The Government of Nepal
Ministry of Energy, Water Resources and Irrigation
Alternative Energy Promotion Centre (AEPC)
Making Renewable Energy Mainstream Supply in Nepal

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

PROMOTION OF SOLAR TECHNOLOGIES FOR ECONOMIC DEVELOPMENT (POSTED)

SUMMARY OF MAIN INTERVENTIONS

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December 2024

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FOREWORD

The Alternative Energy Promotion Centre (AEPC) has made remarkable progress in advancing renewable energy and alleviating energy poverty. Over the last 28 years, AEPC has reached a cumulative number of 3.65 million households, delivering more than 90 megawatts (MW) of renewable energy projects and clean cooking solutions including electric cookstoves, biogas, and improved cookstoves. These initiatives provide households with reliable and affordable energy while generating employment for 30,000 plus individuals through 500 private companies in the renewable energy sector. Additionally, AEPC has implemented eight Clean Development Mechanism (CDM) projects/programmes, significantly contributing to the reduction of deforestation and carbon emissions.

In this context, AEPC, in collaboration with local governments, development partners and private sector, has been instrumental in promoting the widespread use of these renewable energy technologies. The *Promotion of Solar Technologies for Economic Development* (POSTED) project, implemented by AEPC and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH from 2022 to 2024, was launched with the goal of accelerating the adoption of solar PV technologies across Nepal. The project focused on policy advocacy, supporting sub-national government bodies in the design and implementation of solar PV initiatives, fostering digital monitoring solutions, and establishing sustainable training programs throughout the country.

This final report provides a brief overview of the key interventions and outcomes of the POSTED project. Over the course of its implementation, POSTED developed several technology specific guidelines, conducted evidence-based research, and implemented pilot projects of Remote Monitoring System. Additionally, the project supported local partners in the design and delivery of various training programmes. Notable achievements include the successful development of GHG and e-waste reporting modules, and the establishment of a solar water pumping (SWP) service network. Moreover, to ensure reliable electricity access for remote communities in Karnali Province, a comprehensive electrification plan was formulated, clearly defining the roles and responsibilities of all involved stakeholders. All project outputs have been meticulously documented and are now available on AEPC's updated online Resource Centre.

I would like to take this opportunity to extend my heartfelt gratitude to Mr. Felix Nitz, Team Leader; Dr. Bharat Raj Poudel, Deputy Team Leader; and the entire POSTED team for their dedication and exceptional contributions to the success of this project. I also express my sincere thanks to Dr. Narayan Adhikari, Deputy Executive Director; Dr. Laxman Prasad Ghimire, Deputy Director of AEPC; and the project focal point, along with all AEPC staff who provided continuous support and invaluable contributions. Lastly, I would like to acknowledge GIZ's team and the Project Manager Mr. Diego Senoner, for their unwavering support and collaboration throughout this important initiative.

Nawa Raj Dhakal
Executive Director
Alternative Energy Promotion Centre (AEPC)

Message

The Promotion of Solar Technologies for Economic Development (POSTED) project in Nepal, initiated in 2021 and concluded in 2024, has been a collaborative effort between the Government of Nepal and the German Federal Ministry for Economic Cooperation and Development (BMZ). Implemented by the Alternative Energy Promotion Centre (AEPC) and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, the project aimed to enhance the adoption of solar photovoltaic (PV) technologies, establish demand-driven trainings to foster the development of the solar PV sector and climate-friendly economic development in selected provinces of Nepal.

We placed high priority on the often discussed but not often attained goal of sustainability. Every guideline and tool we created aids stakeholders in their respective roles. We also took aim at breaking out of the short-lived design limiting training access to the project lifetime. For trainings needed in future, the project worked hard to identify and empower local training providers willing and able to provide training in the future against a fee to defray the entailing costs. This, we trust, creates the starting point for long-term accessibility. We hope other development partners will find these offerings relevant and useful for attaining their own capacity development goals. Patronage and scholarships would serve to build the human resources needed for the development of the sector and assist young people and professionals in charting a career path in it.

This report highlights POSTED's key interventions, achievements, and recommendations, with focus on guidelines and policy development, capacity building, planning support, monitoring, and digital tools.

We extend our gratitude to all partners, stakeholders, and community members whose dedication and collaboration have been instrumental in the success of the POSTED project. It is our hope that the insights and experiences documented in this report will serve as a valuable resource for future initiatives aimed at promoting solar PV, renewable energy technologies, and sustainable economic development in Nepal and beyond.

Diego Senoner
Programme Manager
Promotion of Solar Technologies for Economic Development
Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH

Table of Contents

List of Abbreviations

AEPC	Alternative Energy Promotion Centre
API	Application programming interface
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
BOQ	Bill of quantities
CES	Centre for Energy Studies, Institute of Engineering, Tribhuvan University, Lalitpur
CIMMYT	International Maize and Wheat Improvement Center
CTEVT	Council for Technical Education and Vocational Training
DFS	Detailed feasibility studies
DKTI	Deutscher Klima- und Technologiefond
e-waste	Electronic waste
ESAP	Energy Sector Assistance Programme
ESCO	Energy services company
EUR	Euro
GHG	Greenhouse gas
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GWRDB	Ground Water Resources Development Board
IWMI	International Water Management Institute
KfW	Kreditanstalt für Wiederaufbau
kW	Kilowatt
MoEWRI	Ministry of Energy, Water Resources and Irrigation, Government of Nepal
MoPID	Ministry of Physical Infrastructure Development, Sudurpashim Province
MoWRED	Ministry of Water Resources and Energy Development, Karnali Province
MoWSIE	Ministry of Water Supply, Irrigation and Energy, Koshi Province
NDC	Nationally Determined Contributions
NEA	Nepal Electricity Authority
NEPQA	Nepal Photovoltaic Quality Assurance
NPR	Nepalese rupee
NREMIS	National Renewable Energy Management Information System
NREP	Nepal Renewable Energy Programme
POSTED	Promotion of Solar Technologies for Economic Development
PV	Photovoltaic
SEMAN	Solar Electric Manufacturers Association Nepal
SHS	Solar home system
SMG	Solar mini-grid (system)
SPRTA	Sudurpashchim Provincial Research and Training Academy (SPRTA), Doti
SRT	Solar rooftop (system)
SWP	Solar water pumping (system)
ToT	Training of trainers
TWh	Terawatt hours
UCEP	Underprivileged Children Education Programme, Bhaktapur
WECS	Water and Energy Commission Secretariat

1. ABOUT THE PROJECT

Project title	Promotion of Solar Technologies for Economic Development (POSTED)
Project type	Technical assistance
Duration	2022-2024
Budget	EUR 4 million
Source of funding	Deutscher Klima- und Technologiefond (DKTI), *provided through* Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung (BMZ), Federal Government of Germany

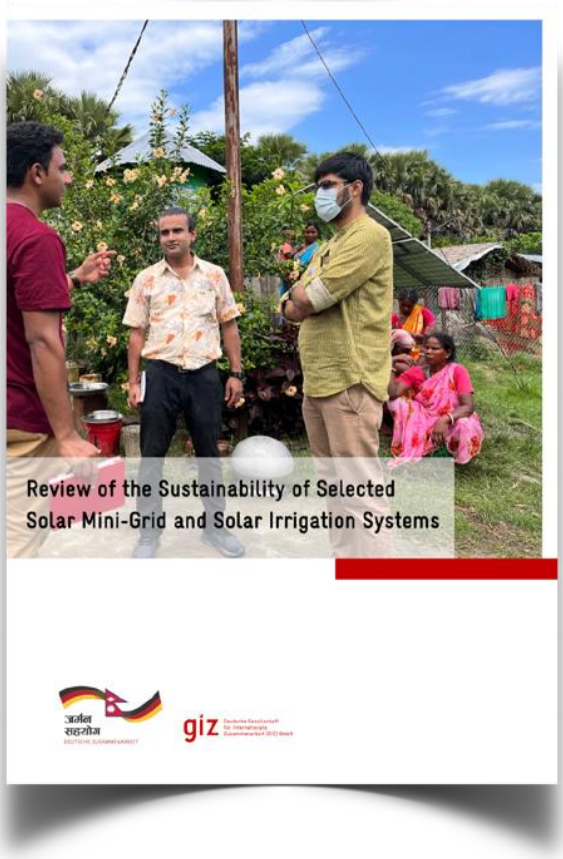
Institutional setup	
Implementer	Deutsche Gesellschaft für Internationale Zusammenarbeit (**GIZ**) GmbH with support of **INTEGRATION** Umwelt & Energie GmbH, Germany
Implementation partner	Alternative Energy Promotion Centre (**AEPC**), Ministry of Energy, Water Resources and Irrigation (MoEWRI), Federal Republic of Nepal
Partnerships with Provincial Governments	▪ Ministry of Physical Infrastructure Development (MoPID), Sudurpashim Province ▪ Ministry of Water Resources and Energy Development (MoWRED), Karnali Province ▪ Ministry of Water Supply, Irrigation and Energy (MoWSIE), Koshi Province
Partnerships with training providers	▪ Bhumi Urja Pvt. Ltd., Lalitpur ▪ Centre for Energy Studies (CES), Institute of Engineering, Tribhuvan University, Lalitpur ▪ Don Bosco Institute of Engineering & Technology, Tankisinuwari ▪ Sudurpashim Provincial Research and Training Academy (SPRTA), Doti ▪ Underprivileged Children Education Programme (UCEP), Bhaktapur

Mandate	
Output areas	1) Policy and regulation 2) Training and capacity development 3) Digital monitoring
Geographic focus	▪ Koshi Province ▪ Karnali Province ▪ Sudurpashim Province
Technical focus	▪ Solar water pumping systems ▪ Solar mini-grids ▪ Solar rooftop systems

2. MAIN ACTIVITIES

2.1. Guidelines, Tools and Advisories

2.1.1. Performance review of SMG and SWP systems in the field



Challenges addressed

Solar mini-grids (SMG) and solar water pumping (SWP) systems are becoming increasingly popular in rural areas, as they enable access to electricity and to water for irrigation and drinking. However, the sustainability of these interventions is often questioned. AEPC in collaboration with various development partners has been actively promoting these solutions in rural communities. Despite these efforts, post-installation support remains a challenge. Many systems experience poor performance after the installation, leading to reduced functionality or complete shutdown. Such issues undermine the credibility of the technology and decrease local willingness to pay for the services. Therefore, it is crucial to identify the key challenges by examining all inherent and contextual factors.

