Capacity Building and Skills Development in the Solar Energy Sector in Egypt: The Case of Tiba

A Case Study
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1 INTRODUCTION

As a country located on the global sunbelt, with very high levels of solar radiation as well as expanses of non-arable land, Egypt's solar energy potential is substantial. In 2008, the Supreme Council of Energy introduced a national goal to fulfill 20% of Egypt's energy demand with renewable energy, by 2020. The renewable energy mix would consist of 12% wind, 6% hydro and 2% solar energy.[1] The current energy mix as reported in the 2014/2015 in the Egyptian Electricity Holding Company Annual Report stands at 91% thermal energy (natural gas and oil) 8% hydro energy, 0.8% renewables.[2] In order to achieve the 2020 goal, local capacities and infrastructures require considerable development.

Literature on the domestic capacity for developing solar energy in Egypt emphasizes the need for both innovative and technical skills development. Given the presence of foreign firms and lack of investment in local manufacturing, the transfer of technology and skills is crucial for the growth of the sector. In order to be sustainable, this must be supported by local initiatives and national strategies.

There are multiple advantages to building local capacities, in terms of both technology development and manufacturing required for solar energy projects. Capacity building contributes to job creation and supports non-renewable energy sources. Both technology and development and manufacturing are critical areas of concern with high rates of unemployment.

This study details the experience of one initiative aiming to build local capacities: Tiba Solar, a privately owned Egyptian micro factory producing photovoltaic (PV) cells. Tiba Solar has also made its factory space accessible to the public through various solar energy training courses. They hope to develop the factory into a "makerspace"[3] — a collaborative workspace, where individuals can make, learn, explore, and share tools and materials.

This case study aims to place Tiba Solar's activities within a wider field of multilateral capacity building initiatives. The study explores how and why Tiba Solar's decided to offer training sessions at its factory and to expand the space into a makerspace. It furthermore investigates issues of funding and sustainability of the sessions. In focusing on these questions, the narrative of the case study revolves around Tiba Solar, rather than the training session material, outcomes or students. This case study is thus not an evaluation of Tiba Solar's efforts but instead gives an introduction to this specific small-scale initiative. Further it contributes to the existing literature on skills development in the solar energy sector in Egypt and serves as a starting point for a discussion on alternative models of skill development.

1.1. Methodology

The research for this study was undertaken between April and December 2017. Desk research provided a mapping of the training sessions offered by Tiba Solar. These are detailed in the study and are available on the company's website.[4] Two extended interviews, conducted over the course of 2017 with Ahmed Elabd, CEO of Tiba Solar, provide insights into the objectives and outcomes of the training sessions, and are discussed later on in this study. Elabd was asked a series of semi-structured questions on both occasions.

Questions included asking Elabd to review the training sessions, when they began offering sessions, and the procedures for admission and payment. This included questions on the history and rationale for offering the training sessions and how many sessions have been held. Interviews also covered the cost and revenue from the sessions and addressed future issues of sustainability and funding. Elabd was also asked to describe the current state of Tiba Solar's makerspace and his motivations for developing a makerspace.

[1] New and Renewable Energy Authority, Annual Report 2012/2013, (Ministry of Electricity and Renewable Energy, 2013-2014), http://www.nrea.gov.eg/annual%20report/Annual_Report_2012_2013_eng.pdf.
[2] Egyptian Electricity Holding Company, Annual Report 2014-2015, 20.
[3] "What is a Makerspace," Makerspace, accessed December 15, 2017, https://spaces.makerspace.com/.
[4] Tiba Solar – About," Tiba Solar, 2017, http://www.tibasolar.com.

1.2. Structure

This study is divided into six sections. Following the introduction, section one provides an introduction to the Egyptian solar energy sector, detailing current progress and challenges, with a focus on the potential for job creation. Given national goals for the integration of renewable energy into Egypt's energy mix, building local capacity is a crucial focus. Section three reviews existing literature on technology transfer, particularly the transfer of skills, and includes a discussion of current capacities, projected needs, and methods for skills transfer. Section four provides an outline of the available courses at Tiba Solar, delineating the practical and theoretical components of each. Section five explores the experience of Tiba Solar in providing these courses, with a focus on the practical and innovative aspects of the space. In the sixth and final section, the study concludes with reflections on the future of skills development in Egypt.

2 THE SOLAR ENERGY SECTOR IN EGYPT: POTENTIAL AND CAPACITIES

Over the past decade, the global capacity for renewable energy has more than doubled. The capacity for solar energy in particular has increased by more than 3,000 percent.[5] Due to progress made in the design of solar cells, the price of solar components has been significantly reduced, making solar energy more competitive with conventional energy resources.[6] Like many countries, Egypt is keen to capitalise on renewable energy to meet increasing demands for energy by a growing population.

Currently, electricity in Egypt is supplied through a centralized national grid, operated by the state. According to the latest data provided by the Egyptian Electricity Holding Company (EEHC), the official authority responsible for the transmission and distribution of electricity, the number of electricity purchasers increased by 5.5 percent, from 30.6 million in 2014 to 32.4 million in 2016.[7] The report estimated the average growth rate of electricity purchasers to be 3.7 percent per year.[8] With exposure to approximately 3,000 kWh/m2 of direct solar radiation per year, Egypt's location, combined with the availability of vast stretches of non-arable land, make it a prime candidate for solar energy projects.[9] In 2014, the government announced the implementation of a feed-in tariff (FIT) program.[10] The scheme attracted attention from the private sector, and a number of international consortiums showed an interest in initiating projects. The implementation of the FIT also indicated that the government had made solar energy a priority.

