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Unlocking Green Jobs for Youth in Solar Irrigation

ANALYSIS & PILOT PROGRAM

OCTOBER 2023

To promote skills development and enable youth to access jobs in the SPIS sector, Dalberg and Efficiency for Access (EforA) have developed a pilot concept

The Opportunity

- Market demand for solar-powered irrigation systems (SPIS) is large, with the **market for solar water pumps (SWPs) estimated to be approximately USD 30 million**; and growing sustainably.
- A significant **job opportunity of approximately 7,000 – 10, 000 direct jobs** exists in the solar irrigation sector in Kenya. This opportunity can be seized by under-employed rural youth, if appropriately trained.
- There are multiple types of roles needed to service the solar irrigation sector in Kenya. For these roles, different hard and soft skills are needed.

The Challenge

- Technical and Vocation Education and Training Institutions (TVETs) and short courses are well placed to enable youth to reach successful employment in SPIS and receive continuous on-the-job training.
- However, there are a series of pain points along the training journey of Kenyan youth causing a skills mismatch:
  - TVET and other courses are not practical enough for SPIS needs;
  - SPIS curriculum is insufficient or outdated;
  - Some critical soft skills are not developed to a sufficient level.

Recommendations

- To solve this challenge, we propose:
  - **Strengthening SPIS-relevant TVET courses** (e.g., engineering and plumbing) to better prepare the rural youth to take on specific jobs in the SPIS field;
  - **Providing accessible continuous training** for professionals.
- We aim to pilot a **multi-stakeholder partnership to test different elements of this new training solution:**

- **Proposed partners:**

Ministry of Water, Sanitation and Irrigation; TVETA Kenya; mastercard foundation; SNV; Eastlands College of Technology; Nairobi Technical Training Institute; DAVIS & SHIRTLIFF; giz; World Resources Institute; Strathmore University; NITA; LORENTZ Sun. Water. Life.; Kenya Water Institute; Ministry of Agriculture & Livestock Development; SOLARGEN; Ministry of Education

The market for SPIS in Kenya is large and growing, as evidenced by the increased demand for solar water pumps (SWPs)

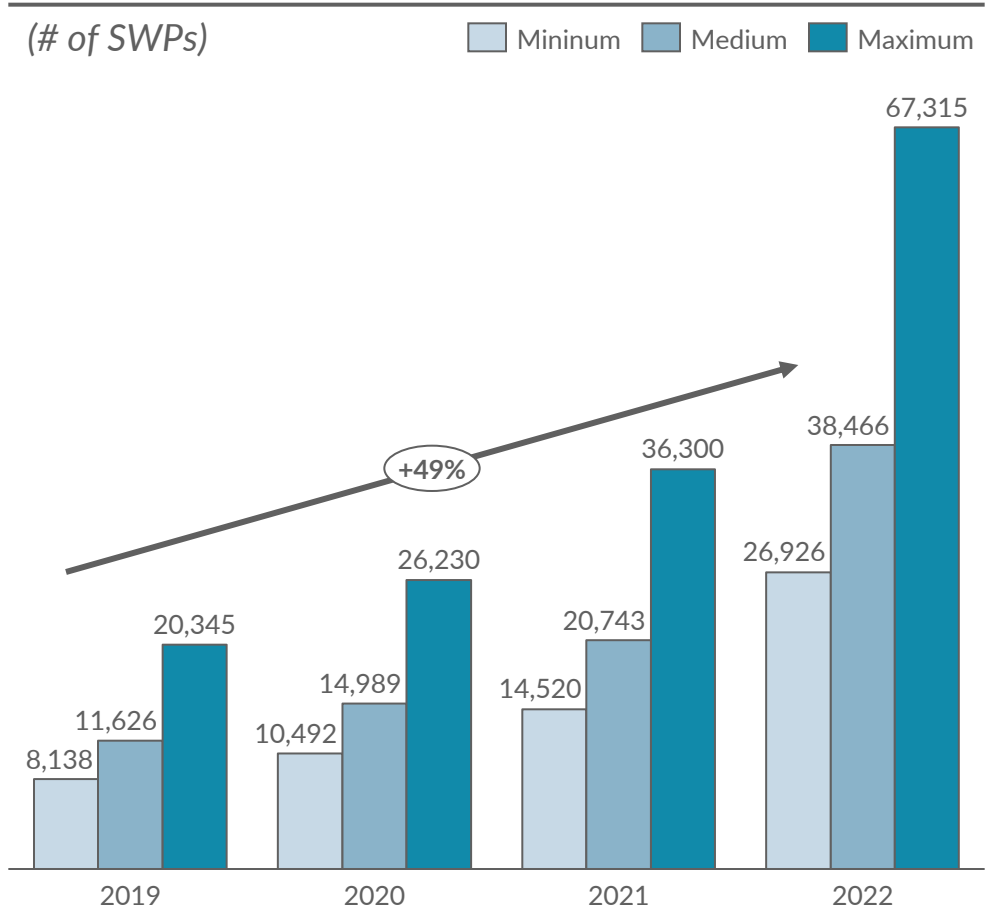
Kenya is the most mature market for SWPs in Sub-Saharan Africa (SSA), **with over 35,000 SWPs sold as of 2021**[1] and **49% compounded annual growth** in sales over the **last 4 years****.

This represents just a small fraction of the addressable market* as there are **4.5 million small-holder farmers (SHFs) in the country**[2] who could benefit from irrigation, especially in the face of climate change.

Around **80%** **of Kenya's land is categorized as arid or semi-arid**

Further, **only about 3% of cultivated land is currently irrigated**, well below the SSA average of 7%. With majority of farmers still relying on bucket irrigation and rain-fed agriculture, this presents a significant opportunity for SPIS to address water scarcity, reduce drudgery among SHF and enhance agricultural productivity[3] and food security.

Approximate volume of SWP sales in Kenya**



Sources: [1]Efficiency for Access, Quality of the Off-Grid Solar Market, November 2021 [2] Ministry of Agriculture, Agricultural Sector Transformation and Growth Strategy; [3]Dalberg, Solar Irrigation Policy Brief, 2020; Notes: *This study is investigating SWP sales to estimate job creation potential but is not a full fledge market sizing exercise ** See Annex 4 for more details on the rationale of our estimations