Partners

AEPC

Investment by partners

AEPC compiled information on SMG and SWP projects to consider in the survey.

Contribution by POSTED

The project developed the study methodology, shortlisted sample projects in Koshi, Karnali, and Sudurpaschim Provinces and inspected 12 sites in detail while conducting interviews and documenting the observations and findings.

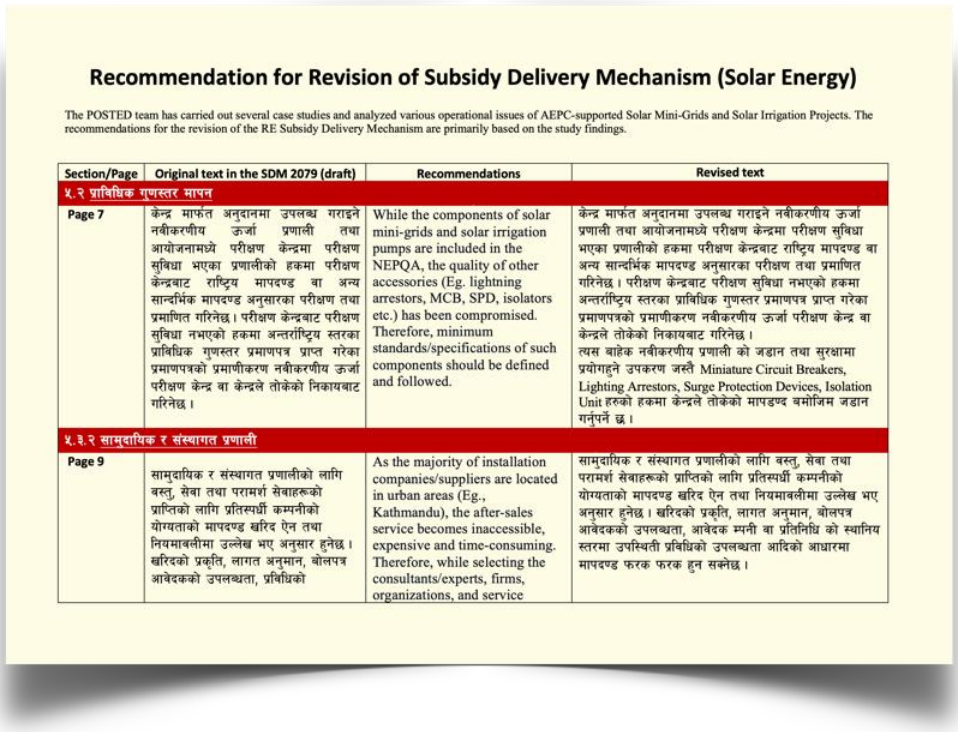
Results achieved

The study, available on the online **Resource Centre of AEPC,** identified several key issues: Design and sizing, operational issues, lack of post-installation support, lack of budget for major replacements, and limited trust in financial governance. The findings highlight the need for improved post-installation support and the importance of skilled operators and effective financial governance. It also informed subsequent work of POSTED, particularly on training and advisory services.

Outlook: Future actions required

Post-installation support and access to training for operators are essential for ensuring sustainable operation of these systems.

2.1.2. Advisory on Subsidy Delivery Mechanism and NEPQA



Recommendation for Revision of Subsidy Delivery Mechanism (Solar Energy)

The POSTED team has carried out several case studies and analyzed various operational issues of AEPC-supported Solar Mini-Grids and Solar Irrigation Projects. The recommendations for the revision of the RE Subsidy Delivery Mechanism are primarily based on the study findings.

Section/Page	Original text in the SDM 2079 (draft)	Recommendations	Revised text
५.२ प्राविधिक गुणस्तर मापन			
Page 7	केन्द्र मार्फत अनुदानमा उपलब्ध गराइने नवीकरणीय ऊर्जा प्रणाली तथा आयोजनामध्ये परीक्षण केन्द्रमा परीक्षण सुविधा भएका प्रणालीको हकमा परीक्षण केन्द्रबाट राष्ट्रिय मापदण्ड वा अन्य सान्दर्भिक मापदण्ड अनुसारका परीक्षण तथा प्रमाणित गरिनेछ। परीक्षण केन्द्रबाट परीक्षण सुविधा नभएको हकमा अन्तर्राष्ट्रिय स्तरका प्राविधिक गुणस्तर प्रमाणपत्र प्राप्त गरेका प्रमाणपत्रको प्रमाणीकरण नवीकरणीय ऊर्जा परीक्षण केन्द्र वा केन्द्रले तोकेको निकायबाट गरिनेछ।	While the components of solar mini-grids and solar irrigation pumps are included in the NEPQA, the quality of other accessories (Eg. lightning arrestors, MCB, SPD, isolators etc.) has been compromised. Therefore, minimum standards/specifications of such components should be defined and followed.	केन्द्र मार्फत अनुदानमा उपलब्ध गराइने नवीकरणीय ऊर्जा प्रणाली तथा आयोजनामध्ये परीक्षण केन्द्रमा परीक्षण सुविधा भएका प्रणालीको हकमा परीक्षण केन्द्रबाट राष्ट्रिय मापदण्ड वा अन्य सान्दर्भिक मापदण्ड अनुसारका परीक्षण तथा प्रमाणित गरिनेछ। परीक्षण केन्द्रबाट परीक्षण सुविधा नभएको हकमा अन्तर्राष्ट्रिय स्तरका प्राविधिक गुणस्तर प्रमाणपत्र प्राप्त गरेका प्रमाणपत्रको प्रमाणीकरण नवीकरणीय ऊर्जा परीक्षण केन्द्र वा केन्द्रले तोकेको निकायबाट गरिनेछ। त्यस बाहेक नवीकरणीय प्रणाली को जडान तथा सुरक्षामा प्रयोगहुने उपकरण जस्तै Miniature Circuit Breakers, Lighting Arrestors, Surge Protection Devices, Isolation Unit हरुको हकमा केन्द्रले तोकेको मापडण्ड बमोजिम जडान गर्नुपर्ने छ।
५.३.२ सामुदायिक र संस्थागत प्रणाली			
Page 9	सामुदायिक र संस्थागत प्रणालीको लागि वस्तु, सेवा तथा परामर्श सेवाहरूको प्राप्तिको लागि प्रतिस्पर्धी कम्पनीको योग्यताको मापदण्ड खरिद ऐन तथा नियमावलीमा उल्लेख भए अनुसार हुनेछ। खरिदको प्रकृति, लागत अनुमान, बोलपत्र आवेदकको उपलब्धता, प्रविधिको	As the majority of installation companies/suppliers are located in urban areas (Eg., Kathmandu), the after-sales service becomes inaccessible, expensive and time-consuming. Therefore, while selecting the consultants/experts, firms, organizations, and service	सामुदायिक र संस्थागत प्रणालीको लागि वस्तु, सेवा तथा परामर्श सेवाहरूको प्राप्तिको लागि प्रतिस्पर्धी कम्पनीको योग्यताको मापदण्ड खरिद ऐन तथा नियमावलीमा उल्लेख भए अनुसार हुनेछ। खरिदको प्रकृति, लागत अनुमान, बोलपत्र आवेदकको उपलब्धता, आवेदक स्थानी वा प्रतिनिधि को स्थानिय स्तरमा उपस्थिती प्रविधिको उपलब्धता आदिको आधारमा मापदण्ड फरक फरक हुन सक्नेछ।

Challenges addressed

As a public institution and promoter of renewable energy technologies, AEPC seeks to raise product quality, affordability as well as increase adoption. Among the instruments to achieve that are the renewable energy subsidy policy and delivery mechanisms as well as the Nepal Photovoltaic Quality Assurance (NEPQA). Both are updated regularly with input from AEPC based on its growing body of experience. As AEPC can monitor operations only to a limited degree while a number of development partners, implementers and experts are involved, AEPC also solicits opinions, learnings and expertise from these so as to broaden the feedback capture for improving these instruments. POSTED was included in these feedback loops during its lifetime.

Partners

AEPC

Investment by partners

Lead and facilitate the discussions, evaluated contributions and concluded based on its own best judgement.

Contribution by POSTED

POSTED contributed to the critical review of the renewable energy subsidy delivery mechanism in 2022 and to the revision of NEPQA. The project documented its feedback for the benefit of AEPC critical review.

Results achieved

AEPC received and considered recommendations from POSTED on vital elements of both instruments. The revised Renewable Energy Subsidy Delivery Mechanism were published in 2022, while the revised NEPQA 2024 whose publication is anticipated at the time of writing.

Outlook: Future actions required

None

2.1.3. Guidelines on implementation processes for SMG, SWP and SRT

Challenges addressed

AEPC, provincial and local governments are actively promoting solar mini-grids (SMG), solar water pumping (SWP) systems and solar rooftops (SRT) across Nepal. To date, 52 SMG projects have been completed, with a total installed capacity of approximately 3,000 kW, benefiting nearly 10,000 families. Additionally, over 4,000 solar water pumping projects have been implemented, primarily for irrigation purposes, while some also serving drinking water needs. However, the implementation is facing challenges due the absence of uniform processes and the consequential variation in procedures followed by different actors. There is also considerable confusion among subnational units of the government as to what process and what standards to follow. As a result, local and provincial governments struggle to execute projects or secure subsidy support. There was a pressing need for standardizing the processes and documenting them for clarity, transparency, and alignment with federal regulations.

Partners

AEPC and various development projects in the sector

Investment by partners

AEPC identified all relevant existing documents, coordinated with stakeholders while leading both desk and workshop reviews of the drafts. It owns and published the guidelines developed.

Contribution by POSTED

While carefully reviewing all available documents on processes and formats, POSTED developed a complete documentation for prescribed steps of each system type. It consulted with all relevant stakeholders through a series of review workshops and consolidated feedback and finalized the guidelines.

