Global Environment Facility (GEF)

United Nations Development Programme (UNDP)

Alternative Energy Promotion Centre (AEPC)
Ministry of Energy, Water Resources and Irrigation (MoEWRI)

Terminal Evaluation

Renewable Energy for Rural Livelihoods (RERL)

UNDP PIMS no.: 4522 GEF PMIS no.: 4345
UNDP Project Id.: 00076958

NEPAL
GEF-5; GEF Climate Change Mitigation; CC3-Favorable policy and regulatory environment created for renewable energy investment, and Investment in renewable energy technologies increased.

Evaluation timeframe: March 2014 – June 2019

Final version

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Disclaimer

Please note that the analysis and recommendations of this evaluation report do not necessarily reflect the views of the United Nations Development Programme, its Executive Board or the United Nations Member States. This publication reflects the views of its authors.

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ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
ADCCN	Association of District Coordination Committees of Nepal
AEPC	Alternative Energy Promotion Centre
AWP	Annual Work Plan
BFI	Banking and financial institution
CEO	Chief Executive Officer
CEO ER	CEO Endorsement Request
CO	Country Office
CO_2	Carbon dioxide
CPP	Community-private partnership
CREF	Central Renewable Energy Fund
DDC	District Development Committee
DFID	Department for International Development (U.K.)
DFS	Detailed feasibility study
DPR	Detailed project report
DoED	Department of Energy Development
EA	GEF Executing Agency (UNDP Implementing Partner)
EE	Energy efficiency
ELC	Electric load controller
EoP	End of project
ESCO	Energy service company
ESMAP	Energy Sector Management Assistance Program (World Bank)
GEF	Global Environment Facility
GESI	Gender and social inclusion
GHG	Greenhouse gas
GIS	Geographic information system
GIZ	Gesellschafft für International Zusammenarbeit (Germany)
GoN	Government of Nepal
GWh	Gigwatt-hour (= 1 billion Watt-hour)
HPNET	Hydro Power Empowerment Network
IA	GEF Implementing Agency
ICIMOD	International Centre for Integrated Mountain Development
ISPV	Institutional solar photovoltaic
KfW	Kreditamstalt für Wiederafbau (Germany)
$ktCO_2$	Kilotons of CO_2
kW	Kilowatt
M&E	Monitoring and evaluation
MoALD	Ministry of Agriculture and Livestock Development
MoEWRI	Ministry of Energy, Water Resources and Irrigation
$MTCO_2$	Millions of tons of CO_2
NPM	National Project Manager
MEP	Municipal Energy Plan
MHP	Micro-hydro plant *or* micro-hydro power
MoU	Memorandum of Understanding
MSME	Micro, medium and small enterprises
MTR	Mid-Term Review
MW	Megawatt (= 1 million Watt)
MHDA	Nepal Micro Hydro Development Association
NACEUN	National Association of Community Energy Users
NEA	Nepal Electricity Authority
NRREP	National Renewable Rural Energy Programme

PEEDA	People, Energy and Environment Development Association
PIF	Project Identification Form
PIR	Project Implementation Review
PFS	Pre-feasibility study
PMU	Project Management Unit
PPA	Power purchase agreement
PPP	Public-private partnership
POV	Power output verification
PUE	Productive use of energy
RE	Renewable energy
RERA	Renewable Energy for Rural Areas
RERL	Renewable Energy for Rural Livelihoods
RET	Renewable energy technology
SASEC	South Asia Sub-regional Economic Cooperation
SDG	Sustainable Development Goal
SEMAN	Solar Equipment Manufactures Association of Nepal
SHS	Solar home system
SPV	Special purpose vehicle
TE	Terminal Evaluation
ToR	Terms of Reference
PV	Photovoltaic
tCO_2	Ton of carbon dioxide
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNCDF	United National Capital Development Fund
USD	United States dollar
VCD	Village Development Committee
WB	World Bank

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EXECUTIVE SUMMARY

Project Title:	**Renewable Energy for Rural Livelihood Project**			
GEF Project ID:	4345		*at endorsement (Million US$)*	*at completion (Million US$)*
UNDP PIMS ID:	4522	GEF financing:	3.00	3.00
Country:	Nepal	IA/EA own:	2.00	2.210
Region:	South Asia	Government:	30.313	42.276
Focal Area:	Climate Change Mitigation	Other:	24.494 (leveraged)	23.627
FA Objectives, (OP/SP):	CCM3-Favorable policy and regulatory environment created for renewable energy investment, and Investment in renewable energy technologies increased	Total co-financing:	56.807	62.903
Executing Agency:	Alternative Energy Promotion Centre (AEPC), Ministry of Energy, Water Resources and Irrigation (MoEWRI)	Total Project Cost:	59.807	65.903

Description of the Project

The Alternative Energy Promotion Centre (AEPC) was established in 1996 and is under the purview of the Ministry of Energy, Water Resources and Irrigation (MoEWRI) since 2018. AEPC is the key government body responsible for off-grid and renewable energy systems.