Although met with criticism from civil society, the gradual removal of subsidies is widely regarded by liberal economists as a way to encourage competition and innovation in the energy market.[11] With growing concern over the country's budget deficit, the government has begun phasing out subsidies on diesel fuel and electricity, a move that has been felt heavily among a population already struggling from inflationary increases following the devaluation of the currency. Government spending on electricity subsidies has historically been higher than subsidies for education, health care, and social welfare combined.[12] A complete removal of subsidies is expected by 2019.[13] As nearly 70 percent of diesel fuel in Egypt is imported, investment in renewable energy has the potential to reduce import expenditure in the government budget.[14]

Solar energy also has the potential to positively impact the Egyptian labour market, as the renewable energy industry is generally more labour intensive in comparison to highly mechanised and capital-intensive fossil fuel-based industries. The latest official statistics indicate that, as of 2016, Egypt's unemployment rate was as high as 12.5 percent,[15] with roughly 40 percent of the population working in the informal sector.[16] Youth unemployment rates are higher than the national average. For youth ages 15 and 39, the unemployment rate stood at 19.2 percent in 2015,

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[5] The International Renewable Energy Agency, "Renewable capacity statistics 2017," (Abu Dhabi: IRENA, 2017), 25.
[6] Louise Sarant, "The Rise of Solar Energy in Egypt," Blog, Middle East Institute, 2015, http://www.mei.edu/content/article/rise-solar-energy-egypt.
[7] Ministry of Electricity and Renewable Energy, "Annual Report 2015/2016", 46 (Egyptian Electricity Holding Company: 2016).
[8] Ibid.
[9] "Egypt - Renewable Energy," Export.gov, last modified July 27, 2017, https://www.export.gov/article?
[10] The feed-in tariff program allows qualified investors to sell electricity produced from their renewable energy systems to the grid at a predetermined price and are guaranteed return on investments for up to 25 years.
[11] Louise Sarant, "The Rise of Solar Energy in Egypt."
[12] International Budget Partnership, "A Guide to The Egyptian Budget" (repr., Budgetary and Human Rights Observatory, 2017), https://www.internationalbudget.org/wp-content/uploads/A-Guide-to-the-Egypt-Budget.pdf.
[13] "Electricity and Renewable Energy Regulations in Egypt," Riad and Riad Firm, July 2016, 9. http://www.riad-riad.com/storage/app/media/Electricity%20and%20Renewable%20Energy%20Regulations%20in%20Egypt-Website.pdf.
[14] RECREE, Diesel to Solar Transformation: Accelerating Achievement of SDG 7 on Sustainable Energy - Assessing Untapped Solar Potential in Existing Off-grid Systems in the Arab Region (RECREE, 2016), 7, accessed October 15, 2017, http://rcreee.org/sites/default/files/d2s_rep_v7.1-31.3.16_web.pdf.
[15] Annual Unemployment Rate, 2017, http://www.capmas.gov.eg/Pages/IndicatorsPage.aspx?page_id=6149&ind_id=1116.
[16] Ahmed Abdel Aziz El-Bakly, "From The "Margins" To The "Engine of Growth: Conceptualization Of The Informal Sector In Egypt" (Institute of National Planning, 2016), https://www.academia.edu/34619853/From_the_Margins_to_the_Engine_of_Growth_Conceptualisation_of_the_Informal_Sector_in_Egypt.

and in the same year, at 26.1 percent for ages 15 and 29.[17]

Given these high numbers of unemployment, the solar energy provides a possible avenue to efficiently create jobs, since more jobs are created per unit of energy generated from renewable resources than from fossil fuel sources.[18] According to the National Renewable Energy Laboratory (NREL), every 100MW of installed concentrated solar power (CSP) can generate an estimated 455 construction jobs.[19] The potential for job creation is further illustrated in Figure 1.

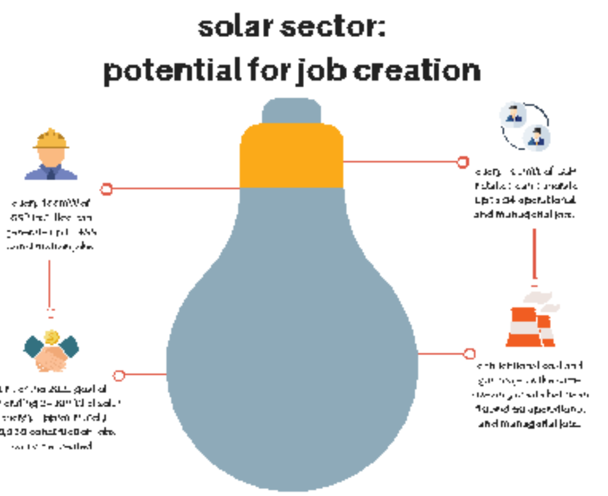

Fig. 1: Potential Job Creation in the Solar Energy Sector adapted from Vidican (2012).

Research previously undertaken by the authors point to both challenges and opportunities in the sector. In 2017, the Access to Knowledge for Development Center (A2K4D) launched The Solar Data Platform,[20] aimed at encouraging access to information in the sector. Through data from several stakeholders in the sector, the platform maps out different players in the sector, bringing together their experiences and insights. Data from this platform gives us preliminary insight into employment dynamics in the sector.

Data and interviews with from the platform indicate that employment in the sector is geographically dispersed across Egypt.[21] Many firms reported not being able to find local workforces outside Cairo, employees are therefore frequently reallocated to new sites. Installers of solar energy systems estimated indirect employment to be notable, particularly in the manufacturing field. They reported that varied skills were necessary, but most skillsets are underserved. Most firms therefore invest heavily in training programs for new staff.[22] Figure 2 illustrates the dispersed nature of the different solar plants.

Fig. 2: A screenshot of the Solar Data Platform mapping feature, available at solardataegypt.info.

Given these findings, it is pertinent to consider local initiatives looking to fill in skill gaps in local workforces. It is particularly important to consider how demand for skills will be fulfilled as investment in the sector continues. This is the case for the latest project to emerge in Egypt, the development of the Benban Solar Park, announced in 2017.

The park is reported to occupy 37 square kilometers of land near Aswan, allocated to the project by the government. The International Finance Corpo-

[17] CAPMAS, Compiled Annual Publication: Study on Manpower in 2015, (2016), http://www.capmas.gov.eg/Pages/ShowPDF.aspx?page_id=/Admin/Pages%20Files/20161027101733LFS%202015- 14SSS.pdf.
[18] "Benefits of Renewable Energy Use," Union of Concerned Scientists, 2017, https://www.ucsusa.org/clean-energy/renewable-energy/public-benefits-of-renewable-power#.WjZlE1T1WAw.
[19] Georgeta Vidican, Building Domestic Capabilities in Renewable Energy: A Case Study of Egypt (German Development Institute Studies 66, 2012), 68. Accessed October 15, 2017. https://www.die-gdi.de/uploads/media/Studies_66.pdf.
[20] The platform is accessible at: solardataegypt.info and is supported by both the Canadian International Development Research Center (IDRC) and the Friedrich Ebert Stiftung Egypt Office.
[21] Fieldwork from which these findings are derived were undertaken between December 2015 – October 2017. A total of 11 solar energy installers were surveyed.
[22] Nagla Rizk, Nancy Salem, Stefanie Felsberger, Dalia Rafik, "Mapping the Solar Energy Ecosystem in Egypt: A Case Study" (working paper, Access to Knowledge for Development Center, American University in Cairo, 2018.)

ration (IFC) and a consortium of nine international banks pledged US$653 million to fund the initiative. The park is scheduled to be fully operational by mid-2019, with a generation capacity of 1,650MW of electricity.[23] According to the IFC, the park is expected to provide more than 10,000 jobs during construction, and around 4,000 once it is fully operational.[24] In light of these developments, the question of capacity building and skill transfer will be discussed in the following section.