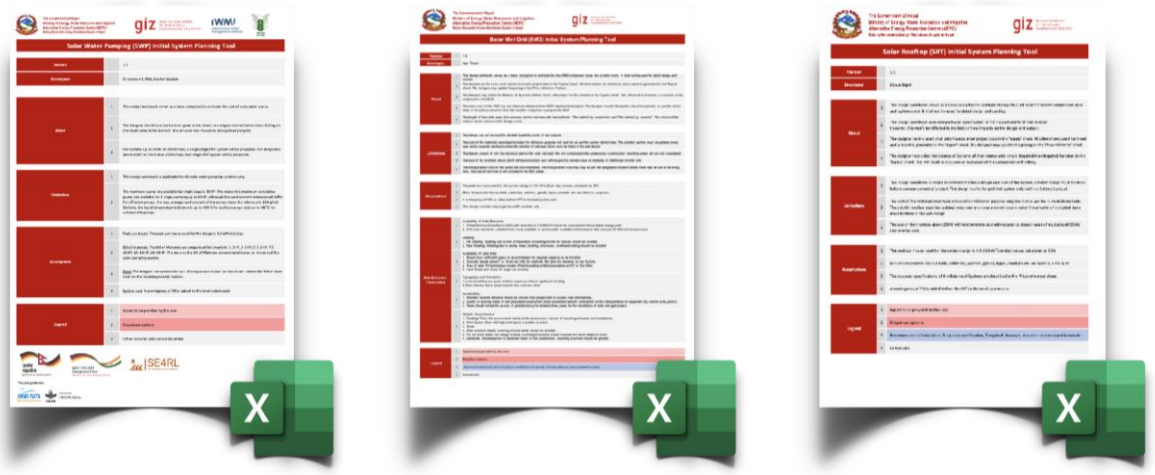
Results achieved

Comprehensive ***'Implementation Process Guidelines'*** for SMG, SRT, and SWP were published in both English and Nepali, available at the online **Resource Centre of AEPC**. Each guideline details the step-by-step process, identifies responsibilities and provides all relevant forms and formats to support the process.

Outlook: Future actions required

Encourage the adoption of these guidelines for such projects by local and provincial governments. Additionally, support local and provincial governments in becoming familiar with these guidelines and associated formats. Finally, technical assistance is required to enable AEPC and other stakeholders to transition to a digital system for managing applications and subsidies.

2.1.4. Planning tools for SMG, SWP and SRT



Challenges addressed

Local governments (LGs) are the primary owners of Nepal's solar mini-grids (SMG), shouldering 10% of equity while AEPC provides 90% of subsidy. Similarly, local and provincial governments are implementing solar water pumping (SWP) projects for irrigation and drinking water, supported by AEPC subsidies and their own funding. Solar rooftops (SRT) are also gaining traction among homeowners, business owners, and provincial governments. In all of these cases, the initiators of projects are rarely subject specialists and struggle with the estimation of the size of projects and associated costs. Experience shows that local governments often allocate budgets that are either insufficient or inflated. Consequently, misallocations frequently prevent the completion of projects or compromise the funding of other important activities. There was a pressing need for introducing simple to use but reliable Excel-based sizing and budget estimation tools to enable promoters to take informed decisions.

Partners

AEPC, Ministry of Water Supply, Irrigation and Energy (MoWSIE), Koshi Province, and International Water Management Institute (IWMI), India

Investment by partners

AEPC and MoWSIE provided expertise and feedback for the development and testing process. AEPC owns and published the three Excel tools developed.

Contribution by POSTED

POSTED conceptualized, designed and developed Excel based tools, one tool for each of the three system types: SMG, SWP and SRT. The project involved a wide gamut of stakeholders in the validation and field testing and concluded the development, flagging the tools off for publication.

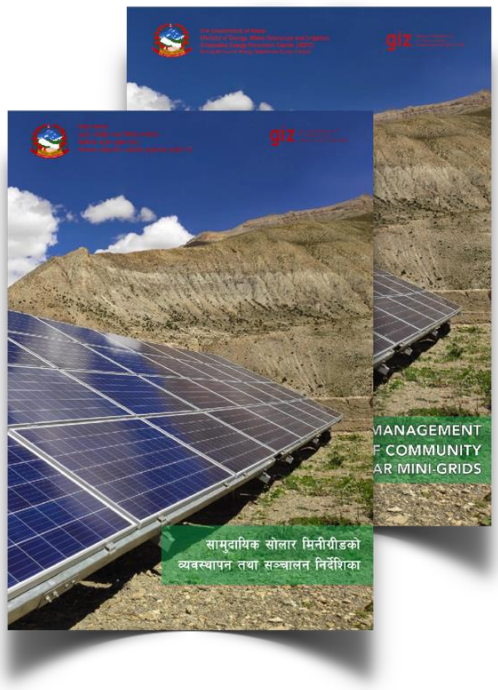
Results achieved

Three Excel-based ***'Planning Tools'*** for estimation of systems size and costing have been published, one for each system type – SMG, SWP and SRT – available at the online **Resource Centre of AEPC.** By inputting basic data on the intended project, project promoters can obtain reliable estimates for the power output (kW), the water output in case of SWP, the system size, the bill of quantities (BOQ), and the approximate required investment costs.

Outlook: Future actions required

Support local and provincial governments to become familiar with and use these tools.

2.1.5. Guideline for operation and management of SMGs



Challenges addressed

Solar mini-grids (SMG) are becoming an increasingly popular solution for electrifying remote communities in Nepal. AEPC offers a 90% subsidy for local municipalities willing to invest 10% equity in constructing such projects. Additionally, some provincial governments, such as Sudurpaschim (MoPID), are also promoting solar mini-grids through their own funding initiatives. Upon completion, these projects are typically handed over to local communities for day-to-day operations. However, local communities, municipalities and cooperatives often lack the knowledge and resources to effectively manage the daily operations of them. As a result, projects frequently fail to provide reliable power or generate sufficient revenue to cover ongoing expenses. To address these operational challenges, Ministry of Physical Infrastructure Development (MoPID), Sudurpashim Province, requested POSTED to develop a comprehensive guideline to support the sustainable operation and management of solar mini-grid projects.

Partners

Ministry of Physical Infrastructure Development (MoPID), Sudurpashim Province, and AEPC

Investment by partners

AEPC compiled a list of SMG projects constructed and shared existing guidelines. Both MoPID and AEPC provided review and feedback in the development process. AEPC owns and published the guideline developed.

Contribution by POSTED

POSTED developed the guideline by reviewing all relevant materials, visiting selected SMG projects, and consulting with various institutions and individuals. Together with MoPID and AEPC, the draft was presented to stakeholders for review and validation prior to finalization.

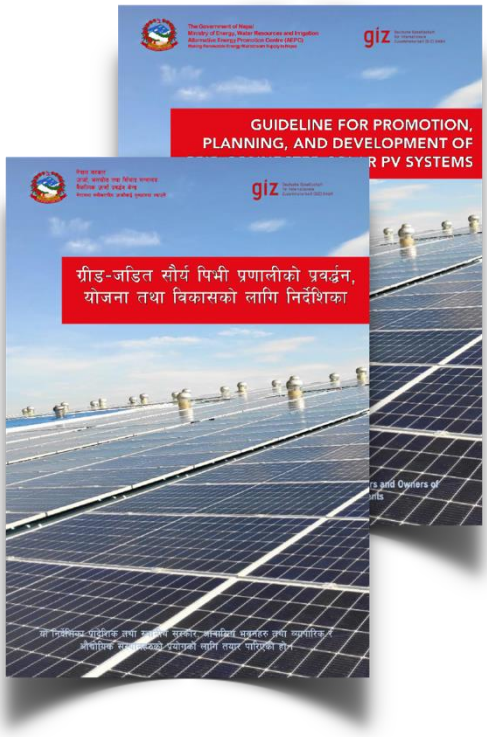
Results achieved

The ***'Guideline for Management and Operation of Community Managed Solar Mini-Grids'*** has been published and is available at the online **Resource Centre of AEPC** in English and Nepali languages. The guideline addresses all vital topics such as organizational modalities, management through user committees and cooperatives, tariff setting and collection, organizational procedures, as well as post-installation maintenance. Though the guideline is comprehensive, it is also concise, accessible and easily navigable. It is anticipated that the guideline will provide guidance to both user committees and cooperatives in managing SMG projects effectively.

Outlook: Future actions required

Support local cooperatives, user groups and local municipalities to become familiar with and use the guideline.

2.1.6. Guideline for promotion, planning and development of SRT



Challenges addressed

Nepal has seen a growing interest in solar PV systems for residential and commercial buildings since the introduction of the net-metering directives. Declining costs of solar PV are further encouraging this development. Many of those interested in solar rooftop systems are homeowners and owners of commercial and industrial establishments who are not experts in the subject and are hence unfamiliar with the technology, processes to follow, costs, and the economic prospects. Solar rooftops are especially suitable for urban homes, industries and commercial establishments with large roof spaces. It is estimated that grid-connected rooftops have technical potential of 6.5 TWh of annual electrical energy to the Nepal's electricity market. Also, sub-national governments, particularly in Koshi Province, are keen to promote solar rooftop installations. However, inability of gauging the prospects combined with unfamiliarity regarding implementation processes, design considerations paired with a shortage of trained experts, has resulted in slow adoption.

Partners

Ministry of Water Supply, Irrigation and Energy (MoWSIE), Koshi Province, and AEPC

Investment by partners

AEPC compiled available resource material while both MoWSIE and AEPC provided review and feedback in the development process. AEPC owns and published the guideline developed.

Contribution by POSTED

POSTED developed the guideline by reviewing all relevant materials and consulting with various institutions and individuals. Together with MoWSIE and AEPC, the draft was presented to stakeholders including selected industries interested in considering SRT systems for review and validation prior to finalization.

