

Impact of Solar Vocational Training in the Amhara region of Ethiopia

Project initiated by



Impact Evaluation Proposal by

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1. Intervention to be studied

The rural communities (80% of the population) in Ethiopia have low access to energy, both for subsistence and productive purposes, and rely almost entirely on biomass fuels. The excessive reliance on firewood as an energy source has become a serious issue that has increasingly led to deforestation, soil erosion, desertification and environmental degradation. Moreover, the unavailability of reliable energy hampers the provision of critical social services such as water supply, health services and educational facilities for which modern energy sources are essential inputs.

The project aims to improve access in rural areas to electricity services from solar energy in a climate-friendly and cost-effective way that also creates new job opportunities for the youth. More specifically, the project called “Solar Learning Ethiopia – solar vocational training and entrepreneurship program for youth self-reliance in Ethiopia”, conducted by Solafrica in cooperation with Education for Sustainable Development (ESD) and Helvetas, aims at improving the economic self-reliance of disadvantaged youths and livelihoods of community members of the Amhara region of Ethiopia through vocational education training in solar technology.

Within a period of 5 years, the project seeks to increase the employability of 540 rural youths through Technical and Vocational Education and Training (TVET) in solar installation, operation and maintenance and the development of entrepreneurial skills to earn accreditation as solar technicians. Moreover, the young people who participated in the program should be successfully linked with job opportunities through job placements and business support for self-employment. This envisages an improvement in the economic self-reliance of disadvantaged youths and the livelihoods of community members. Finally, to increase demand for solar installations in the region, the graduates of the solar TVET should establish demonstrations of solar systems in the Amhara region in Ethiopia to improve the image of solar energy and increase its acceptance. Consequently, these activities should improve access to solar energy in rural off-grid communities in the region.

For the present impact evaluation, we will first outline the theory of change verbally and visually. In the second step, we will assess the different links of the result chain referring to other impact evaluation studies assessing the effectiveness of VET on employability and job opportunities. Thirdly, based on this literature review, we will identify two evidence gaps on which we focus our impact evaluation. To answer the overall policy question of *the impact of solar TVET on the livelihood of disadvantaged youths and access to solar energy in rural off-grid households in the Amhara Region of Ethiopia*, we propose to conduct a mixed methods design consisting of Process Tracing and A Randomised Control Trial. In the final part, we discuss this study's relevance for NGOs and policy makers.

2. Result chain

The initial **activities** required in the project include the development of a needs-based and customized photovoltaic solar curriculum and relevant training modules and materials. This is done through an active know-how exchange with Solafrika's pre-existing TVET colleges and vocational training programs in Kenya. After that, potential instructors to lecture PV courses are identified, and teachers are trained in solar energy installation, operation and maintenance. Once the program's structure and monitoring are developed, appropriate training colleges are chosen to become partner service providers. Ultimately, unemployed rural youths are trained in the field of solar energy, with the opportunity to do a practical attachment as part of the training program. An additional aspect of the training program is the delivery of soft skills and entrepreneurship training with a focus on small business management, customer handling and financial management.

All the activities mentioned above lead to the following **outputs**: A functioning solar vocational training and entrepreneurship program should be established where students have acquired theoretical and practical knowledge and soft skills in solar energy installation, operation, maintenance, and business management. Upon successful completion of the training program, graduates are linked with employment opportunities. Alternatively, those that are interested in starting their own business receive regular coaching and mentoring and are linked with reliable solar technology providers and credit and saving institutions. These activities lead to the establishment and implementation of job placement and self-employment support services.

Furthermore, to increase demand for solar installation in off-grid communities, demonstrations of solar systems are established in schools, health care facilities and social institutions by the trained youths with the support of the training institution. This, in turn, leads to an improved image and access to information about solar energy at a grassroots level. Consequently, demand for solar systems is expected to rise.

As youth have acquired relevant skills in solar technology and received adequate job placement services or self-employment support, trained technicians are able to establish their own small solar businesses or find formal employment and install and maintain solar systems in their communities. Consequently, demand for solar installations further increases.

This final output leads to the following three targeted **outcomes**:

- 1) Increased employability among all youths who have completed the solar TVET
- 2) Youth are successfully linked with job opportunities
- 3) Improved access to solar energy in rural communities

Finally, these outcomes lead to the targeted **long-term development effect (impacts)**, which involves improving the economic self-reliance of disadvantaged youths and the livelihoods of community members of the Amhara region of Ethiopia.

The Result chain verbally outlined in this chapter is visualised in *Appendix 1*.

3. Knowledge gaps

For simplicity reasons, we have decided to specifically focus on knowledge gaps within the blue boundary, indicated in our Result Chain in *Appendix 1*.

Link A: Vocational training leads to youths acquiring relevant technical and soft skills and identifying their entrepreneurial skills → Accreditation as solar technicians and increased employability of youths

Different impact evaluations shows that specific employment and vocational training enhances the employability of young people in LIC. However, according to a systematic review of 26 TVET interventions in LIC and MIC, there are considerable differences in the size of the effects (Tripney et al., 2013). For instance, a study from the Philippines shows that participation in a Special Student Employment Program has increased work prospects and the likelihood of employment with private employers, local government units or NGOs by 70% (Beam et al., 2018). In contrast, a TVET program in Romania resulted in a 15% higher chance of being employed, which was higher for people below 25 and those living in urban areas (Popescu & Roman, 2018).

Other important factors in enhancing youth employment are soft skills. Several studies in LIC and MIC conclude that soft skills provide youth with the tools and confidence finding work (Rankin et al., 2015). A Randomized Control Trial (RCT) from Tanzania finds that management training, coaching and consultation programs positively impact participants' management knowledge and practice. Another RCT on entrepreneurship and vocational training program for youth in Malawi showed that the training resulted in skills development, increased human capital, and improved well-being, with more positive effects for men than for women (Cho et al., 2013). All findings emphasize the positive impact of vocational education on youth employability.

Link B: Increased employability of youths → Improved economic self-reliance and livelihoods of disadvantaged youths

Great evidence shows that graduates of VET programs can become economically self-reliant. A meta-analysis evaluating 26 studies on TVET and youth in LIC and MIC found a positive and significant effect of TVET on overall payment and earnings (Tripney et al., 2013). Another meta-analysis on the impact of VET on youth labour market outcomes comparing 89 studies finds similar effects of TVET on earnings (Stöterau et al., 2022). Finally, VET can positively affects employment and monthly earnings in the short and medium term (Batchuluun et al., 2017; Camargo et al., 2021).