Data from prior research undertaken at A2K4D on job creation by companies in the sector is illustrated in Figure 3. These figures are not representative of the whole sector but serve as an indication of employment generation in the field. Power plants and solar projects are geographically dispersed across the various Egyptian governorates and villages, creating employment opportunities throughout the country.

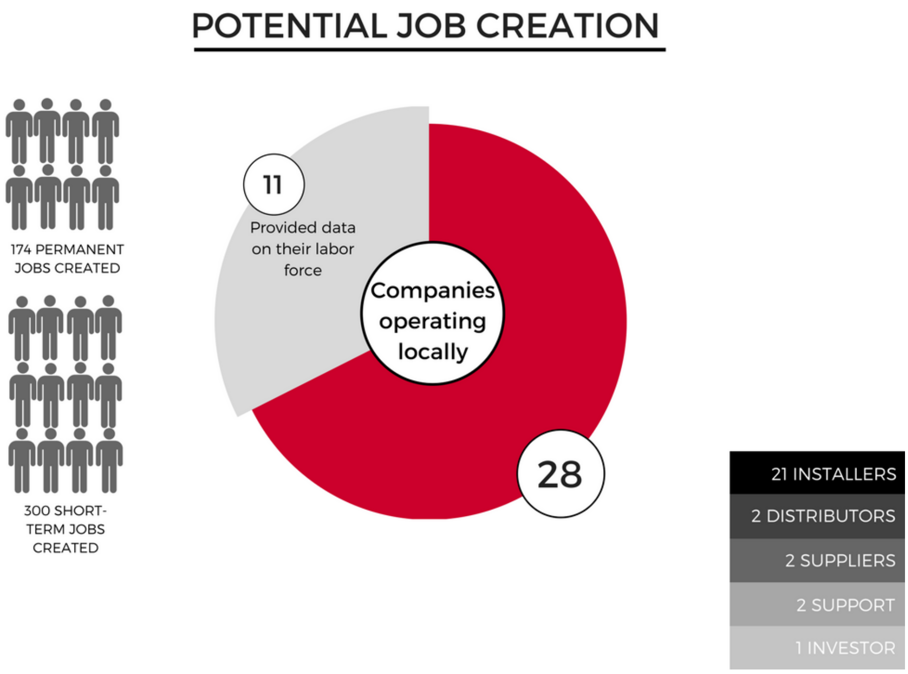

Fig. 3: Job Creation in Solar Energy Sector in Egypt adapted from A2K4D (2017).

[23] Andrew Ravens, "A New Solar Park Shines a Light on Egypt's Potential," Blog, International Finance Corporation, 2017, http://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/cm-stories/benban-solar-park-egypt.
[24] Ibid.

3 TECHNOLOGY AND SKILLS TRANSFER

Given the unique requirements for the installation and management of renewable energy technologies, the importance of training and capacity building within the sector is paramount. Within the context of renewables, capacity building generally refers to the transfer of experiences, the strengthening of knowledge and the advancement of technical skills relating to the respective technology in order to ensure the longevity and sustainability of any given renewable energy system. According to Chris Brookes and Tania Urmee in their 2014 article, "…adequate training in system operation and basic maintenance would alleviate […] issues as well as play a very critical role in system sustainability."[25]

In his 2001 article, J.P. Painuly proposed a framework for analyzing barriers to the effective diffusion of renewable energy technologies (RETs). As illustrated in Figure 4, he identified four critical barriers: 1) A lack of skilled personnel operating within the sector, 2) a lack of training facilities and professional institutions, 3) a gap in important market information and 4) a lack of necessary infrastructure.[26] The author highlighted the role of governments in "building human and institutional capacity" in order to create an enabling environment for RETs to function.[27]

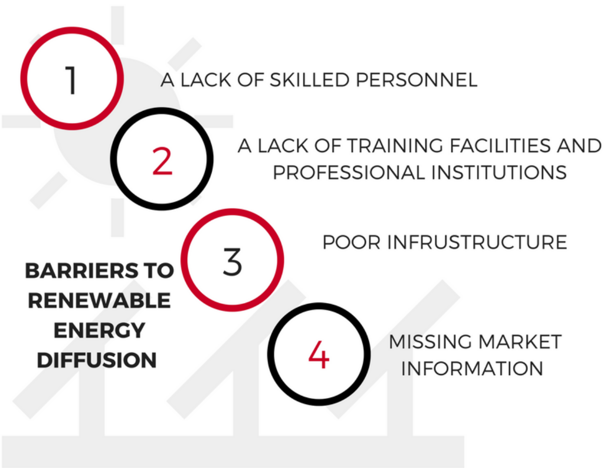

Fig. 4: Barriers to Renewable Energy, adapted from Reddy and Painuly (2003)

Technology transfer refers to the mechanisms by which a country or entity can benefit from another's knowledge on the functionalities of a product or technology developed by the latter. Skills transfer is considered a key part of this. The transfer of technology and skills relates to some of the critical barriers outlined by Painuly.

In their 2011 analysis of technology transfer and innovation in the Chinese PV market, Arnaud de la Tour, Matthieu Glachant, and Yann Meniere identified foreign direct investment (FDI) as one of the main channels of skills transfer.[28] FDI can result in joint venture partnerships in which local workforces are hired to carry out activities, facilitating a transfer of skills and knowledge. Additionally, the subsequent movement of personnel from one firm to another creates further spillover effects for technology transfer within the sector. This type of transfer is more likely to occur at an operational level than on a technical level or in construction.