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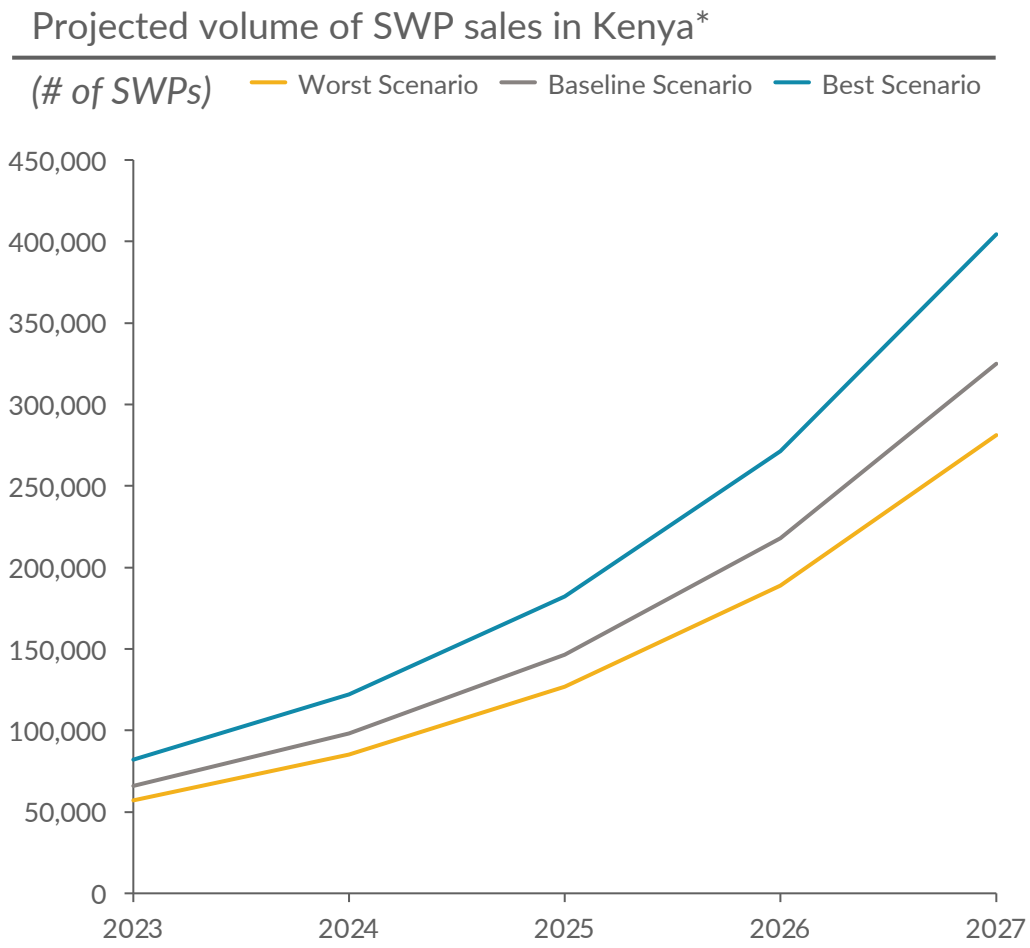
Demand is expected to grow further, sustained by stable drivers in policy, cost, business and awareness



The growth drivers are sustainable

- **Policy:** The Government has **proposed plans to expand irrigation and promote the uptake of efficient off-grid energy equipment in agriculture** through capacity building and demonstration projects outlined in the National Energy Efficiency and Conservation Strategy (2020-2025) and the National Water Management Plan (2030).
- **Cost: Financing for SPIS to boost affordability is gaining traction** with banking organizations such as Equity Bank Limited utilizing partnerships to increase lending in the agriculture and food security sector[1]. Other efforts are from EforA and Nithio who have set up a financing facility that offers Productive Use of Renewable Energy (PURE) companies access to consumer financing [2]; and Davis and Shirtliff who recently launched Daylipa[3], a save-to-purchase product. Nonetheless, Government support for targeted subsidies is crucial for widespread adoption.[4]
- **Business and operations:** Solar companies are leveraging **innovative business models to stimulate customer demand** e.g., SunCulture's product bundling approach is strategically designed to attract customers to SWP products.
- **Awareness: Consumer awareness campaigns** are ramping up to inform potential customers about SWP advantages and stimulate demand. As an example, EforA sponsored two Shamba Shape Up episodes on solar irrigation.[5] Shamba Shape Up has an average viewership of about 3.4 million households each weekend. These two episodes generated 12,676 social media impressions.

Sources: [1]Equity Group Foundation, *PUE*; [2]EforA & Nithio *Financing Faciility*, 2023; [3]Davis and Shirtliff, accessed 2023; [4] MercyCorps Agrifin, 2020; [5]Efficiency for Access, Consumer Awareness Campaign Readout, 2021 Note: * See Annex 4 for more details on the rationale of our estimations

A significant job opportunity exists in solar irrigation; with future projections showing increased employment opportunities in the sector

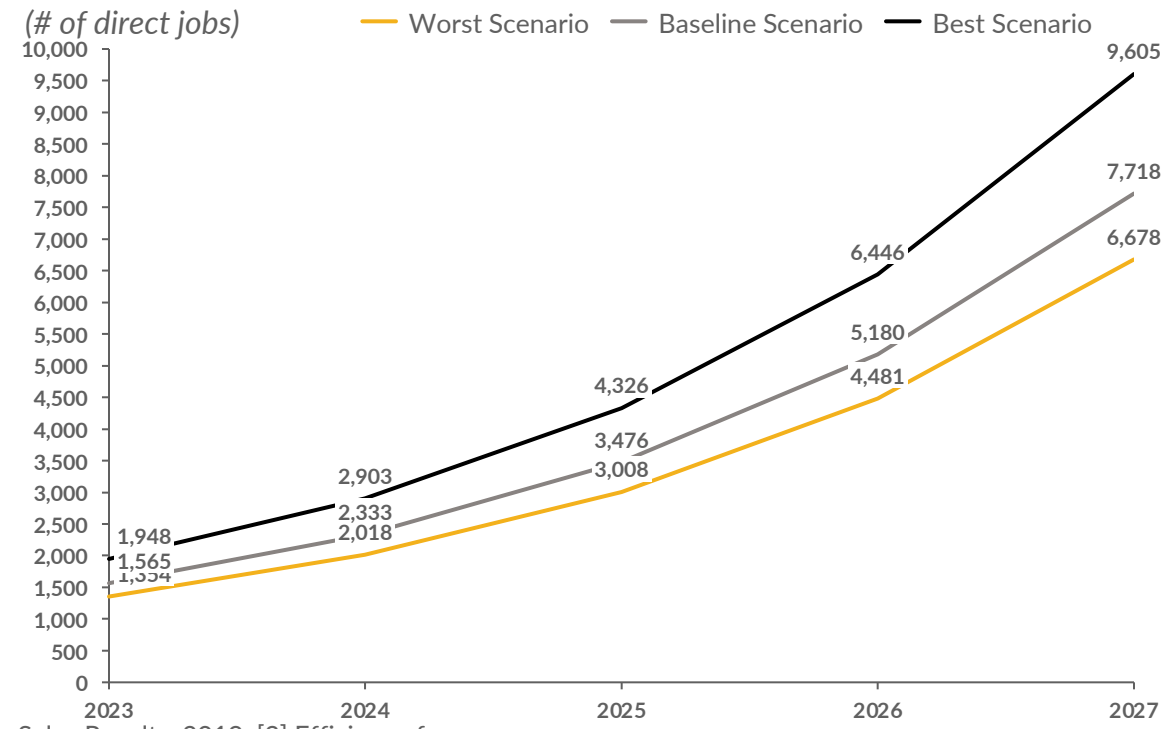
Current demand

- The Distributed Renewable Energy (DRE) sector in Kenya provided **10, 000 direct, formal jobs* in 2017-2018, with mini-grids and SWPs contributing to 4% of these jobs i.e., 400 jobs.** DRE provided a further **15, 000 direct informal jobs*** and **65, 000 productive use* jobs in Kenya.**[1]
- A more recent study reported the number of jobs in the DRE sector to be 48,280, **with women accounting for 41% of the workforce.**[1] While the study did not include SWPs, it is indicative of the potential for gender inclusivity in the sector which can be applied to SPIS.
- Based on sales of SWPs and a ratio of 9.5 jobs per 1,000 SWPs sold, it is estimated that the sale of SWPs is **currently offering ~500 jobs.**[1]
- SWP sales are high in counties such as **Trans Nzoia, Uasin Gishu, and Makueni** which have a significant demand for agricultural and irrigation skills. Creation of most of the SPIS jobs is thus expected in these regions to meet the demand.[2]

Future Demand

- It is estimated that the sale of SWPs will create **6, 000 – 9, 000 direct formal and informal jobs by 2027**
- As the need for irrigation rises, these jobs will be spread across multiple counties such as Laikipia, Kisumu, Machakos, and Taita Taveta.[3]

Projected job opportunities from SWP**



Sources: [1]Power for All, Powering Jobs, 2019 and 2022; [2]EforA Global LEAP Results Based Financing Sales Results, 2019. [3] Efficiency for Access, Using Technology to build Affordable Business Intelligence for SWP Market, 2021, Note: *See Annex 1 for definition of terms; **See Annex 4 for more details on the rationale of our estimations and Annex 5 for more information on the direct formal, direct informal and productive use jobs that can be potentially created

