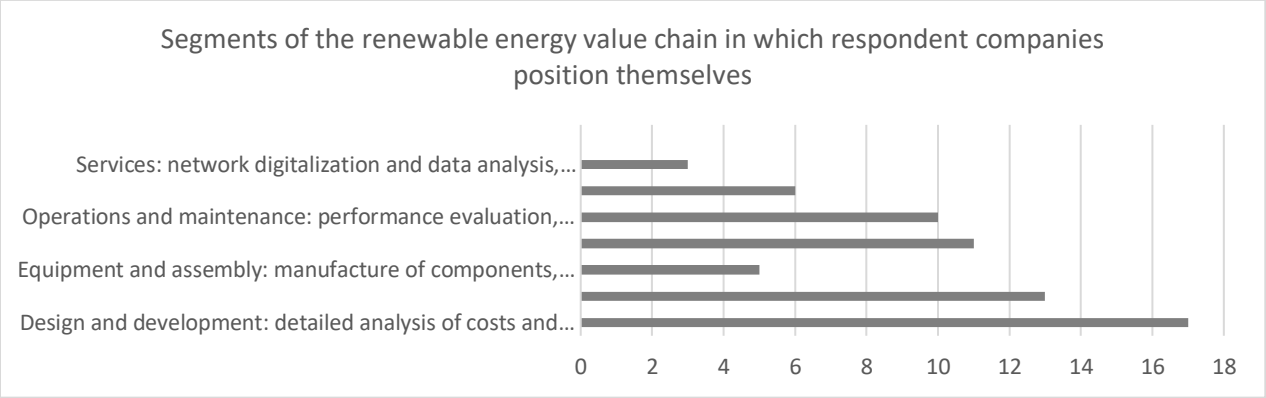
Note: PV = photovoltaic.

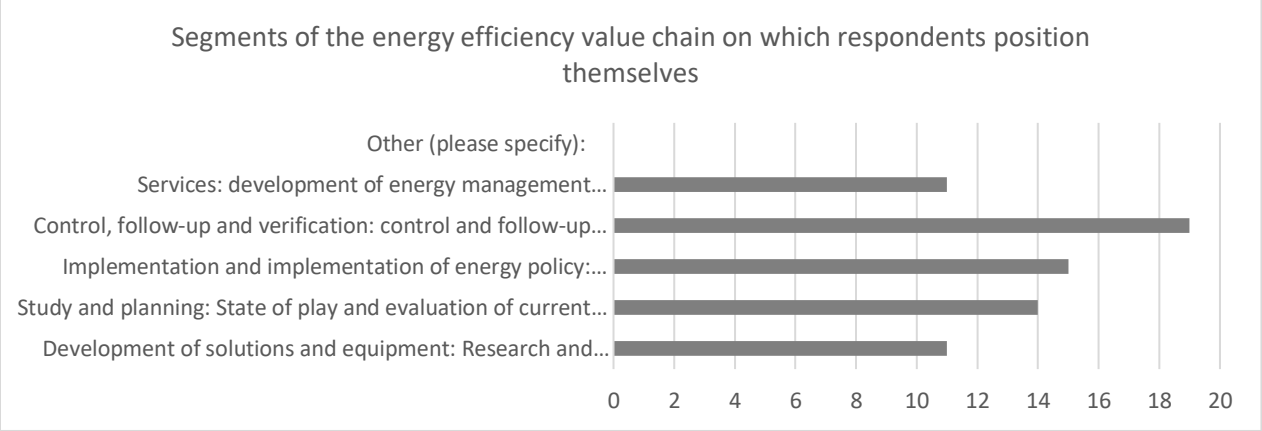
SECTOR IN WHICH THE RESPONDING COMPANIES ARE POSITIONED



Note: PV = photovoltaic.

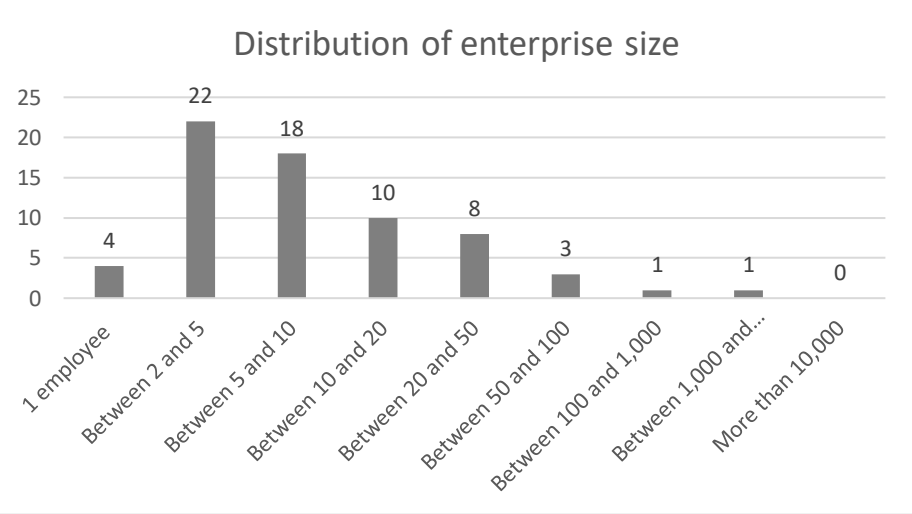
SEGMENTS OF THE VALUE CHAIN IN WHICH RESPONDENT COMPANIES ARE POSITIONED





Note: PV = photovoltaic.

SIZE OF RESPONDENTS



KEY RESULTS OF THE ONLINE SURVEY

AVERAGE QUALIFICATION LEVEL OF RESPONDING ENTERPRISES

The average qualification level of the companies responding to the survey makes it possible to identify the qualification levels of employees in the renewable energy and energy efficiency sectors.

	Rate (%)
Average rate of low-skilled employees (e.g., operators, manual workers)	24
Average rate of medium-skilled employees (e.g., technicians, specialists)	31
Average rate of highly qualified employees (e.g., engineers, managers)	45
Total	**100**

NUMBER OF HIRES DESIRED IN THE NEXT FIVE YEARS BY RESPONDENT COMPANIES (67 RESPONDENTS IN TOTAL)

The total number of hires planned by the responding companies (67 complete responses) results in an average per company over the next five years of 10 low-skilled FTEs (full-time equivalents), 6 medium-skilled FTEs, and 4 high-skilled FTEs.

	Number of FTEs
Number of low-skilled employees (e.g., operators, workers)	644
Number of medium-skilled employees (e.g., technicians, specialists)	388
Number of highly qualified employees (e.g., engineers, managers)	295
Total	**1,327**

Note: FTE = full-time equivalent.

AVERAGE SHARES OF WOMEN AND YOUTH IN RESPONDENT ENTERPRISES

	Average share of employees (%)
Share of women in the company	30.7
Share of young people under 25 in the enterprise	23.6

MAIN OBSTACLES ENCOUNTERED BY RESPONDENT COMPANIES FOR THE DEVELOPMENT OF THEIR ACTIVITY—FOR EACH SUGGESTED OBSTACLE: SHARE (%) OF RESPONDENT COMPANIES WHO IDENTIFIED THE OBSTACLE AS ONE OF THE TOP THREE ON THEIR ACTIVITY

	Share of respondent enterprises (%)
Regulatory/public policies: Lack of appropriate regulations, investment policies, or incentives	82
Market size/supply chain: Domestic market and low growth prospects, limited domestic supply chain	42
Labor quality and cost: Limited availability of sufficiently skilled workers, high local labor costs (limiting competitiveness)	0
Innovation: Lack of research and development, innovation capacity, or possibility of technology transfer	13
Competitiveness of the sector: High market entry costs, low bargaining power, threat of substitution of products/services	42
Funding: Difficulty in raising funds	76

LEVEL OF BUSINESS DEMAND FOR LABOR—RENEWABLE ENERGY VALUE CHAIN

The overall level of need is determined by a score: the weighted sum of the number of responses for each level of need proposed in the questionnaire. The higher the score, the more companies are looking for the profiles concerned. Questionnaire responses were scored as follows:

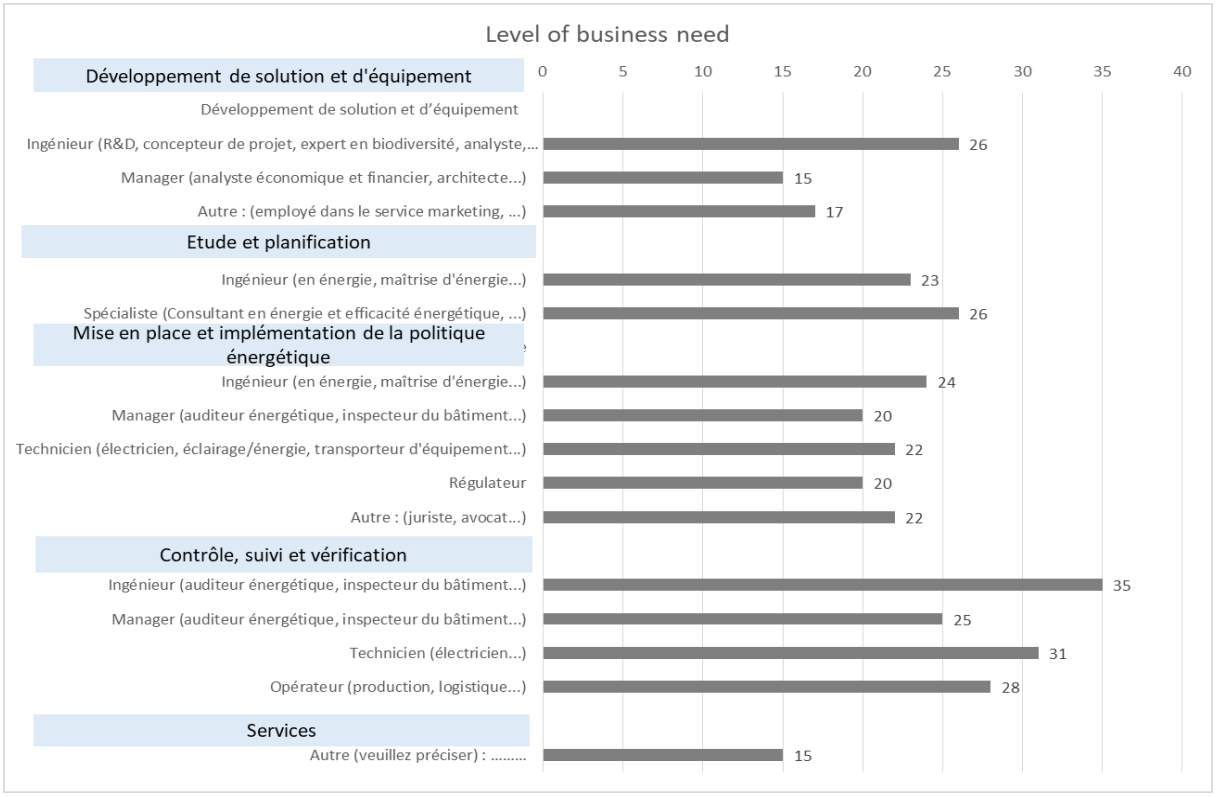
No need = 1, Little need = 2, Some need = 3, High need = 4

Note: R&D = research and development.

LEVEL OF BUSINESS WORKFORCE NEEDS—ENERGY EFFICIENCY VALUE CHAIN

The overall level of need is determined by a score: the weighted sum of the number of responses per level of need proposed in the questionnaire. The higher the score, the more companies are looking for the profiles concerned. Questionnaire responses were scored as follows:

No need = 1, Little need = 2, Some need = 3, High need = 4

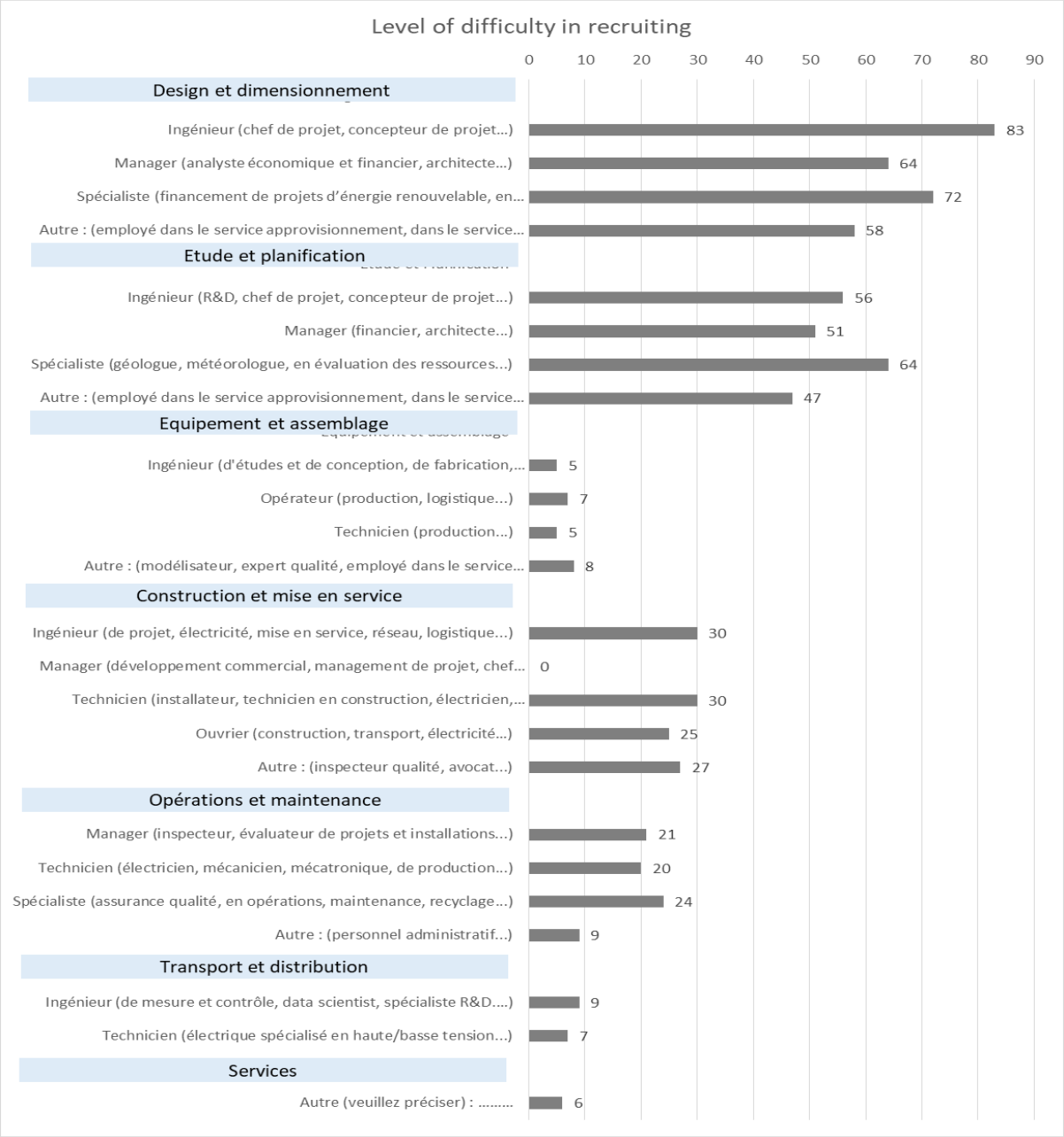


Note: R&D = research and development.

