

GRÜNE BÜRGERENERGIE  
(GREEN PEOPLE'S ENERGY)  
THEMATIC KNOWLEDGE PRODUCT



# Improving training offers for decentralised renewable energy – Skills development for professionals

Learnings from the Green People's Energy Programme



## Purpose of the thematic knowledge product

About 600 million people in Sub-Saharan Africa (SSA) lack access to electricity. Electrification is particularly low in rural areas, where less than 20% of the population has access to electricity (IEA, IRENA, UNSD, World Bank, WHO, 2023)<sup>1</sup>. Against this background, the programme “Green People’s Energy” (Grüne Bürgerenergie, GBE) implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) aims to improve access to electricity in rural areas using decentralised renewable energy (DRE). A particular focus is on promoting the productive use of energy (PUE).

The programme follows a holistic approach addressing key challenges the off-grid, decentralised renewable energy (DRE) sector faces. The conditions for DRE supply in rural areas are improved through skills development

measures for professionals, business development services, access to finance for local enterprises, and improving the political and regulatory framework. The programme is implemented in nine African countries: Benin, Côte d’Ivoire, Ethiopia, Ghana, Mozambique, Namibia, Senegal, Uganda and Zambia.

GBE intends to give impulses for German and international development cooperation in the sector. There are four thematic knowledge products that analyse the intermediate impacts and lessons learned from selected interventions in four thematic areas. They identify key success factors for why and how which support measures have worked. This knowledge product focuses on GBE’s work on **skills development in the DRE sector**.



*VTI Teachers measuring the solar voltage during the Solar PV Training at the Daniel Comboni Vocational Institute (DCVI) in Uganda*

<sup>1</sup> IEA, IRENA, UNSD, World Bank, WHO, 2023. Tracking SDG 7: The Energy Progress Report. World Bank, Washington DC



# GBE approach to skills development for DRE



*Practical outdoor exercises during training in Mozambique*

The growing demand for off-grid, decentralised renewable energy solutions is challenged by a shortage of skilled professionals to design, finance, sell, install, operate and maintain the systems.

Especially in rural areas, the lack of skilled professionals leads to:

- low-quality products and system installations, which can result in equipment failure and lack of trust in renewable energy technologies,
- low knowledge about DRE systems and thus demand,
- lack of distribution networks and business models for sales, operation and maintenance,
- lack of access to finance for end-users.

As such, GBE aims to improve skills development opportunities for key stakeholders in the DRE ecosystem (e.g. technicians, sales agents, extension officers, credit officers in banks and teachers). To achieve this, GBE supports vocational training institutes (VTI) and technical universities to offer new and improved curricula, focusing on practical training modules for professionals. The training curricula are **short courses** targeted at local professionals with some experience, in some cases also students. They provide **practical skills** to better plan, finance, implement, operate and maintain DRE systems. The technological focus is on **solar PV systems**, productive use technologies (solar irrigation, solar cooling, solar drying, solar water heaters) and mini-grids.

The **sustainability** of the new training offers is ensured either by integrating them in existing national TVET structures or cooperating with business-oriented schools.

GBE measures apply the following approach:

- Training needs analysis and selection of partner training institutes,
- Private sector-led development of curricula and training handbooks,
- Supply of demo systems, training stands and materials for partner schools,
- Training of trainers (ToT) programmes,
- Roll-out of short-course training modules in cooperation with trained trainers,
- Facilitation of practical placements for trained professionals (only in Zambia),
- Support to training institutes in integrating the training in training plans.

In addition, to train a sufficient number of key stakeholders, especially during Covid, in some countries high-quality one-off virtual trainings were provided.

For this knowledge product four case studies (CS) of GBE skills development projects have been chosen from Mozambique, Namibia, Zambia and Uganda. The aim is to identify overarching learnings and success factors that benefit practitioners developing similar projects. An overview of the four selected skills development measures is provided in *Table 1*.