Link C: Job placement and self-employment support services for graduates from the TVET program → successfully linking youth with job opportunities

There is mixed evidence on how effective job placement and self-employment support services link youth to jobs. VET in LIC and MIC serves as a signalling and screening mechanism to overcome information asymmetries between employers and employees. It allows firms to hire a better selection of employees and youth to signal their skills and productivity, resulting in better integration of youth in the labour market (Stöterau et al., 2022). A meta-analysis of 26 studies found a small but positive effect of TVET on paid and formal employment. Moreover, an impact evaluation from Chile found that a micro-entrepreneurship support program was successful in providing poor individuals with the skills required to generate income through self-employment (Martínez et al., 2016), whereas a study from Ghana found a positive effect of participating in a government-sponsored VET program on youth to shift out of wage work into self-employment (Hardy et al., 2019).

However, there is little evidence on *how* youths are successfully connected to job opportunities through job placements. For instance, a field experiment from Ethiopia investigates how effective job fairs match firms with workers. Despite a rich interaction between the two sides and a set of follow-up interviews, there was only little successful match between firms and workers. Firms preferred hiring staff with long-term work experience outside the job fair rather than entry-level young professionals (Abebe et al., 2017).

Link D: Youths are successfully linked with job opportunities in the solar sector → Economic self-reliance and livelihoods of disadvantaged youths are improved

There is a clear positive effect of VET on monthly earnings from employment shown in the meta-analysis comparing 26 studies on TVET in LIC. In contrast, there was a negative and non-significant effect on self-employment earnings (Tripney et al., 2013).

Link E: Trained technicians establish their own small solar business or are formally employed in the solar sector → Off-grid communities have improved access to solar energy

Several studies acknowledge the importance of creating more “green jobs” through TVET to achieve the Sustainable Development Goals (Allais & Wedekind, 2020; ILO, 2022; Mustapha, 2015). TVET is recognized as an effective way to foster renewable energies, especially when women are included, the training considers differences between urban and rural requirements and access to finance is facilitated (ILO, 2016). However, we did not find any studies assessing *to what extent* solar TVET influences the uptake of renewable energy, particularly solar energy.

4. Impact evaluation objective and impact questions

Our findings of the evidence gap search show a clear positive relationship between TVET and employability and there is evidence that youth increase their monthly earnings after participating in TVET, especially through employment (there is no effect on self-employment).

However, we have identified two gaps that we want to address in this impact evaluation. Firstly, we found limited and contradictory evidence on *how* youths are successfully linked to the job market through job placement and business support services. This link will be assessed in a qualitative analysis. Secondly, how TVET contributes to the uptake of renewable energies, particularly solar energy, in rural off-grid households remains understudied. This second link should be analysed using a quantitative method.

The questions this impact evaluation wants to address are the following:

- 1) **Overall policy question:** What is the impact of solar TVET on the livelihood of disadvantaged youths and access to solar energy in rural off-grid households in the Amhara Region of Ethiopia?
- 2) **Qualitative question:** How do disadvantaged youths gain improved economic self-reliance through participating in the solar TVET programme?
- 3) **Quantitative question:** What is the effect of the solar TVET programme on the solar energy technology uptake in rural off-grid households?

5. Proposed study design for qualitative methods

5.1 Qualitative method

To address the extent to which the successful completion of the solar vocational training and entrepreneurship program affects the economic self-reliance of disadvantaged youths in Ethiopia's Amhara region, we propose to apply the **Process Tracing** method. To choose an appropriate method to answer the qualitative evaluation question, we also made use of the "Choosing Appropriate Evaluation Methods" tool from BOND (BOND, 2016). Process Tracing is among the qualitative methods that scored highest in the tool and proved to fit our purpose well (cf. *Appendix 2*).

Process Tracing is based on a detailed description of a sequence of events over time. It analyzes the underlying causal mechanism linking an independent variable with a dependent variable, considering several intervening variables. Instead of only focusing on the *why*, by showing that there is a relationship between X and Y, process tracing assesses *how* this link is likely to occur. At the same time, alternative explanations are ruled out. There are different types of process tracing, namely, *theory-testing* process tracing, *theory-building* process tracing, and *explaining-outcome* process tracing (Collier, 2011). A theory-testing process tracing was found to be the most appropriate approach for this analysis. This type of process tracing assumes that X and Y are known and that there is a causal link between the two (Beach & Brun Pedersen, 2013; Collier, 2011).

5.2 Application of Process Tracing

Firstly, a hypothesized causal mechanism will be developed that explains how X is linked to Y, and alternative explanations will be studied. We hypothesize that the successful completion of the TVET program leads to higher economic self-reliance of the youth who went through the program. The underlying causal mechanism we developed is depicted in the causal chain, see Figure 2. The different elements of this causal mechanism are partially based on the concept note from Solafrica, discussions with the representative of Solafrica and partially derived from the literature (Abebe et al., 2017). It is important to note that we assumed that every student who has completed the vocational training is employable.

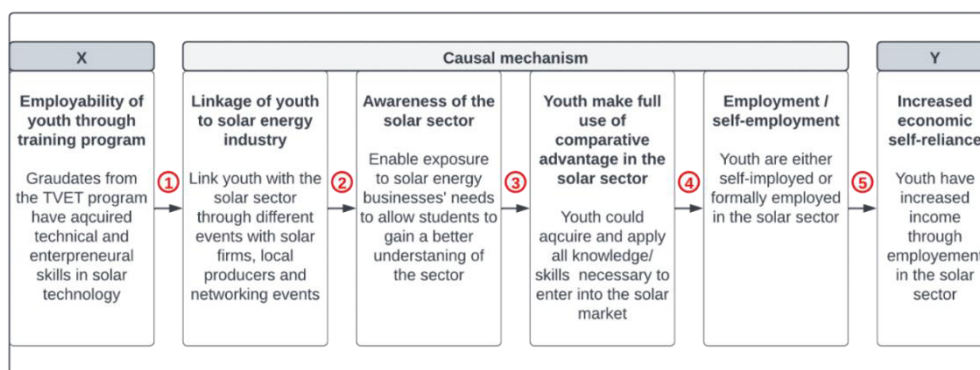


Figure 1: Causal mechanism (Source: own graphic)

Secondly, different types of evidence to formally test the underlying hypotheses of the causal mechanism are specified, namely, account evidence, trace evidence, pattern evidence, sequence evidence (Punton & Welle, 2015). These evidences are outlined in detail in Task 6 and in *Appendix 3*.