With donor support, AEPC has played a leading role in the development of rural renewable energy systems, notably micro-hydro mini-grids, solar home systems, solar water pumping, and biogas systems. It was realised that there is was niche for developing off-grid electrification with larger systems than had been the focus in past decades. For example, while micro-hydropower had a relatively significant share (15 MW), relatively few mini-hydropower projects (> 100 kW) had been added due to technical and organisational challenges. In comparison with micro hydro or individual solar home systems (SHS), larger mini-hydropower and village-scale PV systems offer better economies of scale (lower per unit cost), higher load utilisation potential (accommodating larger productive applications), and better revenue flows. Thus, these larger systems may be able to attract private sector investment and financing. However, the private sector generally has experience and know-how of smaller RE off-grid systems, but less so with larger systems (mini-hydro, solar mini-grids) and face manufacturing capacity constraints. Moving to larger systems implies an expansion of production capacity and hiring of external knowledge for which financing is needed. However, risk perception of banks and financial institutions to invest in rural areas to be very high.

In this context, the RERL project was formulated to support AEPC to remove barriers for scaling up of interventions which promote less disseminated larger renewable energy systems such as mini hydro, large micro hydro and large solar PV systems. The RERL has been funded by Global Environmental Facility (GEF) with a USD 3.00 million contribution and the United Nations Development Programme (UNDP) with USD 2.210 million, and co-financing by Government of Nepal (GoN) with leveraged financing (equity from private sector and communities, loans from banks).

The objective of the project is "*Removal of barriers to increased utilization of renewable energy resources in rural Nepal in order to support the economic, environmental, and social development of people in the rural areas and to reduce GHG emissions*". The core strategies of RERL with an emphasis on demonstration projects, private sector involvement for financing and attainment of financial sustainability through the promotion of productive use of renewable energy are driven towards the following specific four **Outcomes:**

1. Strengthened legal, institutional and policy environment to support RE and other low – carbon technology development and utilization
2. Increased investment in larger RE systems (mini hydro, grid connection, larger micro hydro; solar mini-grids and other larger solar PV applications)
3. Improved availability of financial investment supports and improved design and packaging of financial mechanisms for rural RE and other low-carbon technology applications
4. Enhanced capacities and skill of various stakeholders in the RE sector

A summary of the project's **main achievements** is summarized in the table below:

Subject	**RERL inputs provided**	**Shorter and longer-term impacts**
Objective		**Transformational change of rural energy market**
Component 1 Strengthened legal, institutional and policy environment to support RE and other low – carbon technology development and utilization		
Policy formulation: • 15th Periodic Plan (draft) • White Paper MoWRI (2018) • Draft REPC (Renewable Energy Promotion Centre) Act	Inputs provided by RERL: • Inclusion of commercial operation larger RE (mini hydro) and post installation support • Promotion of electric cooking (for optimal demand stimulation MHP) • Carbon tax (for RE promotion) • Municipal energy planning • Establishing AEPC as RE Centre of Excellence) and role in the federal context • Greater representation of local and provincial governments in AEPC governance • Establishment of local and provincial energy units and dedicated funds	• Included in energy-relevant parts/chapters of the 15th Plan • White Paper is guiding document for RE sector • Draft REPC Act (also referred to in reports as Draft AEPC Act) is under discussion at MoEWRI • Support Package for Local and Provincial Governments for the promotion of RE in Nepal. Support package includes model RE policy, methodology for MEP preparation, forms and formats for subsidy processing)
Draft RE Policy	RERL drafted and organized stakeholder consultation for feedbacks on RE Policy. Main elements include: • Feed-in tariff, power exchange agreement, net metering • National database management • Increased role of local governments with decentralized energy plans • Research and development • Carbon taxation as a sustainable means to subsidize RE sector • Diversifying energy mix • Linking energy targets with SDGs	Status: the draft RE Policy needs to be updated to reflect new federal context with local decision making
Decentralisation: • Local Government Operation Act (2017) • Municipal Energy Plans (MEPs)	• By reviewing elements of the new Constitution (2015), RERL did clarify and elaborated further the roles and responsibilities of the federal, provincial and local governments on RE activities; • Development of methodology for formulation of MEPs (energy vision and objective; analyse demand for energy in households, community/social and productive/commercial uses and identify least-cost option; identify electricity access and identify least cost (LCOE) electricity supply option	• Clarity on the roles and responsibilities of the local, provincial and federal government • Re-positioning of AEPC in the federal context • Localizing SDGs at the local level • 23 municipalities have been supported with their MEP formulation using RERL-developed methodology