LEVEL OF DIFFICULTY IN RECRUITMENT—RENEWABLE ENERGY VALUE CHAIN

The overall level of difficulty is determined by a score: the weighted sum of the number of responses per level of need proposed in the questionnaire. The higher the score, the greater the difficulty encountered in recruitment. Questionnaire responses were scored as follows:

Level of difficulty in recruiting: No difficulty = 1, Some difficulty = 2, Great difficulty = 3

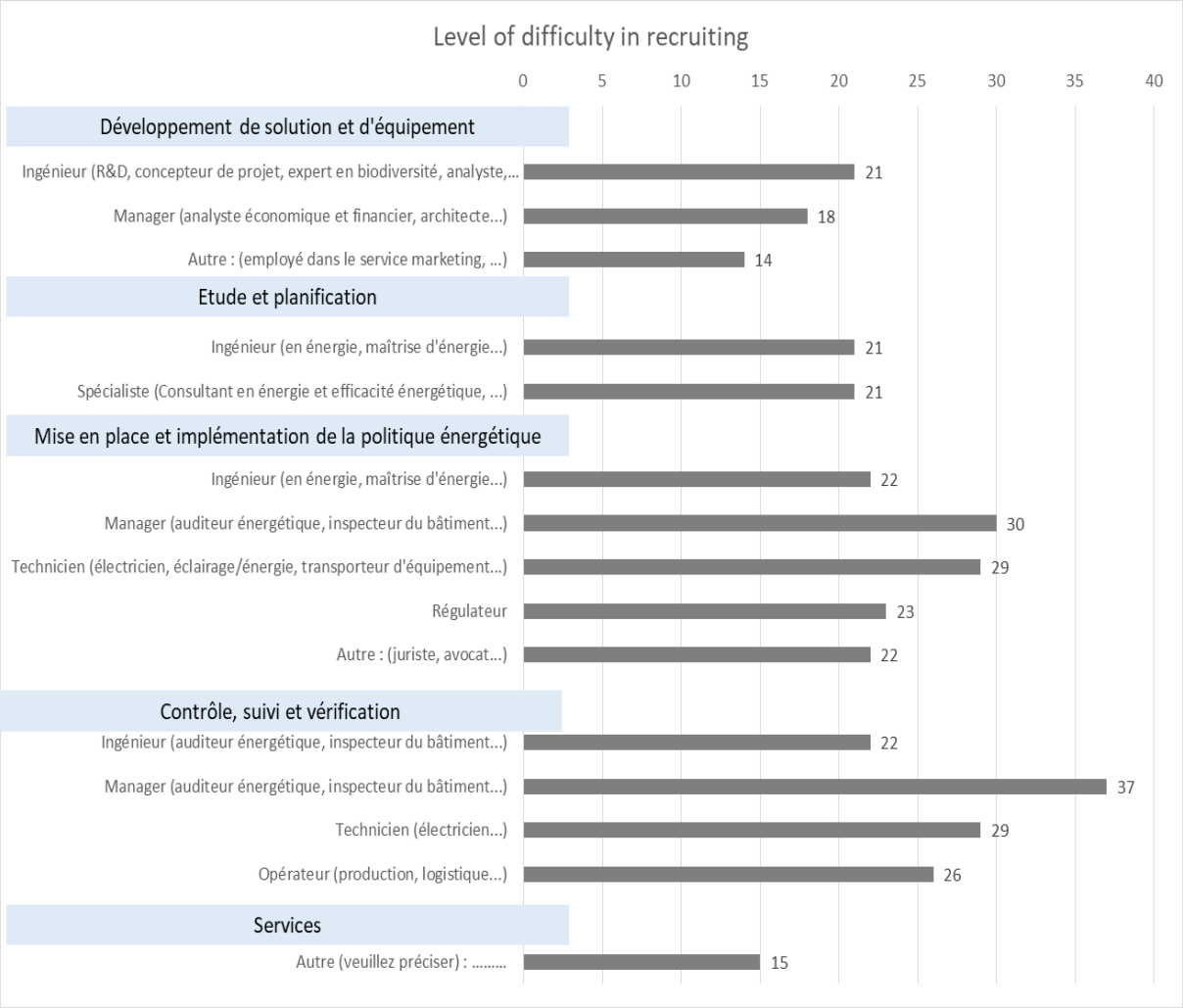


Note: R&D = research and development.

LEVEL OF DIFFICULTY IN RECRUITMENT—ENERGY EFFICIENCY VALUE CHAIN

The overall level of difficulty is determined by a score: the weighted sum of the number of responses per level of need proposed in the questionnaire. The higher the score, the greater the difficulty encountered in recruitment. Questionnaire responses were scored as follows:

Level of difficulty in recruiting: No difficulty = 1, Some difficulty = 2, Great difficulty = 3



Note: R&D = research and development.

TYPE OF TRAINING REQUIRED TO MEET RECRUITMENT CHALLENGES IN THE ENERGY TRANSITION

Results are presented based on the share (percent) of survey respondents who selected each type of training as a key training to overcome the recruitment challenges mentioned above. Several courses could be chosen by the responding companies.

	Share of enterprises that selected the response (%)
Field training	69
Requalification and/or upskilling programs	70
Medium-term training programs (several months)	28
Technical and vocational education and training	55
Specialized university programs	28

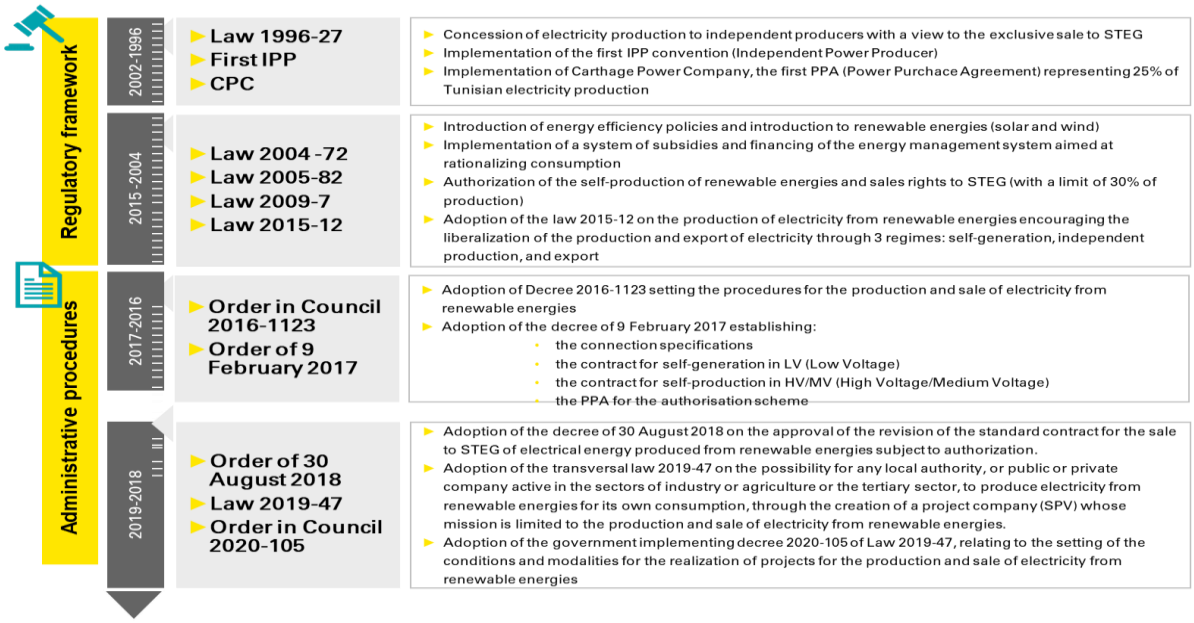
APPENDIX 6 COMPANIES RESPONDING TO THE ONLINE SURVEY

The companies listed below agreed to be contacted by education stakeholders, the aim being to facilitate discussions on the alignment of training provision with market demands.

Abdelhamid B Belguec Mahmoudi
ACCENT
Akrout Energy and Fluid Services Company
AMEA Power
AZIMIUT PV Prod
BACK PV
Be Wireless Solutions
Beon Energy
CAMI Engineering
Chalghaf Electrical Technology
Clean Energy Sources
Consulting Engineer Lilia Sahnoun
ECB
EKELEC ENERGY
Electrika Energy
ENER
Enersol
Essafi
Eureka Engineering
FMS Tech
Global Evolution Solar Energy
Harrabi Renewable and Conventional Energies Company
ICF
IN-ENERGY
Invictus Consulting
Just for Future
Medlight Company
MES Distribution
Messa Innovation
MHS Engineering
Novatek Solutions
Oasis Company Equipment and Maintenance
Qair
Sastra Energy
SEMAP SOLAR
SMNSE
Solarium Perfect
Spectra
Sun Sol Energy
Sunshine Photovoltaic Energy
SunSouth
Supramax Energy
Technopro
Tunisian Company of New Energies, STEN
Winsome Energy
Zied Barhoumi Company

APPENDIX 7 LAWS AND DECREES GOVERNING THE ENERGY SECTOR IN TUNISIA AND SOME INVESTMENT INCENTIVE MECHANISMS

REGULATORY FRAMEWORK



Note: SPV = special purpose vehicle; STEG = Tunisian Electricity and Gas Company.

ENERGY EFFICIENCY AND RENEWABLE ENERGY INVESTMENT MECHANISMS

Measurements	Description	Support structures
Energy Transition Fund	Law 2005-82 was promulgated for the creation of the FNME, whose objective is to provide financial support for actions aimed at rationalizing energy consumption, promoting renewable energies and energy substitution. Since 2014, the FNME has been converted to the Energy Transition Fund (FTE) with a significant increase in its resources through the application of new taxes on energy products (Law No. 2013-54) and the diversification of its modes of intervention by granting credits and supporting energy management projects in the form of repayable endowments or equity participation. A decree setting out the procedures for the organization and management of this fund has been promulgated (Decree 2017-983 of 26 July 2017) with new advantages in favor of energy management.	
Lines of credit	Two credit lines have been set up to support the energy efficiency programme and encourage investment in energy efficiency: ▶ **Support Program for the Energy Management Line (ALME) launched by AFD** with a credit line of 40 million euros aimed at improving the energy efficiency of Tunisian companies, spreading the use of renewable energies and contributing to the reduction of air and water pollution. ▶ **The World Bank** has set up a €45 million credit line dedicated to energy management for the benefit of industrialists and cogeneration projects.	

Note: AFD = Agence Française de DéveloppemenT; FNME = Energy Efficiency Fund.

APPENDIX 8 EVOLUTION OF RENEWABLE ENERGY PROJECTS IN TUNISIA

2018–21

Regime	Sources	Projects	Status
Self-production	Solar PV energy	Low voltage	The Low Voltage projects (Prosol Elec) have enabled the installation of 58,000 solar roof units with a total capacity of 158 MW.
		MT/HT	302 authorizations were granted for a total capacity of 68MW
Concession	Solar PV energy	1 call for tenders of 500 MW (sites proposed by the State)	Key phases: • Launch of the call for prequalification tenders (May 2018) • Approval by decree-laws in December 2021 Advancement: • The projects are currently in the advanced phase of financial closure, environmental and social studies. Agreements have been signed with 3 developers on 5 sites. • Work is scheduled to start in early 2023.
	Wind	2 call for tenders: • 1 call for tenders of 300 MW (sites proposed by the State): • 1 call for tenders of 200 MW (Sites proposed by the promoters	Key phases: • Launch of the 1st call for tenders for prequalification (May 2018) • Development of project agreements and recruitment of an office to carry out the wind measurement campaign • Acquisition of measuring masts in May 2021 Advancement: The start of the shared measurement campaign has been scheduled for the end of 2022 for the 1st call for tenders and the projects are being restructured for the 2nd call for tenders
Authorization	Solar PV energy	4 calls for projects with a total capacity of 274 MW: • 1st call for projects (May 2017) • 2nd call for projects (May 2018) • 3rd call for projects (July 2019) • 4th call for projects (August 2020)	Preliminary results: • 1st call for projects: Award of 10 agreements in principle (4 projects category 1MW + 6 projects category 10MW) and creation of 7 project companies • 2nd call for projects: Award of 16 agreements in principle (10 projects category 1MW + 6 projects category 10MW) and creation of 5 project companies • 3rd call for projects: Award of 16 agreements in principle (6 10MW category projects + 10 1MW category projects) • 4th call for projects: Award of 16 agreements in principle (10 1MW category projects + 6 10MW category projects) Advancement: • Commissioning of some projects relating to the 1st and 2nd calls for projects. • Most of these projects are in the process of seeking funding and a letter of comfort has been issued by the Ministry to facilitate the funding of certain projects. Developers have also benefited from an extension of the deadlines of the agreements in principle
	Wind	2nd call for projects (January 2019) with a capacity of 120 MW	• Award of 4 agreements in principle (4 projects of 30MW) and creation of 2 project companies

Note: HT/MT = High Tension (HI)/Medium Tension (MT); MW = megawatt; PV = photovoltaic.