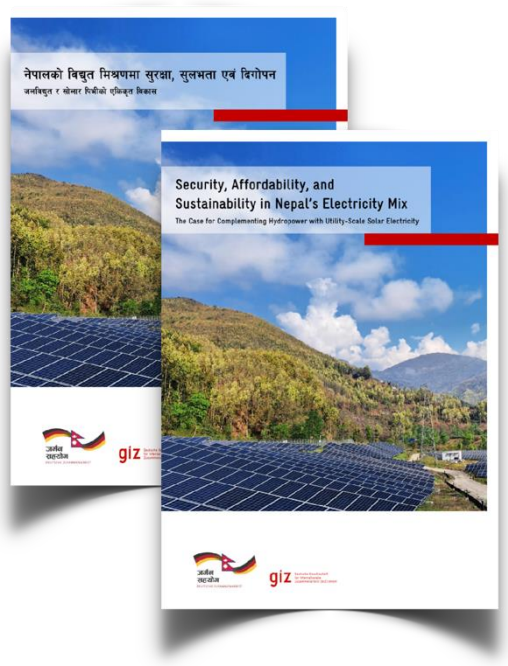
Results achieved

The ***'Guideline for Promotion, Planning and Development of Grid-Connected Solar PV Systems'*** is available at the online **Resource Centre of AEPC** in English and Nepali languages. The guideline covers all key topics such as planning, feasibility studies, economic analysis, and implementation considerations. It is designed for homeowners, owners of commercial and industrial establishment as well as provincial governments seeking to promote solar rooftop systems in their jurisdiction. Additionally, the guideline serves as comprehensive reference for professionals and engineers.

Outlook: Future actions required

Encourage utilization of the guideline. A revision is recommended if warranted by changes in the net meeting guidelines or other material aspects.

2.1.7. Policy advisory on utility-scale solar for Nepal's energy security



Challenges addressed

Nepal's electricity market is heavily reliant on hydropower, which accounts for approximately 98% of the total generation capacity. Furthermore, the majority of hydropower projects are of the run-of-river type. Electricity generation is thus dependent on the monsoon and seasonal fluctuations in river discharge. As a result, Nepal is obliged to import electricity to meet peak demand during the dry season. Additionally, hydropower is becoming increasingly susceptible to the impacts of climate change, which further exacerbates the risks to long-term generation stability. From an energy security perspective, relying on a single generation source is risky, and diversifying the energy mix is crucial for ensuring the country's future energy security. While policymakers continue to view hydropower as the primary solution, utility-scale solar has the potential to complement the country's hydropower assets in a cost-effective manner. Current policies limit the share of non-hydro renewable energy sources to 10% of the national grid's capacity. To address these impediments, an evidence-based research study was proposed to gather factual data on how solar PV could contribute to Nepal's electricity mix and what actions would be required to attract private sector investment to leverage its strength for complementing Nepal's energy mix.

Partners

AEPC

Investment by partners

AEPC contributed to the strategy development and conceptualisation of the study. It also assisted in identification of suitable experts and liaison with government agencies concerned. AEPC organized and hosted workshops for the review of drafts and the presentation of the study.

Contribution by POSTED

POSTED engaged a team of international and national experts, and organized over 50 consultative meetings with government agencies, sector specialists, and research institutions whose positions and contributed to shaping and developed the study whose development stretched over 18 months. The project facilitated consultative workshops to share and discuss preliminary findings and the release of the report after all conclusions had been vetted.

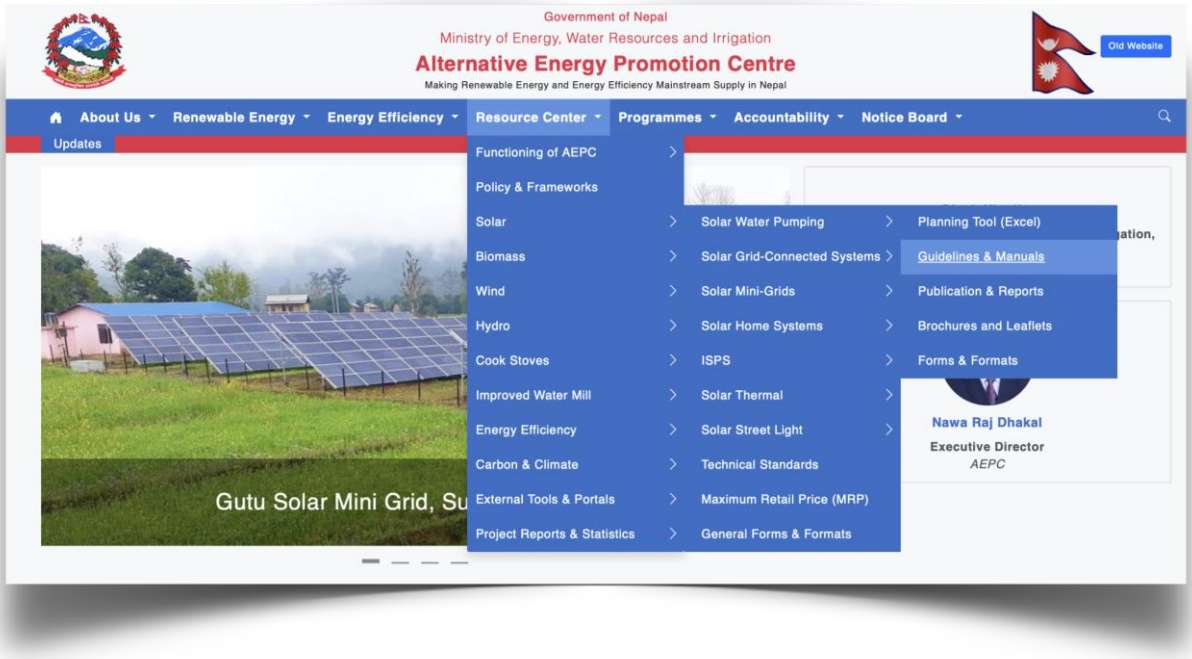
Results achieved

The report titled ***'Security, Affordability, and Sustainability in Nepal's Electricity Mix: The Case for Complementing Hydropower with Utility-Scale Solar Electricity'*** has been published in both English and Nepali, offering nine strategic recommendations for expanding solar PV projects to enhance diversification in Nepal's electricity mix. It is available at the online **Resource Centre of AEPC**.

Outlook: Future actions required

The recommendations are strategic in nature, requiring policy advocacy and awareness campaigns to effectively address the challenges. Additionally, support is needed to implement ministry-level directives and regulations to drive progress.

2.1.8. Enhancement of AEPC's online Resource Centre



Challenges addressed

Provincial and local governments have an active role in the implementation of government-supported solar projects. However, their experience with the topic is scant while the required expertise has been developed by AEPC over three decades. To share its vast body of knowledge, AEPC has created an online Resource Centre where standards, guidelines, technical knowledge and formats are available. That portal has served the purpose well as long as there were fewer documents and limited requirement for access. With the body of knowledge now spanning several hundred documents, the existing structure inhibited navigation and access by users, particularly by local and provincial governments. AEPC's online Resource Centre required a redesign of navigation and presentation to facilitate access.

Partners

AEPC

Investment by partners

AEPC contributed to the review of the Resource Centre and development of concepts for an improved navigation and mock-ups. It facilitated the implementation process with the service provider. AEPC is the owner of the Resource Centre and maintains it.

Contribution by POSTED

POSTED reviewed the existing online Resource Centre, identified areas for improvement, developed concepts and mock-ups and finalised the redesign together with AEPC. Additionally, POSTED mobilized a service provider to implement the redesign and uploaded all documents new and existing to the portal.

Results achieved

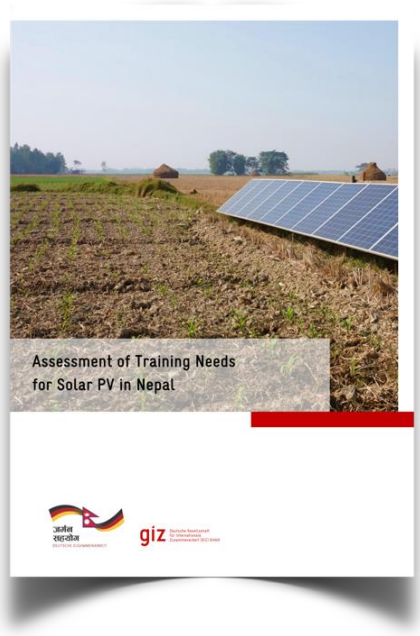
AEPC **online Resource Centre** has been upgraded. The revised structure reduced the number of topics of the main menu to 12 and organized navigation and access to the about 550 documents through layers of submenus. The revised portal is live.

Outlook: Future actions required

None other than continued updating with new documents by AEPC.

2.2. Capacity Development and Training

2.2.1. Identifying capacity challenges and training needs



Challenges addressed

Nepal has a large number of companies who have long been in the business of solar home systems (SHS) and, more recently, solar water pumping (SWP) systems. Recently, a new brace of companies emerged with a focus on large, technically more complex solar roof-top (SRT) systems with net-metering. What is common to all companies is that they face human resource-related capacity challenges. Hiring always entails on-the-job training since Nepal, until 2023, did not have any standard training qualifying young engineers and technicians for work in the sector. Various development partners had at one point offered training programmes free of charge. However, most were theory focused and with limited practical training sessions as hands-on training opportunities were rare. And once funding for programmes or projects ended these training initiatives ceased. Given this scenario and also given that POSTED was mandated to introduce training also for the private sector, it seemed appropriate to assess the situation in companies in respect of capacity gaps to identify potential demand for training in solar PV.

Partners

Solar Electric Manufacturers Association Nepal (SEMAN), and AEPC

Investment by partners

SEMAN supported the endeavour, notified its members and facilitated the survey by sharing members' contact details. AEPC and SEMAN participated in the in-depth review of findings and conclusions.

Contribution by POSTED

POSTED surveyed all active solar companies across the country – more than 60 – and collected through in-depth interviews information on specific challenges they have been facing, prior access to trainings and how new hires are being inducted. Evaluating these findings, POSTED conducted a training needs assessment in which inferences were made regarding apparent training needs and potential demand. Also considered in this assessment were the needs at local governments and in communities operating off-grid solar PV systems. In total, 10 training offerings were identified as required in Nepal's market, 8 of which were eventually introduced by POSTED. A series of consultations was held with the private sector and AEPC before finalizing the assessment.