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With appropriate training, this opportunity can be seized by youth, particularly in rural areas where unemployment rates and demand for SPIS are higher

Unemployment among youth, especially rural youth

- **The share of youth not in education, employment, or training stands at approximately 17% in rural settings, and 28% in urban areas**[1] though the actual number of unemployed rural youth is higher due to the far greater rural population in Kenya (72%).[2]
- **There is limited education among rural youth with only ~15% currently enrolled in tertiary learning institutions**, and 56% of them engaged in certificate and diploma courses at middle-level training institutions such as technical and vocational training institutions (TVETs).[3]

Opportunities in SPIS require specialized skills that are hard to find among youth

- There is a **gap in practical skills, soft skills, and knowledge of current technology** among professionals entering the SPIS field.[4]
- **Companies are compelled to organize elaborate training** for their staff and distribution partners.[4]
- **Companies serve clients in rural areas by deploying technicians based in urban areas** to rural areas where the majority of solar-powered irrigation occurs.[4]
- **There is an emerging need for skilled labor for consumer protection** to enable SHF to maximize their investments in SWPs which are relatively expensive assets.

Training and certification for roles that do not require advanced degrees

- **Offering SPIS training** to youth post-high school, during TVET education and post-TVET can equip them to seize opportunities in solar irrigation and particularly in rural areas, filling the demand for skills by employers.

Sources: [1ILO Youth Country Briefs, 2023, [2]]UNW, Status of NEET Kenya, 2022; [3]KPHC, Analytical Report on Education and Training, 2022, [4]Stakeholder Interviews;

There are multiple types of roles needed to service the solar irrigation sector in Kenya

The following job types were selected from a long list due to their level of direct involvement in the SPIS sector and the size of the demand

Type of work	Description	Monthly salary (KSH)	Demand distribution	Geography
Quality Assurance Technician	• Assembles products • Performs tests and quality controls for each project • Controls and monitors the quality of products and parts • Creates and improves documentation and testing procedures • Trains and manages after-sales teams	~ 60, 000[1]	• **Medium demand: ~19%[2] of total demand for SPIS professionals, i.e., about 1,500 jobs[3]**	Centralized often in urban areas with limited field visits
Field Technician / Solar Installer	• Conducts site assessment in preparation for SPIS installation projects • Creates or interprets solar panel installation plans • Installs, inspects, maintains and repairs SPIS including all electrical work • Builds relationship with clients			Decentralized with frequent trips to the field
Agricultural-Irrigation Technician	• Tests the soil and vegetation to determine irrigation needs. • Assesses areas for irrigation installation. • Installs pipes, lines, pumps and electrical timers. • Conducts routine maintenance checks and replaces faulty parts			
Technician Assistant	• Follows lead technician's plans in installation and supports in the solar installation • Utilizes local knowledge to guide technicians around the site and its environment	~35, 000[1]		
Salesperson/ Marketer	• Identifies and contacts potential customers • Educates potential customers about the benefits of SPIS • Prepares and presents product demonstrations to potential customers • Negotiates and closes sales deals with potential customers	~ 100,000 – 150,000[1] or above	• **High demand: ~57%[2] of total demand for SPIS professionals, i.e., about 4500 jobs[3]**	

Sources:1]Stakeholder Interviews; 2]GOGLA, Off-Grid Solar: Growth Engine for Jobs, 2022, 3]Dalberg Estimates, 2023. Note: The jobs selected on the job typologies have been developed based on an assessment of the "SPIS value chain" as presented in Annex 2. The five types of jobs included in this slide were selected due to their level of direct involvement in the SPIS sector and the size of the demand for each job. For full job descriptions, please refer to Annex 2c.

For these roles, different hard and soft skills are needed

		Quality Assurance Technician	Technicians (Maintenance / Installation)	Irrigation technician	Technician Assistant	Salesperson/ Marketer
Hard skills (technical skills)	Solar PV systems knowledge	🟢	🟢	🔴	🟢	🟡
	Electrical / plumbing proficiency	🟢	🟢	🟢	🟢	🟡
	Site assessment and sizing	🔴	🟢	🟢	🟢	🔴
	Customization and assembly skills	🟢	🟢	🟢	🟡	🔴
	Market research and go-to-market strategy	🔴	🟡	🟡	🔴	🟢
Soft skills (behavioral skills)	**Customer Interaction** (engage and understand customers, effective communication, empathy)	🔴	🟢	🟡	🟢	🟢
	Safety Awareness (Follow safety protocols, dress and behave professionally)	🟢	🟢	🟢	🟢	🔴
	Financial Management (Understand costs and budgets, efficient resource management)	🟡	🟡	🟡	🟡	🟢
	Tech and Learning (Basic IT and courseming, continuous skill improvement)	🟢	🟢	🟢	🟡	🟢
	Team Collaboration (Work well with others, Effective report writing)	🟢	🟢	🟢	🟢	🟢

This skills mapping provides an overview of what **subjects and skills should be taught or developed at TVET or short course level**, and further cultivated through **on-the-job training and continuous learning**

🟢 Must have 🟡 Nice to have 🔴 Not required

Note: * To curate this comprehensive list of skills, we conducted an exhaustive analysis of job descriptions and engaged in interviews with key stakeholder

Ideally, TVET/short courses help youth gain employment in SPIS, and provide continuous (on job) upskilling to meet changing industry needs

Ann's successful journey from selecting a SPIS-relevant course to landing dignified employment

1. Course selection

Review course catalogues & requirements

Decision-making

Consultation of trusted friends/family

Ann reviews a KUCCPS* **course catalog aligned with industry job demands** and selects a course relevant to solar irrigation **considering future job prospects** in addition to other personal considerations and **without negative societal pressure.**

2. Enrolment

Admission notification

Submission of candidacy

Fee payment

Ann **gains admission** to the TVET of choice and **is able to pay** (potentially with financial assistance) for enrollment and other dues.

3. Study experience

Courses by teaching staff

Graduation

Exams

Internship

Ann attends **well-sized classes** with **holistic, industry-relevant SPIS curricula** that includes hard and soft skills dev. and practical experience. She is taught by **qualified trainers**. Ann completes exams and **attends an internship with the support of the TVET** before graduating on time.

4. Employment search

Review job post/attend job fair

Employ-ment offer

Submit candidacy, interview process

Ann receives **industry linkages** e.g., through career fairs and student alumni groups; and **career support** e.g., recommendation letters while applying for jobs resulting in **a competitive offer.**

5. Employment and continuous learning

Initial on job training

Continuous training

Opportunity for certification

Ann accepts a job offer that **leverages skills obtained in college** and **offers training on more specific skills**. Ann continues to work in a **positive environment** with accessible **opportunities for continued learning** and further certification.