La Tour, Glachant and Meniere also found that the importing of goods and services can result in a transfer of skills. This would appear to be the case with Egypt, where the components for solar energy initiatives are purchased from abroad and assembled locally. The technology of and mechanisms behind goods and services are embedded within them, and through "reverse engineering," the importing party can gain access to these technologies. In doing so, they are able to lay out a blueprint of the inner-workings of the good or service and can then attempt to recreate it - thereby creating a form of knowledge transfer.[29] In order for technology transfer to be effective, however, the authors argue that the local absorptive capacity is crucial.

[25] Chris Brooks and Tania Urmee, "Importance of individual capacity building for successful solar program implementation: A case study in the Philippines," Renewable Energy 71 (2014): 176-184, https://doi.org/10.1016/j.renene.2014.05.016.
[26] J.P Painuly, "Barriers to Renewable Energy Penetration; A Framework for Analysis," Renewable Energy 24, no. 1 (2001): 82-84, https://doi.org/10.1016/S0960-1481(00)00186-5.
[27] Ibid., 84.
[28] Arnaud de la Tour, Matthieu Glachant and Yann Ménière, "Innovation And International Technology Transfer: The Case Of The Chinese Photovoltaic Industry," Energy Policy 39, no. 2 (2011): 764, doi:10.1016/j.enpol.2010.10.050. Ibid.
[29] Ibid.

In a comprehensive case study of the domestic capabilities for renewable energy in Egypt, led by the German Development Institute in 2012, Georgeta Vidican highlighted the importance of strengthening local knowledge and R&D capabilities in order to develop this absorptive capacity, and ultimately facilitate the effective transfer of knowledge during the early stages of any project. She emphasized the need for a strengthened knowledge base, arguing that without efforts from the donor to augment absorptive capacity, the receiver of the technology is not likely to be able to "adapt, manage and expand [the] acquired knowledge."[30] Given low rates of R&D in the Egyptian solar energy sector, the greatest potential for transfer is likely to come from international collaborations. Vidican goes on to further argue that a strengthened knowledge base ensures the existence of some form of local capacity, which can in turn ensure "the internalization of benefits from international collaborations."[31]

These thoughts are echoed in D. Green's paper on the role of technology transfer in sustainable energy systems, published in 1999. Green warned against the oversimplification of the term "technology transfer," stressing the importance of an "institutional framework which has a capacity to absorb, adapt, and ultimately improve" the technology being transferred.[32] As local stakeholders are at the core of these frameworks, Green advocated for their involvement at various levels of project implementation in order to ensure success.[33] J.P. Painuly echoed the importance of involving stakeholders at a policy level and argued that stakeholders can play a crucial role in providing different perspectives, helping to identify gaps in existing policies, and tackling other barriers to renewable energy diffusion.[34] He added that institutional structures and support mechanisms from governments are key determinants in the success of renewable energy projects. As Vidican posed, there is little debate that limited technological capabilities undermine national sustainable development strategies.[35]

In the context of Egypt both a unified approach from stakeholders and institutional support are missing in the sector. Centralized initiatives, that involve a number of different stakeholders, would ensure that knowledge gained through technology transfer are dispersed in the sector. It similarly would allow for a better insight into which skills are over- and underserved in the field. Currently, varied skillsets are available in Egypt, as detailed in the following section.

3.1. Capacity and Skill Gaps in Egypt

In her research, Vidican drew on categories of production, project execution, and innovation capabilities developed by developmental economist Alice Amsden.[36] These are used to guide the breakdown of technology capabilities in Egypt into skill components, as outlined below in Figure 5.

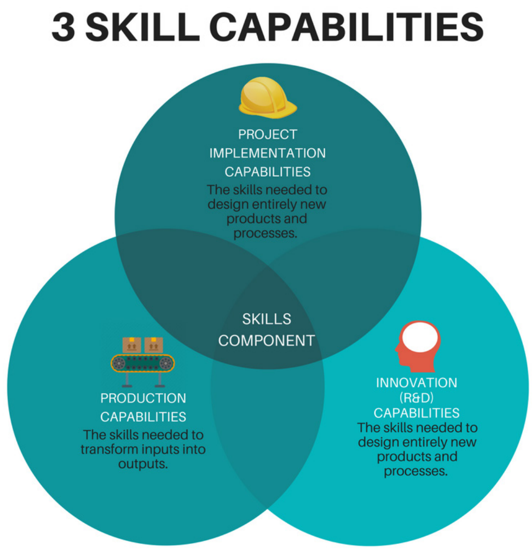

Fig. 5: A breakdown of skill capabilities adapted from Vidican (2012).

[30] Vidican, "Building Domestic Capabilities," 50.
[31] Ibid., 29.
[32] D. Green, "Cross Cultural Technology Transfer of Sustainable Energy Systems: A Critical Analysis," Renewable Energy 16, no. 1-4 (1999): 1133, doi:10.1016/s0960-1481(98)00443-1.
[33] Green, "Cross Cultural Technology."
[34] Painuly, "Barriers to Renewable," 78.
[35] Vidican, "Building Domestic Capabilities."
[36] Ibid.

3 TECHNOLOGY AND SKILLS TRANSFER

In order for Egypt to become a regional player in the renewable energy industry, one big gap identified are R&D capabilities which play a vital role. This focus on R&D was echoed in a 2015 report conducted by the European Investment Bank (EIB), the Facility for Euro-Mediterranean Investment and Partnership (FEMIP) Trust Fund, and the International Renewable Energy Agency (IRENA), titled Evaluating Renewable Energy Manufacturing Potential in the Mediterranean Partner Countries. The report argued that R&D enables local companies to enter the market with the necessary knowledge of technology and skills, ensuring their sustainability and competitiveness. This further emphasizes the need for technological specialization — such as selecting a specific area of solar energy manufacturing — contingent on regional assets, natural resources and the local workforce.

The second large gap Vidican identifies in her work is related to specialized training.[37] She stressed that most jobs in the solar energy sector require specialized training. The study indicated that chemical, electrical, mechanical and industrial engineering are popular professions that are under-supported in the Egyptian education system.[38] Vidican argued this is because both university and vocational programs are often focused on theoretical rather than practical knowledge. She found that skills related to project development and implementation, such as those needed by environmental and atmospheric scientists, are often underdeveloped.[39] Construction skills on the other hand, she discovered are more readily available in Egypt, due to a well-established and thriving local market.