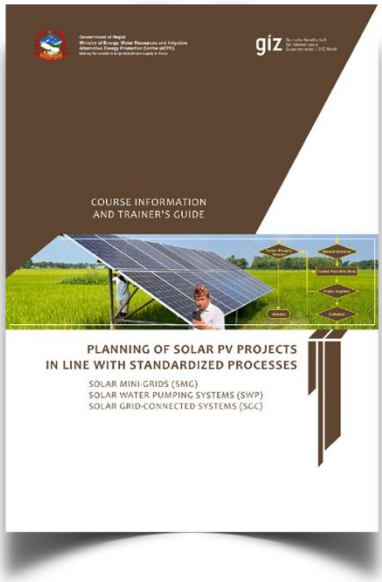
Results achieved

The ***'Assessment of Training Needs for Solar PV in Nepal'***, available at the online **Resource Centre of AEPC**, provided a compass to POSTED. Firstly, it clarified what training offerings POSTED would pursue to develop and introduce, namely: 1 training course for local and provincial governments; 3 courses for community operators and ESCOs; 2 courses for technicians; and 4 courses for engineers - 10 in total. Secondly, it established that training needs are not temporary in nature and rather than providing training through the project, POSTED is required to establish institutionalized training offerings through local training providers willing to embrace this opportunity for expanding services by providing training against a fee so as to sustain offerings beyond the project's lifetime.

Outlook: Future actions required

None

2.2.2. Training for sub-national project implementers



Challenges addressed

Since the constitutional reform provincial and local governments have an active role in the implementation of government supported solar projects. However, experience with the topic is scant while the required expertise is available only at AEPC. Provincial and local governments are actively promoting off-grid systems using their own funds in addition to subsidies from AEPC. However, projects often follow varied modalities and processes, leaving sub-national units of government without access to consistent process-related information. Quality control and progress monitoring are common challenges faced. As a result, many local-level projects are either delayed or completed with budget overruns or substandard quality. Additionally, sub-national units of government often struggle to mobilize their own funds for such initiatives. To address these challenges, there is an urgent need for a standardized and comprehensive approach to implementing specific projects. Provincial and local governments require a clear understanding of the entailing processes, including prescribed forms and formats, as well as their roles and responsibilities in the implementation process.

Partners

Sudurpashim Provincial Research and Training Academy (SPRTA), Doti, and AEPC

Investment by partners

SPRTA identified a pool of adjunct faculty as trainers, identified trainees, supported the planning of training and hosted training deliveries facilitated by its faculty. AEPC is the owner of the training package.

Contribution by POSTED

Based on the guidelines POSTED developed for the implementation of SRT, SMG, and SWP projects, training syllabi and content were developed, consistent with the needs identified for a training of 2.5 days. The project identified SPRTA as local training provider adequately placed in Sudurpashim and conducted a training of trainers (ToT) for their trainer pool. Additionally, the project assisted SPRTA in organizing training sessions, selecting participants and providing co-trainers for the first deliveries of the training.

Results achieved

SPRTA has been empowered to deliver the training ***'Planning of Solar PV Projects in Line with Standardized Processes'***. Two runs of the training were conducted by SPRTA. In Karnali and Koshi Provinces, where no suitable local training partner could be found, POSTED conducted this training on its own. All together 9 trainings were conducted in three provinces for a total of 224 participants. The training package – comprising an instructor's guide, lesson plans, media, handouts and assignments – has been published, available at the online **Resource Centre of AEPC**.

Outlook: Future actions required

SPRTA still has limited experience for the competent delivery of follow-on trainings and requires further technical assistance to safeguard the required quality and knowledge transfer. The topic is also relevant to other provinces. Process training with focus on SMG is particularly important in provinces where electrification of last miles communities is ongoing. Training with a focus on SWP and SRT is especially relevant in the Tarai and in urban areas. It is recommended to direct future technical assistance to identifying suitable provincial training providers in Karnali and other provinces and empowering them to deliver this training package independently, with scholarship support.

2.2.3. Training for community system operators

Challenges addressed

While community energy systems such as solar mini-grids, institutional solar PV systems, and solar water pumping systems offer significant benefits, ensuring their long-term functionality continues to be a major challenge. Post-installation support is often inadequate, leaving local communities to manage day-to-day operations on their own. Many community projects are operated by semiskilled or untrained personnel, unable to follow standard operating procedures. As a result, even minor issues may not be addressed adequately, often resulting into eventual breakdowns. To ensure the sustainability of these projects, local governments and community organizations need access to affordable and effective training programmes to qualify operators for their crucial role.

Partners

Bhumi Urja Pvt. Ltd., Don Bosco Institute of Engineering & Technology, Tankisinuwari, Underprivileged Children Education Programme (UCEP), Bhaktapur, and AEPC

Investment by partners

Bhumi Urja Pvt. Ltd., Don Bosco and UCEP participated in the development of training content. Bhumi Urja Pvt. Ltd. and Don Bosco embarked on the delivery of these training packages. AEPC is the owner of the training packages.

Contribution by POSTED

POSTED conceptualized the training approach and modalities, developing three training packages, one for SMG, SWP and SRT each. Three local training partners were identified, Bhumi Urja Pvt. Ltd., Don Bosco and UCEP who contributed to the content development and for whose faculty POSTED conducted a training of trainers (ToT), supported the training delivery through mentors and offered limited scholarships to encourage that training providers seek scholarships from other partners as well.

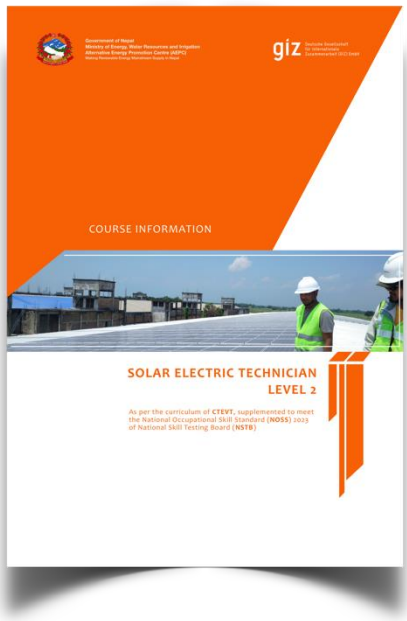
Results achieved

'Operator Training' for SWP systems, SRT systems, and SMG, each spanning 2-3 days, is now available against a training fee through Bhumi Urja Pvt. Ltd. and Don Bosco. Altogether 9 trainings were conducted during the lifespan of POSTED in which 189 participants qualified for the role of operators. The three training packages – each comprising of an instructor's guide in English and handouts in Nepali – are available at the online Resource Centre of AEPC.

Outlook: Future actions required

This type of training is required to be continued to benefit projects in operation and those to commence in future. It would be appropriate to encourage the acquisition of relevant skills and knowledge and participation from rural areas through scholarships.

2.2.4. Training of technicians



Challenges addressed

Seeking to address the need for qualified technicians, AEPC, with support of the erstwhile Energy Sector Assistance Programme (ESAP), introduced into Nepal standard trainings. It comprised of offerings Solar Electric Technician Level 1 – addressing the need for a basic training for especially solar home systems (SHS) – and a Level 2 training for larger and more complex systems. They were established under and regulated by the Council for Technical Education and Vocational Training (CTEVT). Several technicians had been qualified for Level 1, but only a few for Level 2. Both trainings had fallen into disuse after the end of ESAP and neither was available anymore at the commencement of POSTED. At the same time, the market for solar photovoltaic market has matured significantly, shifting from small-scale solar home systems to larger community or utility-scale systems and the growing demand for skilled technicians capable of system installations in accordance with standards and providing after-sales support remained unmet.

Partners

Don Bosco Institute of Engineering & Technology, Tankisinuwari,
Underprivileged Children Education Programme (UCEP), Bhaktapur, and AEPC

Investment by partners

Don Bosco and UCEP contributed to the expansion and updating of training materials. They also planned, organized, advertised and delivered trainings while seeking scholarships beyond those provided by POSTED. AEPC is the owner of the training package developed which provides substantial supplements to CTEVT's training manual.

Contribution by POSTED

Focusing on Level 2 which is the best match for today's market demand, POSTED revived the existing curriculum and expanded it to meet requirements of the revised National Occupational Skills Standard (NOSS) 2023. POSTED identified training providers with existing experience in the subject, willing and able to offer this training against fee, and qualified their instructors for training delivery through training of trainers (ToT), ensuring 80% of practical and equipped them with the equipment required for training. Furthermore, POSTED provided continuous mentorship support to faculty during trainings and offered scholarships for 50% of the trainees.

Results achieved

'Solar Electric Technician (Level 2)' training spanning 260 hours is now available against training fee through Don Bosco and UCEP. Altogether 6 trainings for 93 participants were conducted during the lifespan of POSTED. An assessment by the National Skills Testing Board (NSTB) is open to all candidates once they completed the mandatory 3 years of relevant professional experience. The training package – comprising of an instructor's guide, CTEVT's training manual, lesson plans, media, handouts and assignments – has been released at the online Resource Centre of AEPC.

Outlook: Future actions required

This training is required to be continued to build a growing pool of technicians. The acquisition of relevant skills and knowledge should be encouraged through scholarships.

2.2.5. Training of engineers

Challenges addressed

In 2022, the country lacked training programmes for engineers keen to qualify for work in the solar PV sector. While some training had been conducted in the past, they were discontinued once funding ceased. As a result, companies were obliged to provide in-house training for new hires. At the same time, many projects suffered with incorrect sizing or equipment selection, while installation, testing, and commissioning were often overseen by personnel with insufficient expertise. This has led to poor system performance and contributed to a negative reputation of solar PV in the eyes of the public. The introduction of practice-oriented training for engineers is crucial to sustain the development of the sector, reduce hiring costs, and open career pathways for young professionals.

Partners

Centre for Energy Studies (CES), Institute of Engineering, Tribhuvan University, Lalitpur, and AEPC

Investment by partners

CES shouldered a significant part of the development and revision of training materials. CES also planned, organized, advertised and delivered trainings while soliciting support for scholarships beyond those of by POSTED. AEPC is the owner of the training package.