2022–25

Regime	Sources	2022	2023	2024	2025	Total capacity (MW)
Self-production	Solar PV energy	350				350
	Wind	150				150
Concession	Solar PV energy	500	200	500	200	1 200
	Wind	150	150	150	150	600
Authorization	Solar PV energy	70	–	70	–	140
	Wind	–	–	–	–	–

Source: MIME 2022c.
Note: MW = megawatt; PV = photovoltaic.

APPENDIX 9 JOB CREATION POTENTIAL IN RENEWABLE ENERGY BY VALUE CHAIN SEGMENT AND PROJECT SIZE

SMALL TO MEDIUM PROJECTS—AUTOPRODUCTION SCHEME AND PERMIT SCHEME FOR SMALL CAPACITIES (BELOW 1 MEGAWATT)

EQUIPMENT AND ASSEMBLY

For solar photovoltaic (PV) and wind energy projects, local integration is mainly in the assembly stage, with the components being mostly imported. Indeed, the Tunisian market has limited availability of components, allowing limited local job creation. Local integration in these projects is thus rather limited to a modification of existing jobs, rather than to the creation of local jobs.

For solar PV projects, PV modules are predominantly imported, since importation is considered cheaper than locally developing the skills and economic fabric necessary for their production. Other electrical and electronic components (World Bank 2015), such as cables, inverters (including mini- and microinverters), and electrical panels (Compto Electrical Industries n.d.), can be supplied by local Tunisian companies specialized in electricity and electronics. Meeting this demand suggests a modification of existing jobs in this industry so that employees can produce components specific to PV installations. Further, PV panels can be assembled locally, including encapsulation, paneling, glazing, and cell testing, and create jobs.

For wind energy projects, the turbine support tower is the main component that can be manufactured locally (Socomenin n.d.). Although a production line dedicated to the domestic market is currently absent for support towers, a Tunisian company specializing in their production has previously been mobilized by the Tunisian Electricity and Gas Company (STEG) to produce this component specifically for a wind project in Tunisia. This mobilization for the domestic market, so far an isolated case, could be redeployed for the construction of other wind turbines in Tunisia. In the same way as for PV projects, electrical and electronic components, such as cables, transformers, regulators, ballasts, and control panels, can be supplied by local companies specializing in electrical and electronics (World Bank 2015), implying a modification of existing jobs in this industry. On the other hand, the nacelle, multiplier, mechanical brake, and blades are systematically imported, since actors specific to these components are not present in Tunisia.

CONSTRUCTION AND COMMISSIONING

For both technologies studied, the construction and commissioning phase (including the on-site assembly and installation phase for wind infrastructure) has an important local component in civil engineering, electrical engineering, and testing (World Bank 2015).

According to the responses to the Ministry of Industry, Mines and Energy's (MIME's) call for projects, dating from July 2019 and based on which 16 project leaders were chosen to execute solar PV projects under the authorization scheme, the construction phase allows job creation of about 3,000 man-days for a 1 megawatt (MW) installation and 15,500 man-days for a 10 MW installation (MIME 2019). These jobs include an engineer position, which is in charge of managing the installation's construction and supervising the entire construction phase; an electrical engineer position, which supervises workers and technicians in charge of carrying out the

electrical work; and a civil engineer position, which supervises workers and technicians in charge of carrying out other works.

For wind projects, the German Agency for International Cooperation (GIZ) estimated in 2012 that construction and commissioning would create 0.2 jobs per megawatt installed (GIZ and ANME 2012). However, an empirical analysis of the subject is hindered by a lack of recent precise statistical data on job creation specifically for Tunisia, where a handful of projects have so far been implemented.

OPERATION AND MAINTENANCE

For solar PV projects, according to the responses to the MIME's call for projects, mentioned above, the management of operation and maintenance allows the creation of 10 jobs on average per project, combining all installed capacity (1 MW or 10 MW). These jobs include an engineer position, which supervises operation and maintenance, five technicians and senior technicians in charge of carrying out maintenance, three individuals in charge of infrastructure monitoring, an administrative manager, and a chartered accountant position.

For wind projects, the GIZ estimated in 2012 that operation and maintenance would create 0.4 jobs per megawatt installed (GIZ and ANME 2012).

OTHER SEGMENTS OF THE VALUE CHAIN

These projects are mainly financed by Tunisian banks, thus creating indirect jobs in the banking and financial sectors.

LARGE PROJECTS—CONCESSION AND AUTHORIZATION SCHEMES FOR LARGE CAPACITIES (ABOVE 1 MW)

Local integration is weaker for larger PV and wind projects. Upstream of the value chain, foreign design offices often participate in technical studies, which, however, are occasionally conducted in collaboration with local design offices, especially for the realization of field analyses. The need for local employment is therefore limited for the realization of these studies.

Equipment is predominantly produced and assembled abroad to meet the quality standards of the project funders and developers.

Local operators construct, commission, and operate and maintain projects (installers, maintainers, workers, etc.), which are typically supervised by foreign labor, however. The above activities mainly create low- to medium-skilled jobs.

Finally, these projects are generally financed by foreign banks.

APPENDIX 10 STRATEGIC JOBS

RENEWABLE ENERGY (SOLAR PHOTOVOLTAIC AND WIND)

Strategic jobs in the solar photovoltaic and wind sectors are described below.

HIGHLY QUALIFIED JOB PROFILES

ELECTRICAL ENGINEER, SPECIALIZED IN RENEWABLE ENERGY, WITH SEVERAL YEARS OF EXPERIENCE IN THE RELATED SECTOR

These experienced engineers are considered key in the design and implementation of renewable energy projects, especially in positions as project managers or site managers and, if necessary, to train companies' senior technicians in the specifics of renewable energy. The companies surveyed mentioned they primarily look for electrical engineers, with specialization in renewable energy being an asset rather than a necessary condition for hiring.

However, companies face challenges in hiring experienced engineers as well as retaining engineers who gain experience. These difficulties can be attributed especially to the increasing relocation of engineers abroad for better living conditions and more lucrative salaries.

SOFTWARE ENGINEER WITH MULTIPLE YEARS OF EXPERIENCE, IDEALLY IN THE RENEWABLE ENERGY SECTOR

The increasing digitalization of the renewable energy sector is creating a strong demand for information technology (IT) engineers in Tunisia. Indeed, companies operating in this sector require IT skills to develop energy management tools, simulation and modeling software, facility monitoring and surveillance platforms, and so on.

However, companies struggle to retain their software engineers, who are often in high demand in the Tunisian job market. Indeed, IT skills are in high demand in different sectors, which creates increased competition for talent. Further, the increased trend of foreign relocation among engineers is creating hurdles for companies looking to hire experienced IT engineers who can lead the implementation of complex projects.

ENGINEER WITH SKILLS IN RENEWABLE ENERGY AND FINANCE

The companies interviewed for this study mentioned financing access as a major obstacle to the development of renewable energy projects. This is especially attributed to the scarcity of engineers with dual renewable energy and finance skills. For Tunisian companies (particularly small and medium enterprises [SMEs]), such dual profiles help them present well-prepared and viable proposals to banking and financial actors. They help Tunisian banks better analyze and thus process companies' proposals. The job profiles that are in particular demand are SME managers, who can help Tunisian SMEs prepare bankable proposals.

CIVIL ENGINEER SPECIALIZED IN RENEWABLE ENERGIES

Few civil engineers in Tunisia have specific renewable energy skills. However, the anticipated growth in renewable energy projects creates a growing need for civil engineers to help companies understand the specifics of renewable energy installations. These skills may include, among others, designing and engineering support structures for solar panels or wind turbines, planning construction factoring in environmental and topographical factors.

MEDIUM-QUALIFIED JOB PROFILES

SENIOR ELECTRICAL TECHNICIAN SPECIALIZED IN RENEWABLE ENERGIES, WITH SEVERAL YEARS OF EXPERIENCE IN THE RELATED SECTOR

These senior technicians are considered essential to drive the implementation of renewable energy projects, especially in positions such as site managers and, if necessary, to train companies' technicians in the specific aspects of renewable energies. These are highly sought after profiles due to their specialization in renewable energies and professional experience, which helps them work autonomously and immediately after they are hired (thus saving time and training costs). However, like renewable energy electrical engineers, companies struggle to retain these senior technicians or find senior experienced electrical technicians, especially who could become site managers.

DRAFTSMEN

Draftsmen (and particularly, building information modeling designers) are few on the job market, even though these profiles are essential for designing and three-dimensional modeling for construction plans for renewable energy facilities. Thus, although projects' completion requires very few draftsmen (one per project on average), their labor market scarcity can hinder companies' ability to execute renewable energy projects.

SALES

In Tunisia, technical sales representatives are key players in the commercial development of energy sector companies, including those in renewable energy. Their role is to promote and sell energy-related products or services, and they must be able to understand customers' needs, develop appropriate solutions, and conclude contracts. In the context of renewable energy, technical sales representatives must therefore be able to understand the technical aspects of product or service offerings, as well as the advantages and drawbacks of each technology. However, many technical sales representatives struggle to convert to renewable energy since their skills are specific to conventional energy.

LOW-SKILLED JOB PROFILES

CABLE TECHNICIAN

Renewable energy growth suggests modernization and enhancement of the existing electricity grid so that it can absorb the increase in electricity production. In this context, cable technicians will be increasingly in demand on

the job market. In anticipation of this demand increase, in January 2023, the National Agency for Energy Management (ANME) launched a training course for cable technicians to specialize them in renewable energies.

ENERGY EFFICIENCY OF BUILDINGS

Strategic jobs in the energy efficiency of buildings are described below.

HIGHLY SKILLED JOB PROFILES

ARCHITECT

Architects are crucial in envisioning the energy efficiency of a building right from the design phase. They can become ANME relay experts to support companies and organizations in implementing energy efficiency projects for buildings. Also, property developers must be accompanied by a pair of expert energy auditors (or consulting engineers) and architects to make their projects energy efficient.

Further, architects can play an important role in integrating renewable energy systems into buildings from the initial design stage. This requires specialist knowledge and expertise in building design, as well as an understanding of the technical and economic aspects of renewable energy systems. This is the reason the energy sector has a high demand for architects experienced in the design of energy-efficient buildings and the integration of renewable energies.

ENERGY ENGINEER (THERMAL AND ELECTRICAL)

Energy engineers are in high demand, especially for the position of energy auditor and test manager or accompanying relay expert.

Energy auditors are important considering ANME has made energy audits mandatory for the highest-energy-consumption buildings. They are the driving force behind the execution of energy efficiency projects in buildings, including renovation. In addition, like architects, they can become relay experts or accompany real estate developers in their projects.

Test managers verify that the energy performance claimed for the building construction and renovation equipment or materials aligns with their scientific realities. Thus, they inform project managers on the equipment and materials to be purchased.

HEATING, VENTILATION, AND AIR-CONDITIONING (HVAC) ENGINEER

This job profile is particularly sought after for the energy manager position, which supervises the proper implementation of energy efficiency action plans in buildings. The Tunisian Electricity and Gas Company (STEG) has identified a need for 100 new engineering positions dedicated to energy management.

MEDIUM-SKILLED JOB PROFILES

SENIOR ELECTRICAL AND THERMAL TECHNICIAN (HEATING AND AIR-CONDITIONING)

Senior electrical and thermal technicians specialized in heating and cooling are responsible for carrying out and maintaining electrical, heating, and air-conditioning installations in different types of buildings (residential, commercial, industrial, etc.).

These technicians must be able to read and interpret electrical plans and diagrams, and install electrical wiring systems, distribution panels, and electrical panels. They must also be able to carry out welding and brazing work, as well as plumbing work for heating and cooling installations.

These technicians are also responsible for maintaining and repairing existing heating and cooling systems. The individual working in the senior electrical and thermal technician role must diagnose faults, replace defective components, and conduct functional tests to ensure facilities are in good working condition.

LOW-SKILLED JOB PROFILES

CONSTRUCTION WORKERS AND TECHNICIANS, ESPECIALLY MASONS AND INSULATION TECHNICIANS

Although technicians are available on the job market, they do not have a specialization in energy efficiency or basic knowledge of the related sector. Companies wishing to develop in the sector are therefore faced with a shortage of technicians who can participate in projects. In particular, the insulation sector faces a shortage of trained technicians.

Finally, for the same reasons as in the renewable energy sector, the following positions are considered strategic in the energy efficiency of buildings:

- Software engineers,
- Designers,
- Technical sales.

APPENDIX 11 KEY COMPETENCES IN THE RENEWABLE ENERGY AND ENERGY EFFICIENCY SECTORS

STRATEGIC SKILLS SPECIFIC TO RENEWABLE ENERGY PROFESSIONS

MASTERY OF THE APPLICATION OF RENEWABLE ENERGY FUNDAMENTALS (INSTALLATION, COMMISSIONING, CONNECTION, AND OPERATION AND MAINTENANCE)

Mastery of the application of renewable energy fundamentals implies knowledge of the related basic principles. This competence also includes the ability to install, commission, connect, and maintain renewable energy systems. This requires an understanding of the components of the renewable energy system and appropriate installation methods.

This competence is considered strategic since anyone working in the renewable energy sector needs it for project design, implementation, or monitoring. The competence includes practical skills for low- or medium-skilled employees (e.g., knowing how to install a photovoltaic panel or assemble a wind turbine) and more theoretical skills for highly qualified employees (e.g., knowing how to anticipate the maintenance of a photovoltaic power plant).

MASTERY OF THE LEGAL AND CONTRACTUAL FRAMEWORK

Mastery of the legal and contractual framework implies knowledge of the laws, regulations, and legal standards applicable to renewable energy projects, as well as an understanding of the terms and conditions of project contracts. This skill also includes the ability to negotiate, draft, and manage contracts, and resolve potential contractual disputes.

This competence is considered strategic because it helps companies implement renewable energy projects by ensuring compliance with existing regulations and conducting effective legal negotiations to overcome the administrative pitfalls encountered when launching such projects (especially for the grid connection part).

MASTERY OF FINANCIAL AND ECONOMIC SKILLS

Mastery of financial and economic skills in the renewable energy context implies an employee's ability to understand the financial and economic concepts related to the renewable energy industry, as well as use this knowledge to assess projects' financial viability, identify appropriate financing sources, and prepare the necessary documents to obtain the financing.

This competence is considered strategic because a lack of economic skills would render Tunisian renewable energy companies (especially small and medium enterprises) incapable of presenting viable and complete files to banking, financial, and insurance actors that they deem satisfactory. This competence is thus key for companies to be able to obtain the required development financing.