Source: *istock*, accessed 2023, *Kenya Universities and Colleges Central Placement Service (KUCCPS) is s a State Corporation that provides career guidance and selects students for admission to universities, national polytechnics, technical training institutes and other accredited higher learning institutions for government-sponsored programs

However, there are few course offerings on SPIS and few students demanding those courses

Course Selection and Course Enrolment

There are few course offerings on SPIS

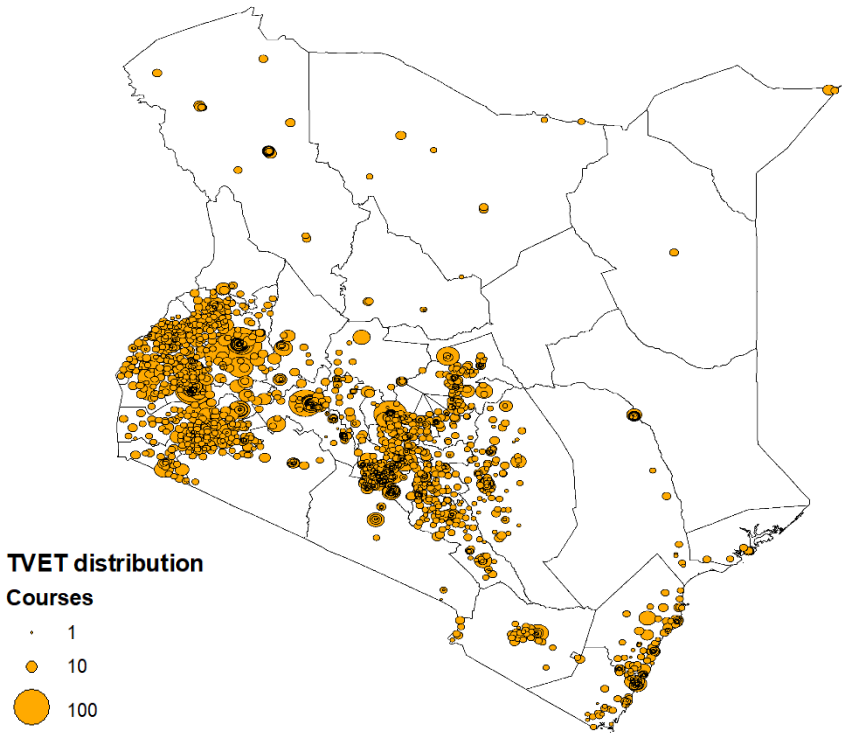
- **There are no courses on SPIS in Kenya that are open to all –** there are only some industry-driven courses in solar installation. Other courses like electrical engineering offer some courses that teach some SPIS elements,[1] however they do not fully prepare trainees for careers in SPIS.
- **Limited dialogue on industry requirements between the private sector, government & TVETs coupled with bureaucracy likely drive this lag** in the adaptation of offerings to industry demand.
- **The situation is more dire in rural areas**, particularly in North-eastern Kenya with reduced access to TVET institutions due to the low density of such institutions in this region.[2]

There is a low demand from students for SPIS training, largely due to a lack of awareness of the job prospects

- **Few (only 12%) of trainees consider job prospects in their decision to study courses.**[2]
- Those who would like to consider job prospects are **unable to find the right information** – both because forecast data is scarce, and because they do not know where to find existing data.
- **Women also perceive job prospects in SPIS as fewer than men do.** As with most STEM courses, fewer women select SPIS-relevant courses likely due to the societal perception of these courses as masculine[3]. Among the relevant SPIS courses in TVETs women comprised only ~1% of the total student population

TVET density by location

Number of TVET courses, 2020



Source: 1] Stakeholder Interview 2]Dalberg, 'TVET Insights Report', 2021; 3][International Journal of Contemporary Education](), 2023

High cost of tuition and accompanying expenses hinder enrolment of potential trainees

Course Selection and Course Enrolment

In the News:
In May 2023, the Government of Kenya launched a new need-based funding model for tertiary education which necessitates individual students to apply for funding via the Higher Education Financing portal.[3] While this may help bring equity in access, it is likely that vulnerable students will have lower access to the necessary technology to make applications on time. Monitoring of this new model is critical to ensure need assessment is accurate and that disadvantaged populations are not left behind.

The cost of tuition and accompanying expenses impact the demand for TVET education in SPIS

- **The cost of TVET education is high compared to earnings post graduation** with the average employed TVET graduate requiring the equivalent of 5-8 months of wages in SPIS jobs to repay the full cost of education.[1]
- **This is likely fueled by limited state-sponsored funding and limited scholarships in tertiary education, which includes TVETs and SPIS courses:**
  - **The government recently reduced funding to the Higher Education Loans Board,** the statutory board providing affordable loans to Kenyans pursuing Higher Education, by over KSH 5 billion the funds, reducing access to affordable loans among TVET trainees and other higher education scholars.[2]
  - **Available loans and grants are often available only to students placed by KUCCPS# l**eaving behind the students who seek admissions outside the KUCCPs placement.[3]
  - **Scholarship opportunities are often limited,** e.g., Optiven Foundation committed KSh1 million for TVET trainees which compared to the cost of education, would cover less than 20 students.[4]

Limited equity consideration in admissions

- **The minimum grade requirement to enroll in courses is similar across general applicants and disadvantaged populations,**[5] increasing the scarcity of already disadvantaged populations such as women in SPIS.

Source: 1] Dalberg, 'TVET Insights Report', 2021; 2] *The Star*, accessed 2023; 3]*Higher Education Financing*, accessed 2023; 4] *Optiven*, 2022
Note: #The Kenya Universities and Colleges Central Placement Service (KUCCPS) is a State Corporation that provides career guidance and selects students for admission to universities, national polytechnics, technical training institutes and other accredited higher learning institutions for Government of Kenya-sponsored programmes

Further, gaps in curricula and a lack of practical experience impact the learnings and skills development of trainees

3 Study Experience (1/2)

Lack of – or insufficient – practical training components

- **The largest gap in SPIS trainings is insufficient practical experience**, which leaves trainees poorly equipped for real life jobs.[1]
- **Only 31% of TVET trainees in SPIS-relevant courses having participated in an industrial attachment* report that they received support from the institution** even though attachments increase employment prospects by ~50%.[2]

Technical/theoretical gaps in curricula

- **Trainees are often taught outdated technology** and hands-on learning is limited. Internships are the first time that some have the opportunity to interact with a pump.[1]
- **Further, studies show that the solar PV curricula developed by TVETs does not equip students with the business and financial skills** needed on the job.[3]
- **Only 32% of TVETs are engaging private sector organizations in curriculum review**. Approximately 30% of public and 33% of non-accredited institutions have never reviewed their curriculum.[2] This scarcity of review is particularly important in the SPIS field due to the fast-changing nature of technology in the sector[1]

Industrial attachments improve employment prospects for TVET graduates by **50%.** Nonetheless, only 31% of students receive institutional support to obtain these opportunities

Source: [1]Stakeholder Interviews [2]Dalberg Survey on TVETs, 2021, [3] Strathmore University, Insights from the Solar PV Industry in Kenya, 2021 *Industrial attachment - a structured, credit-bearing work experience in a professional work setting during which the student applies and acquires knowledge and skills

In addition, inadequately qualified trainers may compromise the learning and skills development of trainees

3

Study Experience (2/2)

> The current establishment of trainers in TVET institutions is 6,201 trainers, **indicating a shortage of 8,817 trainers**. This means that we are unable to meet the recommended trainer-to-trainee ratio of 1:30 for business courses and 1:20 for STEM (science, technology, engineering, and mathematics) courses.
>
> *–Cabinet Secretary Education, Ezekiel Machogu*

Scarcity of trainers and gaps in the quality of trainers

- **The minimum requirements for TVET trainers, e.g., the level of education and experience, are low** which may impact the quality of training, including in SPIS relevant courses. Our survey found that 90% of institutions require less than 3 years of industry experience, 75% of TVETs require technical training as a minimum requirement for trainers and only 10% of institutions require a Bachelors' or Undergraduate degree.[1]
- **Continuous learning requirements for TVET are low** which may result in outdated training, particularly in SPIS courses since technology in the field is fast changing. Among TVETs, 34% of institutions are not imposing any continuous professional development requirements on their trainers, potentially impacting the quality of training.[1]
- **These low requirements are likely fueled by a scarcity of training personnel,** as trainee-trainer ratios are higher than the TVET standard of 20:1 for practical and 25:1 for theoretical training.[2] To exemplify, the trainees-trainer ratio across TVET institutions in Kenya is high at 32:1, 33:1 in public institutions, and 31:1 in private institutions.[1]