These challenges can be mitigated by appropriate educational and training initiatives that address these skill gaps. This should occur at different levels, including university and vocational learning, as well as practical and working experiences, along with the attainment of appropriate certification. Vidican notes that a national strategy would bring together various activities operating in the sector.[40] In the following section, this case study looks at the training sessions offered by Tiba Solar, which include elements of both technical and operational education. Tiba Solar's trainings offer insights into one existing, albeit limited, attempt to close the above-mentioned gaps.

[37] Ibid.
[38] Ibid., 68.
[39] Ibid.
[40] Ibid.,3.

4 CAPACITY AND SKILL BUILDING IN EGYPT – THE CASE OF TIBA SOLAR

Tiba Solar's core activities are industrial production, educational training, and research and development.[41] According to Tiba Solar CEO Ahmed Elabd, they have trained approximately 1,000 individuals since the inception of the company in November 2015.[42] Tiba Solar runs eight different programs, focusing on providing skills that they believe are underdeveloped in the current labor market. Annex 1 outlines the training sessions offered.

These training sessions are composed of theoretical and practical skills, a sample of which are illustrated in Figures 6 and 7 below. Although the courses differ in terms of material offered and scope of focus, all of them incorporate a theoretical component that provides trainees with the relevant knowledge required for them to see through a practical application of their work. The theoretical components offered in these courses attempt to provide a detailed outlook on the solar sector and the different facets that exist within it. Trainees are provided with a breadth of topics ranging from an introduction to the different types of materials and design modules used in solar panels, to the legal and financial frameworks the sector operates within.

Some of the more intensive courses have an assessment component requiring trainees to submit a project and pass a theoretical exam. One such example is the Solar Water Pumping Training course, where trainees are asked to design their own solar water pumping project.[43] Another course – focusing on more practical elements – is a workshop for children aged 8 to 12 years old and aims to raise awareness to the youth on renewable energy as a career path. This practical workshop allows the children the opportunity to construct a basic solar-powered robot. In doing so, Tiba Solar affords its trainees the opportunity to gain firsthand, practical experience, coupled with a theoretical understanding of the mechanisms behind the sector. Upon completion of the courses, trainees receive a certificate from the Tiba Solar factory.

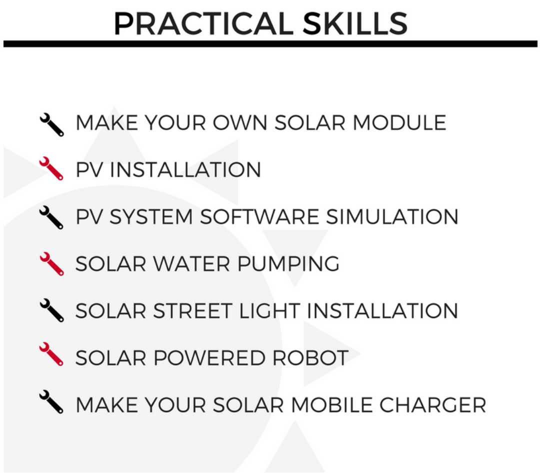

Fig. 6: A sample of practical skills offered by Tiba Solar adapted from Tiba's website.

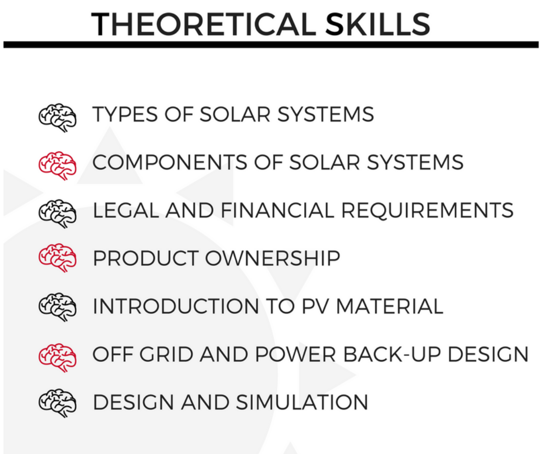

Fig. 7: A sample of theoretical skills offered by Tiba Solar adapted from Tiba's website.

[41] Tiba Solar, "Tiba Solar – About."
[42] Ahmed Elabd (Tiba Solar). Interviewed by A2K4D research team [personal interview], July 30, 2017.
[43] "Solar Water Pump – Tiba Solar," Tiba Solar, 2017, https://www.tibasolar.com/solar-water-pump.html.

The training sessions range from LE850 to LE1,850, and occasional financial support is available. The exception to this is the Make your own module, with two options offered at different prices, depending on the solar panels: 5 Watts for LE300 and 10 Watts for LE400. According to Elabd, pricing is set to cover the cost of the sessions and materials.[44] They are intermittently adjusted according to inflation.

Priority for application is given to engineering students or individuals working in the field. Tiba Solar also attempts to maintain similar levels of education and experience within individual groups. Training sessions are capped at 20 participants, which are then occasionally broken into smaller groups. Elabd notes that a key challenge they consistently face is that, while trainees often have theoretical knowledge, they lack practical experience.[45] The emphasis on practical skills is both in line with the need to create skills that the company would require, PV cell production, as well as with their interest in R&D. Both these themes are explored in the depth in the subsequent section.

[44] Ahmed Elabd (Tiba Solar). Interviewed by A2K4D research team [personal interview], July 30, 2017.
[45] Ibid.

5 EXPLORING TIBA SOLAR: A COMMUNITY OF PRACTICE

The following section looks at evaluating experiences. In most cases, no formal evaluation is undertaken after course-completion, but anecdotal evidence provides insight into student progress after they finish. Aside from training sessions, Elabd indicated the desire to create a makerspace.[46] This case study therefore explores the concept of a makerspace and Tiba Solar's emphasis on practical knowledge and collaboration as a potential pathway to bridge the skill and capacity gap in Egypt. According to Elabd, a central motivation for offering training sessions is to provide practical experience that is missing in the sector. This also works towards the benefit of Tiba Solar, as it serves the purpose of creating expertise and labor they are not able to currently find in the market.