STRATEGIC COMPETENCES SPECIFIC TO ENERGY EFFICIENCY PROFESSIONS

MASTERY OF THE APPLICATION OF ENERGY FUNDAMENTALS TO ENERGY EFFICIENCY

Mastery of the application of energy fundamentals to energy efficiency implies knowledge of the energy efficiency basics, such as identifying energy losses, assessing energy performance, implementing energy efficiency measures, and measuring results. This competence also includes the ability to apply effective technologies and practices to reduce energy consumption. Mastery is also needed in simulation tools to calculate buildings' energy performance.

This competence is considered strategic since anyone working in the energy efficiency sector needs it for project design, implementation, or monitoring. The competence includes practical skills for low- and medium-skilled employees (e.g., knowing how to install double-glazed windows) and more theoretical skills for highly qualified employees (e.g., knowing how to conduct an energy audit).

MASTERY OF CONSTRUCTION OR RENOVATION MATERIALS, METHODS, AND TOOLS

Mastery of construction or renovation materials, methods, and tools implies knowledge of the materials, assembly methods, and tools to construct or renovate buildings. This skill includes the ability to design and plan construction projects using the most appropriate techniques, and requires understanding the properties of building materials, installation techniques, and the tools needed to complete construction work.

This competence is considered strategic because one of the largest energy efficiency projects in Tunisia includes the renovation of buildings and the construction of new energy-efficient buildings. The Tunisian market for energy efficiency for buildings requires this competence for development, even though this field predominantly has workers not specifically trained for energy efficiency work (lack of knowledge and know-how in terms of the use of thermal paint, insulation materials, alternative building materials to those used commonly in Tunisia, and so on).

STRATEGIC COMPETENCES FOR BOTH RENEWABLE ENERGY AND ENERGY EFFICIENCY SECTORS

MASTERY OF ENERGY FUNDAMENTALS (NETWORKS, STORAGE, ETC.)

Mastery of the energy fundamentals implies an understanding of these fundamentals, for example, energy conservation, the different forms of energy (including electric), the laws of thermodynamics, and the notions of power. This competence also involves the ability to apply these concepts to practical situations, for example, assessing energy consumption and designing efficient energy systems.

This competence is considered strategic because an understanding of the different forms of energy and their workings is essential to be able to identify opportunities for energy efficiency and conversion into renewable energies. Companies must also be able to design effective systems using the most advanced technologies and best practices.

MASTERY OF ENVIRONMENTAL, ENERGY EFFICIENCY, AND RENEWABLE ENERGY STANDARDS AND REGULATIONS

Mastery of environmental, energy efficiency, and renewable energy standards and regulations implies knowledge of them and an ability to apply them in specific projects, for example, the installation of renewable energy systems or the implementation of energy management systems. International Organization for Standardization (ISO) standards and energy-efficient building labels are examples of such standards and regulations.

This competence is considered strategic because it helps companies ensure compliance with standards, which is necessary for deploying renewable energy and energy efficiency projects.

MASTERY OF FOREIGN LANGUAGES

Proficiency in foreign languages refers to the ability to read and speak at least French, in addition to Arabic. Knowledge of English is also increasingly in demand, in the current context of globalization.

This skill is considered strategic because it is in high demand on the job market, given the extensive collaboration between Tunisian and international (mainly European) companies on renewable energy and energy efficiency projects. This skill is especially important for reading technical documents and helps streamline companies' internal exchanges and exchanges with external actors (suppliers, customers, service providers, etc.). This skill is particularly lacking among low-skilled employees.

ORGANIZATION

This competence refers to an employee's ability to effectively plan, order, and manage tasks and activities related to their work. It also includes the ability to prioritize tasks based on importance to effectively manage time so as to achieve objectives and avoid stress, to the extent possible.

This skill is considered strategic because it allows employees to deliver projects on time. Further, it stands as one of the most frequently sought-after skills in the job offers examined on employment portals, regardless of the expected qualification for the positions offered.

PROJECT OR TEAM MANAGEMENT

This competence refers to an employee's ability to plan, organize, direct, and control the financial, material, and human resources to complete a renewable energy or energy efficiency project. Specifically, this skill includes knowing how to define a project's objectives, identify the tasks to be completed and monitor their achievement, estimate and reassess the required human resources, anticipate and monitor financial resources to ensure profitability of projects, communicate effectively with the stakeholders, and evaluate projects' results.

This competence is considered strategic especially for project managers and site managers, who must have interdisciplinary skills and an ability to manage renewable energy or energy efficiency projects in their entirety, in turn to manage teams with varied skills, needs, or operational issues.

MASTERY OF SPECIFIC SOFTWARE

This skill refers to an employee's ability to use sector-specific software (excluding office automation software) to perform technical tasks (software directly related to the company's activity or current project) or even management tasks (e.g., purchase orders).

This competence is considered strategic since project planning, design, and implementation in the renewable energy or energy efficiency sectors often use specific software for technical analyses, simulations, modeling, and calculations (e.g., solar or wind energy modeling software, thermal modeling, energy management, technical drawing and mapping software, and so on).

ANALYTICAL AND SYNTHESIS SKILLS (INCLUDING WRITING SKILLS)

This competence refers to an employee's ability to collect and analyze data; draw conclusions from the analyses; and present the results in the form of a concise, precise, and understandable summary document that can be read and utilized internally as well as by external stakeholders.

This competence is considered strategic because it facilitates effective internal communication between employees and companies on various analyses, and the pitfalls and successes identified. It is especially important that technical documents are well understood internally in companies. This skill is also important for responding effectively to calls for tenders (renewable energy projects).

APPENDIX 12 DETAILED DESCRIPTIONS OF STRATEGIC JOBS IDENTIFIED IN THE STUDY

For each of the 14 jobs identified as strategic in chapter 2, the job descriptions contain the following:

- The job title with precision of the sectors concerned (renewable energy—solar PV (photovoltaic) / renewable energy—wind / energy efficiency) and the qualification level of the trade (score from 1 to 3: low-skilled [1], medium-skilled [2], or high-skilled [3]).
- The value chain of the sector concerned as well as the parts of the value chain or the profession may be requested.
- A word cloud semantic analysis that presents the keywords of the job offers for this position, if it comes from the job portal scans. To be noted that the words remain in French to truly represent the wording obtained.
- A radar format graphic including the level of skills needed for the strategic competencies identified in chapter 2 (11 renewable energy competencies or 9 energy efficiency competencies).
- The main missions and responsibilities of the position.
- The level of experience most often required for this position (from exchanges with companies as well as the results of scans of job portals).
- The training required for the practice of this trade, as well as examples of institutions providing the required training.

Level of qualification of the job

●●●

Electrical Engineer

Specialized in renewable energies

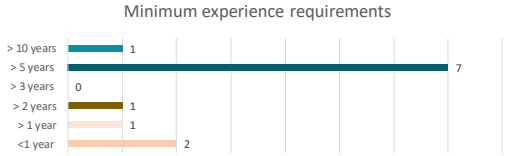
Sectors concerned

Missions and responsibilities

- **Design and develop** renewable energy projects, such as solar power plants, or wind turbines.
- Conduct **feasibility studies** and **business cases** to determine the viability of projects.
- Control the proper operation of sites in compliance with defined objectives (availability, production, budget and security, standards, HSQE practices, etc.) and manage the proper management of maintenance and maintenance actions (preventive, predictive, curative) by ensuring the optimization of site availability
- Work with customers, partners and regulators to ensure effective communication and compliance with local and national renewable energy regulations and contract enforcement.

Experience required:

- Although any level of experience is sought, profiles with several years of experience in the renewable energy sector (> 5 years) are particularly popular.



Required training and examples of available training

Engineering degree or master's degree specialized in the fields of energy, electricity, electromechanics, electronics, environment or renewable energy

- **The National School of Engineers of Monastir (ENIM):** offers training in the field of energy through the specialty of "Energy Engineering".
- **The National Agronomic Institute of Tunis (INAT):** offers a specialty "Rural Engineering, Water and Forest" of the institute which includes an option dedicated to the field of energy.
- **The Free University of Tunis (ULT):** offers a national energy engineer level training.
- **The National School of Engineers of Tunis (ENIT):** Master's program specialized in renewable energies.
- **Mediterranean school of business MedTech (MSB MedTech):** Renewable Energy Engineering Program

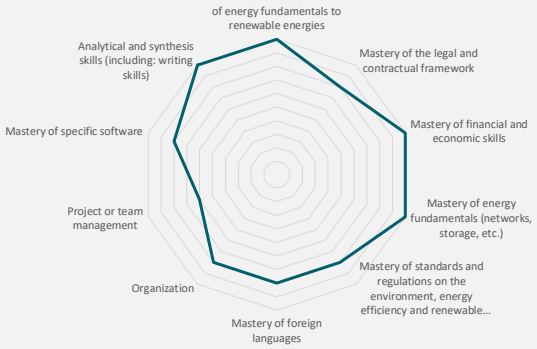
Level of qualification of the job

●●●

Engineer

With skills in renewable energy and finance

Sectors concerned



Missions and responsibilities

- Design and develop renewable energy projects, such as solar power plants, or wind turbines.
- Conduct feasibility studies, financial modelling and business cases to determine the viability of projects.
- Compile financing applications with banks and other investors, and ensure the follow-up and validation of these applications.
- Control the proper operation of sites in compliance with defined objectives (availability, production, budget and safety, standards, etc.) and manage the proper management of maintenance and maintenance actions (preventive, predictive, curative) by ensuring the optimization of site availability

Experience required:

- As the financing of renewable energy projects is one of the main obstacles identified during this study, companies are looking for experienced profiles directly autonomous to ensure the financing and financial solvency of projects, and remove the brake related to financing difficulties.

Required training and examples of available training

Engineering degree or specialized master's degree in the fields of energy, electricity, electromechanics, electronics, environment or renewable energy ***with additional training or specialization in project finance***

or

Engineering degree or master's degree specialized in finance or project finance with additional ***training*** *in electricity or renewable energies.*

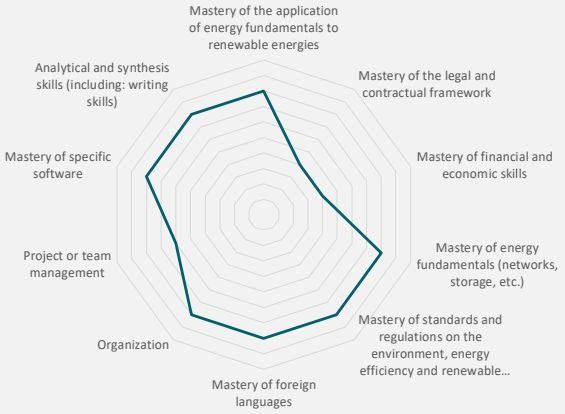
- **The Polytechnic School of Tunis**: offers an energy engineering training with courses in economics of sustainable development.
- **The Higher Business Studies Institute of Carthage (IHEC):** offers a professional master's degree in financial analysts

Level of qualification of the job

Senior Electrical Technician

Specialized in renewable energies

Sectors concerned

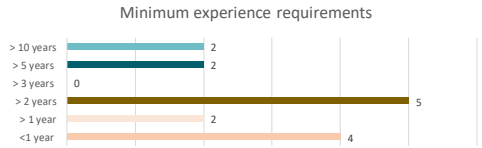


Missions and responsibilities

- Lead the implementation of renewable energy projects, in particular to hold positions as site managers.
- Train the company's technicians in the specificities of renewable energies.
- Ensure the maintenance of renewable energy production systems and equipment such as batteries, inverters, etc.
- Carry out tests, measurements and analyses to guarantee the quality and safety of electrical installations related to renewable energies, in accordance with current standards and regulations.
- Technical assistance and advice to customers, partners and employees for the implementation of renewable energy solutions adapted to their needs and their environment.

Experience required:

- The interviews reveal that the most difficult senior technicians to find are experienced profiles (> 5 years). Nevertheless, the current job offer is spread over the different levels of experience.



Required training and examples of available training

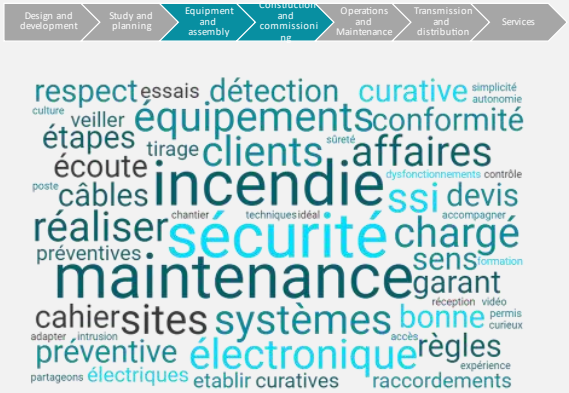
Bachelor's degree or specialized master's degree in the fields of energy, electricity, electromechanics, electronics, environment or renewable energy. CAP or equivalent (BAC +2) in the field of electricity.

- **The Higher Institute of Environmental Science and Technology of Borj Cedria (ISSTE)**
- **The Faculty of Sciences of Bizerte**
- **The Higher School of Science and Technology of Hammam Sousse (ESST)**
- **The Higher Institute of Applied Sciences and Technologies of Sousse (ISSAT)**
- **The Higher Institute of Energy Sciences and Technologies of Gafsa (ISSTEG)**
- **The Free University of Tunis (ULT)**
- **The Private Arab University of Sciences of Tunis (UAS)**

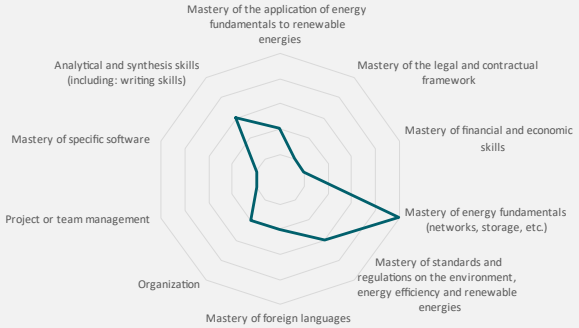
Level of qualification of the job

Technician
Cable Operator

Sectors concerned



*Example of word cloud from a job posting

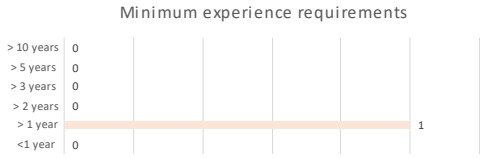


Missions and responsibilities

- Perform electrical wiring: all connections (cables, conductors, connectors, etc.) of an installation to the electrical network.
- Perform preventive maintenance of electrical installations implementation of test protocols.
- Perform a diagnosis of the electrical system in case of failure and implementation of solutions.