## Overview of GBE case studies and approaches to promote skills development for DRE

Target Groups	Involved Educational Institutions	Training Content	Milestones
<b>MOZAMBIQUE</b> GBE-project: ↗ <b>GreenSkills4Dev</b>			
› Students (vocational certificate 2 (CV2) level)	› 14 TVET training centres	› PV systems incl. productive use appliances	› 14 technical training institutions received high-quality laboratory equipment and tools for practical PV courses › Practical training module and materials developed and integrated into existing curriculum for photovoltaic (CV2 level) › 34 teachers trained › First implementation of training module supported through mentoring › VTIs plan to continue offering the developed course and module
› Students (university master's degree level)	› Universidade Eduardo Mondlane (UEM) in Maputo	› RE science technology › RE systems management	› 60 students participated in new blended-learning master courses (thereof partial scholarship for 40 students funded by GBE) › UEM offers two improved curricula for master students (blended-learning): Master Programme in Science and Technology of Renewable Energy and Master Programme in Management of Renewable Energy System
› Stakeholders in the DRE sector, especially private sector, TVET training centres and university	› Digital learning platform provided by RENAC (international training provider); other training providers like Max Solar, Florence School of Regulation, Microenergy, UEM	› RE technologies, especially small-scale PV › Powering agriculture › RE business models	› 455 professionals and additional 90 teachers trained
<b>NAMIBIA</b> GBE-project: ↗ <b>Skills Development in the Field of Renewable Energy</b>			
› Trainers of Vocational Training Centres (VTCs) › Professionals from the private sector	› Eenhana Vocational training centre	› PV systems › Solar pumping and thermal systems	› 12 VTC teachers and 60 professionals trained › Practical teaching material and equipment provided to Eenhana Vocational Training Centre to offer trainings for professionals in the long run › Trained teachers report to integrate training content into existing VTC courses, using developed training material
<b>UGANDA</b> GBE-project: ↗ <b>Strengthening Solar PV Vocational Training and Promoting Energy Skills Development for Women in Uganda</b>			
› Trainers of educational institutions › Engineers and technicians from private sector and district administrations › Students in electrical engineering	› Two VTIs in Northern Uganda › Gulu University (GU)	› PV systems › Solar powered irrigation systems (SPIS)	› 180 teachers and 173 professionals trained › Solar training rooms at VTIs equipped › Demonstration garden for SPIS established at GU and VTIs › Developed training modules offered by the training institutions to attract new students
› Professionals from the energy sector	› Digital Learning provided by RENAC	› Solar PV	› 145 professionals trained
<b>ZAMBIA</b> GBE-project: ↗ <b>Improved Decentralised Energy Supply through TVET for Solar Professionals in Off-grid Areas</b>			
› Trainers of educational institutions › Solar practitioners › Private businesses which are looking for new employees	› Four VTIs › University of Zambia (supporting training of VTI staff)	› Electrical background of solar energy applications › PUE applications in agriculture	› 16 teachers and 281 professionals trained › Installation of solar demonstration systems at VTIs › Development and implementation of two curricula for VTIs › 78 trained professionals placed in internships at Zambian solar companies

Table 1: Overview of selected skills development measures

# Main case study results

For the case studies, the target groups were approached with a quantitative survey at least six months after the respective training. A total of 543 professionals and 198 teachers participated in the survey. Furthermore, key project stakeholders were interviewed. Aggregated

data across the four case studies was analysed. Qualitative findings presented in this Knowledge Product are primarily also drawn from the four case studies of the skills development focus projects. Some insights are taken from other GBE projects.

## Professionals and Companies

In the four skills development projects **more than 1,000 professionals (around 26% women) were trained**. Several project stakeholders stated that the demand for trainings by professionals exceeded the supply that was possible with GBE's resources. While more than 63% of trained persons assess the received training as highly relevant for their job, around 21% perceive it as moderately relevant. Only around 16% assess the training as slightly or not relevant.

Around 78% of trained professionals claim to apply the knowledge in their job (Figure 1). When asked for examples, some survey respondents gave very concrete answer such as "(I) was able to help a farmer group irrigate a tomato garden"; "[I am using the knowledge for] solar system sizing, solar panel positioning and installation of solar water pumps and solar fridges"; "I was able to install solar panels and pumps in the rural schools as part of my job" or "I was able to install a [...] system at Mazabuka general hospital which required a hybrid inverter".

These subjective self-assessments were corroborated by individual statements from company owners who had sent their staff on training courses. They said they could see

concrete improvements in their work, for example because their staff had learned how to tilt solar panels to optimise energy yield.

An indication that the performance of trained professionals has improved may also indirectly be shown by the fact that 43% of professionals claim to experience an income increase due to the training (Figure 2).