5.1. Learning by Making

Training sessions at Tiba Solar take place at their facility in New Cairo. This space functions as a factory for PV cells, which Elabd indicated a desire to expand into a makerspace. Such spaces combine elements of community and education, with access to manufacturing equipment that allows members to design and create prototypes.[47] At Tiba Solar, raw materials, a 3D printer and solar components are available for use within the factory. Their small-scale production allows them to halt the production line in order to allow students a chance to explore and learn about the uses of the machines. Elabd notes that his operations have begun to expand due to an increase in demand, which he links to an increase in the price of electricity in 2016.[48]

The learning that takes place in makerspaces is markedly different than in other settings. In their 2014 essay on the maker movement in education, Erica Halverson and Kimberly Sheridan argued that the learning taking place while making is not interchangeable with schooling, but instead bridges formal and informal learning.[49] Furthermore, research on makerspaces across Africa undertaken by the Open African Innovation Research Network (Open AIR), revealed that, as collaborative spaces, makerspaces "offer a unique sandbox for action research on how to promote inclusivity in technological development."[50] As the North African hub of the network, A2K4D notes that the emergence of such spaces in the region emphasizes the important role they play in supporting creativity among youth.

Makerspaces can also be entrepreneurial places, with makers benefiting from human capital and flexible environments that can provide a flexible, creative environment to aid innovation and provide support for them to transform products from idea to reality.[51] Again Vidican's argument about the necessity of research and development capabilities in the sector needs to be considered here. Vidican emphasized that, in a developing sector, the ability to innovate in products, finance, and business can be a competitive advantage.[52]

5.2. Reflections on Learning

Participants are asked about their motivation to take the courses and the expectations they have of them. According to Elabd, in most instances, the main motivation for students to take courses is to better prepare them to open their own businesses in the sector. Training sessions have therefore begun to include a level of business management support. This includes commercial learning – from legal requirements, financial basics, management and product ownership, to case studies in the sector and cost analysis. Although Elabd considers Tiba Solar to be a start-up, he sees value in encouraging other start-ups, as this develops the market Tiba Solar can sell PV panels to. He argues that their training and sup-

[46] Ibid.
[47] Makerspace, "What is a Makerspace."
[48] Ahmed Elabd (Tiba Solar). Interviewed by A2K4D research team [personal interview], July 30, 2017
[49] Erica Rosenfeld Halverson and Kimberly M. Sheridan, "The Maker Movement in Education," Harvard Educational Review 84 (2014): 495-504, accessed December 15, 2017 https://doi.org/10.17763/haer.84.4.34j1g68140382063.
[50] "Africa's Maker Movement: An Overview of Ongoing Research," Open Aftican Innovation Research, updated October 2017, http://www.openair.org.za/africas-maker-movement-an-overview-of-ongoing-research/
[51] Eric Joseph Van Holm, "Makerspaces and Contributions to Entrepreneurship," Social and Behavioral Sciences 195 (2015): 24 – 31, accessed December 15, 2017, https://doi.org/10.1016/j.sbspro.2015.06.167.
[52] Vidican, "Building Domestic Capabilities."

port enables the growth of the sector, which is ultimately good for the sector as a whole.[53]

A key finding of the study has been the conceptualization of a symbiotic relationship between Tiba Solar and the participants of the training sessions. The solar energy sector in Egypt is relatively new. The developing sector still lacks cohesion in the growing ecosystem.[54] At this stage, competition between firms is not a key concern as demand for solar is growing. Tiba Solar has noted that many trainees return to work at their facility. One particular session trains, certifies, and then employs trainees as freelance PV cell makers. This complements Tiba Solar's structure as a micro factory, where freelancers can be called upon to meet varied demand in production. Tiba Solar actively utilizes its network of student alum when hiring trainees for installation projects when appropriate.

Trainees who go on to open their own firms may source cells from Tiba Solar, given the familiarity they already have with the company. In this sense, Tiba Solar is contributing to the growth of the market on which it depends, and which is still developing. The motivation for holding training sessions may be better understood in these terms, as revenue and sustainability remain a concern for the factory.

Fieldwork has explored Tiba Solar as a focal point of this study, with a particular interest on the motivations of Tiba Solar in offering courses. It is equally important to consider the experience, as well as the demographic make-up, of trainees. While this study introduces the initiative from one angle, this is an area where additional research is required. While Tiba Solar does not have a formal evaluation process. According to Elabd, most trainees cite the practical elements of courses as a rationale for choosing Tiba Solar. One particular experience shared by Elabd was that of an entrepreneur who underwent a career change from the export industry to installation in the solar energy sector. After joining a summer training course in 2016, the trainee founded a solar energy start-up. The trainee asked Tiba Solar for support when later given funding to create a prototype for a client. Trainees who are looking to pursue similar initiatives are also introduced and encouraged to collaborate with the company.

A challenge for Tiba Solar has been to link the training sessions to professional development. While trainees can currently learn basic practical skills, and produce their own simple products, like mobile phone chargers, there is little space to engage with research and development or advanced materials. Referring to the 'reverse engineering' concept discussed earlier, importing materials which are then replicated, altered, and improved upon is a form of knowledge transfer.[55] Elabd hopes that expanding the makerspace will allow for this, but it is a costly process. Currently, Tiba Solar breaks even in terms of costs and income from the training, but Elabd believes that keeping courses affordable will become challenging as their overhead expenses increase.[56]

Tiba Solar has begun to reach out to international organizations to sponsor training sessions, and to find paid internships for their trainees. According to Elabd, having a third party finance the training sessions will allow them to scale up their current project. They continue to depend on social media to reach potential trainees and sponsors. At the time of writing, the official Tiba Solar factory page had 50,597 followers regularly creating and engaging with event pages for the training sessions offered.[57] Recommendations for sustainability, as well as other challenges, are taken up in the following concluding section.

[53] Ahmed Elabd (Tiba Solar). Interviewed by A2K4D research team [personal interview], July 30, 2017.
[54] Ahmed Zahran (Karm Solar). Interviewed by A2K4D research team [personal interview], August 23, 2016.
[55] La Tour, Glachant and Ménière, "Innovation And International Technology Transfer.".
[56] Ahmed Elabd (Tiba Solar). Interviewed by A2K4D research team [personal interview], July 30, 2017.
[57] Tiba Solar Factory, "Home," Facebook, December 18, 2017, https://www.facebook.com/TibaSolar/.