Experience required:

- Tunisia is the leader in cable manufacturing The interviews reveal that companies are not specifically looking for experienced profiles because the vast majority of cable technicians are trained in the field. On the other hand, training that includes a module specific to renewable energy installations is a plus.



Required training and examples of available training

Depending on the specialization chosen, the cabler may have to validate a diploma level between the CAP and the Bac + 2:
- *CAP level: CAP in the preparation and realization of electrical works*
- *Professional Bac level: Professions of electricity and its connected environments / Digital electronic systems*
- *Bac + 2 level: BTS digital systems or DUT Electrical engineering and industrial computing*

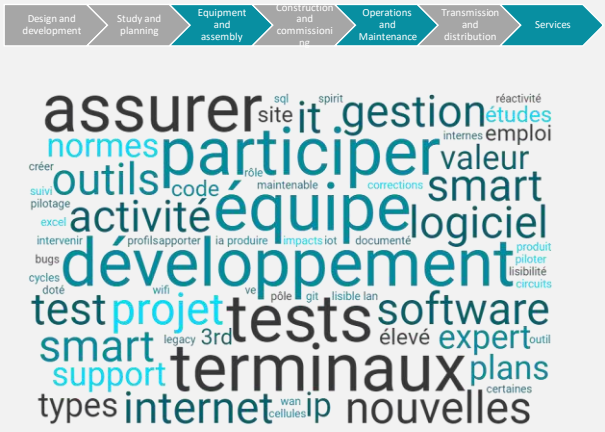
- **ATFP:** Sectoral Training Centers in Electricity and Electronics
- **ANME**: offers since January 2023 a training for cable technicians, in order to specialize them cable technicians which will begin in January 2023, so that they specialize in renewable energies.

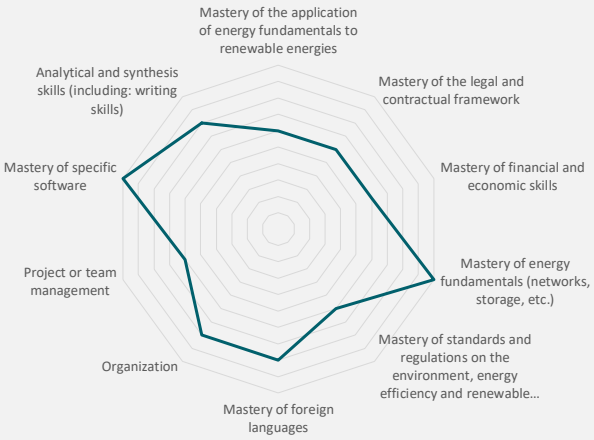
Level of qualification of the job

Software Engineer

With skills in renewable energy

Sectors concerned



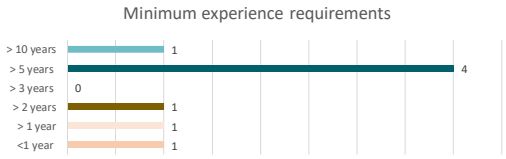


Missions and responsibilities

- Design, develop and implement computer systems and software for simulation and modeling, facilities monitoring and surveillance platforms, etc.
- Manage software or information systems development projects for renewable energy projects, including planning, coordinating and supervising development teams.
- Analyze and process data generated by renewable energy projects, including measurement, production and performance data.
- Optimize renewable energy production processes using data analysis and modeling techniques to improve efficiency and profitability.

Experience required:

- Companies most need experienced IT engineers (>5 years) who can drive the implementation of complex projects. These are difficult to find, especially because of the increasing departure of engineers abroad.



Required training and examples of available training

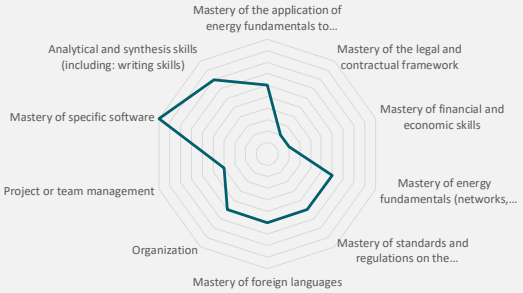
An engineering degree in computer science, software engineering, data science, or a master's degree specializing in computer science.

- **Higher School of Communications of Tunis (SUP'COM)**
- **The National School of Engineering of Tunis (ENIT)**
- **National School of Computer Science (ENSI)**
- **Higher Institutes of Technological Studies (ISET Nabeul, Sousse, Kairouan, Gabès, Sfax, Gafsa)**
- **Higher Institute of Applied Sciences and Technology of Sousse (ISSAT Sousse)**
- **Private Higher School of Engineering and Technology (ESPRIT)**
- **Free University of Tunis (ULT)**

Level of qualification of the job

Draughtsman

Sectors concerned



Missions and responsibilities

- Design and model in 3D detailed construction plans of renewable energy facilities (creation of BIM models for the project, which will include information on renewable energy systems, equipment, networks).
- Work with engineers, architects and other project team members to ensure BIM models conform to project specifications.
- Build and write technical files for the execution and/or manufacture of equipment.

Experience required:

- Very few draftsmen are needed to complete a project (one draftsman per project on average), but their lack of scarcity in the labour market can hinder companies' ability to carry out their renewable energy development projects. We did not identify any job postings for draftsmen in this study. Nevertheless, during the interviews, companies told us about the difficulties encountered in finding designers for renewable energy projects.

Required training and examples of available training

Applied Bachelor's degree in Civil Engineering or equivalent senior technician in civil engineering with draughtsman specialty

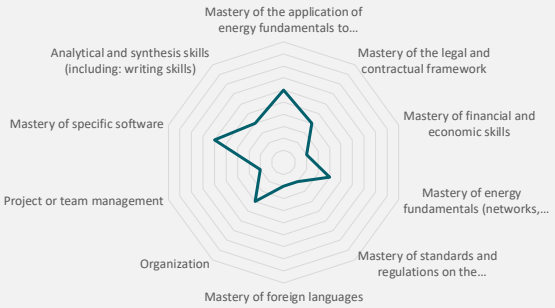
- **Higher Institutes of Technological Studies (ISET Nabeul, Sousse, Kairouan, Gabès, Sfax, Gafsa, Tozeur):** "Buildings" course , or "Topography and geomatics" course.
- **ATFP:** Sectoral Training Centres in Building and Annexes
- **ATFP :** Sectoral Training Centres in Metallic Construction

Level of qualification of the job

Technical sales agent

Specialized in renewable energies

Sectors concerned

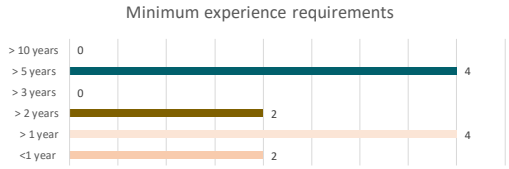


Missions and responsibilities

- Prospect and develop a portfolio of potential customers by identifying their renewable energy needs.
- Ensure the management and follow-up of sales projects, from negotiation to final delivery on time and on budget.
- Ensure customer satisfaction by resolving technical or commercial problems that may arise during the project.
- Collaborate with technical teams to develop customized solutions for customers, which requires understanding the technical specifics of different products or services offered, as well as the advantages and disadvantages of each technology

Experience required:

- There are few technical and commercial profiles specialising in renewable energies due to the historical monopoly of the public sector and the complexity of transferring conventional energies to renewable energies. Companies are looking for varied experience profiles.



Required training and examples of available training

Diploma of advanced technician in electrical, electronics with specialty in renewable energies or professional license in commerce and sales with specialization in renewable energies

- **Additional training in technical sales in a center approved by UTICA and ANME.**

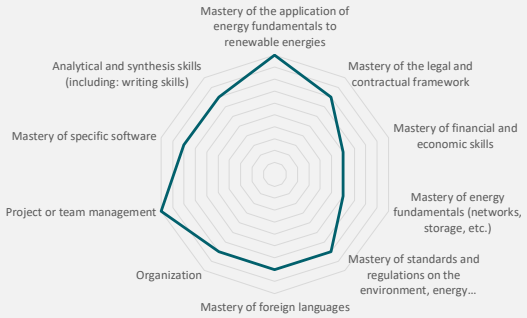
Level of qualification of the job

●●●

Civil Engineer

Specialized in renewable energies

Sectors concerned

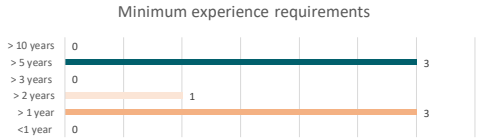


Missions and responsibilities

- Design and define support structures for solar panels or wind turbines, and plan construction taking into account environmental and topographical factors of the construction site.
- Oversee the construction and installation of renewable energy infrastructure to ensure it is built to safety and quality standards, specifications and contract terms.
- Assess the feasibility of renewable energy projects by studying environmental conditions, available resources and costs.

Experience required:

- In Tunisia, few civil engineers have specific skills in renewable energy. Experienced profiles on the rarest. On the profiles sought, companies are looking for experienced profiles (> 5 years) and junior (> 1 year).



Required training and examples of available training

Engineering degree in civil engineering. In Tunisia, there is no civil engineering school that specializes its graduates in renewable energy specifically. Some schools offer engineering programs that include courses on renewable energy.

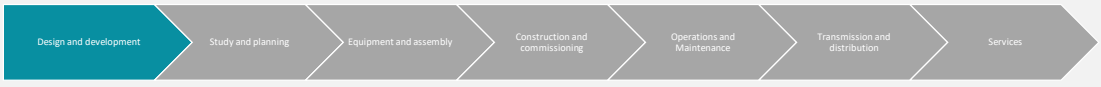
- **The National School of Engineers of Tunis (ENIT):** civil engineering training including courses on renewable energies.
- **The Higher Institute of Applied Sciences and Technology of Sousse (ISSAT**): training in civil engineering with a renewable energy option.
- **The Higher School of Engineering Sciences and Technologies of Sousse (ESSTI):** civil engineering program that includes courses on renewable energies.
- **Private Higher School of Engineering and Technology(ESPRIT):** civil engineering training
- **Free University of Tunis (ULT):** engineering training in civil engineering

Level of qualification of the job

●●●

Architect

Sectors concerned



Missions and responsibilities

Missions and responsibilities expected of an architect relating to the energy performance of buildings:

- Evaluate the needs for a construction project, carry out the design.
- Carry out a diagnosis of a building: carry out energy performance calculations, carry out system and equipment assessments, etc.
- Advise the client to lead him to build or evolve his building towards optimal energy solutions: choice of materials in particular, optimization of space ...
- Coordination and supervision of the work: Ensure the proper coordination of the various stakeholders, definition of the budget, definition of the schedule, management of regulatory and financial compliance (building permits for example).

Experience required:

Architects play a key role in integrating renewable energy systems into buildings from the design stage. They can become relay experts to support organizations in implementing their energy efficiency projects. Also, it is important that real estate developers are accompanied by a couple expert energy auditor and architect to take into account energy efficiency in their project. For example, architects with experience in the design of energy-efficient buildings as well as in the integration of renewable energies are in high demand in the energy sector.

Required training and examples of available training

Training in architecture school in order to obtain a national diploma in architecture is necessary. The duration of studies is at least 5 years. Some schools offer modules on energy efficiency in buildings.

There are several schools of architecture in Tunisia, including public schools:

- **National School of Architecture and Urbanism (ENAU) - Tunis**
- **Higher School of Architecture of Tunis (ESAT) – Tunis**

But also private schools:

- **School of Architecture and Design in Tunisia (CSAD – Carthage School of Architecture and Design – de l'UTC)**

Level of qualification of the job

Energy engineer (thermal and electrical)

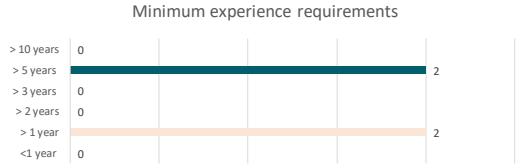
Sectors concerned

Missions and responsibilities

- Study the energy consumption of a building, its CO2 emissions and deduce an energy balance.
- Conduct studies to optimize energy consumption and develop energy efficiency strategies. Design, implement and coordinate these actions by developing new processes based on renewable energies (wind, solar, etc.) and alternative energies (hydrogen – biofuel – methanol – ammonia, etc.).
- Establish energy accounting by ensuring reporting with a view to measuring and verifying the savings achieved. Define and monitor energy performance indicators.
- Perform energy audits.

Experience required:

- Depending on the job performed by the energy efficiency engineer, the experience expected by the employer differs. For key positions involving the supervision of a team, significant experience will be required. On the other hand, for regulatory compliance assessment positions, for example, the level of experience will be less discriminating.



Required training and examples of available training

The training to become an energy efficiency engineer lasts 5 years (master level). Different schools offer courses oriented towards energy efficiency:

- **The National School of Engineers of Monastir (ENIM):** offers training in the field of energy through the "Energy Engineering" curriculum, the school offers a specialty "Energy Efficiency".
- **The National School of Engineering of Tunis (ENIT)** through the "Energy Engineering" course.
- **Central Higher Private Polytechnic School of Tunis** thanks to the training of energy engineer.
- **National School of Engineers of Sfax(ENIS)**

Level of qualification of the job

HVAC engineer

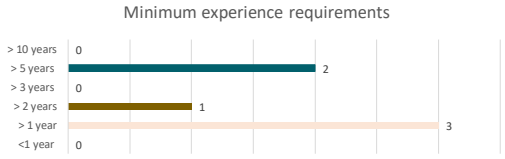
Sectors concerned

Missions and responsibilities

- Design of complete thermal systems (air conditioning, heating, ventilation), installation and maintenance.
- Ensure the thermal comfort of building occupants while optimizing energy consumption and minimizing environmental impact: optimizing temperature and air quality.
- Ensures regulatory standards.
- Management of financing plans.