There are several possible reasons for the observable income gains. 16% of persons trained report that they obtained a new position within the same organisation/company and 14% started a new job at a different organisation/company. It is likely that the majority of those 30% trained with new positions/jobs could also achieve an income increase.

**"I had a training with RENAC, and this has made me get a job in a renewable energy company where I size systems and install them."**

*Training Participant, Uganda*

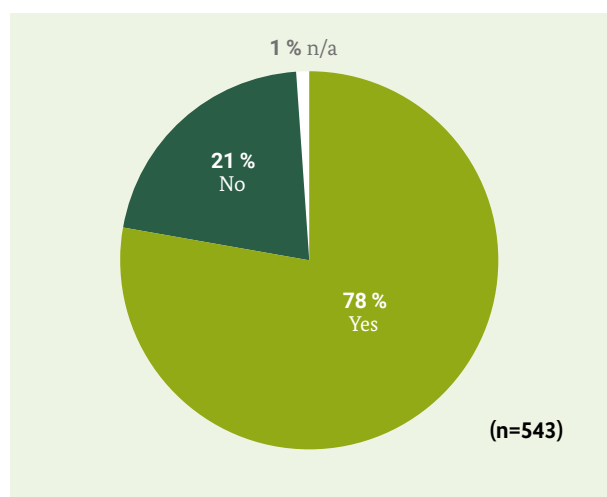


Figure 1: Application of Knowledge (Professionals)

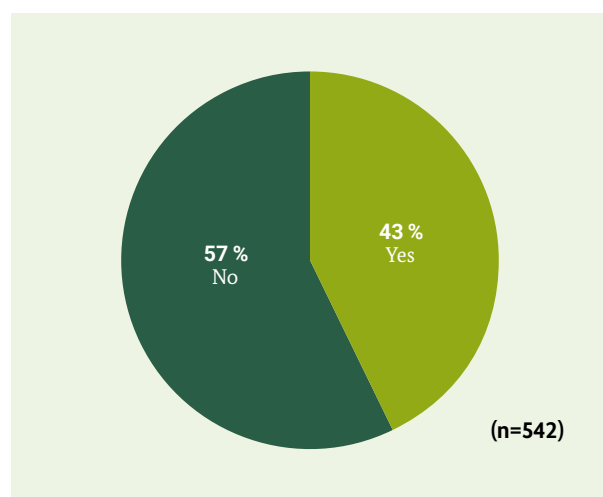


Figure 2: Impact on Income (Professionals)

Other training participants may have increased their income through improved professional performance (cited by 89% of respondents as an impact of the training). Furthermore, getting new professional tasks (as claimed by 84% of persons trained) might justify a salary increase. Finally, some of those who were trained, stated that they now have the knowledge to help neighbours or other members of the community to install or repair solar systems on a private basis. This could be another source of extra income.

“A very good initiative for the communities and upcoming companies. The practical and theory opens our minds on how to cut costs by using natural resources.”

*Training Participant, Namibia*

**Companies see a clear added value in the training.** In Namibia, companies invested directly in the training by covering travel and accommodation costs. One company owner explained that his trained salesperson had gained a better understanding of the overall PV system design and became more confident to make quotations on her own without involving additional colleagues. This saves time and ultimately costs for the company. **Finally, customers and local communities** seem to benefit from the improved skills of the professionals and from better private sector service delivery.

## Teachers and training institutions:

In the four skills development projects 242 teachers (around 20% women) were trained. While more than 80% of teachers assess the received training as highly relevant for their job, 13% perceive it as moderately relevant. Only around 7% assess the training as slightly or not relevant.

“I have been able to apply this knowledge in my job by recommending or designing solar-powered water pumping systems for communities that rely on traditional pumps fuelled by fossil fuels. Through these efforts, we have been able to not only reduce the cost of water pumping, but also decrease the carbon footprint of the communities. I have also been able to apply the knowledge gained from the training to evaluate the environmental impact of different energy systems used in my field.”