6 RECOMMENDATIONS

If Egypt pursues its 2020 renewable energy goal, it is critical to ensure the sustainable development of local capacities. Literature reviewed in this case study has emphasized the need for both technical skills development and building R&D and innovation capacities. The ability to adapt and be innovative with technology can be a competitive advantage for local firms, and for Egypt as a regional player in renewable energy. A focus on theoretical rather than practical learning in education is also an important concern for the sector.

There continues to be significant foreign direct investment and the import of materials in the sector in Egypt, with the need to source expertise and raw materials from abroad. As outlined in Section two of this study, it is crucial to build local capacities in order to ensure sustainable technological and skills transfer. However, this requires the support of local initiatives and stakeholders, and the space to build upon skills acquired.

As this study has outlined, the potential for job creation in the sector is noteworthy. This case study has explored the experience of Egyptian firm Tiba Solar in offering training sessions for the solar energy sector. Tiba Solar represents a private firm offering skills training that they believe is lacking in the sector. This is a chance for many to engage in practical skills but is also an opportunity for Tiba Solar to create the skills and a market they require for their own work. Their inclusion of practical skills is relevant, as these were found to be lacking in other existing training programs. Furthermore, the desire to build a makerspace addresses concerns regarding the lack of innovative R&D taking place in the sector.

There remain pressing questions for Tiba Solar.[58] It would be difficult for Tiba Solar to scale activities without significant support from organizations like the government, academia or civil society, or from other businesses in the sector. Sustainability has already been singled out as a concern for the company, particularly with the equipment and materials needed for R&D in mind.

Additionally, as Tiba Solar looks to establish a makerspace, membership programs and community dues need to be considered. There are various types of makerspace models, varying from member-only spaces, to community drop-in spaces. Referring again to the research undertaken by the Open AIR network in Egypt, most makerspaces tend to have membership structures. Sustainability still remains a concern for these spaces, but in the case of Tiba Solar, could offer a new source of revenue.

This case study represents an introductory contribution to the literature on skills development in solar energy in Egypt. The symbiotic relationship between Tiba Solar and its trainees appears to support the objectives of both parties. There are other noteworthy examples of both private and public initiatives that support the diffusion of skills in Egypt. It is critical that this line of research be picked up to better document the variety of initiatives and activities available in the sector.

While initiatives like that of Tiba Solar are important, they do not negate the need for support from larger organizations and the state. There is space for further support from the public sector, and the integration of more practical learning in educational institutions. A coordinated effort to design local ways of building capacity, and research and development would ensure further sustainability.

[58] The authors are grateful for the discussion and feedback received from discussants and attendees at a roundtable event presenting preliminary findings from this case study. The opinion and knowledge shared at this event have influenced our recommendations moving forward.

7 BIBLIOGRAPHY

Interviews:

Ahmed Elabd (Tiba Solar). Interviewed by A2K4D research team [personal interview], July 30, 2017.

Ahmed Zahran (Karm Solar). Interviewed by A2K4D research team [personal interview], August 23, 2016.

Secondary Sources:

"Africa's Maker Movement: An Overview of Ongoing Research." Open African Innovation Research, updated October 2017. http://www.openair.org.za/africas-maker-movement-an-overview-of-ongoing-research/.

"Annual Unemployment Rate - 2017 ." http://www.capmas.gov.eg/Pages/IndicatorsPage.aspx?page_id=6149&ind_id=1116.

El-Bakly, Ahmed Elabdel Aziz. "From The "Margins" To The "Engine Of Growth: Conceptualisation Of The Informal Sector In Egypt." Institute of National Planning, 2016. https://www.academia.edu/34619853/From_the_Margins_to_the_Engine_of_Growth_Conceptualisation_of_the_Informal_Sector_in_Egypt.

"Benefits of Renewable Energy Use." Union Of Concerned Scientists, 2017. https://www.ucsusa.org/clean-energy/renewable-energy/public-benefits-of-renewable-power#.WjZlE1T1WAw.

Brooks, Chris and Tania Urmee. "Importance of individual capacity building for successful solar program implementation: A case study in the Philippines." Renewable Energy 71 (2014): 176-184. https://doi.org/10.1016/j.renene.2014.05.016.

CAPMAS. Compiled Annual Publication: Study on Manpower in 2015. (2016) Accessed April 24, 2017. http://www.capmas.gov.eg/Pages/ShowPDF.aspx?page_id=/Admin/Pages%20Files/20161027101733LFS%202015- 14SSS.pdf.

De la Tour, Arnaud, Matthieu Glachant, and Yann Ménière. "Innovation And International Technology Transfer: The Case Of The Chinese Photovoltaic Industry." Energy Policy 39, no. 2 (2011): 761-770. doi:10.1016/j.enpol.2010.10.050.

Egyptian Electricity Holding Company, Annual Report 2014-2015. Ministry of Electricity and Renewable Energy, 2014-2015. http://www.moee.gov.eg/english_new/EEHC_Rep/2014-2015en.pdf

Export.gov. Egypt - Renewable Energy. https://www.export.gov/article?id=Egypt-Renewable-Energy.

Green, D. "Cross Cultural Technology Transfer of Sustainable Energy Systems: A Critical Analysis." Renewable Energy 16, no. 1-4 (1999): 1133-1137. doi:10.1016/s0960-1481(98)00443-1.

"Electricity and Renewable Energy Regulations in Egypt." Riad and Riad Firm, July 2016. http://

www.riad-riad.com/storage/app/media/Electricity%20and%20Renewable%20Energy%20Regulations%20in%20Egypt-Website.pdf

Halverson, Erica Rosenfeld and Sheridan, Kimberly M. “The Maker Movement in Education.” Harvard Educational Review 84 (2014): 495-504. Accessed December 15, 2017, https://doi.org/10.1177/2043820613513388.

International Budget Partnership. “A Guide To The Egyptian Budget.” Reprint, Budgetary and Human Rights Observatory, 2017. https://www.internationalbudget.org/wp-content/uploads/A-Guide-to-the-Egypt-Budget.pdf.

Makerspace. “What is a Makerspace.” Accessed December 15, 2017. https://spaces.makerspace.com/.

Ministry of Electricity and Renewable Energy. “Annual Report 2015/2016.” Reprint, Egyptian Electricity Holding Company, 2016.