Experience required:

- If the job description concerns the implementation of an energy efficiency policy, minimal experience will be required. On the other hand, for a strategic position such as the position of energy manager, which aims to supervise the proper implementation of energy efficiency action plans in buildings, significant experience is expected from employers.



Required training and examples of available training

The training to become a HVAC engineer lasts 5 years (master level):

- **The National School of Engineers of Monastir (ENIM):** offers training in the field of energy through the "Energy Engineering" curriculum, the school offers a specialty "Energy Efficiency".
- **The National School of Engineering of Tunis (ENIT)** through the "Energy Engineering" course.
- **Central Higher Private Polytechnic School of Tunis** thanks to the training of energy engineer.
- **National School of Engineers of Sfax(ENIS).**

Level of qualification of the job

Mason

Sectors concerned

Missions and responsibilities

- Carry out the structural work on new and old constructions: create the foundations according to the instructions of the surveyor, mount the walls, install the partitions, seal the beams ...
- Manage waterproofing, building strength, sound and thermal insulation and standards related to sustainable development

Experience required:

- The interviews highlighted that masons with a good knowledge of the materials used in the energy performance framework are highly sought after. Similarly, mastering application or construction techniques with these materials are key skills, employers are very demanding profiles with previous experience in energy efficiency projects.

Required training and examples of available training

There are various vocational training centres across the country that offer masonry training:

- **Manouba Vocational Training Center for Building and Public Works:** This center offers short and practical training for the various trades of construction, including masonry.
- **National Institute of Building and Public Works of Tunis:** This establishment offers professional training in masonry, ranging from 1 to 2 years, as well as training in project management in the field of construction.
- **Goulette Vocational Training Center:** This centre offers 1-year mason training, with a practice-oriented program.

Level of qualification of the job

Technician

Specialized in insulation

Sectors concerned

Missions and responsibilities

• Prepare materials

• Install the insulation

• Ensuring the quality of thermal insulation

• Master implementation techniques

• Comply with compliance checks

Experience required:

- The interviews revealed that energy efficiency technicians with a good knowledge of the materials used in the energy performance framework and particularly insulation are highly sought after. Similarly, mastering application or construction techniques with these materials are key skills, employers are very demanding profiles with previous experience in energy efficiency projects.

Required training and examples of available training

The training required to become an insulation technician is 2 years. Different institutions offer these courses in thermal and acoustic insulation:

- **Higher Institute of Environmental Technologies , Urban Planning and Building (ISTEUB)**
- **Higher Institute of Technological Studies of Sousse (ISET Sousse)**
- **Higher Institute of Training for Industrial Professions of Gabes (ISFORMIG)**

It is also possible, from a technician diploma in the building sector, to specialize later with additional training:

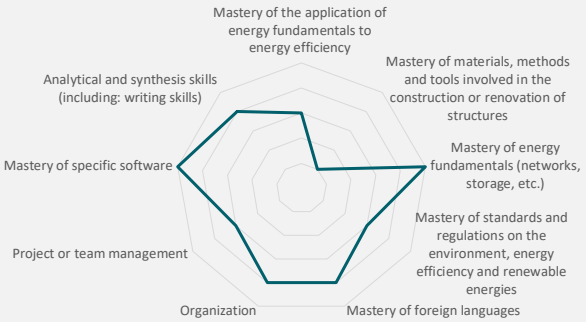
- **Training Center for Insulation and Sealing Professions (CFMIE):** This training centre offers professional training in thermal and acoustic insulation, as well as roof waterproofing. The trainings last between two and six months.

Level of qualification of the job

Software Engineer

Having skills in energy

Sectors concerned

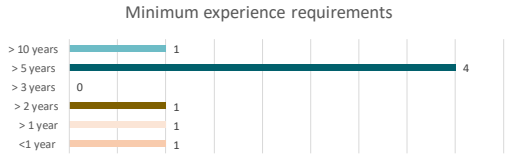


Missions and responsibilities

- Design, develop and implement computer systems and software for simulation and modeling, platforms for monitoring and monitoring the energy performance of the building, etc.
- Manage software or information systems development projects for energy efficiency projects, including planning, coordinating and supervising development teams.
- Analyze and process data generated by building equipment, including measurement and performance data.
- Optimize energy management processes using data analysis and modeling techniques to improve efficiency and profitability.

Experience required:

- Companies most need experienced IT engineers (>5 years) who can drive the implementation of complex projects. These are difficult to find, especially because of the increasing departure of engineers abroad.



Required training and examples of available training

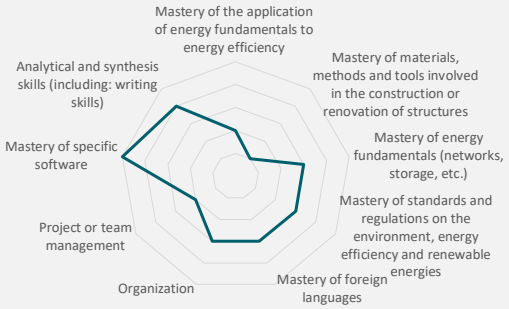
An engineering degree in computer science, software engineering, data science, or a master's degree specializing in computer science.

- **The National School of Engineering of Tunis (ENIT)**
- **National School of Computer Science (ENSI)**
- **Higher Institutes of Technological Studies (ISET Nabeul, Sousse, Kairouan, Gabès, Sfax, Gafsa)**
- **Higher Institute of Applied Sciences and Technology of Sousse (ISSAT Sousse)**
- **Higher School of Communications of Tunis (SUP'COM)**

Level of qualification of the job

Draughtsman

Sectors concerned



Missions and responsibilities

- Design and model in 3D detailed plans for the construction or renovation of buildings (creation of BIM models for the project, which will include information on the plan, equipment, networks).
- Work with engineers, architects and other project team members to ensure BIM models conform to project specifications.
- Build and write technical execution and/or manufacturing files.

Experience required:

- Very few draftsmen are needed to carry out a project (one draftsman per project on average), but their lack of scarceness on the labour market can hinder the ability of companies to carry out their energy efficiency projects of the building (especially for structural renovations).

Required training and examples of available training

Applied Bachelor's degree in Civil Engineering or equivalent senior technician in civil engineering with draughtsman specialty

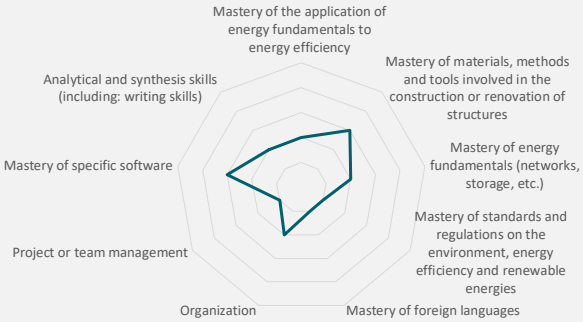
- **Higher Institutes of Technological Studies (ISET Nabeul, Sousse, Kairouan, Gabès, Sfax, Gafsa, Tozeur):** "Buildings" course , or "Topography and geomatics" course.
- **ATFP:** Sectoral Training Centres in Building and Annexes
- **ATFP :** Sectoral Training Centres in Metallic Construction

Level of qualification of the job

Technical sales agent

Specialized in energy efficiency

Sectors concerned

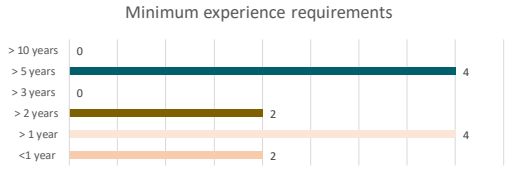


Missions and responsibilities

- Prospect and develop a portfolio of potential customers by identifying their energy management needs.
- Ensure the management and follow-up of sales projects, from negotiation to final delivery on time and on budget.
- Ensure customer satisfaction by resolving technical or commercial problems that may arise during the project.
- Collaborate with technical teams to develop customized solutions for customers, which requires understanding the technical specifics of different products or services offered, as well as the advantages and disadvantages of each technology.

Experience required:

- Technical sales profiles specialized in energy efficiency are sought-after profiles at several levels of experience.



Required training and examples of available training

Diploma of advanced technician in electrical, electronics with specialty in renewable energies or professional license in commerce and sales with specialization in renewable energies

- **Additional training in technical sales in a center approved by UTICA and ANME.**

APPENDIX 13 DETAILED DESCRIPTIONS OF RECOMMENDATIONS

Low: ●○○ *Moderate:* ●●○ *High:* ●●●

RECOMMENDATION 1 ENHANCE COLLABORATION AMONG EDUCATORS, TRAINERS, AND COMPANIES INVOLVED IN THE CLEAN ENERGY TRANSITION

Recommendation 1.1 Strengthen existing initiatives to identify and cultivate skills needed for the energy transition	
Priority level and level of difficulty of implementation	• Priority level: ●●● • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy and energy efficiency in buildings • Jobs: All jobs
Context	• The education sector struggles to effectively meet enterprises' skill needs. • Also, companies struggle to find certain key job profiles in the market to implement their projects. • Federated research projects (FRPs) have been implemented to facilitate the launch of skill development projects, which are jointly governed by education and energy stakeholders. Other initiatives, for example, the establishment of a postsecondary council, linked to MESRS, have been carried out.
Challenge identified	• Education actors and private actors do communicate, especially in the context of co-construction of academic programs or FRPs, although the exchanges remain too few or in the form of pilot projects (in the case of FRPs) and are not strategically coordinated at the highest level. • Despite its strategic scope of application (the entire education system, vocational training, and employment), the postsecondary council is not specific to the sectors studied and recommendations are apparently updated infrequently. • The absence of a strategic body dedicated to skill development for the energy transition poses the risk of a mismatch between the training offered and companies' skill needs.
Detailed recommendation	• The FRPs constitute a first draft of cross-governance between education and energy actors. Extending the scope of action of FRPs would enable sustaining collaboration between these two types of actors and the creation of a new governance body dedicated to skill development specifically focused on renewable energy and energy efficiency of buildings. This extension of the FRPs would ultimately aim to create SCCs. • Two SCCs could be set up, one dedicated to renewable energy and the other dedicated to energy efficiency. The SCCs would comprise representatives from the education and training sectors (including vocational training) and representatives of the companies operating in the sectors concerned. • The SCCs would be new bodies promoting cross-governance between the education sector and the energy transition sector. The objective would be to ensure regular training content is updated regularly. The SCCs should help to bridge the gap between these two actors and have a mandate for skill development: ○ The skills needed by companies would be synthesized by their representatives and then transmitted to education and training

	stakeholders. This would enable a better match between the skills requested and those to be developed. ○ Education stakeholders could present their feedback on the employability of the people under training. This will help companies adjust their skill/job demands if necessary. • These interactions would also allow the education and training sectors to move from a skill-supply-based approach to a skill-demand-based approach, including by making recommendations to the education sector. Representatives of existing bodies (including the postsecondary council mentioned above) could share their work and conclusions within the SSCs. • This new governance will prevent the emergence of new mismatches between the skills available on the labor market and the skills sought by companies.
Governance	• Education and training sector representatives: Ministry of Vocational Training and Employment, MESRS—designing/updating training content • Employment sector representatives: Private training organizations and organizations under the supervision of the Ministry of Vocational Training and Employment—organization of training • Business representatives: UTICA; CONECT; and STEG—expression of needs

Note: CONECT = Confederation of Citizen Enterprises of Tunisia; MESRS = Ministry of Higher Education and Scientific Research; SCCs = sectoral competence councils; STEG = Tunisian Electricity and Gas Company; UTICA = Tunisian Union of Industry, Commerce and Handicrafts.

Recommendation 1.2 Encourage the development of small renewable energy projects within larger government plans to deploy renewable energy	
Priority level and level of difficulty of implementation	• Priority level: ●●● • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy • Jobs: All jobs
Context	• Most private renewable energy businesses are small and have limited growth potential predominantly due to their inability to foresee the sector's dynamism. • The number of jobs created depends on the size of renewable energy projects. Tunisian companies manage to participate under the self-production scheme, while the authorization scheme covers small solar projects of 1 MW. For 10 MW projects and projects under the concession scheme, few Tunisian companies have assumed the developer's role, most acting as subcontractors.
Challenge identified	• While **small- to medium-size projects involve many Tunisian companies** (especially small and medium enterprises), large projects in Tunisia promote the involvement of foreign groups, in turn promoting limited local job creation.
Detailed recommendation	• Small-scale renewable energy projects could be given more prominence in government targets as they generate more jobs than larger projects. • For this, the Ministry of Industry, Mines and Energy (MIME) could: ○ Include in its renewable energy development strategy a target for the share of small projects that will develop the targeted production capacities; ○ Promote the development of projects under the self-production scheme; and

	○ Encourage the creation of projects of 1 MW or less or projects under the permit scheme. • However, there must a diverse mix of project size typology for the Tunisian landscape to ensure the benefits due to each project size. While small projects promote local job creation, large projects contribute to project costs through economies of scale.
Governance	• MIME—direction of government objectives for small-scale projects

Note: MW = megawatt.

RECOMMENDATION 2 RAISE THE SKILLS OF THE WORKFORCE BY CREATING OR IMPROVING TRAINING PROGRAMS

Recommendation 2.1 Strengthen STEG's upskilling programs to facilitate the company's transition to renewable energy	
Priority level and level of difficulty of implementation	• Priority level: ●●● • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy • Jobs: All jobs
Context	• It typically takes three years between STEG directors identifying the required talents and the actual recruitment of skilled staff. This long recruitment process is because STEG conducts hiring only through open contests, in partnership with MIME, which must first approve the implementation of these competitions. • STEG systematically includes a capacity-building component in all calls for tenders, although this mechanism is not sufficiently effective in filling the skill gap because it only trains technical people working in projects. Also, STEG employees need to be trained in other transversal skills not included in capacity building (e.g., cybersecurity and digital skills).
Challenge identified	• Considering the renewable energy sector evolves rapidly, STEG runs a very high risk of mismatch between its skill needs and its employees' skills. • STEG has launched projects led by its training department. Examples of this include projects cocreated with universities, as well as an e-learning platform for all employees. These projects, however, are only partially implemented and are not based on STEG's future skill and job needs.
Detailed recommendation	• STEG's employee skill adaptation programs could be strengthened to enable its current employees to acquire the skills needed to work in the renewable energy sector. • Also, there must be prospective analyses of the short-, medium-, and long-term skill and occupation needs. Program improvement must facilitate better and efficient project implementation and must ensure that programs are based on the results of prospective analyses. • Training could be delivered by STEG employees or by external training centers if no STEG employee has the skills covered by training. Practical training could also be included.