Limited accommodations for disadvantaged populations

- **Few trainees in TVETs report benefitting from gender and disability support services** despite TVET institutions implementing various inclusion policies.[1]

Source: [1]Dalberg Survey on TVETs, 2021, [2] TVETA, *TVET Standard Requirements and Guidelines*, 2020

Securing a job with dignified working conditions also seems to be a challenge with few graduates receiving career support to secure jobs

4 Employment Search

Limited career support from TVET and other training institutions

- **Limited SPIS industry linkages** such as career fairs on SPIS are provided to TVET students with only 39% of trainees in SPIS-relevant TVET courses receiving support to network with industry players. [1]

Gender-based hardship

- **46% of women report facing a hard time securing a job based on their gender identity** compared to 11% of men; this is likely due to societal perception of women as unsuited to roles in a male-dominated field [1]

Unemployment

- **72% of graduates from SPIS-relevant courses remain unemployed** in 2020 compared to 60% of TVET graduates in general. However, relative to dropouts from SPIS-relevant courses with an unemployment of rate of 81%, graduates are doing better.[1]
- Issues highlighted in the study experience section such as training using outdated technologies and a lack of practical experience have **led to a mismatch between skills acquired and job demands.**

Women face more hurdles securing jobs, with **46% reporting difficulties due to their gender identity**, compared to 11% of men.

Source: [1] Dalberg Survey on TVETs, 2021

For those that secure employment, low income remains an issue as well as limited opportunities for continuous learning

71% recent TVET graduates earn under KSH 24,000/month. **SPIS jobs offer much higher incomes** with salaries ranging from KSH 35,000-60,000 for technicians and KSH 100,000-150,00 for sales and marketing roles.

5 Employment and continuous journey

Low income

- **Most (71%) employed recent graduates earn less than KSH 24,000/month** with 19% of employed graduates and 23% of female employed graduates of SPIS-relevant courses earning less than KSH 10,000/month, which is significantly lower than the minimum wage of KSH 13,572/month.
- **However, should the graduates secure jobs in SPIS, they can earn more**; approximately, KSH 35, 000 for technician assistant roles, KSH 60, 000 for technician roles and KSH 100, 000 – 150, 000 and above for roles in sales and marketing.[2]

Geographical and financial inaccessibility of continuous learning

- **It costs tens of thousands of shillings to attend most SPIS short courses.** While this may be affordable for professionals in SPIS who earn ~35, 000 - ~150, 000 depending on their designation, it is unaffordable for unemployed graduates who may want to upskill in order to be competitive candidates.
- **Among the institutions identified as offering short courses on solar PV, 11 out of 28 are situated in Nairobi**, while other regions typically have only one or two institutions providing such courses. The remaining institutions are primarily located in major cities and towns, including Kisumu, Eldoret, and Machakos.

Limited specificity of short courses on SPIS

- **Only 5 out of the 28 institutions** we identified that offer solar PV training had clearly indicated that they have training on solar-powered irrigation.

Source: [1] Dalberg Survey on TVETs, 2021, [2]Stakeholder Interviews

Improved training, validated by a pilot, can address the pain points along student journeys, bridging the skills mismatch and private sector demand

Dalberg and EforA have partnered to initiate the development a pilot program aimed at effectively equipping young individuals with the necessary skills to seize employment opportunities in the SPIS sector

Overview of the pilot

In collaboration with key partners, we will design and test a new training curriculum and model to address the mismatch between skills taught in TVETs and those demanded by employers in SPIS. In addition to an improved curriculum, the pilot will link trainees to industry actors and provide on-the-job training. Learnings from the pilot will be applied in other TVETs and green sectors to boost youth employment.

Target participants	Target Outcome	Key Partners
• Youth not in education, training or employment particularly from rural areas.	✓ Increased course offerings in SPIS, with skills taught matching industry demand ✓ Improved access to SPIS training for female, rural, and or low-income youth ✓ Improved employment outcomes for graduates from SPIS training ✓ Increased accessibility of continuous training while working in SPIS	• Government Institutions • Training Institutions • Private Sector Entities • Development Partners

Pathway to Scale

Design
An up-to-date curriculum and training model

Test
The curriculum and model in a few TVETs

Refine
The curriculum and training model based on learnings

Scale
To other TVETs and green sectors

We are inviting a funder to help us pilot this concept, thereby advancing climate-resilient agriculture while providing jobs for youth and solving a talent challenge for employers in SPIS

Involving government entities and the private sector is crucial to ensure the pilot's success

Collaboration between the Government, training institutions, private sector entities, and development partners is critical to pilot's success; with the **Government** leading curriculum design, access to training and institutional reform while the **private sector** supports in curriculum design, implementation, and opportunity creation.

Key actions for Government entities

- **Co-design the SPIS curriculum** with training institutions and other stakeholders, ensuring it meets set standards and guidelines.
- **Stimulate training institutions to offer enough courses** to meet industry demand.
- **Investigate the possibility of expanding scholarship opportunities** for courses tailored to the requirements of the SPIS market.
- **Leverage this as an opportunity to test TVET curriculum reforms** from theory-based learning to higher-industry-based learning.

Key actions for the private sector

- **Co-design a new SPIS curriculum** with training institutions and other stakeholders, to ensure training incorporates all requirements for on-the-job success.
- **Share latest technology** with training institutions for practical classes in TVET/short course.
- **Participate in job fairs** to share job and internship opportunities with trainees with the goal of offering internships/jobs to trainees.
- **Invest in on-the-job training** to supplement school experience and ensure continuous learning is accessible to trainees.

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Please note the mentioned institutions are examples of ideal partners, and that they have **not given any formal consent to be part of the proposed partnership.**

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Additionally, the involvement of development partners and training institutions is critical to the pilot's success

Collaboration between the Government, training institutions, private sector entities, and development partners is critical to pilot's success; with **development partners** supporting convening, learning, funding and tracking while **training institutions** lead on curriculum design, implementation, and linkage of trainees to industry.

Key actions for development partners

- **Convene to facilitate collaboration** among relevant development partners, government agencies and training institutions to ensure comprehensive curriculum design.
- **Establish learning partnerships to share knowledge** based on lessons learned in SPIS and workforce development from past and current projects.
- **Provide funding** to be used to subsidize training.
- **Support tracking** through data collection and courseme monitoring to track outcomes and impacts of pilot.

Key actions for training institutions

- **Co-design a new SPIS-focused curriculum** with other stakeholders, that is practical and anchored in private-sector requirements to ensure acquisition of relevant knowledge and skills.
- **Host job fairs at the midpoint and towards the end of training** to link trainees to private sector companies that may offer internship and full-time opportunities.
- **Enforce standards of learning** as required by TVETA e.g., practical experiences.