New and Renewable Energy Authority, Annual Report 2012/2013. Ministry of Electricty and Renewable Energy, 2012-2013. http://www.nrea.gov.eg/annual%20report/Annual_Report

Painuly, J.P. “Barriers to Renewable Energy Penetration; A Framework For Analysis.” Renewable Energy 24, no. 1 (2000): 73-89. doi:10.1016/s0960-1481(00)00186-5.

Rizk, Nagla, Nancy Salem, Stefanie Felsberger, Dalia Rafik, “Mapping the Solar Energy Ecosystem in Egypt: A Case Study.” Working paper, Access to Knowledge for Development Center. American University in Cairo, 2018.

Ravens, Andrew. “A New Solar Park Shines A Light On Egypt’s Potential.” Blog. International Finance Corporation, 2017. http://www.ifc.org/wps/wcm/connect/news_ext_content/ifc_external_corporate_site/news+and+events/news/cm-stories/benban-solar-park-egypt.

RECREE, Diesel to Solar Transformation: Accelerating Achievement of SDG 7 on Sustainable Energy - Assessing Untapped Solar Potential in Existing Off-grid Systems in the Arab Region. RECREE, 2016. Accessed October 15, 2017. http://rcreee.org/sites/default/files/d2s_rep_v7.1-31.3.16_web.pdf

Sarant, Louise. “The Rise of Solar Energy In Egypt.” Blog. Middle East Institute, 2015. http://www.mei.edu/content/article/rise-solar-energy-egypt.

The International Renewable Energy Agency. “Renewable capacity statistics 2017.” (Abu Dhabi: IRENA, 2017). 25.

Tiba Solar. “Tiba Solar – About.” Accessed December 18, 2017. http://www.tibasolar.com.

Tiba Solar Factory. “Home.” Accessed December 18, 2017. Facebook. https://www.facebook.com/TibaSolar/.

7 BIBLIOGRAPHY

Tiba Solar. "Solar Water Pump – Tiba Solar." Accessed December 18, 2017. https://www.tibasolar.com/solar-water-pump.html.

Van Holm, Eric Joseph. "Makerspaces and Contributions to Entrepreneurship." Social and Behavioral Sciences 195 (2015): 24 – 31. Accessed December 15, 2017, https://doi.org/10.1016/j.sbspro.2015.06.167.

Vidican, Georgeta. "Building Domestic Capabilities in Renewable Energy; A Case Study of Egypt." German Development Institute Studies Series 66, (2012): 68. Accessed on October 31, 2017. https://www.die-gdi.de/studies/article/building-domestic-capabilities-in-renewable-energy-a-case-study-of-egypt/.

Training	Date/Time	Price	Theoretical Topics	Practical Topics	Assessment
Solar Water Pumping Training	1/10, 3/10, 5/10, 8/10, 10/10 & 13/10 Weekdays from 17:30 - 20:30 Friday from 10:00 - 15:30 (Practical component)	EGP1850	- The functions and application of solar energy - The functions and types of solar cells - How to build series and parallel connections on solar cells - Types of solar systems - Components of each system - Inverters (types and functions) - Batteries (types and selection) - PV C/Cs - PV data sheet - What is solar pumping? - Irrigation systems - Pumps (types and functions) - Types of pumping systems (2 sessions) - Design of PV solar pumping - Cable sizing - Protection of the system.	- Make your own solar module - Steps for making solar modules - Wiring of modules - Cost of solar modules - Case study - Cost analysis	- Design your project - Exam on the theoretical component
Start-Up Diploma (Solar Energy)	Over the course of 3 months. Dates are not specified.	Not specified.	- Simulation - Design - Analysis - Legal requirements - Financial basics - Management - Product ownership	- PV production - Installation - Prototype -Find your product	- Open your own business.

Training	Date/Time	Price	Theoretical Topics	Practical Topics	Assessment
Summer Training	August & September 10:00 - 16:00	EGP1500	- Introduction to PV material - Standard panel 250W - Design and simulation: • Effects on panels, solar angles, shading, sun tracking and simulation • Inverters, charge control, batteries and connection • Water heater assembly and solar street light design - Off grid & power backup design	- Making 5W solar panels - Factory production lines - PV production lines (soldering-layup-lamination-farming-testing) - PV system software simulation • Project 1 analysis • Project 2 analysis • Project 3 analysis (September sessions only) • Install 1 KW solar station - Shading analysis - Panel testing - Load estimation - Solar water pumping system - Solar street light installation - Solar ice - 2 all day factory work days (September sessions only)	Upon completion, the trainees receive a certificate of completion from Tiba Solar.
Mid-Year Training	28/01, 30/01, 01/02, 04/02, 06/02 & 08/02 10:00 - 16:00	EGP1000	- Introduction to PV materials - Standard panel 250W - Design and simulation • Effects on panels, solar angles, shading, sun tracking and simulation • Inverters, charge control, batteries and connection • Water heater assembly and solar street light design - Off grid & power backup design	Making 5W solar panels - Factory production line - PV production line (soldering-layup-lamination-farming-testing) - PV system software simulation • Project 1 analysis • Project 2 analysis • Install 1 KW solar station - Shading analysis - Panels testing - Load estimation - Solar water pumping systems - Solar street light installation	Upon completion the trainees receive a certificate of completion from Tiba Solar

6 ANNEX

Training	Date/Time	Price	Theoretical Topics	Practical Topics	Assessment
Weekend Training	Saturdays 12/08, 19/08, 26,08 and 2/09	EGP850	**12/08** - Intro to PV materials - Solar cell specification - Standard panels 250W - PV production line **19/08** - Design and simulation • Effects on panels, solar angles, shading, sun tracking and simulation • PV system software simulation • Shading analysis • Panel testing **26/08** - Design and simulation • Inverters, charge control, batteries and connection • Off grid & power backup • Install 1KW solar station **02/09** - Off grid & power backup - Water heater assembly - Solar street light design		Not specified
Make Your Own Module	Not specified	- 5 Watt for LE300 - 10 Watt for LE400	- Detailed study of the components of solar panels - Detailed study of the materials needed to produce solar panels	- Practical experience in the production of solar panels	Not specified
Make Your Own Power Bank	Not specified	-2,000 mAh for LE450 -4,000 mAh for LE550 -6,000 mAh for LE650 -8,000 mAh for LE750 -10,000 mAh for LE850	Not specified	Not specified	Not specified
Solar Junior Training	Summer weekends	Not specified.	Not specified	Practical workshop: - Construct a basic solar-powered robot	Not specified