	• These programs would allow STEG to become more agile in obtaining renewable-energy-specific skills, in turn compensating for the time-consuming recruitment processes.
Governance	• STEG • External training centers

Note: MIME = Ministry of Industry, Mines and Energy; STEG = Tunisian Electricity and Gas Company.

Recommendation 2.2 Develop national programs to strengthen the skills of the trainers working in ANME-accredited training centers	
Priority level and level of difficulty of implementation	• Priority level: ●●● • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy and energy efficiency of buildings • Jobs: All jobs

Context	• In the renewable energy and energy efficiency sectors, certification training exists and is provided by ANME-accredited training centers.
	• This training is provided to the workforce for two reasons:
	  ○ Mandatory training ensures everyone engaged in these sectors is appropriately qualified, in turn guaranteeing quality of the tasks performed.
	  ○ All training courses offered facilitate professional retraining, especially for people in the energy and construction sectors.

Challenge identified	• The companies interviewed for this study indicated that some workers in renewable energy and energy efficiency in buildings are inadequately qualified and produce work of modest quality, despite having certifications. The perceived risk for these companies is a reputational loss, based on past experiences with companies with inadequately trained individuals. This weakens the market dynamics.
	• These companies identify two sources for this issue:
	  ○ Certain certification training courses are not sufficiently rigorous, but could include additional requirements, such as longer training duration or greater qualification level to obtain certification. This could be achieved, especially, by homogenizing the evaluation system and moving it out from under training centers.
	  ○ Some trainers lack knowledge of the way to deliver training (pedagogy). This hinders effective learning for trainees, even though the training content is adapted from a technical point of view.
	• Also, ANME is struggling with limited human resources: Recruitments were frozen for several years, and although they have been authorized again, they are not sufficient to allow ANME to thoroughly monitor the quality of the training offered in all its accredited training centers.

Detailed recommendation	• Strengthening ANME's human resources would enable it to make its certification training courses more rigorous in two ways: ○ There could be more surveys on the quality of the training provided at ANME-accredited training centers (surveys conducted by control offices). This would help identify training courses that could be improved. Tools and solutions could be used to improve training when its quality appears too low.

	○ There could be studies on service quality in the studied sectors. Especially, it could be examined whether certification training for the use of insulation materials and techniques to work toward energy efficiency in buildings should be made mandatory. The companies surveyed for this study considered these skills key, so there should be a more comprehensive and in-depth study specifically on this topic. • CENAFFIF's resources should be expanded to teach trainers in training pedagogy and andragogy, providing them with the tools they need to acquire that knowledge. • It should be noted that: ○ The objective is not to standardize training but to ensure that trainers have the right know-how and soft skills to conduct training. ○ It will be possible to adapt ANME's controls and CENAFFIF's training over time to avoid training being deemed archaic. • Expanding ANME's and CENAFFIF's resources should enable making these certification training courses more rigorous, in turn ensuring that anyone with a certification is sufficiently qualified to participate in renewable energy or energy efficiency projects, ultimately promoting the sector's development. This deepening of workforce training would also allow companies to reduce their training need for new employees as well as training costs, and become more efficient.
Governance	• MIME—ANME funding • Ministry of Vocational Training and Employment—CENAFFIF funding (if additional funding is needed) • ANME—more in-depth monitoring of the quality of the training provided at the accredited training centers • CENAFFIF—implementation of training courses on training pedagogy and andragogy for all trainers operating in ANME-certified centers

Note: ANME = National Agency for Energy Management; CENAFFIF = National Center for the Training of Trainers and Training Engineering; MIME = Ministry of Industry, Mines and Energy.

Recommendation 2.3 Facilitate the workforce's access to short-term vocational training	
Priority level and level of difficulty of implementation	• Priority level: ●●● • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy and energy efficiency • Jobs: All jobs
Context	• Short-term vocational training is now offered at training centers to help professionals in the conventional energy and buildings sectors to retrain to work in renewable energy and energy efficiency in buildings.
Challenge identified	• ANETI considers these training courses useful. This indicates that they are quite effective in professional retraining. • This training is relatively inexpensive for workers since they are of a limited duration. Longer training courses exist but are less affordable for workers who wish to benefit from them. This is because they have to finance the training and suffer substantial income loss due to prolonged absence from work.

	• Further, these training courses are typically funded on an ad hoc basis by international stakeholders (e.g., international donors). This funding is not considered sustainable and could eventually end abruptly.
Detailed recommendation	• Develop state funding for training centers offering short-term vocational training so that they can benefit from sustainable funding and can develop and create more short-term training courses if required (according to the conclusions of ANME's work, as described under recommendation no. 4). These training courses will leverage pilot actions of international stakeholders, which have demonstrated notable integration. • International stakeholders wishing to finance training of this type could either continue funding projects as executed today or finance a training-related fund led by the Ministry of Employment and the Ministry of Energy. Stakeholders will need to coordinate with relevant institutional and private actors (e.g., ATFP/UTICA) to launch these training courses in other centers and update the programs regularly. • The development of such training would enable out-of-job workers or people wishing to retrain in renewable energy and energy efficiency in buildings to acquire the skills expected in these sectors at a lower cost than long-term training. These courses will also enable them to obtain diplomas, which they can use to obtain funding if they wish to start their own businesses. • Considering the energy transition technologies and the related market evolve rapidly, access to online and especially international training courses is crucial. However, these courses are expensive or require payment in international currencies for enrolment. Although private training centers could facilitate foreign currency payment, it is not very straightforward. Meanwhile, state funding for training centers will allow them to buy online training licenses and offer them in local currency and at lower prices in Tunisia. The state may also consider other facilitation mechanisms.
Governance	• Ministry of Employment and Vocational Training, including the centers under its supervision • MIME • MESRS

Note: AFTP = Tunisian Agency of Professional Training; ANETI = National Agency for Employment and Self-Employment; ANME = National Agency for Energy Management; MESRS = Ministry of Higher Education and Scientific Research; MIME = Ministry of Industry, Mines and Energy; UTICA = Tunisian Union of Industry, Commerce and Handicrafts.

Recommendation 2.4 Offer students of renewable energy and employees of companies operating in the sector training in administrative and financial management of projects	
Priority level and level of difficulty of implementation	• Priority level: ●●● • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy • Jobs: Mainly high-skilled jobs
Context	• The implementation of renewable energy projects requires obtaining administrative and financial validation upstream. • Renewable energy and energy efficiency companies seeking funding must submit applications to banking and financial players. This requires them to compile files presenting such information as their activity, development prospects, or financial viability.

	• While energy efficiency files are described as more "classic" for banking and financial players and, therefore, "easier" to process, files concerning renewable energy projects are considered more technical and complex. Especially applications for financing submitted by Tunisian SMEs are considered complex insofar as their limited human resources results in them submitting less exhaustive and precise files than large groups, for example.
Challenge identified	• The companies interviewed for this study indicated that their development could be hindered due to the complexity of the process of obtaining administrative and financial validation. This can be explained by the lack of understanding of the steps in obtaining administrative and financial validation, and the lack of knowledge of the financial issues specific to renewable energy projects. This occasionally results in incomplete or unviable files. • Dual-competence job profiles are key for an SME manager's position (in charge of supporting SMEs in their financing). • Tunisian SMEs may submit improperly presented and evaluated funding requests, causing potential inadequacy of the funding received.
Detailed recommendation	• In the continuing education sector, renewable energy sectors could be offered training on the administrative and financial management of projects: ○ Administrative skills will be especially in demand by (1) VSEs and SMEs, which must be able to set up administrative files and obtain the necessary authorizations to put their projects into operation; and (2) actors specialized in supporting VSEs or craftsmen for the realization of these administrative procedures. ○ Financial skills will be requested by (1) VSEs and SMEs, which must be able to submit complete and viable financing files to banking and financial actors; and (2) actors specializing in supporting VSEs or craftsmen for the financial structuring of their projects. ○ This training could be included in the courses delivered at accredited training centers and developed by external experts (such as CBF). Before that, it will be necessary to conduct a study on the specific needs to be developed so that training can be adapted. In a second step, the training content will be sent to accredited centers, which can train companies based on their assessment of whether they have qualified people as trainers. • In the education sector, optional subjects could be offered to engineers studying in the energy sector, especially to those wishing to work in the renewable energy sector. This will help those who wish to obtain dual competences in renewable energy and finance. Indeed, although every energy or renewable energy engineer need not necessarily be trained in finance, in-depth finance lessons can be beneficial for those wishing to specialize in energy or renewable energy.
Governance	• CBF—determination of the elements to be included in training • SCCs—validation of the elements to be included in training, in agreement with sector representatives • Academic centers (universities, vocational high schools, etc.) and continuing education centers offering courses in energy or buildings—training implementation • MESRS

Note: CBF = the banking and financial advisory; MESRS = Ministry of Higher Education and Scientific Research; MIME = Ministry of Industry, Mines and Energy; SCCs = sectoral competence councils; SMEs = small and medium enterprises; VSEs = very small enterprises.

Recommendation 2.5 Expand existing training for bank employees to cover the specific requirements of renewable energy projects	
Priority level and level of difficulty of implementation	• Priority level: ●●● • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy • Jobs: Mainly high-skilled jobs
Context	• The banking and financial stakeholders interviewed for this study indicated that the labor market has a scarcity of people with in-depth knowledge of renewable energy and finance. Such knowledge is especially sought after to evaluate and critically review the financing requests submitted by Tunisian renewable energy companies, especially SMEs, which occasionally struggle to submit complete and viable files. Also, the sector struggles to retain individuals with dual renewable energy and financial competences.
Challenge identified	• Funding requests submitted by Tunisian SMEs may thus not be properly evaluated, causing potential inadequacy of the funding received.
Detailed recommendation	• International donors (World Bank, German Agency for International Cooperation [GIZ]) and ANME have developed a program to train bank employees on renewable energy topics. However, the program has seen limited scale-up and dissemination across all banks: ○ There exist training courses as well as qualified trainers. The number of beneficiaries could be increased through continued and intensified efforts in this direction, including, for example, increasing the number of trainers, using the internal communication channels of the banking sector (thanks to the CBF), or providing special offers to encourage banks to register for training (this may include discounts for the first registrants or reduced rates). • The banking sector also struggles to retain individuals with dual technical and financial skills. Meanwhile, a study of the positions accessible to dual-competence applicants and the conditions offered by employers could help the banking sector situate offers on the market (salaries, career development opportunities, benefits and bonuses, work-life balance, etc.). Banks will thus be able to offer more attractive conditions to boost the appeal of these key positions.
Governance	• CBF—determination of the elements to be included in training • Academic centers (universities, vocational high schools, etc.) and continuing education centers offering courses in energy or buildings—training implementation

Note: ANME = National Agency for Energy Management; CBF = the banking and financial advisory; SMEs = small and medium enterprises.

Recommendation 2.6 Mandate that academic curricula include training in insulation materials and techniques used in building construction and renovation	
Priority level and level of difficulty of implementation	• Priority level: ●●● • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Energy efficiency of buildings • Jobs: Mainly low- to medium-skilled jobs, such as masons and building technicians
Context	• The energy efficiency in buildings sector is seeing limited development due its workforce's limited knowledge of insulation materials and insulation techniques.
Challenge identified	• Growth of energy efficiency in buildings could be hampered by a lack of proficiency in insulation materials and techniques. • Postsecondary training is not available in energy renovation and energy efficiency of buildings. The limited dynamism of the sector causes a low or complete lack of labor market demand for applicants with such training.
Detailed recommendation	• It would be beneficial to induce the sector to sponsor postsecondary training in building energy efficiency. • Current academic training courses related to the construction and renovation of buildings (in the broad sense) could include at least a module on insulation materials and techniques. This will allow future graduates to have the skills considered key by companies in this sector. This will facilitate their professional retraining. • This training could either be included in the mandatory energy efficiency modules or could supplement these modules. • Making certification training on this subject mandatory for participation in the energy efficiency of buildings (following ANME's work; described under recommendation no. 4) could help students to obtain a degree that is equivalent to ANME's certification training.
Governance	• SCCs—determination of the elements to be included in training • Academic centers (universities, vocational high schools, etc.) offering courses in energy or buildings—training implementation • MESRS

Note: ANME = National Agency for Energy Management; MESRS = Ministry of Higher Education and Scientific Research; SCCs = sectoral competence councils.