Thirdly, at a later stage, the actual collection of evidence and its assessment should take place. To evaluate the quality of the evidence, four formal tests can be used to define whether the evidence is necessary and/or sufficient for accepting the causal claim, see Figure 1 (Collier, 2011).

		SUFFICIENT FOR AFFIRMING CAUSAL INFERENCE	
		No	Yes
NECESSARY FOR AFFIRMING CAUSAL INFERENCE	No	1. Straw-in-the-Wind	3. Smoking-Gun
		a. Passing: Affirms relevance of hypothesis, but does not confirm it.	a. Passing: Confirms hypothesis.
		b. Failing: Hypothesis is not eliminated, but is slightly weakened.	b. Failing: Hypothesis is not eliminated, but is somewhat weakened.
	Yes	c. Implications for rival hypotheses: Passing slightly weakens them. Failing slightly strengthens them.	c. Implications for rival hypotheses: Passing substantially weakens them. Failing somewhat strengthens them.
		2. Hoop	4. Doubly Decisive
		a. Passing: Affirms relevance of hypothesis, but does not confirm it.	a. Passing: Confirms hypothesis and eliminates others.
		b. Failing: Eliminates hypothesis.	b. Failing: Eliminates hypothesis.
		c. Implications for rival hypotheses: Passing somewhat weakens them. Failing somewhat strengthens them.	c. Implications for rival hypotheses: Passing eliminates them. Failing substantially strengthens them.

Source: Adapted from Bennett (2010, 210), who builds on categories formulated by Van Evera (1997, 31–32).

Figure 2: Formal Process Tracing tests to assess the quality of evidence underlying the hypothesized causal mechanism (Source: Collier, 2011)

5.3 Alternative explanations

Other factors influence the number of people working in the solar sector and, based on that, affect people's self-reliance. For example, it is possible that even though job fairs are taking place, the respective youth is not successfully linked to the stakeholders along the solar energy value chain. Instead, the youth might still find more lucrative employment in another sector or move away to bigger cities where job opportunities are more frequent. Moreover, employers may still not be fully aware of the program and do not value its quality, but instead might be more interested in employees with several years of work experience (Abebe et al., 2017). Furthermore, it is also likely that, due to the very limited presence of solar energy (IRENA, 2022), the demand for solar energy is not big enough yet. Consequently, youth, despite their employment in the sector, are not able to earn enough and thus are not self-reliant - or become self-employed in the sector but are not able to significantly increase their earnings (Tripney et al., 2013).

All these alternative explanations will also be tested through the different types of evidence outlined in Task 6 and *Appendix 3*.

5.4 Potential biases

One major challenge when conducting interviews is the risk of confirmation bias, i.e., the interviewed person is interested in a positive evaluation of the project and answers accordingly. Given that many questions are asked retrospectively, and people have difficulties properly remembering past situations, there is also a risk for a recall bias. For the focus group discussions with different actors in the solar market, there is a risk of a sampling bias and self-selection bias because not every single actor can be considered, and actors have different reasons why they would join a discussion. Moreover, the latter can also occur in surveys since participation is most likely voluntary. Finally, there is also a confounding bias, given that each step of the hypothesized causal chain can also be influenced by other factors that then lead to the expected outcome (cf. Alternative Explanation).

6. Proposed study design for quantitative methods

6.1 Quantitative method

To assess the effect of VET in solar installation, operation and maintenance on the solar uptake among the off-grid communities in the Amhara region of Ethiopia, we propose to conduct a Randomised Control Trial (RCT) with encouragement.

An RCT is an experimental approach aiming at testing the effect of an intervention on a target population. A treatment is randomly assigned to some groups (treatment group), in the present case villages surrounding the six cities where the TVET training is provided, and not to others (control group). Given that both groups are large enough, they are assumed to have, on average, similar characteristics. Then, the change in solar uptake is measured between the treated and control villages (Simister & James, 2017).

In the present case, we cannot – and for ethical reasons, do not want to – exclude anyone from joining the solar program. However, forcing anyone to participate in the solar program is also not feasible. Therefore,

we propose to introduce some variation by encouraging half of the sample to take up the treatment, i.e. to participate in the solar training. This random encouragement is expected to influence people's likelihood of participating in the solar training. It is crucial to ensure that the encouragement promotion substantially changes enrolment rates in the encouraged group relative to the non-encouraged group. Therefore, randomisation is introduced by randomly assigning an encouragement significantly correlated with participating in the solar training but uncorrelated with participants' characteristics or income level after completion of the training (for details, cf. Task 6).

6.2 Baseline study

Once the villages have been randomly assigned to receive the encouragement, the encouraged youth decide whether they want to participate in the solar program. Once enrolled in the solar TVET (treatment uptake), we propose to examine the social stratification of the participants (for details cf. Task 6). This step is not necessary for the RCT but could provide interesting insights about the students.

6.3 Survey and effect size

Two years after the completion of the solar program, another survey will be undertaken assessing the share of households with solar installations in all the treatment and control villages (for details, cf. Task 6). Based on this information, the Local Average Treatment Effect (LATE) will be calculated, which estimates the effect of having participated in the solar VET on solar uptake for villages with an encouraged young person who has participated in the training (compliers).

6.4 Limitations

From a methodological perspective, an ineffective encouragement that does not induce any significant difference between the encouraged and non-encouraged village is useless. Therefore, the encouragement must be effective, and its effectiveness should be assessed upfront. Moreover, the method only estimates the training program's impact for a subset of the population (compliers). Hence, one cannot directly extrapolate the LATE estimate to the whole population.

From a practical perspective, we would like to highlight three points that cannot directly be addressed by the proposed research methods but are still worth considering:

Firstly, the entire project is based on the expectation of increasing demand for solar energy in Ethiopia, particularly in the sunny Amhara region. However, numbers show that – up to today – almost no solar energy has been installed (IRENA, 2022). So, the question remains whether people in rural areas of Ethiopia are willing to take up solar energy as a new and unknown energy source. Secondly, the program addresses unemployed youth. This program bears enormous potential if the youth are unemployed due to a lack of job opportunities. However, if those young people are already somewhat the “troublemakers” in the village, it is questionable whether *exactly this* program can make a difference. Finally, we expect the trained youth to return to their villages and apply their new skills in the rural area. However, the well-trained youth may prefer to move to bigger cities or stay in the town where they underwent the training due to better income and more job opportunities. Thereby, the towns might experience some increase in solar energy, while the villages remain undersupplied.