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The next steps to pilot the SPIS training are to secure partnerships, design the curriculum, plan implementation then scale up if successful

	Partnership identification	Curriculum and course design	Implementation and Monitoring, evaluation & learning (MEL) plan	Review the pilot mid-way and upon ending	Scale up
	~10 weeks	~10 weeks	~10 weeks	~6 weeks	TBD
Summary	**Facilitate discussions with potential partners** for the pilot implementation and agree on **partnership modalities**.	Collaborate with key stakeholders to **design an up-to-date SPIS-focused curriculum within engineering courses and an accompanying business model** to fund training	In partnership with the identified partners, **develop an implementation plan and pilot the designed curriculum and business model**	**Undertake a MEL review half-way into the pilot** and a second one at the end	Incorporate learnings from the pilot and **expand the training course**
Key Activities	• Gauge the interest of potential partners • Design criteria for partner selection • Support conversations to test the fit, and identify partners' value propositions • Develop a partnership modality and support the negotiation of terms incl. resources provided by the different parties • Draft and sign a Memorandum of Understanding (MOU) to affirm partners' commitment and coordinate activities	• Conduct a review of existing SPIS curricula, course catalogs, and training courses/models leveraging Dalberg and EforA's previous work • Hold ~2 working sessions with relevant stakeholders (incl. government and industry leaders) to: – Develop the curriculum incl. changes to existing curricula and courses to cover SPIS-specific modules; to fill identified soft skills gaps; to ensure a strong focus on practical on-field experience – Develop different business models aimed at sustainable training	• Define the pilot parameters e.g., the number of trainees • Investigate ways to strengthen institutions' career support to trainees e.g., in securing industrial attachments and employment • Incentivize and support training institutions to track and share employment outcome data • Formulate TVET-specific gender interventions aimed at improving employment outcomes for female graduates • Design an MEL framework to measure the impact of the pilot: indicators, modes and frequency of collection	• Review the performance of the pilot mid way, based on the MEL framework • Undertake modular changes to the courseme to respond to potential challenges faced in achieving the intended outcomes • Convene with partners to review findings and decide on potential for upscaling the courseme and discuss ways to further refine/strengthen the courseme • Review the performance of the pilot towards the end of it to inform potential design changes	• Launch a full course with more trainees • Expand the course in other TVETs, with a view of reaching out rural areas further • Investigate the potential for scaling up to other countries in the region • Investigate applicability and scale to other sectors e.g., cold storage
Target Outcome	• Defined partnership with necessary members	• Up-to-date curriculum and training model co-designed by key stakeholders	• Rolled out the pilot with minimum hiccups	• Learnings from the pilot	• Increased uptake of the training

The pilot has the potential to be a proof of concept for other geographies and for green jobs particularly in the PURE sector

Opportunity in different PUSLE areas and geographies

- PURE technologies **offer significant opportunities for the expansion of job opportunities in Sub-Saharan Africa**. In Ethiopia for instance, across three value chains (horticulture, wheat and milk), the adoption of these solutions could create over 190,000 jobs[1]
- Data gathered from companies via the EforA and Nithio Financing Facility indicated an approximate creation of **21,400 jobs***, primarily in Nigeria, Ethiopia, and Kenya. PURE technologies with high job creation estimates included refrigerators/freezers, walk-in cold rooms, and solar water pumps[2]
- This pilot program can be replicated across other geographies such as Uganda, Ethiopia, and Nigeria where PURE technology sales are high and for other technologies such as:
  - Solar refrigerators
  - Walk-in cold rooms
  - Solar mills[3]

Transferable Elements

- **Core skills identification methodology**: The process of identifying and fostering essential core skills, as showcased in this pilot course, can be applied across various sectors.
- **Customized training models**: The adaptable curriculum design used in this pilot courseme can be tailored to suit the requirements of various PURE technologies.
- **Practical skills development**: The emphasis on practical training and soft skills development to equip graduates with the necessary competencies to excel in real-world job environments can be applied in other roles with similar demands.
- **Promotion and inclusivity**: The marketing and enrolment strategies employed to engage rural and female students in this pilot can be adapted to reach diverse demographics in other sectors.
- **Entrepreneurship and networking**: The strategy of providing small business grants and organizing job fairs for graduates can be mirrored to other sectors to promote entrepreneurial pursuits, job placements, and networking; all of which enhance employment prospects.

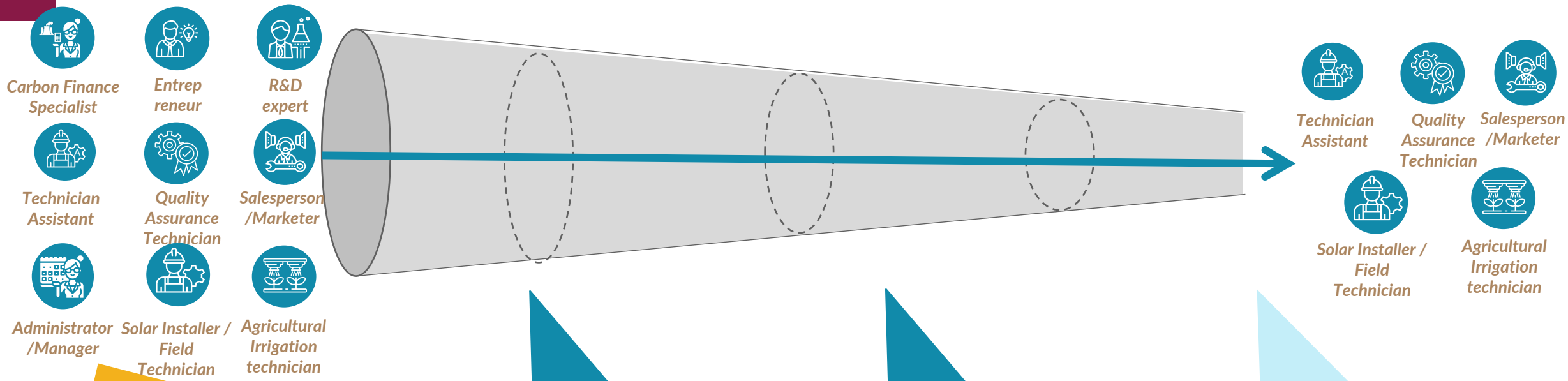
Sources: [1] IRENA, Renewable Energy Jobs, 2022; [2] EforA *Financing Facility* data collected from 18 companies across 6 SSA countries and 7 PURE technologies, i.e., electric pressure cookers, electric induction cookers, SWPs, refrigerators/freezers, mills, walk-in cold rooms and fans *Data is self-reported, companies used different approached to estimate job creation [3] GOGLA, Sales and Impacts Report, 2022

Annex 1: Definition of terms

Direct formal jobs	Direct, formal jobs are those created through contractual engagement with an incorporated company in the DRE sector. For example, an IT professional or a project manager who is employed by a DRE company. The term “job” as used in this study is agnostic to the socioeconomic benefits that may accompany a full-time job, such as insurance.
Direct informal jobs	Direct, informal jobs are informal jobs created through contractual or non-contractual engagement with an incorporated company in the DRE sector. Informal employment in the sector takes on various forms, from long-term arrangements with companies, like product retail, to commissioned sales, like a home business owner who works as the village sales representative
Productive use jobs	Productive use jobs are those created by the DRE end users themselves as a result of newly acquired or enhanced electricity access. For the purpose of this study, productive use is defined as any income-generating application of a DRE product or service. An example would be the new jobs created by the purchase of a solar milling plant. Productive use jobs are estimated through insights from focus groups and literature, as most surveyed respondents did not readily have data on jobs created by their product or service at the customer lev

Source: Power for All, Powering Jobs Census Report, 2019

Annex 2a: Process of mapping and selecting critical job types



List of jobs in SPIS

We mapped a long list of jobs based on our experience in SPIS. To ensure this list was comprehensive:

- We reviewed job posts online
- Based on our value chain map (see slide 2b), we ensured different subtasks were covered by identified jobs
- We validated it with stakeholders interviewed

Formality & direct jobs

We then filtered for direct jobs, encompassing roles tied to SWP actions, and disregarded jobs that emerge downstream in SWP utilization. Among these direct jobs, we examined both formal full-time positions and informal tasks performed by skilled individuals, leading to the removal of the carbon specialist.

Market demand

We selected the roles for which market demand was highest. For example, the R&D expert role was removed as demand in Kenya is relatively low and this is not expected to drastically change in the near future.

Note on education level

While not a formal criteria, we mostly focused on roles that are well-suited for individuals that did not necessarily pursue high education degrees. These require practical skills and local insights with direct contact with customers.

This approach fosters inclusivity, creating accessible pathways to meaningful employment for a wider demographic. To note that the marketer job is however mostly occupied by graduates.