*Training Participant, Uganda*



Board set up by students and teachers after receiving the equipment in Mozambique



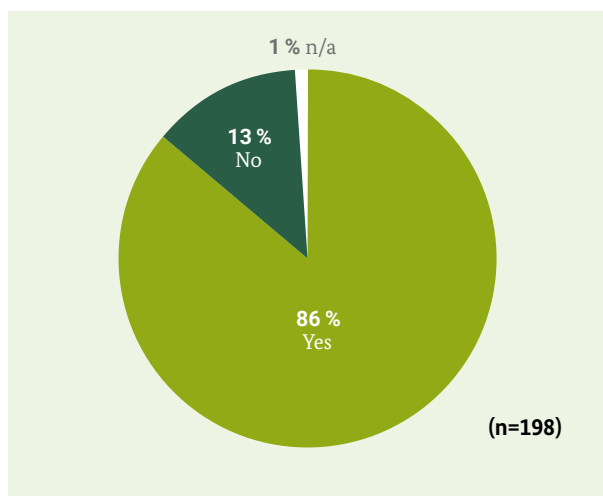


Figure 3: Applied Knowledge (Teachers)

Around 86% of teachers claim to apply the knowledge in their job (Figure 3). The examples of application are manifold and sometimes even go beyond teaching activities at educational organisations (see example in text box).

“Before [the training] I was just a part-time teacher in a technical job, but afterwards I got a job in that line of solar, as in sales you need to know the product you are selling. Even in the job interview I used knowledge from GIZ training. And, in the school I used to lecture, I became a specialist in lecturing solar.

When I came back from the training, I trained people in the community and my friends, and they went out to buy solar PV systems because I guaranteed them to maintain them for five years. I could teach them how to manage the batteries and the installations.”

*Training Participant, Uganda*

The **quality and practice-orientation of new training modules** developed by GBE together with the educational institutions is assessed positively by most the teachers. For example, 26% consider the newly developed courses to be much more practical and 60% consider them to be more practical than previous training modules<sup>2</sup>. A majority of 87% of teachers feels confident to teach the new modules, while 13% have doubts or do not feel confident at all, e.g. because they are still lacking the required technical knowledge or the practical experience in teaching the modules.

79% of teachers have already taught new training modules and are sharing their knowledge with their students.

“I have trained over 70 students who are currently applying the knowledge.”

*Training Participant, Zambia*

The development of **new training courses** was closely coordinated with local stakeholders and **integrated into the course offer of educational institutions** to ensure sustainability. Many of the supported schools are continuing to implement the training modules developed. For example, in Zambia two training curricula with an electrical and an agricultural focus were developed together with stakeholders from TVET and the private sector. Both curricula were validated by a panel of experts and approved by the Zambian Technical Education, Vocational and Entrepreneurship Training Authority (TEVETA). In Uganda, the training courses that were developed have been integrated into in the B.Sc. programme “Principals and Practices of Irrigation” and the M.Sc. “Irrigation Drainage Design and Management” at Gulu University.



*Trainer of trainers explaining the operation of a solar water heater during launch of training of trainers*

Another major impact of GBE is the **delivery of equipment which enhanced the quality of learning** at the technical training institutions. For example, in Mozambique trainees state that they are now able to gain hands-on experience by working with equipment such as PV modules and batteries. In Uganda, trainees appreciated e.g., that they learned in practice how direct current (DC) can be converted to alternating current (AC). Despite these positive developments, 55% of survey respondents see a lack of resources (e.g., equipment) as a challenge to teaching new training modules. One possible explanation for this is that the equipment provided was not complete at the time of the survey due to procurement problems (see also following chapter).

<sup>2</sup> Due to differences in the timing of data collection and adjustments to the survey, not all questions were asked to all survey participants. Therefore, these and the following statistics refer to a group of 66 respondents.



## Lessons learned and recommendations

Based on the case studies and above analysis, the following lessons learned and recommendations for skills development projects in the DRE sector were identified.

**Agricultural extension officers and advisors play a key role in promoting productive use of energy in rural areas. They were an important target group for the skills development measures.**

GBE did not only focus on training PV installers, but also focused on training multipliers in rural areas like agricultural extension officers and advisors. Extension workers can raise awareness for RE solutions among farmers, but also advise on the optimal use e.g., of solar irrigation systems with regard to the type of irrigation, cultivation of new crops, etc. The relevance of the training for this target group is underlined by the survey results. The share of extension workers who rate the trainings they received as highly relevant was even higher than the share of technicians (78% vs. 67%).