6.5 Potential biases

While RCT overcomes the *selection bias*, several other biases remain. *Spillover effects* can distort impact estimates. They occur, for example, when people who received the encouragement spread the word to other villages and encouraged others (e.g. from control villages) to join the solar training; or when graduates install solar energy services in villages other than their own one. Furthermore, by design, we assume that people who participate in the solar training also complete it and are then, as a result, employable. However, some people might leave the program after registration and not finish it. We cannot directly account for this *attrition bias* but should bear it in mind. A functioning encouragement overcomes *self-selection and program selection bias*, and given the design, there is no threat of any *recall bias*.

7. Data, sample size, and indicators

7.1 Quantitative method

7.1.1 Data collection and indicators

For the RCT, we propose to conduct two surveys, a baseline survey and a post-treatment survey. The **baseline survey**, an online survey conducted at the beginning of the training (e.g. on distributed tablets), serves to better understand the solar VET participants and their social stratification, such as their:

- Household settings: number of people living in the household, family income, occupation of parents, access to electricity at home or elsewhere
- Prior work experience: in the formal and informal sector
- Motivation: for participating in the solar TVET
- Previous experience with renewable energies: any solar installation at home, prior experience with solar energy, other experiences with renewable energies

For the **post-treatment survey**, data should be collected on the share of solar installations in the treatment and control villages. First, enumerators should randomly select a set of households among the sample villages in the treatment and the control group. Then, they should assess whether these households have any solar installations on or around their house, i.e. large or small photovoltaic systems/Solar Home Systems. If present, they should interview the households and assess who installed them, whether they are functioning, and what they use the energy for.

7.1.2 Sample size

For the post-treatment survey, the enumerators should check in the 14 treatment and 14 control villages whether the number of solar installations has significantly increased in the former compared to the latter. Then they should randomly pick 30 households per village and assess

whether there is a solar home system in place or not. This results in a representative sample of 840 randomly picked households (30 households x (14 treatment + 14 control villages)).

The post-treatment survey should be conducted two years after graduation to give students enough time to establish their own businesses or find employment.

The desired significance level is 5%, and the power is 0.8. To assess the sample size of 14 villages per group (treatment and control group), we assume that the variation of true proportions between clusters within each group (variation between villages) is 0.25. Moreover, given the almost total absence of solar energy in Ethiopia (IRENA, 2022; Solafrica, 2022), we set the true proportion of solar installation in the study region to 5%, i.e. 5% of the households have solar units installed before the study. For the program to be effective, we would like to see an increase of 5% points (minimal detectable effect size), i.e. 10% of households in the treatment villages have solar installations two years after the youth have graduated. For calculations, cf. *Table 1*.

Table 1: Two-level cluster randomized trials with individual level outcomes (inspired by Djimen & Houndolo, 2016)

Parameter	Value	Definition
α	0.05	Significance level
β	0.8	Desired power of the test
Tail	1	One-tailed or two-tailed test
z_1	1.64	Z-value corresponding to the desired significance level of the test
z_2	0.84	Z-value corresponding to the desired power of the design
a	6.18	$(z_1 + z_2)^2$
n	30	Number of individuals in each cluster
k	0.25	The coefficient of variation of true proportions between clusters within each group
μ_0	0.05	True (population) proportion in the absence of the intervention
μ_1	0.1	True (population) proportion in the presence of the intervention
J	14	Number of clusters in treatment each group

We propose encouraging one unemployed youth per treatment village to participate in the solar training by providing an in-depth explanation of the program's benefits and future job perspectives, and the application procedure. Then, we give them two weeks to apply. Should they not apply, we encourage another person. We start this process three months before the official application deadline for the solar TVET program and repeat it three times (12, 10 and 8 weeks before the application deadline) to ideally have one person participating per treatment village. The idea behind this approach is that it is sufficient to have one trained youth per village who can bring the knowledge from the TVET back to the villages.

7.2 Qualitative method

To formally test the underlying hypotheses of the causal mechanism, each link indicated in *Figure 2* will be tested using different types of evidence. For this, we propose to conduct interviews, surveys and focus group discussions with key stakeholders two years after TVET. For more details, including a set of possible interview, survey and focus group questions, please refer to *Appendix 3*. Thereafter, for each part of the mechanism, the quality of evidence from various sources is tested using different process tracing tests, outlined in *Figure 1*, in order to put together a case that gives a reasonable degree of confidence that each part of the mechanism exists or does not exist. All the elements in the mechanism are necessary for it to operate. If the tests conclude strong evidence for each link, it provides us with empirical knowledge on how and why improved economic self-reliance of youth occurred through the TVET program. However, if there is weak evidence for the causal mechanism it does not mean that the solar training did not lead to improved economic self-reliance of youth. It is still possible that it occurred, but in a different way. It simply proves that there is insufficient evidence to show it did so through our specified mechanism. Mechanisms tested and accepted in one case cannot simply be held to predict success elsewhere and thus do not allow for generalizations to other cases (Punton & Welle, 2015).

8. Relevance of the study

There is an enormous energy access gap globally, with around 3.5 billion people without access to reliable electricity (Ayaburi et al., 2020). In Ethiopia, 80% of the population lives in rural areas and almost entirely relies on biomass fuels which has increasingly led to environmental degradation and health risks due to indoor air pollution (Guta, 2018). Therefore, the SDGs highlight the importance of access to reliable and affordable renewable energy services (Franco et al., 2020). In particular solar energy has a huge potential. As many LIC countries are located in the tropics, they have abundant and freely available solar energy resources. For example, Ethiopia experiences a solar energy potential of 4–6 KWh/m²/day (Guta, 2018). Moreover, the price of solar PV modules has declined by 91% over the past 20 years, making them more and more affordable and cost-effective (Kannan & Vakeesan, 2016). Therefore, solar energy has become a tool to sustain the lives of many underprivileged people while meeting the objective of an energy supply that is reliable, clean, and affordable.