Annex 2b: Map of SPIS product value chain, relevant hard skills needed and mapping of long list of SPIS jobs

Stage	Research and Development	Manufacturing and Assembly	Admin, Sales and Marketing	Site Assessment and Preparation	Installation	Maintenance and Repair
Hard skills	• Prototype building e.g., including pump sizing • Entrepreneurship • Advocacy • Financing & carbon market knowledge	• Component analysis of solar control boxes, customized connecting cables, solar panels • Initial screening and quality checks of faulty devices to identify product failure reasons	• Communication skills • Customer service • Understanding of solar and irrigation systems and equipment • Financing	• Water reservoir assessment • Soil Assessment • Agronomy • Site management • Solution recommendation including type of solar panel positions, irrigation system • Borehole drilling	• Weatherproofing solar installation in accordance with local safety regulations and the specifications of the manufacturer • Electrical installation including DC management and inverters • Mechanical installation • Identification and resolution of potential hazards	• Electrical and mechanical troubleshooting • Cleaning of solar PV • Meter reading • Initial screening and quality checks of faulty devices to identify product failure reasons • Technical repairs including post-repair checks
Professions	*R&D expert*; *Entrepreneur*	*Quality Assurance Technician*	*Administrator /Manager*; *Carbon Finance Specialist*; *Salesperson /Marketer*	*Solar Installer / Field Technician*; *Agricultural Irrigation technician*	*Solar Installer / Field Technician*; *Technician Assistant*; *Quality Assurance Technician*	*Solar Installer / Field Technician*; *Agricultural Irrigation technician*
Demand	Low – Kenya imports more but might be key in long term	Medium – Due to localization and Kenya imports	Medium – Skill lacks among technical graduates but not among graduates in general	High – Delocalized and high demand projection	High - Delocalized and high demand projection	High - Delocalized and high demand projection

Source: SPIS Toolbox, Solar Technician Job Ads - Mkopa, Solar, Solar Gen Technologies; CP Solar Resources; Confidential Company

Annex 2c: A detailed description of selected jobs (sort list)

Quality Assurance Technician

Brief JD: Ensures the quality of solar systems in accordance with relevant specifications and associated standards, through on-time and in-budget initial screening checks, component analysis of solar control boxes, and customization of connecting cables, solar panels, etc.; while engaging customers and keeping records e.g., customer feedback, warranty reporting, product replacement management replacement stock & spare part management tracking

Projected Demand & Rationale: Low | **Medium** | High — Together with other technical roles in installation and maintenance, accounts for 19% of projected roles[1]

Relevant product stage: R&D | **Manufacturing & Assembly** | Admin, Sales & Marketing | Site Assessment & Preparation | Installation | **Maintenance & Repair**

Relevant Courses/Certification: Dip. Electronic and Electrical Engineering or other relevant disciplines

Relevant Skills: Understanding of Solar Electricals including troubleshooting and some repair, Understanding of Quality Control Tools, Data Management,, Customer Service, Understanding of business goals as well as recommending new approaches

Entry Salary Estimate: KSH 60, 000

Demand Distribution: Centralized often in urban areas with limited need for field visits

Salesperson/Marketer

Brief JD: A Salesperson/Marketer has studied sales and marketing. s/he have a good understanding of the sells products and provides technical information about these products and coordinate aftersales services.

Projected Demand & Rationale: Low | Medium | **High** — Accounts for ~57% of total demand for SPIS professionals[1]

Relevant product stage: R&D | Manufacturing & Assembly | **Admin, Sales & Marketing** | Site Assessment & Preparation | Installation | Maintenance & Repair

Relevant Courses/Certification: Bachelor degree in sales or Marketing, In-depth knowledge of solar equipment and installations.

Relevant Skills: Provide customers with information about solar-powered equipment, demonstrate company solar products in a working environment, Gather information to accurately identify the customer's solar needs, Ability to relate technical information in layman's terms.

Entry Salary Estimate: KSH 100,000 – 150,000 based on years of experience

Demand Distribution: Decentralized with frequent trips to the field

JD for quality assurance technicians – *sample 1*, 2019, *sample 2*, accessed 2023, JD for salesperson – *sample 1*, accessed 2023

Annex 2c: A detailed description of selected jobs (sort list)

Solar Installer/ Field Technician

Brief JD: Assembles and mounts solar panels, configures the wiring and inspect all electrical parts to ensure everything is working properly. Also installs and connect any batteries or other accessories, performs maintenance on all systems, and ensures that they are up to code and meet safety requirements. Additionally performs site surveys, conducts performance tests and troubleshoot any issues that arise.

Projected Demand & Rationale: Low | **Medium** | High — Together with other technical roles in installation and maintenance, accounts for 19% of projected roles[1]

Relevant product stage: R&D | **Manufacturing & Assembly** | Admin, Sales & Marketing | **Site Assessment & Preparation** | **Installation** | **Maintenance & Repair**

Relevant Courses : High school Dip. In electricity and wiring procedures, as well as advanced cognition about solar energy and solar systems in general

Relevant Skills: Knowledge of photovoltaic systems and their operation, Ability to read and interpret electrical plans and diagrams, Experience in electrical installation and construction work, Knowledge of local electrical codes and standards.

Salary Estimate: KSH 60,000

Demand Distribution: Decentralized with frequent trips to the field

Agricultural Irrigation Technician

Brief JD: Conducts site evaluations to assess the irrigation needs/requirements then designs and plans efficient irrigation systems tailored to specific crop types and field conditions and supports the installation and setup of irrigation equipment, conducts irrigation system tests, troubleshoots issues, and performs maintenance tasks while keeping a record of activities and necessary data including water distribution, uniformity, and efficiency

Projected Demand & Rationale: Low | **Medium** | High — While the need is decentralized, these services will likely be taken up by commercial farms with more capital

Relevant product stage: R&D | Manufacturing & Assembly | Admin, Sales & Marketing | **Site Assessment & Preparation** | Installation | Maintenance & Repair

Relevant Courses: Agriculture or a related field, Dip. Water engineering

Relevant Skills: Knowledge of irrigation system components, design principles, and water hydraulics, Familiarity with irrigation scheduling techniques and water conservation practices, Proficiency in using irrigation design software or willingness to learn.

Salary Estimate: KSH 60, 000

Demand Distribution: Decentralized with frequent trips to the field

JD for solar installer *sample 1*, 2023; JD for agricultural technician (intern sample for reference) – *Sample 1*, *Sample 2* , *Sample 3*, *Sample 4*

Annex 2c: A detailed description of selected jobs (sort list)

Technician Assistant

Brief JD: Under the control of Solar installer/field technician or the agricultural irrigation technician, the technician assistant assembles and mounts solar panels, configures the wiring and inspect all electrical parts to ensure everything is working properly. Also installs and connect any batteries or other accessories, performs maintenance on all systems, and ensures that they are up to code and meet safety requirements. Additionally performs site surveys, conducts performance tests and troubleshoot any issues that arise.

Projected Demand & Rationale: Low | **Medium** | High — Together with other technical roles in installation and maintenance, accounts for 19% of projected roles[1]

Relevant product stage: R&D | **Manufacturing & Assembly** | Admin, Sales & Marketing | **Site Assessment & Preparation** | **Installation** | **Maintenance & Repair**

Relevant Courses : High school Dip. In electricity and wiring procedures, as well as advanced cognition about solar energy and solar systems in general

Relevant Skills: Knowledge of photovoltaic systems and their operation. Ability to read and interpret electrical plans and diagrams, Experience in electrical installation and construction work, Knowledge of local electrical codes and standards / Knowledge of irrigation system components Familiarity with irrigation scheduling techniques and water conservation practices

Salary Estimate: KSH 35,000

Demand Distribution: Decentralized with frequent trips to the field

Annex 2d: A brief description of the jobs that were deselected

Research and Development **R&D expert**

A R&D expert has studied engineering and has an entrepreneurial mindset. S/he comes up with new ideas, builds prototypes and tests them. S/he has skills similar to technicians and earns ~KSH 150,000 - 200,000.