**Professionals involved in installation of PV systems should be strengthened in their role as advisors towards end-users of the PV systems on correct use and maintenance.**

Various GBE projects show that the knowledge level in rural areas regarding the use of electrical appliances is very low. This can quickly lead to incorrect use of systems. For example, overloading refrigerators reduces their cooling capacity. Furthermore, as stated in the [Knowledge Product about Productive Use of Energy \(PUE\) available on the Energypedia PUE topic page](#), not even 2/3 of the end-users (e.g. farmers or small entrepreneurs) save money for maintenance and repairs. Therefore, it is important that trained professionals also understand the end-users' level of knowledge and needs. They should have the skills to instruct the end-users effectively on use and maintenance of the systems. Future measures could include capacity building for companies on how to produce simple and easy to understand manuals for end-users.

**To reach professionals in remote areas, training locations need to be accessible for the target group.**

Distances and travel times in rural areas are long and arduous. The choice of training location must therefore be carefully considered. An alternative approach was tested in Uganda, where a mobile training truck enabled training to be delivered in different locations. One of the advantages of such a mobile solution is that it allows people to attend training who would otherwise find it difficult to travel for several days (e.g., due to family commitments).

**If training participants have different professional backgrounds, this needs to be considered in the training design.**

Professionals with different professional backgrounds may apply for trainings in DRE. If their participation is intended, this must be considered when designing skills development measures. For example, professionals with prior plumbing and piping work experience have different training needs in electricity than educated electricians. Ideally, a variety of tailored trainings can be offered to professionals with different levels of prior knowledge. An alternative option is to offer crash courses to impart the necessary basic knowledge, e.g., on the subject of electrics. These courses can take place directly before the more advanced training courses to level the initial knowledge base of all training participants.

**Practice-oriented trainings require equipment. What to procure, when and how needs to be well planned for.**

GBE puts a special emphasis on practice-oriented trainings. In most of the trainings, practical equipment was used. Survey results suggest that this was appreciated by the trai-



ning participants, some of whom requested even greater amounts of hands-on practice. For example, depending on the training environment, it may be possible to keep demo plots or sample appliances available for some time after the training to increase the possible amount of hands-on time. For training purposes, it can be helpful to have both optimal and less optimal equipment available in the demonstration field to explain, demonstrate and discuss the appropriateness of different systems and/or appliances. This approach was found to be effective in Mozambique.

Procurement was a challenge in all four case study projects (Namibia, Mozambique, Uganda and Zambia). (International) procurement took longer than expected causing delays in project implementation. Some trainings even had to take place without or with incomplete equipment. To overcome this challenge in the future, the following is recommended:

- Putting a higher emphasis on the procurement process when planning the project and estimating realistic timelines.
- In tenders, explicit preference can be given to training providers who source their training equipment locally or at least regionally. A selection of readily available equipment that is commonly used in the country can be predefined (e.g. a selection of possible water pump models). This would also have the advantage of ensuring that the training is carried out with equipment that is used in practice.
- In some cases, it can make sense to rent equipment for a fee for the trainings.

**Internships support professionals in further developing practical skills. To maximise the added value, a prior formal agreement on content and objectives should be signed between company and intern.**

As GBE Zambia introduced internships in partnership with the solar association, it turned out that the content of the training courses could often not be applied during the internships. For example, a training participant reported that once the internship started the interns were “only supposed to sell solar lights and not allowed to touch the solar panels”. Close coordination and consistency of content between trainings and internships is therefore important. This can be promoted, for example, by making written agreements with the participating companies before the internships regarding the content of the internship. In addition, many trained professionals could not be placed in internships in the first place, due to the inability of contacted employers to take on interns. This risk should be mitigated. For example, expectation management with the students is important when the option is presented.

**To enable an assessment of learning results, introducing tests at the end of trainings should be considered.**

GBE conducted tracer studies, asking training participants half a year after the trainings about various (intermediate) effects (see results above). This did not allow a direct assessment of whether the training objectives were achieved. In some countries, tests were done at the end of trainings (e.g. Mozambique). Observations during knowledge application in the field would be another way of having more standardised data on learning results.

**For training measures to have employment effects, as in any market, there must be local demand for the skilled workers.**

The demand for RE in rural areas faces various challenges like the limited financial resources of potential end-users. There may also be restrictions in the supply chain that limit employment opportunities despite the availability of a workforce. For instance, a shortage of equipment and spare parts can limit the possibility of employment in the sector. This needs to be considered when designing skills development measures.