Furthermore, youth unemployment is prevalent across the world and is exacerbated in many LIC due to a rapidly increasing labour force. The increasing demand and adoption of solar energy at the household level may have the potential to tackle unemployment. In many countries, Technical and Vocational Trainings have been identified as major means of technology adaptation and

transfer that can enhance national growth (Wondwosen, 2022). Therefore, it is important to have a rigorous empirical understanding of how solar TVET affects both youth employability and the adoption of solar energy at the household level.

If the project works, it may be financially and administratively feasible to scale it up within the country. In Ethiopia over 80 percent of the population live in rural areas without access to grid electricity (Guta, 2018), which presents great opportunities and needs to scale up the project to extend clean energy access. Furthermore, the proposed impact evaluation results can also benefit NGOs and policymakers beyond national boundaries. If the results show that the solar TVET program has a statistically significant positive impact on solar energy uptake in rural off-grid households, NGOs can use the results to attract Official Development Assistance (ODA) and federal funding etc. for similar projects around the world. Likewise, negative results can also enhance the understanding of how to improve or adjust such interventions in the future to achieve better outcomes for the beneficiaries.

In addition, positive results could encourage policymakers at the national level to ease the transition from initial TVET into further and higher education, which has been a challenge experienced in many countries across the world (Field, 2017). This could make such training centres more attractive and sustainable by giving graduates more opportunities for genuine lifelong learning as technicians. Political commitment to TVET and willingness to open doors more fully to TVET graduates are surely required.

9. Implementation plan “from evidence to practice”

Solafrica has an intention to roll out the solar training program in other regions of Ethiopia. The goal is that the training program from Solafrica is accredited by the Ethiopian government soon. This would lead to the government support of the training through in-kind contribution, while the developed curriculum is consistent with the requirements of the Federal TVET authority so that the training program can smoothly be advanced and replicated within the country. Therefore, the utility of the impact evaluation is undisputed to avoid the expansion of the program when the effects observed are not or only to a small extent attributable to the program activities.

The insights gained from the impact evaluation can be used in a targeted manner for strategic internal decision-making on how to direct resources to future programs and make adjustments to the ongoing training program in the Amhara Region. Findings may also be extended and applied to the development of new programs in other contexts. Moreover, if the impact results are positive, they can be used to demonstrate impact and improve Solafrica’s reputation to external stakeholders which in turn can help secure more funds.

Furthermore, Solafrica has pointed out to us that they have not systematically collected data on their solar training project in Ethiopia for monitoring and evaluation purposes and thus lack a good concise database. Consequently, the impact evaluation can help to track, analyse and report on relevant information and data throughout the life cycle of the entire project. A good database can also improve their accountability to its board, donors, government stakeholders, the private sector, target groups and communities.

Ultimately, an impact evaluation is able to produce useful findings and is crucial in particular today with a growing demand for quantitative and qualitative evidence for policy- and decision-making that aims to achieve a higher impact in development cooperation. Therefore, quantifiable and measurable results should be identified as the gains from providing evidence through results management have, by far, not been exploited yet.

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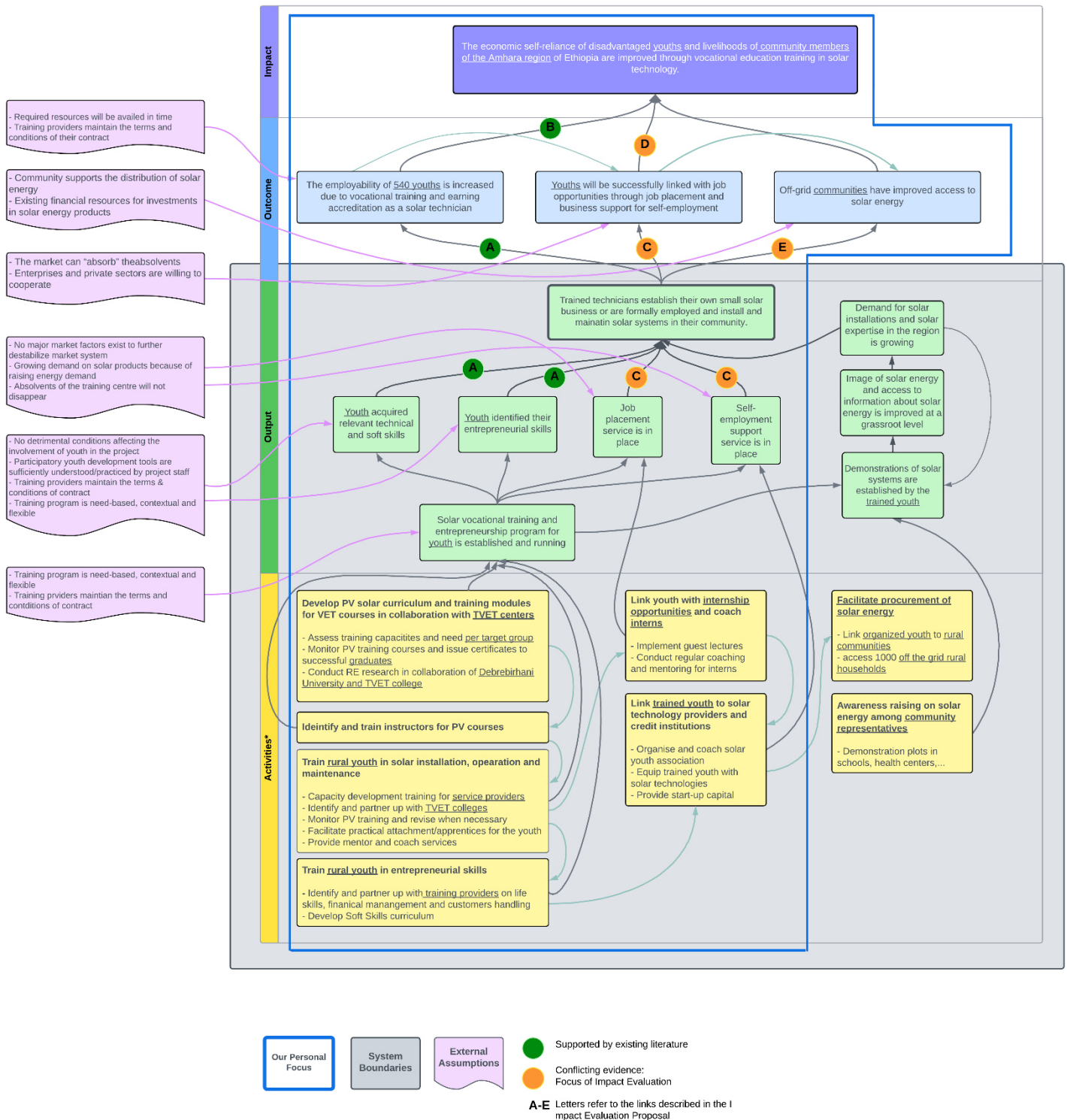
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Appendix 1: Result chain