Admin, Sales & Marketing **SPIS Entrepreneur**

An entrepreneur sets up a business or businesses in the SPIS sector. S/he identifies customers, develops marketing strategies, manages finances, builds relationships with stakeholders, recruits and manages employees, stays informed about industry developments.

Admin, Sales & Marketing **Carbon Finance Specialist (CFS)**

A CFS leverages carbon revenue and financial mechanisms to promote sustainable and climate-smart innovations, focusing on SPIS and agriculture. They analyze economic viability, develop pricing strategies for solar irrigation at scale, and explore carbon market opportunities to drive adoption and reduce costs.

Admin, Sales & Marketing **Administrator/manager**

An administrator/manager has studied a course in business or related and oversees the planning. S/he manages planning and organization and schedule day-to-day activities including installment, and maintenance calendars. S/he may also support with fund raising and earns ~KSH 100,000– 150,000

Annex 3a: Identification of necessary hard skills* and technical knowledge, as well as courses to ensure the development of those skills

After reviewing job posts and job descriptions available online, we developed a list of hard skills that are necessary for different roles within the SPIS industry in Kenya, which we mapped along the SPIS supply chain. This list was validated through stakeholder consultations. This process helped us define what courses were necessary to equip trainees with the capabilities to later succeed as SPIS professionals.

Stage	Research and Development	Manufacturing and Assembly	Admin, Sales and Marketing	Site Assessment and Preparation	Installation	Maintenance and Repair
Hard skills	• Prototype building, e.g., including pump sizing • Entrepreneurship • Advocacy • Financing and carbon market knowledge	• Component analysis of solar control boxes, customized connecting cables, solar panels • Initial screening and quality checks of devices to identify product failure reasons	• Good communication to dissipate technical information • Customer service mindset • Understanding of solar and irrigation systems and equipment • Financing knowledge	• Water reservoir assessment • Soil assessment • Agronomy • Need assessment to recommend an optimum solution, incl. type of irrigation system • Borehole drilling	• Weatherproofing solar installation in accordance with local safety regulations and the specifications of the manufacturer • Electrical installation incl. DC management and inverters • Mechanical installation • Identification and resolution of potential hazards	• Electrical and mechanical troubleshooting • Cleaning of solar PV • Meter reading • Initial screening and quality checks of faulty devices to identify product failure reasons • Technical repairs including post-repair checks
Courses	• Electrical Engineering • Mechanical Engineering	• Electrical Engineering • Mechanical Engineering	• Sales and Marketing • Introduction to Finance	• Agronomy • Mechanical Engineering • Solar Installation • Water and Irrigation Engineering • Plumbing	• Electrical Engineering • Mechanical Engineering • Solar Installation (often comes with electrical engineering. or as short courses) • Water and Irrigation Engineering • Plumbing	• Electrical Engineering • Mechanical Engineering • Solar Installation (often comes with electrical engineering. or as short courses) • Water and Irrigation Engineering • Plumbing

Source: SPIS Toolbox, Solar Technician Job Ads - Mkopa, Solar, Solar Gen Technologies; CP Solar Resources; Confidential Company; Note: * According to indeed.com, a worldwide employment website, hard skills are technical skills that are specific to a particular job or industry; they are often acquired through formal education and training courses.

Annex 3b: Identification of necessary soft skills,* as well as courses and approaches to ensure the development of those skills

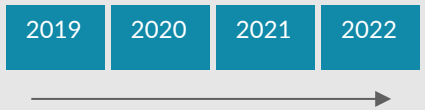
Similarly, we developed a list of soft skills* that are necessary for different roles within the SPIS industry, which we mapped along the SPIS supply chain. This list was validated through stakeholder consultations. This process helped us define what courses and teaching approaches were necessary to equip trainees with the capabilities to later succeed and grow as SPIS professionals.

Stage	Research and Development	Manufacturing and Assembly	Admin, Sales and Marketing	Site Assessment and Preparation	Installation	Maintenance and Repair
Skills	• Problem-solving and ability to be creative and innovative • Teamwork • Record keeping • Financial awareness • Basic IT • Communication	• Adherence to safety protocols • Teamwork • Attention to detail and accuracy	• Communication • Teamwork • Report writing • Basic IT	• Adherence to safety protocols • Teamwork • Report writing • Basic IT and programming • Adaptability to new tech • Time management during field trips • Communication	• Adherence to safety protocols • Customer service • Communication • Basic IT and programming • Adaptability to new tech • Teamwork	• Adherence to safety protocols • Customer service • Communication • Basic IT and programming • Adaptability to new tech • Time management during field trips • Teamwork
Courses	• Basic programming concepts and languages	• Workplace safety and health	• Customer service • Introduction to computer systems and networks	• Workplace safety and health • Introduction to computer systems and networks	• Workplace safety and health • Introduction to computer systems and networks	• Workplace safety and health • Introduction to computer systems and networks
Approach	• Group exercises (rather than individual ones) • Compliance training • Innovation challenges or hackathons	• Group exercises • Conduct safety drills intermittently	• Conduct regular oral presentation exercises • Writing seminars • General soft skills training • Simulate interactions with customers	• Conduct safety drills intermittently • Simulate interactions with customers • Writing seminars • Group exercises • Tech evolution discussions	• Conduct safety drills intermittently • Simulate interactions with customers • Group exercises • Tech evolution discussions	• Conduct safety drills intermittently • Simulate interactions with customers • Group exercises • Tech evolution discussions

Source: SPIS Toolbox, Solar Technician Job Ads - Mkopa, Solar, Solar Gen Technologies; Solar Technicians (Manufacturing & assembly, Installation, Maintenance and repair - Assembly Engineer Solar; Note: *According to indeed.com, a worldwide employment website, soft skills are personal attributes that enable someone to interact effectively and harmoniously with other people and are often described as interpersonal skills or people skills.

Annex 4: Detailed explanation behind our estimations of market size and job opportunities

Actual number of SWPs sold in Kenya is estimated at 20 - 50% of market share[1,2]



We calculated the CAGR of sales across 2019 - 2022

Market size of SPIS in Kenya based on the estimated share of reported SWP sales

- We estimated a minimum, medium and maximum market size assuming sales reported are 1) 50% for the maximum figure, 35% for the medium, and 20% for the maximum 2) USD 900 cost per SWP[1,2]
- For further analysis, we used the average of the three cases, as the value of sales for each year

Projected number of SWPs sold in Kenya

- We applied the calculated the compound annual growth rate (CAGR) of sales to the next 5 years, starting with the average value of sales from the minimum, medium and maximum cases in 2022 (see market size estimation above) to predict the value for 2023
- The value derived from CAGR calculations formed our baseline scenario
- For the best-case scenario, we assumed the highest year-on-year (YoY) change in sale across the projected 5 years
- For the worst-case scenario, we assumed the lowest YoY change in sale across the projected 5 years

Job opportunities from SWP

- For direct formal jobs as a result of SWPs, we used the ratio of 9.5 jobs per 1, 000 SWPs, sourced from PowerforAll's analysis of jobs in the sector[3]
- For direct informal jobs, we multiplied the number of direct jobs by 1.5, as per the ratio identified by Powerforall, assuming that this remains constant through the years[3]
- For productive use jobs, we multiplied the number of direct jobs by 6.5, as per the ratio identified by Powerforall, assuming that this remains constant through the years[3]

Sources: 1]GOGLA, Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data July - December 2022 2] GOGLA, Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data July - December 2021; [3] Power for all, "Powering Jobs Census 2019: The Energy Access Workforce", 2019

Annex 5: In addition to the direct formal and informal opportunities, productive use opportunities are anticipated to the tune of x6.5 of the direct formal jobs