Contribution by POSTED

CES was selected as national partner through a call for expressions of interest. POSTED supported CES's quest to lead the development of three training packages, achieved through dedicated resources, infusing the practitioner's angle. Additionally, POSTED conducted trainings of trainers (ToT) for faculty, provided mentorship and scholarships for 50% of the participants and assisted CES with the creation of a LinkedIn channel to present its work and market training programmes.

Results achieved

The first obstacles have been cleared for making training on the subjects ***'Preparation of DFS for Solar PV Projects'***, ***'Implementation of SWP Systems'***, and ***'Implementation of SMG and SRT Systems'***, available in Nepal. 7 trainings for 88 participants were conducted during the lifespan of POSTED. Three training packages – each comprising an instructor's guide, lesson plans, media, handouts and assignments – are available at the online **Resource Centre of AEPC.**

Outlook: Future actions required

Further support and mentorship are required to assist CES to make trainings of practical relevance to young engineers and practitioners. Though CES is well familiar with contents, the expertise of faculty at this point gravitates to the theory, not the practice. It is recommended to support CES in conducting training on a regular basis providing expertise, mentorship, scholarships and marketing support.

2.2.6. Overview of solar PV qualifications established in Nepal

Catalogue of training available

Nepal's **solar PV sector** is growing. The demand for solar rooftop and utility-scale systems is on an upward trajectory. Similarly, the demand for community systems – solar mini-grids, and solar water irrigation and water supply – will continue to play a key role in the last-mile electrification efforts for the next years.

The market is growing while the complexity of system has increased considerably. To sustain the growth, the private sector, communities, and sub-national governments need access to **qualified technicians, engineers, operators, and planners**. Access to relevant professional training is essential to ensure adequate project design, good craftsmanship, and years of operation and service.

Five training providers across Nepal have **introduced training offerings** that closely respond to the needs and demands of the market. In this effort, they were supported by GIZ Promotion of Solar Technologies for Economic Development (POSTED) through the development of relevant training offers, capacity development of faculty, training equipment and scholarships. A training fee is being charged by training providers to defray the cost of training. The training fee also opens the door to enrolment from individuals, the private sector, government agencies, and development partners alike. The intention is to ensure that these offerings remain available through the coming years regardless of the closure of POSTED, assuming adequate quality, recognition, and demand.

For Engineers, engineering students and professionals in the solar sector

Preparation of **Detailed Feasibility Studies** for Solar PV Projects	*Successful graduates will be able* to plan, prepare, carry out, and document detailed feasibility studies (DFS) for solar rooftop (SRT), solar mini-grid (SMG) and solar water pumping (SWP) systems using accepted standard guidelines.	15 days	NPR 33,000 (approx.)
Implementation of **Solar Water Pumping** Systems	*Successful graduates will be able* to plan, supervise the installation, test and commission solar water pumping (SWP) systems besides overseeing maintenance tasks and conducting troubleshooting.	6 days	NPR 19,000 (approx.)
Implementation of **Solar Mini-Grid and Solar Rooftop** Systems	*Successful graduates will be able* to plan, supervise the installation, test and commission solar rooftop (SRT) and solar mini-grid (SMG) systems besides overseeing maintenance tasks and conducting troubleshooting.	6 days	NPR 19,000 (approx.)

Centre for Energy Studies (CES), Institute of Engineering, Tribhuvan University, Lalitpur
Contact: Arun Bikram Thapa, 98511 96503
Arun.Thapa@pcampus.edu.np
Training venue Kathmandu

For Technicians, *electricians, solar technicians and L1 graduates*

Solar Electric Technician Level 2 (CTEVT) as per NOSS 2023	*Successful graduates will acquire the knowledge and skills* to install, troubleshoot and maintain domestic and commercial solar PV systems up to 10-kilowatt peak (10 kW_P) in single and three-phase systems. For the subsequent NSTB test and certification, graduates require 3 years of relevant work experiences accumulated before or after the training.	260 hours	NPR 30,000 (day scholars) NPR 73,000 (residential)

Don Bosco Institute of Engineering and Technology, Tankisinuwari, Biratnagar *Contact:* Aman Ray, 98433 778124 Aman92Ray@gmail.com
Training venue Biratnagar

UCEP Nepal, Sanothimi, Bhaktapur
Contact: Sangam Chalise, 98437 55865
ChaliseSangam@gmail.com
Training venue Kathmandu

For Operators *of community systems and ESCO personnel*

Operator Training for **Solar Water Pumping** Systems	*This course equips trainees with limited technical expertise with the skills and knowledge* required to operate solar water pumping systems, conduct routine maintenance, and escalate faults requiring experts.	2 days	NPR 15,000 to 20,000 (approx.)
Operator Training for **Solar Mini-Grids**	*This course equips trainees who have limited technical expertise with the skills and knowledge* required to operate solar mini-grids systems, conduct routine maintenance, and escalate faults requiring experts.	3 days	NPR 20,000 to 40,000 (approx.)
Operator Training for **Solar Rooftop** Systems	*This course equips trainees who have limited technical expertise with the skills and knowledge* required to operate solar rooftop systems, conduct routine maintenance, and escalate faults requiring experts.	3 days	NPR 15,000 to 20,000 (approx.)

Bhumi Urja Pvt. Ltd.
Kathmandu, *Contact:*
Gyanendra Malla, 98511 21531
BhumiUrjaNepal@gmail.com
Training venues Dhangadhi + Surkhet

Don Bosco Institute of Engineering and Technology, Tankisinuwari, Biratnagar
Contact: Aman Ray, 98433 778124
Aman92Ray@gmail.com
Training venue Biratnagar

For Local Governments, *elected members, engineers, admin. officers*

Planning of Solar PV Projects in line with Standardized Processes	*This course equips trainees* to be conversant with all planning steps of solar-related projects under their mandate, fostering decision making and providing oversight in the execution in line with AEPC standards.	2.5 days	Yet to be defined

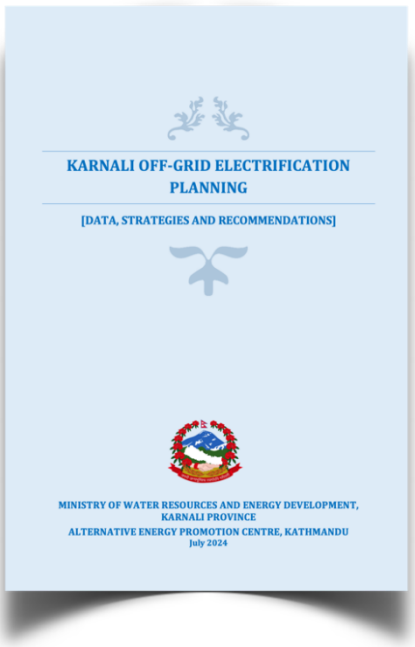
Sudurpaschim Province Research and Training Academy (SPRTA), Dipayal Siligadhi, Doti, Sudurpashim Province, *Contact:* Gehendra Bam 98584 33375, BamGehendra@gmail.com
Training venue Doti, Sudurpashim Province

2.3. Assistance in Planning

2.3.1. Last mile electrification planning support for Karnali

Challenges addressed

The Last Mile Electrification Plan 2022 identified nearly 215,000 unelectrified households of which 45% were earmarked for off-grid solutions. A staggering 49% of these off-grid communities are located in Karnali Province, making it obvious that Karnali is Nepal's priority for off-grid electrification. As POSTED commenced, Karnali's government had no clear strategy how to go about this ardours task. Additionally, the available data was unreliable. Though Nepal Electricity Authority (NEA) and AEPC made significant advances in on-grid and off-grid electrification, both agencies use different data, leading to overlaps and areas ignored by both to the detriment of users. Adding to the list of problems are budget constraints, incomplete off-grid projects plus advances of grid expansion in areas where off-grid systems operate successfully. To resolve these challenges and ensure electricity access for all households in the province, a comprehensive electrification plan is essential, with defined responsibilities for all actors.



Partners

AEPC, Ministry of Water Resources and Energy Development (MoWRED), Karnali Province, and Nepal Renewable Energy Programme (NREP)

Investment by partners

AEPC led the activity and contributed significantly to shaping the process followed, coordinating with MoWRED and MoEWRI, undertaking reviews and providing feedback. MoWRED led the district level consultations and coordination within Karnali. NREP lent financial support to the district level consultations which entailed significant logistics.

Contribution by POSTED

In collaboration with AEPC, the project evolved the planning process for electrification. The project gathered relevant materials and data from various sources and acted as facilitator of the 10 district verification workshops in which the electrification data and plans were validated with local stakeholders. The planning document was developed and drafts reviewed multiple times with MoWRED, AEPC as well as MoEWRI before proposing the final document.

Results achieved

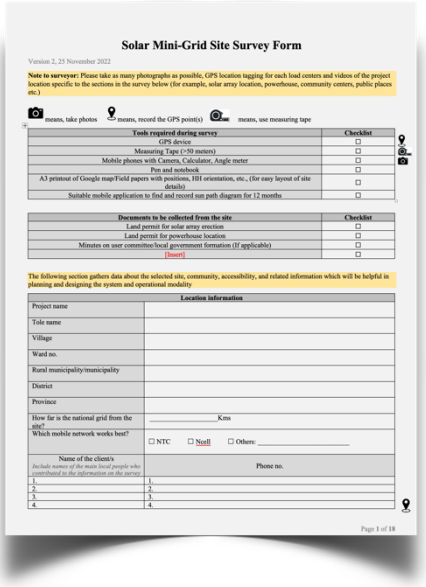
The planning document ***'Karnali Off-Grid Electrification Planning: Data, Strategies, and Recommendations'*** has been finalized. It identifies 172,422 unelectrified households which represent 46% of the households in the province. NEA and AEPC confirmed that they will electrify 147,414 and 11,028 households, respectively, within the next two years while MoWRED, aided by the planning document, will pursue providing the remaining 13,980 off-grid households with electricity.

Outlook: Future actions required

It is crucial to extend these efforts to other provinces as provincial governments have the need but not the expertise for completing this pivotal task. In Karnali, it is recommended to support the province with conducting pre-feasibility studies in all unelectrified wards to identify the most suitable renewable energy options and supported selected local governments in the planning and development of the of the identified off-grid solution.