Solar Learning Ethiopia Solafrica

Theory of Change



Appendix 2: BOND tool

	Do you want your evaluation to answer the following Key Evaluation Questions?	User Response	<u>RCT</u> (Randomised Control Trial)	<u>Difference-in-</u> <u>Difference</u>	<u>Statistical</u> <u>Matching</u>	<u>Outcome</u> <u>Mapping</u>	<u>Most</u> <u>Significant</u> <u>Change</u>	<u>Soft Systems</u> <u>Modelling</u>	<u>Causal Loop</u> <u>Diagram</u>	<u>Realist</u> <u>Evaluation</u>	<u>QCA</u> (Qualitative Comparative Analysis)	<u>Process</u> <u>Tracing/</u> <u>Bayesian</u> <u>Updating</u>	<u>Contribution</u> <u>Analysis</u>
1.1	Do you want to know "What was the additional/ net change caused by the intervention?" or "How much of the observed outcome(s) can be attributed to the intervention?" (Note: this is the core question of experimental and quasi-experimental impact evaluations)	No	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
1.2	Do you want to know "What difference did the intervention make to different population groups, and under what circumstances?" (i.e. you are interested in effects for different groups and contexts, not just an "average" effect)	No	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable
1.3	Do you want to know "How and why did the intervention make a difference, if any? or What was the process/ mechanism by which the intervention led to or contributed to outcomes?" (Note: this is typically the main focus of theory-based evaluations)	Yes	2	2	2	4	3	4	5	5	3	5	5
1.4	Do you want to know "What other factors needed to be present alongside the intervention to produce outcomes observed? (Which factors were necessary and/ or sufficient for the intervention to work?)" (Note this is a focus area of some evaluations where the intervention is not assumed to be the sole cause of change, but works in conjunction with other factors/ interventions)	Yes	3	3	3	2	3	2	3	4	5	3	3
1.5	Do you want to know "Which outcomes of the intervention(s) being evaluated do different population groups consider to be the most important?" (Note: this seeks to understand the relevance of the outcomes to different population groups or stakeholders)	No	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable	not applicable

STAGE 1 RESULT: Ability of a single evaluation method to answer all your key evaluation questions:

2.5	2.5	2.5	3.0	3.0	3.0	4.0	4.5	4.0	4.0	4.0
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How desirable is it for you to be able to address each of the following areas of interest?		User Response	<u>RCT</u> (Randomised Control Trial)	<u>Difference-in-</u> <u>Difference</u>	<u>Statistical</u> <u>Matching</u>	<u>Outcome</u> <u>Mapping</u>	<u>Most</u> <u>Significant</u> <u>Change</u>	<u>Soft Systems</u> <u>Modelling</u>	<u>Causal Loop</u> <u>Diagram</u>	<u>Realist</u> <u>Evaluation</u>	<u>QCA</u> (Qualitative Comparative Analysis)	<u>Process</u> <u>Tracing/</u> <u>Bayesian</u> <u>Updating</u>	<u>Contribution</u> <u>Analysis</u>
2.1	I want to have groups of recipients and non-recipients who are perfectly similar except for their receipt of the intervention (Formally, eliminate selection bias between treatment and control groups complete and produce a perfectly unbiased estimation of the intervention effect)	Not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired
2.2	I want to allow all those meeting the criteria to participate in the intervention to actually receive it (i.e. prevent all eligible people from being excluded)	Not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired
2.3	I want to be able to extrapolate or generalise the evaluation findings outside the cases or sample used for the analysis (i.e. external validity)	Desirable	45%	45%	45%	22%	22%	22%	45%	67%	67%	22%	45%
2.4	I want to allow the community (ies) in which the intervention was carried out to produce a collective evaluation of the most relevant changes at the community level	Desirable	22%	22%	22%	45%	67%	45%	22%	22%	22%	22%	22%
2.5	I want to make a distinction between the achievement of minimum /expected goals and ideal / more ambitious programme goals	Not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired
2.6	I want to explore the higher order goals or values of the participants (like attitudes, norms, values and laws shaping their worldview, i.e. probing why certain results mattered to participants)	Desirable	22%	22%	22%	45%	67%	67%	45%	45%	45%	22%	22%
2.7	I want the evaluation to capture a broad, systemic view of the situation (e.g. understanding how historical forces or path dependency or power relations or the economic system affect results, and seeing how those factors interact)	Very Desirable	33%	33%	33%	33%	33%	100%	100%	67%	67%	67%	33%
2.8	I want the evaluation to make different perspectives about results or the causes of results explicit, particularly between programme participants representing different groups or households within the community, including the weakest	Not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired	not desired
2.9	I want the evaluation to identify and explain unintended changes and consequences, both positive and negative	Very Desirable	67%	67%	67%	33%	100%	100%	100%	100%	100%	100%	67%
2.10	I want to analyse complicated / complex mechanisms, including outcomes of non-linear relationships, vs. a mostly linear description of the programme Theory of Change	Very Desirable	33%	33%	33%	33%	33%	100%	100%	100%	67%	67%	33%
2.11	I want to obtain insights about the behaviour, attitudes and thinking of stakeholders	Very Desirable	67%	67%	67%	67%	67%	100%	67%	100%	67%	100%	100%

2.12	I want to identify the different conditions that enable change in different contexts, as opposed to seeking a universal, population-wide or average explanation	Desirable	45%	45%	45%	45%	45%	45%	45%	67%	67%	45%	45%	
2.13	I want the evaluation to investigate what factors are necessary and / or sufficient for the intervention to produce results	Very Desirable	67%	67%	67%	33%	33%	67%	67%	67%	100%	100%	67%	
2.14	I want the evaluation to measure confidence in one or more causal claims and for example determine whether the evaluation evidence is strong / conclusive for such claims or not	Very Desirable	100%	67%	67%	33%	33%	67%	67%	67%	67%	100%	67%	
2.15	I want the evaluation to provide a detailed description of the process leading from programme activities to outputs, to intermediate outcomes and finally impacts	Very Desirable	33%	33%	33%	67%	33%	67%	67%	67%	33%	67%	100%	
Overall Score			55%	52%	52%	47%	55%	81%	75%	79%	73%	74%	62%	
# of Your "Very Desirable" Interests met in full			7	1	0	0	0	1	4	3	3	2	4	2