*Trainee positioning a solar module during practical assessment of training of trainers by TVETA in Zambia*

For GBE, the main target group was professionals already working in the energy sector. The aim was to enhance their skills to improve the quality of installations and maintenance. According to many surveyed professionals, the multi-day trainings did improve their employment situation in terms of higher performance, new tasks, income, employability (see results above). This confirms that the **training content** is indeed **relevant and in demand**.



*Practical solar course session at Lusaka Business and Technical College (LBTC) in Zambia*



**Training measures aiming to help students into new or better jobs should a) partner with companies that plan to hire trained people and b) offer trainings with a sufficient scope including certifications.**

Those training participants that were hoping to obtain a new or better employment through the trainings sometimes struggled to find employers because the existing industry players are very small operators and were simply not ready to absorb more people. Although trained professionals can take up self-employment, it is likely that not all have the needed entrepreneurial skills and financial capacities without further support. In addition, without being part of a larger company, further professional development will often remain limited. It is therefore recommended to bring larger private companies on board from the start. In addition, for better employment effects to materialise, comprehensive trainings with official certifications in line with national qualification frameworks are recommended.

**Sustainability: Recommendations for projects aiming to establish new or improved training offers with vocational training institutes.**

It is too early to draw final conclusions about the sustainability of the various GBE courses developed. Several of the supported training institutes are already continuing to offer the new or improved training modules, either on their own or supported by other development programmes.

Selection of partner schools is one success factor. All schools were carefully selected at the start of the programme based on their strategic interest and capacities to implement the trainings in the long run.

Further, rural training institutes often need support in establishing new training offers. This should be addressed by projects. The training institute needs to have the necessary know-how to market and organise the training.

Most importantly, it needs a working business case for the training, i.e., employers or professionals willing to invest the time and pay the course fees. It is important to note that the private sector prefers trainings with official recognition by the national TVET agencies, like TEVETA in Zambia.

In general, integrating new training content into longer, existing courses for students, such as those offered by Gulu University (GBE Uganda Case study), makes it easier for training institutes to continue offering the trainings. Training modules then contribute to an official qualification and the school has an established business case for the course. The new training content can be taught without additional administrative or organisational efforts.

**Short-term skills development initiatives like GBE are best embedded in longer-term skills development programmes to support up-scaling and sustainability.**

The GBE-supported short-courses focussed on basic solar PV as well as PUE appliances. Each country measure cooperated with 1-4 training institutes (15 in Mozambique), that implemented the trainings as part of their training plans. In most cases, the trainings were not formally approved by the TVET authorities for formal certification-levels because this was considered a longer-term process. To achieve an up-scaling of the training modules for wider use in the country, a number of GBE country measures (Zambia, Benin, Uganda, Ethiopia) cooperated with other, longer-term GIZ skills development or energy programmes. These programmes are now working on introducing the training modules developed by GBE at further training institutes, on integrating the PV-training modules in TVET authority-approved long-courses, on establishing online offers or simply on funding further training cohorts. Such an up-scaling strategy should be developed and aligned early on in the project development and implementation phases.



## Conclusions

GBE project stakeholders promoting PUE in rural areas identified poor quality RE appliances and installations, lack of financing options and mistrust in RE technologies as a key challenge for the sector. Clearly, developing the skills of professionals working in the sector is essential for expanding DRE use in rural areas.

The high demand for GBE trainings, their positive effects on performance and incomes and the fact that many training institutes are continuing to offer the trainings confirms the relevance of the new training offers.

Several success factors and recommendations for future skills development measures in similar contexts were identified. For example, how target groups in rural areas can be best reached (e.g. through mobile training equipment) and the training participants' professional background (e.g. pump specialist or electrician) are important factors that need to be taken into account during training preparation. In order to deliver practice-oriented training,

respective equipment is necessary. A high emphasis needs to be put on the early procurement of this equipment as this can otherwise become a bottleneck. Cooperating with strong, technical training institutions that have a good overview of market demand, ability and willingness to pay by the private sector is key to establishing training offers in the long-term. Furthermore, the integration of new training courses into the existing educational offer of VTIs and universities increases the likelihood of courses being continued once the development project is over. Adding new content and practice-orientation to longer-term courses with officially recognised certificates improves the quality of these training offers.

Linking short-term skills development measures that focus on developing and testing new training offers to longer-term skills development programmes is key to up-scaling and reaching a higher number of professionals in the sector.



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