RECOMMENDATION 3 PROMOTE AN INCLUSIVE ENERGY TRANSITION THAT CAN CREATE JOBS FOR YOUTH AND WOMEN

Recommendation 3.1 Enhance practical training components in academic curricula focused on renewable energy and energy efficiency-	
Priority level and level of difficulty of implementation	• Priority level: ●●● • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy and energy efficiency of buildings • Jobs: All jobs
Context	• The unemployment rate is very high among youth, especially among young graduates: between 2007 and 2020, the unemployment rate for postsecondary graduates increased. It reached 26.6 percent at the end of 2020 and slightly decreased to 24 percent in 2022.
Challenge identified	• The companies interviewed for this study mentioned lack of practical training (as opposed to theoretical training) among young graduates as a major obstacle to their recruitment. Hiring young graduates without practical training creates training needs that the companies in these sectors (usually small) are occasionally unable to provide. Mostly private businesses, which are small, are reluctant to bear the costs for training the young individuals they hire (limited financial means). • Even if some companies can finance training, they still predominantly look for qualified and experienced personnel: since these are often SMEs, they must demonstrate their ability to execute renewable energy/energy efficiency projects with limited staff. It is therefore more advantageous for them to hire qualified and experienced people. However, the companies surveyed for this study indicated that the market has a scarcity of experienced workers, especially for highly skilled positions, such as engineers, which demonstrate a growing trend of relocating abroad. • Finally, young graduates do not necessarily have the means to self-finance end-of-studies certification training to obtain the experience required by companies (depending on the situation). • This is true for all levels of qualification. • Companies offer internships to students, which are often only end-of-studies internships (and therefore preemployment) during summer, when activity is limited.
Detailed recommendation	• The academic curriculum could systematically include practical courses to enable young graduates acquire experience they can highlight during recruitment. Systematically increasing the share of practical training in academic curricula could enable young graduates to better meet companies' expectations. This would increase the availability of suitable applicants for companies to recruit, while also making young graduates more loyal to their organizations. This could help companies retain experienced people. • In the short term, this practical experience can be made possible through partnerships between universities and training centers, for example, to provide training at a reduced price, enabling young graduates to access courses. • In the medium term, this practical experience can take the format of alternation, or at least internships in companies: ○ University courses should include internships from the first years of training (worker internships, observation, etc.) to expand students' professional

	experience. These internships could be conducted across the year to help students acquire practical skills over longer periods of activity than just the summer, when activity is limited. These internships would contribute to the development of corporate culture pertaining to the employment of young people and promote the implementation of apprenticeship programs. ○ Learning programs, which act as an interface between academia and the professional world, should be more structured and rolled out at the national level. While apprenticeship programs already exist, their visibility among companies appears limited. These programs could help address several of the challenges identified in this study: (1) they could contribute to the successful implementation of the SCCs' recommendations by being a means to test the recommendations; (2) they could help young graduates acquire the necessary experience to be employable at the end of their studies, without having to pay for additional training; and (3) they could promote employer involvement in defining the content of education and thus foster links between education and industry. ○ Also, since women attend postsecondary courses in renewable energy/energy efficiency, designing such courses to serve as gateways to or interfaces with the business world could break down gender stereotypes and promote increased integration of women in renewable energy/energy efficiency companies after course completion. • The result is that youth and women will find it easier to find work after their studies, and companies will be able to hire people who can start working faster, without requiring prior internal training.
Governance	• SCCs—connecting academic actors and business representatives to facilitate communication and ensure all training programs can find partner companies • Academic centers concerned—contact with companies, provision of students • Companies concerned—training of students • MESRS

Note: MESRS = Ministry of Higher Education and Scientific Research; SCCs = sectoral competence councils; SMEs = small and medium enterprises.

Recommendation 3.2 Require at least one module on renewable energy and one on the energy efficiency of buildings in all energy training programs, especially those for senior technicians	
Priority level and level of difficulty of implementation	• Priority level: ●●● • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy and energy efficiency of buildings • Jobs: All jobs, with priority to senior technicians
Context	• The development of renewable energy and the energy efficiency of buildings is carried out in a heterogeneous way, depending on the commissioning of related projects. • Mandating all energy training programs to include at least one module on renewable energy and/or one module on energy efficiency in buildings would allow young graduates to acquire the versatility expected today on the job market. • Although everyone wishing to work in renewable energy and energy efficiency in buildings should develop this versatility, the training programs especially target senior technicians. Indeed, the companies interviewed for this study indicated that the difficulty to retrain energy and construction professionals varied based on the

	qualification level: while companies consider it relatively difficult to retrain engineers (who have strong adaptability) and technicians (who can benefit from certification training that is not very time consuming), it is apparently more difficult for them to retrain senior technicians. Individuals in these roles oversee the technical implementation of projects and must thoroughly understand the design-related and practical aspects of projects.
Challenge identified	• The heterogeneous development of renewable energy and energy efficiency in buildings poses a dual employment risk for young graduates due to a specialization that is either too premature (potentially putting them at risk of not finding enough job offers) or too late (potentially putting them at risk of seeing the market saturated with job demand). • Young graduates must therefore build versatile skills profiles to participate in the conventional energy and buildings sectors, while being available to meet the future demand of the renewable energy and energy efficiency sectors. This challenge of versatility is all the stronger for senior technicians.
Detailed recommendation	• Any training program in energy, especially those targeting future senior technicians, could include at least one module on energy efficiency and/or one module on renewable energy. This will enable students to become versatile, ultimately facilitating their potential professional retraining. • The additional modules could take the form of a Massive Open Online Course, designed by MESRS, based on the SCCs' content recommendations. This training format would target postsecondary students—who appear to have the basic skills and know the tools (through educational institutions) to benefit from it—and contribute to advancing the energy transition by removing the barrier posed by a digital skill gap.
Governance	• SCCs—determination of the elements to be included in training • Academic centers (universities, vocational high schools, etc.) and training centers offering courses in energy or buildings—training implementation • MESRS

Note: MESRS = Ministry of Higher Education and Scientific Research; SCCs = sectoral competence councils.

Recommendation 3.3 Provide free and systematic training in renewable energy and energy efficiency of buildings to young people who are unemployed for a long period or are under CIVP contracts	
Priority level and level of difficulty of implementation	• Priority level: ●●○ • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy and energy efficiency of buildings • Jobs: All jobs
Context	• For young graduates who are unemployed or under Professional Life Integration Contracts (CIVPs), employment access may require developing skills specific to the renewable energy and energy efficiency sectors.
Challenge identified	• Current certification courses are occasionally too expensive for young graduates. This hinders their ability to benefit from practical lessons—generally delivered as part of these courses—and theoretical courses specific to the studied sectors. This hinders their professional retraining and employment access.

	• On the other hand, initial training currently lacks elements related to specific skills (e.g., use of digital models in buildings). This presents an opportunity to create high-value-added training courses for unemployed graduates in the concerned sectors.
Detailed recommendation	• Any young graduate who is unemployed for a long time or under CIVP contracts could systematically, and free of cost, be offered certification training to develop the key skills to participate in the energy transition. This recommendation will build on ANETI's existing mechanisms and will rely on companies' initial commitment to integrating youth. • These courses would allow young graduates to benefit from theoretical as well as practical training, sought after by companies. This will facilitate their long-term integration into the energy transition job market.
Governance	• SCCs—determination of the training to be offered • ANETI—identification of training beneficiaries and financing • Academic centers (universities, vocational high schools, etc.) and training centers offering courses in energy or buildings—training implementation • MESRS

Note: ANETI = National Agency for Employment and Self-Employment; MESRS = Ministry of Higher Education and Scientific Research; MIME = Ministry of Industry, Mines and Energy; SCCs = sectoral competence councils.

Recommendation 3.4 Create communication campaigns focusing on women working in the renewable energy and energy efficiency sectors, especially those in technical positions	
Priority level and level of difficulty of implementation	• Priority level: ●●● • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy and energy efficiency of buildings • Jobs: All jobs, especially those in technical positions
Context	• Tunisia's renewable energy and energy efficiency sectors continue to see limited female representation (only 28 percent of these sectors' workforce).
Challenge identified	• Gender stereotypes and the lack of female representation and role models in the renewable energy and energy efficiency sectors can discourage women from considering careers in these sectors, especially in technical and/or scientific positions.
Detailed recommendation	• Communication campaigns for promoting women in various positions in the energy sector, including technical positions (technician, senior technician, electrical engineer, etc.), could be created and disseminated on television and social media. • The communication campaigns would boost women's ability to envision themselves in the fields of renewable energy and energy efficiency and break down gender stereotypes in these sectors. • These campaigns would also "normalize" female presence in low-skilled technical positions and counter the perception that women cannot or should not occupy technical and/or physical positions in renewable energy construction sites and installations.
Governance	• Ministry of Industry, Mines and Energy (MIME)

Recommendation 3.5 Create incentive mechanisms to encourage women's participation in low-skilled technical training programs	
Priority level and level of difficulty of implementation	• Priority level: ●○○ • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy and energy efficiency of buildings • Jobs: Technical and low-skilled jobs
Context	• The low female representation in low-skilled technical positions can be attributed to their low participation in vocational training (12 percent).
Challenge identified	• Women's low participation in low-skilled technical training means they are poorly represented in the sector. The objective is therefore to encourage greater female participation in low-skilled technical training programs in a nonbinding way, creating a pathway for increased representation in these training courses as well as subsequently within companies (low-skilled technical positions).

Detailed recommendation	• The objective is to push training organizations to encourage greater female participation in a nonbinding manner and ensure women get a job in companies after course completion:
	  ○ Mechanisms such as scholarships or grants for women attending low-skilled technical training could be implemented.
	  ○ Women working in the sector could deliver mentoring sessions to under-training women, encouraging them to obtain a job.

Governance	• SCCs—determination of the incentive mechanisms to be developed in agreement with training sector representatives and annual monitoring of these mechanisms, and annual growth in the number of women in academic and training centers • Relevant academic and training centers—implementation of policies to integrate more women

Note: SCCs = sectoral competence councils.

Recommendation 3.6 Create incentive mechanisms to increase the share of women in highly qualified positions (including top management positions) in companies involved in renewable energy and energy efficiency in buildings	
Priority level and level of difficulty of implementation	• Priority level: ●○○ • Level of difficulty of implementation: ●●●
Sectors and jobs concerned	• Sectors: Renewable energy and energy efficiency of buildings • Jobs: High-skilled jobs (engineers, management positions)
Context	• As described under recommendation no. 3.4, Tunisia's renewable energy and energy efficiency sectors continue to see limited female representation (only 28 percent of these sectors' workforce). When women are present, they primarily occupy administrative positions: women occupy 54 percent of the administrative positions in these sectors, compared with only 22 percent of technical positions and 6 percent of managerial positions.

Challenge identified	• For highly qualified positions (including engineers) and top management, the low female representation is not attributable to their low presence in the related education systems, since they represent 58 percent of university students. The challenge is therefore to ensure:
	  ○ These students obtain employment in the renewable energy and energy efficiency sectors, and
	  ○ They remain employed in this sector, for nonadministrative professions.
	• Thus, for qualified positions (especially engineers) and management, the objective is to directly increase the female representation in a nonbinding manner.

Detailed recommendation	• Companies should deploy incentive mechanisms for qualified positions (especially engineers) and management positions. For example, companies that justify the implementation of the following actions could be favored in the context of responses to calls for projects:
	  ○ Establishment of gender equality policies.
	  ○ Organization of companywide employee awareness workshops to communicate the benefits of gender equality in the workplace and ultimately create a more inclusive work environment.
	  ○ Implementation of flexible working hours, and maternity and parental leave policies to help women balance their professional and personal lives. This could encourage women to pursue long-term careers and take up leadership positions.

Governance	• SCCs—determination of the incentive mechanisms that should be promoted in the context of responses to calls for projects, in agreement with company representatives, and annual monitoring of the results achieved by companies: number of women employees and female representation in qualified and management positions • Companies operating in the concerned sectors—implementation of policies to integrate more women and annual carryover of the achieved female representation share in relevant positions

Note: SCCs = sectoral competence councils.

APPENDIX 14 ADDITIONAL ANALYSES OF TRAINING FOR KEY JOBS IN THE ENERGY TRANSITION

This appendix presents additional by the World Bank on the availability of training for key jobs required for the Tunisian energy transition.

Employment	Number of training programs	Average number of registrants per year	Average number of graduates per year	Comments
Electrical engineer	8	365	357	Soft skills are relatively well developed by most training programs. The number of programs and registrants is adequate. All programs develop skills related to the fundamentals of energy and renewable energy, as well as financial and economic skills, although all of them should aid in reinforcing these skills. Most curricula neither develop competences related to the legal and contractual framework, nor cover skill development related to regulations and standards. All training programs should include these competences.
Renewable energy engineer	2	45	35	Soft skills are relatively well developed by most programs. One of the programs covers all necessary skills relatively adequately. The curricula aid in the development of competences related to the legal and contractual framework, and cover skill development related to regulations and standards, as well as financial and economic skills. However, the curricula should aid in reinforcing these skills. The number of programs and enrolments is very low.
Energy efficiency engineer	2	50	45	Soft skills are well developed by most programs. One of the programs covers all necessary skills adequately. The programs aid in the development of competences related to the legal and contractual framework, standards and regulations, as well as financial and economic skills competencies, although they should aid in skill reinforcement. The number of programs and enrolments is inadequate.
HVAC engineer	1	20	15	Soft skills are well developed by most programs. One of the programs covers all necessary skills adequately. The number of programs and enrolments is very low.
Civil engineer	3	154	153	Soft skills are relatively well developed by most programs. One of the programs covers all necessary skills adequately. Some skills need to be reinforced through the programs.
Architect	1	42	35	Soft skills are well developed by most programs. The training programs adequately cover the fundamentals of energy and energy efficiency, as well as the methods and materials involved in construction, but they should aid in reinforcing these skills.

Employment	Number of training programs	Average number of registrants per year	Average number of graduates per year	Comments
				The number of programs and enrolments is very low.
Software engineer	7	480	440	Soft skills are relatively well developed by most programs. Most programs do not cover skills related to energy and renewable energy fundamentals, legal and contractual framework, finance and economics, and standards and regulations.
Senior electrical technician	2	120	100	Soft skills are well developed by most programs. One of the programs covers all necessary skills adequately. The number of programs and enrolments is very low.
Draftsman (TVET)	2	835	340	Most programs aid in soft skill development but they should aid in their reinforcement. Most programs do not cover skills related to energy and renewable energy fundamentals, legal and contractual framework, finance and economics, and standards and regulations.
Draftsman (HE)	4	115	83	One of the programs covers all necessary skills adequately. The number of programs and enrolments is very low.
Technical (TVET) (cable operator)	5	312	229	There are more than five continuing education programs for this job. The number of registrants is more than 200. Some skills should be reinforced by the programs.
Technician (TVET) (insulation)	1	40	20	One of the programs covers all necessary skills adequately. The number of programs and enrolments is very low.
Technical sales agent (TVET)	1	50	20	The programs do not cover necessary skills, for example, those related to the fundamentals of renewable energy and energy efficiency, or related to the use of construction or renovation materials and tools.
Other engineer	9	703	676	Many other engineering programs cover different skill sets indispensable for the energy transition and climate change mitigation.
Other senior technician	7	545	400	Many programs for other senior technician positions cover different skill sets indispensable for the energy transition and climate change mitigation.
Other technician (TVET)	11	2,455	1,339	Many programs for other technician (TVET) positions cover different skill sets indispensable for the energy transition and climate change mitigation.
Other (TVET)	27	9,051	3,965	Many other HE programs cover skill sets indispensable for the energy transition and climate change mitigation.
Other (vocational training)	11	935	645	Many other programs cover different skill sets indispensable for the energy transition and climate change mitigation.

Source: Original Compilation

Note: HE = High Efficiency; HVAC = heating, ventilation, and air-conditioning; TVET = technical and vocational education and training.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