2.3.2. Detailed feasibility studies for Solar PV projects

Challenge addressed


Solar Mini-Grid Site Survey Form

Version 2, 25 November 2022

Note to surveyor: Please take as many photographs as possible, GPS location tagging for each load centers and videos of the project location specific to the sections in the survey below (for example, solar array location, powerhouse, community centers, public places etc.)

means, take photos means, record the GPS point(s) means, use measuring tape

Tools required during survey	Checklist
GPS device	☐
Measuring Tape (>50 meters)	☐
Mobile phones with Camera, Calculator, Angle meter	☐
Pen and notebook	☐
A3 printout of Google map/Field papers with positions, HH orientation, etc., (for easy layout of site details)	☐
Suitable mobile application to find and record sun path diagram for 12 months	☐

Documents to be collected from the site	Checklist
Land permit for solar array erection	☐
Land permit for powerhouse location	☐
Minutes on user committee/local government formation (If applicable)	☐
[Insert]	☐

The following section gathers data about the selected site, community, accessibility, and related information which will be helpful in planning and designing the system and operational modality

Location information	
Project name	
Tole name	
Village	
Ward no.	
Rural municipality/municipality	
District	
Province	
How far is the national grid from the site?	_____Kms
Which mobile network works best?	☐ NTC ☐ Ncell ☐ Others: _____
Name of the client/s *Include names of the main local people who contributed to the information on the survey.*	Phone no.
1.	1.
2.	2.
3.	3.
4.	4.

Page 1 of 18

Off-grid renewable energy systems, including solar mini-grids, solar water pumps, and solar rooftops, are providing essential services. Ensuring their long-term sustainability remains a primary concern. One key factor influencing performance is adequate system design and sizing. Other critical aspects to be considered during the planning phase include the selection of an appropriate project location, accurate cost estimation, and a realistic implementation schedule. For subsidy-supported projects, detailed feasibility studies (DFS) are conducted by consultants and reviewed by AEPC's technical committee. At the sub-national level, some provincial governments are also promoting solar mini-grids (SMGs) and solar water pumps (SWPs), albeit often without adhering to rigorous reviews of DFS reports. It has been observed that the quality of DFS reports varies significantly. Often, inexperienced engineers and junior technicians, lacking sufficient input from qualified experts, prepare these reports. Additionally, different agencies have adopted varying formats for DFS reports, further compromising their quality. To address these challenges, there is a clear need for standardized procedures for both field and desk-based DFS, along with unified templates to ensure consistency and quality. Another large challenge is that the pool of qualified experts for carrying out DFS in Nepal is still miniscule. The DKTI/AEPC project and governments of provinces where POSTED operates have thus requested POSTED to support them in the development of DFS reports consistent with best practices.

Partners

AEPC, Ministry of Physical Infrastructure Development (MoPID), Sudurpashim Province; Ministry of Water Supply, Irrigation and Energy (MoWSIE), Koshi Province; Deutscher Klima und Technologie (DKTI) project of KfW

Investment by partners

AEPC provided critical review of the unified DFS templates developed. AEPC, MoPID and MoWSIE identified project sites for which DFS were required.

Contribution by POSTED

POSTED reviewed existing DFS reports, identified areas for improvement and developed comprehensive report templates, incorporating feedback from relevant stakeholders. Additionally, POSTED established a pool of field surveyors and experts to conduct desk studies and prepare DFS reports and carried out a good number of DFS and submitted these to AEPC.

Results achieved

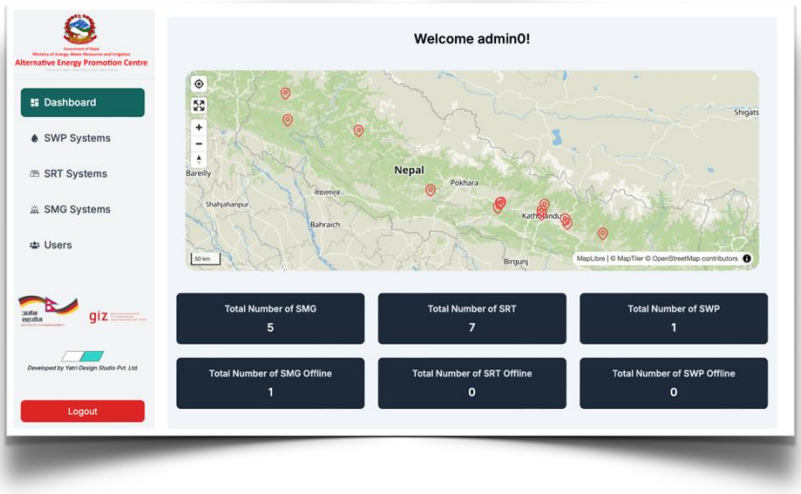
Unified DFS report templates were developed und published for solar mini-grids, solar water pumps, and solar rooftop projects, available at the online **Resource Centre of AEPC**. These were integrated into the AEPC's process implementation guidelines. With the support of a qualified pool of experts, several DFS reports for solar mini-grids and solar water pumps have been successfully prepared for the review of AEPC.

Outlook: Future actions required

Encourage local and provincial governments, consultants and individuals to adopt these DFS templates to nurture the development of accurate and realistic DFS reports for solar PV projects.

2.4. Monitoring and Pilot Projects

2.4.1. Remote monitoring system for solar PV systems at AEPC



Challenges addressed

AEPC is promoting various solar PV technologies including solar rooftop (SRT), solar mini-grid (SMG), and solar water pumping (SWP) systems across the country. AEPC is also responsible for evaluate the performance of these systems and to coordinate with the suppliers/installers for maintenance and repairs. But monitoring has been a physical challenge, especially since many systems are in remote areas. Physical monitoring is too resource-intensive to conduct on a regular basis and consequently, AEPC does not have data on the operational status of the systems it has supported. Even if solutions for digital monitoring generally exist today, they are too expensive, only work with reliable internet connection, and the various technology providers all come with their own remote monitoring system. Hence, AEPC requested POSTED to support the development of a customized solution that is affordable, reliable, and can monitor a variety of systems by compiling all necessary data in one online portal.

Partners

AEPC

Investment by partners

AEPC defined their monitoring requirements, reviewed the findings of the feasibility study and selected the recommended least cost option. APEC gathered the data of sites with installed solar PV systems and selected suitable sites to be included in the pilot. AEPC owns and hosts the platform.

Contribution by POSTED

In the first phase, POSTED conducted a feasibility study and described the technology options available, recommending the least cost option. Upon approval from AEPC, POSTED contracted the development of the hardware and software, and piloting of the system to the service provider Yatri Design Studio Pvt. Ltd., selected through local competitive bidding. Yatri Design Studio developed the hardware, software backend, frontend, tested the equipment and installed the system with customized sensors at 15 selected sites with existing solar PV systems to demonstrate the viability at pilot scale.

Results achieved

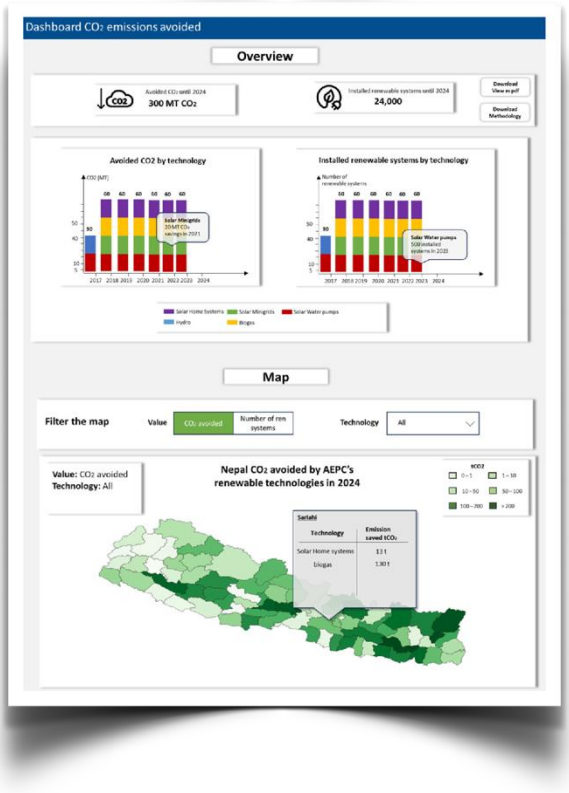
The development of a simple, robust and low-cost remote monitoring system has been successfully completed, with an application programming interface (API) and hardware components that can operate regardless of the manufacturer or brand of the components. The cost for sensors for SWP systems, the most price sensitive component, does not exceed NPR 8,990 (EUR 63). The system has been deployed across 15 solar PV systems and is operational. Live monitoring data can now be accessed through the specially developed web-portal hosted on AEPC's server.

Outlook: Future actions required

Expand the remote monitoring system to all upcoming AEPC projects. Support is required for the installation at existing solar PV and other renewable energy systems.

2.4.2. Reporting modules GHG and e-waste for AEPC's NREMIS

Challenges addressed



AEPC has been promoting various solar PV technologies, including solar home-systems (SHS), solar rooftop (SRT), solar mini-grid (SMG), and solar water pumping (SWP) systems across the country, as well as biogas and micro-hydro systems. Despite the implementation of many projects, their contribution in terms of greenhouse gas (GHG) emissions avoided was unknown. Knowledge of this is essential, considering Nepal's commitment to reducing GHG emissions and its contribution to climate targets under the Nationally Determined Contributions (NDC). Another environmental aspect to consider is that solar PV systems, once they reach the end of their lifetime, contribute to electronic waste (e-waste). No estimates exist here yet, while it is only a question of time when Nepal will embark on addressing electronic and hazardous waste in a systematic manner. AEPC has already established and operationalized the National Renewable Energy Management Information System (NREMIS). It was recognized that, by utilizing this database, the database was available for estimating GHG emissions avoided and e-waste generated in future, to make it available for planning and reporting of government agencies and development partners.