[illegible]

Is it feasible	3.8	Can at least 30 pairs or couples of participants and non-participants be identified and "matched" on the basis of the above-mentioned high quality data or comparable surveys? <i>[Note: if this is not applicable to your intervention, please answer 'no']</i>	No	Does not affect ability to use this method	Does not affect ability to use this method	0%	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method
	3.9	To what extent is high-quality baseline data available for both those participating and not participating in the intervention (treatment and control groups)? <i>(Note: baseline data refers to indicators on intended outcomes and outputs, measured prior to the start of the intervention. It is distinct from "background characteristics" above. If this is not applicable to your intervention, please answer 'not at all')</i>	Not at all	0%	0%	0%	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method
	3.10	To what extent has previous (time series) data confirmed that the trend in your outcome indicators of interest before the intervention started was the same for both those receiving and not receiving the intervention (treatment and control group)? <i>(Formally: is the common trend assumption verified?)</i> <i>[Note: if this is not applicable to your intervention, please answer 'not at all']</i>	Not at all	Does not affect ability to use this method	0%	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method
theory-based evaluation methods to evaluate your intervention?	3.11	To what extent is information on (at least a small number of) factors which are assumed to affect the outcome consistently available across at least 5 or 10 cases? <i>(Note: each 'case' can refer to an application of the intervention in different locations/ contexts, or among different individuals, institutions or groups. If the concept of cases is not applicable to your intervention, please answer 'not at all')</i>	Don't know	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	not known	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method
	3.12	To what extent are excellent facilitation skills available in the evaluation team? <i>(Note: if your evaluation team has not yet been appointed, please answer based on skills you will be seeking and your expected ability to secure those. This question highlights those methods for which such skills are most important)</i>	Don't know	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	not known	not known	not known	not known	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method
	3.13	To what extent does the success of the intervention depend on the behaviour of several stakeholders which may be relatively unpredictable? <i>(Note: this question highlights methods particularly suited to working within complex systems, e.g. where you are trying to affect social dynamics or market dynamics)</i>	Fully	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	100%	Does not affect ability to use this method	50%	100%	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method
	3.14	To what extent are both those likely to conduct the evaluation and those who will be consulted for the evaluation likely to be open to airing different perspectives on the intervention, its outcomes and how change happened? <i>(e.g. the power dynamics are such that multiple worldviews could be expressed, rather than only one dominant worldview being voiced)</i>	Fully	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	50%	50%	100%	50%	50%	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method
	3.15	When examining a number of different cases, to what extent do you expect the evaluation team to be able consistently to get an understanding of the contextual factors that affected the outcomes of your intervention? <i>(E.g. if your intervention deals with different locations, population groups or institutions that can affect how the mechanisms between your intervention and outcomes work)</i>	Fully	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	100%	100%	100%	50%	50%	50%

Is it feasible to use non-experimental or t	3.16	To what extent is the evaluation team be able to formulate, test and refine theoretical assumptions about the behaviour, attitudes and thinking of stakeholders? (i.e. "identifying the mechanisms generating the outcomes"; this might require good insights in political science, psychology, social sciences, or specific domains; hence might be easier in multi-disciplinary teams)	To some extent	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	67%	34%	34%	34%
	3.17	To what extent is the evaluation team be able to map or understand complicated / complex mechanisms, including outcomes of non-linear relationships? (Note: this is as opposed to taking a mostly linear description of the programme Theory of Change or intervention logic)	To some extent	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	67%	67%	34%	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method
	3.18	To what extent are evaluators able to access to a broad range of detailed and high quality data necessary to answer your evaluation questions, including hard to find data? (Note: this could include - for example - data on sensitive issues (e.g. on protection/ safeguarding issues); or data from conflict-affected or hard-to-reach areas/ populations; or minutes of private meetings, personal emails, etc.)	Fully	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	50%	50%	Does not affect ability to use this method	Does not affect ability to use this method	100%	Does not affect ability to use this method
	3.19	To what extent can you be confident that your chosen evaluator is able to set up a Theory of Change with a causal chain, and risks and assumptions for each step that would help shape complementary or alternative explanations for observed changes, either from scratch or making use of an existing theory of change for the intervention?	Fully	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	Does not affect ability to use this method	50%	50%	50%	100%
Number of Essential Requirements to Use this Method that your intervention cannot meet				4	6	5	0	0	0	0	0	0	0	0
Number of Essential Requirements to Use this Method which you "don't know" if you can meet				1	1	1	0	1	1	1	0	1	0	0
Number of Desirable Requirements to Use this Method that your intervention cannot meet				2	0	1	0	0	0	0	0	0	0	0
Score as % of Maximum for that Method				10%	0%	0%	100%	33%	73%	73%	75%	53%	93%	92%

SUMMARY RESULTS - ALL STAGES	<u>RCT</u> (Randomised Control Trial)	<u>Difference-in</u> <u>Difference</u>	<u>Statistical</u> <u>Matching</u>	<u>Outcome</u> <u>Mapping</u>	<u>Most</u> <u>Significant</u> <u>Change</u>	<u>Soft Systems</u> <u>Modelling</u>	<u>Causal Loop</u> <u>Diagram</u>	<u>Realist</u> <u>Evaluation</u>	<u>QCA</u> (Qualitative Comparative Analysis)	<u>Process</u> <u>Tracing/</u> <u>Bayesian</u> <u>Updating</u>	<u>Contribution</u> <u>Analysis</u>
Stage 1: Which Method is Best Suited to Answering My Key Evaluation Question(s)?	2.5	2.5	2.5	3.0	3.0	3.0	4.0	4.5	4.0	4.0	4.0
Stage 2: Which method is most able to address my other interests?	55%	52%	52%	47%	55%	81%	75%	79%	73%	74%	62%
Stage 3: Which Method has the fewest essential methodological requirements that cannot be met by my intervention? (Which method is most feasible to use?)	4	6	5	0	0	0	0	0	0	0	0

Appendix 3: Data collection tools and instruments

To formally test the underlying hypotheses of the causal mechanism, each link indicated in *Figure 2* will be tested using different types of evidence:

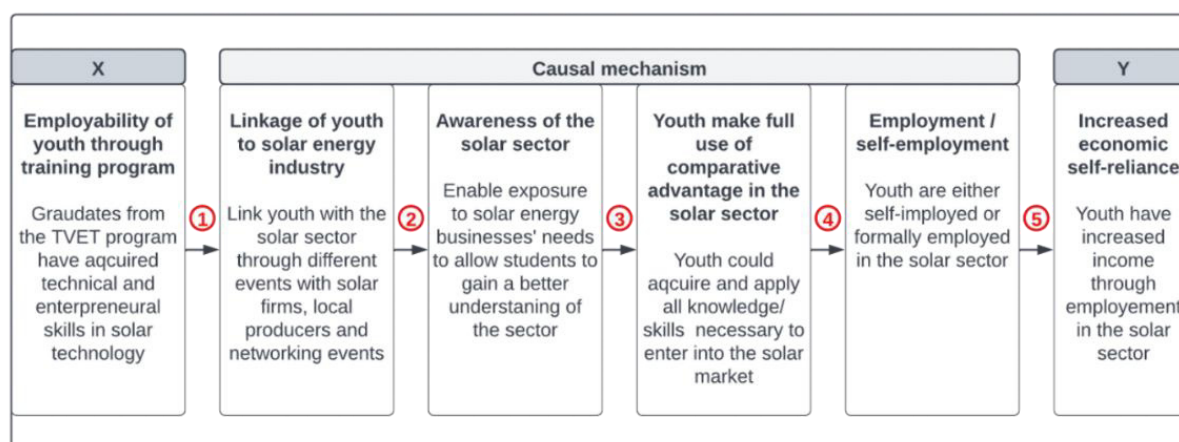


Figure 3: Causal Mechanism (as introduced in Chapter 5)

Link ①

Method: Face-to-face semi-structured interview (account evidence)

Target group: Training providers at TVET colleges

- Are they aware of the most important actors in the field of solar installation, operation and maintenance?
- How do they collaborate and connect with these stakeholders?
- Do they frequently link youth with suitable internship opportunities? How? Where? How often?
- Do they regularly invite guest lecturers from the private sector working in the solar sector?
- What job-placement services and self-employment services do they offer to the students? How do you inform them about these opportunities? How are these services embedded in the curriculum?
- What challenges do they face in job-placement services and self-employment services at TVET? What challenges must be addressed to improve these services?

Target group: Potential employers, financial creditors and important actors along the supply chain of solar products

- Do they know of the training program?
- Have they collaborated with or employed former TVET students?
- Do they frequently offer internship opportunities? Where do their interns come from/have they participated or are they participating in any solar TVET program?
- Is their company expanding/growing? (Not targeted at financial creditors)
- How do they recruit employees/trainees or choose business partners?
- Is there a demand for entry-level technicians in the private sector/ their business?
- What are their conditions/ expectations for entry-level positions or collaboration?
- How was their experience collaborating with or employing former TVET students? (Provided they have experience)

Method: Meeting minutes and action plans (Trace Evidence)

Target group: Training providers at TVET colleges

- Assess how they collaborate with employers, financial creditors and actors along the supply chain of solar products to coordinate linking opportunities (e.g. job fairs, agreements/contracts, meeting minutes etc.)

Link ②

Method: Online survey (Pattern Evidence)

Target group: Graduates of the TVET

- Assess their understanding of the current solar labour market, local stakeholders, and stakeholder's interests.
- Do they have an understanding of the gaps in the service provision and supply chain of solar energy?
- Have they been able to make connections with stakeholders in the solar sector?
- Are they well versed with the types of solar technology promoted in the private sector?

Link ③

Method: Face-to-face semi-structured interview (Pattern Evidence)

Target group: Graduates of the VET

- Are there continuous and satisfactory support services in place which provide guidance for the graduates whenever needed?
- Do they receive regular coaching and mentoring from their tutors/teachers as part of the solar program?
- How well prepared/equipped do they feel to enter the job market after VET completion?

If formally employed:

- Do they have a clear understanding of how to proceed to get connected with potential employers?
- Do they know where to find job offerings and how to apply (written and orally)?
- Do they know how to write suitable applications that meet high-quality standards?
- Have they received interviewing skills training?

If self-employed:

- Do they have a clear understanding of how to get connected with financial creditors and important actors along the supply chain of solar products?
- Did they gain access to financial resources and investors to start their business? Where? How?
- Were they supported with start-up capital/seed money? How?
- Do they have a clear business plan?
- Were they able to link with reliable solar technology providers?

Link ④

Method: Online survey (Pattern Evidence)

Target group: Graduates of the TVET

If formally employed:

- After how many months/years after successful completion of the program did they find a job?
- How many applications did they send?
- How many interview invitations did they receive? From whom?
- How many job offerings did they receive? From whom?
- What are students' experienced barriers to paid employment?
- Where are they currently employed? In what geographical region are they offering their services/ serving customers?

If self-employed:

- After how many months/years after successful completion of the program did they start a business in the solar sector?
- Was there a demand for solar installation in their community/village?
- What are students' experienced barriers to starting a business and being self-employment?
- In what geographical region are they offering their services/ serving customers?

Method: Focus group discussion (Account evidence)

Target group: Training providers (TVET colleges) and different actors along the solar supply chain

- Assess whether the expectations and needs of employers match the skills the youth offer
- How could barriers to include graduates of the TVET in the labour market be removed?

Link ⑤

Method: Online survey (Pattern Evidence)

Target group: Graduates of the TVET

- Do they work in the solar sector?
- If they currently do not work in the solar sector, what are the reasons they chose to work in another sector?
- What are their hours of employment in the solar sector and outside the solar sector?
- What are their income sources (within vs outside solar sector)?
- What are their patterns of work (seasonal fluctuations)?
- What types of solar energy services do they provide?
- Are they able to repay debt due to business creation in the solar sector?
- Are they able to afford daily basic needs from the income of solar employment?
- Is the demand for solar energy in their village growing?
- What are their ambitions for the future to improve economic self-reliance?
- Are they satisfied in the sector they work in or would they prefer to change the sector?

Alternative explanation

- Do they still live/work in the village they lived in before they joined the TVET program?
- Do they deliver solar energy services only to their own community or do you also offer services to communities outside the village/town they live in?

Appendix 4: Timeline

[illegible]