Partners

AEPC

Investment by partners

AEPC took the ownership for this undertaking, keen to obtain valuable additional information from its existing data. AEPC reviewed and contributed to the validation of the methodology and approved it and facilitated implementation on its own server.

Contribution by POSTED

POSTED carried out this task in two phases. In the first phase, methods for calculating GHG emissions avoided and e-waste generated in future were developed and validated. In the second phase, the implementation phase, the methodology was coded into backend and frontend parts of the NREMIS, creating a dashboard with two additional reporting modules.

Results achieved

The dashboard featuring current estimates for accumulated GHG emissions avoided and e-waste generated in future is now operational on AEPC's server. The GHG emission avoidance report covers solar PV systems, as well as micro-hydro and biogas systems, while the e-waste report focuses solely on solar systems. The reporting modules are based assumed lifespans for systems and components, paired with computational factors changeable by authorized users. Reports can be generated for specific provinces, years and system types under consideration.

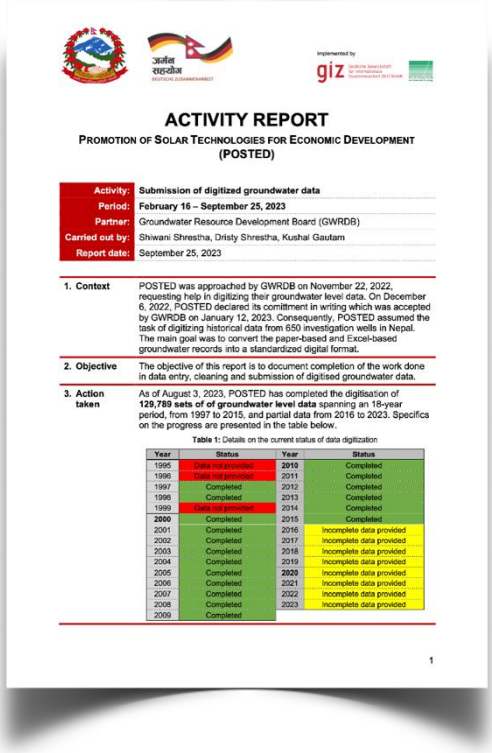
Outlook: Future actions required

None expect for the operation by AEPC and keeping the structure of the NREMIS consist with processes implemented by AEPC for supporting renewable energy systems.

2.4.3. Groundwater level monitoring

Challenges addressed

Groundwater extraction is promoted for irrigation of agricultural crops. Also, solar PV systems are increasingly being deployed for this purpose. Solar water pumping systems are concentrated in certain clusters of the Terai, raising concerns about unsafe water abstraction in some aquifers. As an elementary safeguard for ensuring the extraction is below the level of recharge, the monitoring of groundwater levels is important for Nepal. Access to groundwater level data is essential not only for designing of water pumping systems but also for observing annual recharge trends, as well as for hydrological research and modelling. The Ground Water Resources Development Board (GWRDB) has been monitoring water levels through 650 investigation wells situated across 21 Terai districts. Historically, the data was stored on paper records which today impedes access and use of the data. With support CIMMYT, GWRDB piloted digital access to groundwater level data in Banke and Bardiya districts. The success of this undertaking led to the expansion of the project to the national level to make all groundwater level data public through a web-based dashboard. For that, the historical data of the paper-based records represent references vital for the purpose of the database – if they could only be digitized.



ACTIVITY REPORT

PROMOTION OF SOLAR TECHNOLOGIES FOR ECONOMIC DEVELOPMENT (POSTED)

Activity:	Submission of digitized groundwater data
Period:	February 16 – September 25, 2023
Partner:	Groundwater Resource Development Board (GWRDB)
Carried out by:	Shiwani Shrestha, Dristy Shrestha, Kushal Gautam
Report date:	September 25, 2023

1. Context	POSTED was approached by GWRDB on November 22, 2022, requesting help in digitizing their groundwater level data. On December 6, 2022, POSTED declared its comitment in writing which was accepted by GWRDB on January 12, 2023. Consequently, POSTED assumed the task of digitizing historical data from 650 investigation wells in Nepal. The main goal was to convert the paper-based and Excel-based groundwater records into a standardized digital format.
2. Objective	The objective of this report is to document completion of the work done in data entry, cleaning and submission of digitised groundwater data.
3. Action taken	As of August 3, 2023, POSTED has completed the digitisation of **129,789 sets of of groundwater level data** spanning an 18-year period, from 1997 to 2015, and partial data from 2016 to 2023. Specifics on the progress are presented in the table below.

Table 1: Details on the current status of data digitization

Year	Status	Year	Status
1995	Data not provided	2010	Completed
1996	Data not provided	2011	Completed
1997	Completed	2012	Completed
1998	Completed	2013	Completed
1999	Data not provided	2014	Completed
2000	Completed	2015	Completed
2001	Completed	2016	Incomplete data provided
2002	Completed	2017	Incomplete data provided
2003	Completed	2018	Incomplete data provided
2004	Completed	2019	Incomplete data provided
2005	Completed	2020	Incomplete data provided
2006	Completed	2021	Incomplete data provided
2007	Completed	2022	Incomplete data provided
2008	Completed	2023	Incomplete data provided
2009	Completed		

1

Partners

Ground Water Resources Development Board (GWRDB), and
Water and Energy Commission Secretariat (WECS)

Investment by partners

GWRDB provided the historical records from 1997 to 2015 (complete data) as well as partial data for the years 2016 to 2023 and coordinated the work of CIMMYT's development of the dashboard for public access.

Contribution by POSTED

On request of GWRDB, the project digitized the historical groundwater records from 1997–2023 to the extend data was available by GWRDB, all in all about 130,000 data sets. After digitization, the data was scrutinized for errors and cleaned in accordance with a procedure approved by GWRDB. The project also trained field monitors in digital collection of data.

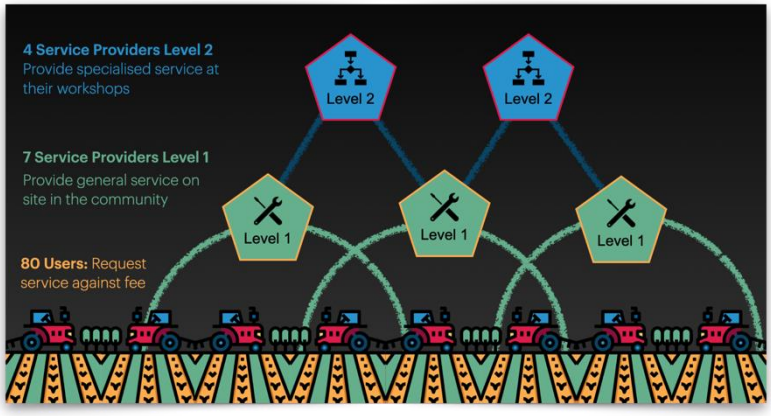
Results achieved

In September 2023, the digitization and cleaning of data was completed, and the consolidated final datasets were submitted to GWRDB for inclusion in the dashboard. After dissolution of GWRDB, WECS took over the responsibility for groundwater data, library and hosting of the data portal. POSTED resubmitted the consolidated final datasets to WECS in November 2024.

Outlook: Future actions required

WECS has taken over the coordination of publication of the dashboard for public access and importing the digitized data into the database. The collection of field data has been vested with Department of Water Resources and Irrigation.

2.4.4. Piloting a service network for SWP



Challenges addressed

Owing to the subsidies provided by AEPC, solar water pumping (SWP) systems are becoming increasingly popular for irrigation and drinking water, yielding promising results. However, their long-term functioning has shown to be problematic. Many systems do not operate as per the design and fail eventually, some of them shortly after installation. The beneficiaries are typically farmers unfamiliar with the technology. The installation companies are often far away and out of reach. Though there are local repair shops they are not familiar with these systems. As the subsidies cover most of the system cost, the ownership for SWP systems and the willingness to pay for repairs is limited. This situation puts the entire sub-sector at risk, as many people perceive the technology as unreliable, needlessly damaging its reputation. Therefore, there is a need for establishing a system for service, bridging the gap between the demand and supply of repair services – if only service providers could be empowered and the limited willingness to pay for services was not an obstruction.

Partners

AEPC

Investment by partners

AEPC assisted in the identification of SWP clusters by compiling and providing all available data of installed projects and their specific locations

Contribution by POSTED

POSTED conducted a field survey of 45 SWP users in the Chitwan, Morang, and Jhapa districts, gathering data on the problems faced with the system and the ability to pay for repairs. Potential service providers were identified and the in-principle feasibility confirmed. Then a pilot was conducted in a selected cluster in Jhapa and Morang. Expressions of interest (EoI) were solicited from service providers, offering support in the development of a new business area through training and tooling. Service providers were empowered for two levels: One for local service at the user's site without specialised services. The second level capable of providing specialised repair services. POSTED trained service providers, provided tools, brought them together with the 80 users in the cluster and monitored repair interventions for seven months during 2024.

Results achieved

The pilot yielded surprisingly positive results. From among 80 users a staggering 39 service requests were made over a period of seven months. 26 of the repair interventions were successful, and 22 of them paid for by users while four were done on a pro bono basis, which is helpful for establishing trust. Seven of the repair interventions required involvement of the second level of service providers providing specialised services. These results indicate that there is a market for repairs and that it can be catalysed to function with limited input, leaving pricing to the market itself.

Outlook: Future actions required

Though results are promising, the monitoring period was short, too short to arrive at definite conclusions regarding bottlenecks to may need to be addressed. A longer period of technical assistance and facilitation is required to prevent that this fledgling effort falls apart.

3. CREDITS

GIZ Project Team

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External Service Providers

All Three Media Ghar Pvt. Ltd., *TV episode "The Bravo Delta Show"*

Ohm Energy Nepal Pvt. Ltd., *Supply of solar PV training equipment*

Sustainable Energy & Technology Management (SETM) Pvt. Ltd., *Translations into Nepali* | *Digitization of groundwater data*

Smart Solutions Technology Pvt. Ltd., *Website development*

Yatri Design Studio Pvt. Ltd., *Remote monitoring system development, deployment*

Project Babies

Amalia, March 12, 2022

Aashwi, October 1, 2022

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