Subject	RERL inputs provided	Shorter and longer-term impacts
RE Subsidy Policy (2016) and draft RE Subsidy Delivery Mechanism (2017)	RERL conceptualized with the following: • Based on energy service provision and promotion of least-cost (lowest LCOE) and best available technology rather than just subsidizing power capacity' • Enhancing the role of private sector form just technology vendors to service providers • Incorporating larger RE systems	• Private sector (including special purpose vehicles) are eligible for RE subsidy • Subsidy on energy services based on least-cost rather than equipment-based grants • Subsidy encompassing mini hydro • In solar pumping, subsidy extended to solar irrigation
Grid connection and system interconnection	• Prepared technical standards for grid interconnection that was approved by NEA Board • Posted tariff applicable for MHPs even if subsidy has been provided during construction	• Equipment standards, specifications and guidelines for connection of small-scale hydro and solar PV mini grids
Sustainable Energy for All (SE4All)	• RERL team carried out Rapid Assessment and Gap Analysis (RAGA) on clean energy access in Nepal for SE4ALL	• World Bank ESMAP is monitoring country performance under multi-tiered framework (MTF) • The World Bank ESMAP recently studied clean energy access in Nepal
Component 2 Increased investment in larger RE systems		
Mini hydro projects[1] (0.1-1 MW)	• Technical assistance (TA) for 9 mini-hydro projects with a total capacity of 3.53 MW are completed or under construction. RERL support includes site identification, feasibility study, financial closure, procurement, construction supervision, social mobilization and institution setup and post-installation support • TA for Detailed Feasibility Study (DFS) of 10 other mini-hydro projects and five Pre-Feasibility Studies (PFS) carried out	• Completed three mini hydros (total, 0.782 MW; Juddi, Simrutu and Tara Khola) • Six under construction (2.748 MW; Giri, Phawa, Bom, Khatyad, Chukeni and Junbesi Khola) • Pipeline of 15 mini hydro (9.4 MW in total, of which 7.9 MW with completed DFS or PFS)
Larger micro hydro projects (MHP; over 60 kW)	TA including DFS, TRC approval, monitoring and POV provided for 54 (60kW+) micro-hydro project with a total capacity of 4.35MW benefiting over 36,000 households	• 46 MHPs have been constructed (4.34 MW in total). • Rapid assessment of 140 MHPs and 104 MHP systems were supported by AEPC and RERL as part of post-earthquake relief and rehabilitation (3.10 MW)
Grid connection and MHP-interconnection	TA for MHP interconnected Gulmi and Taplejung Mini Grids (site identification, feasibility study, identification of suitable technology, procurement, construction supervision, institution setup and post- installation support and capacity development of local private sector on design and fabrication of load controller).	Nepali companies are capable to design and fabricate ELC for MHP to MHP interconnection and MHP to Grid Interconnection. Following MHPs have been connected with the grid (Syauribhumi, Leguwa Kh., Chimal Kh., and Midim Kh.; 0.254 MW). Five MHPs in Tapiejung and two MHPs in Gulmi have been interconnected (0.544 MW in total)
Solar PV demonstration projects	• TA provided to a total of 0.78 MW of solar PV systems (site identification, feasibility study, procurement, institution setup and post-installation support), including:	• 22 solar mini-grids are completed (0.67 MW), of which 8 SASEC-funded and nine solar PV systems are grid-connected (2.32

[1] Mini hydro: 100 kW-1 MW; micro hydro: 5 to 100 kW; pico hydro < 5 kW

Subject	RERL inputs provided	Shorter and longer-term impacts
	• TA for Grid Interconnection of 2.32 MW Solar PV (MK Paper Mill, CIAA, NEA, KU, TUTH) • TA for 50 KfW-funded solar pumping projects • Conceptualized and implemented different innovative solar PV projects in collaboration with UNESCAP, SNV, KfW, Korean Govt. (Energy for Education, E4E; Energy for Health, E4H; Energy for Irrigation, E4I; Energy for Micro Industrial)	MW, including the 1 MW Nawalparasi solar) • AEPC and RERL have promoted over 1,400 solar water pumping systems • Installation of over 1,200 institutional solar PV (schools, health, offices) with 1.63 MW in total (of which 258 systems, 0.80 MW, as part of relief and rehabilitation)
Component 3	*Improved availability of financial investment supports and improved design and packaging of financial mechanisms for rural RE and other low-carbon technology applications*	
Financial mechanism and support to Central Renewable Energy Fund (CREF)	• Preparation of CREF's business plan, in collaboration with UNCDF • Study on the reluctance of banks and financial institutions (BFIs) to fund RE projects • Prepared Vendor Financing Manual and provided fund (in collaboration with UNCDF) • Designed Financial Instruments for RE projects and provided USD 600,000 to support these ○ Credit guarantee ○ Soft credit ○ Vendor financing ○ Vendor Challenge Fund ○ LFI/MFI Lending (local/micro-finance) ○ Project insurance	• CREF operational as the financial intermediary for AEPC supported RE projects • Financial closure of 7 mini-hydro projects (with loans provided by commercial banks, backed up with CREF financial mechanisms)
Productive uses of energy (PUE)	• Commercial Operation of mini/micro hydro ○ Conceptualization ▪ Institutional strengthening to address collective action problems by formulating and following incentive-based Rules and Regulations, ▪ Computerized financial management, ▪ Business opportunity assessment for productive end uses ○ Supported 25 micro/mini hydropower facilities • Technological adaption and field testing of equipment for fuel switching (lokta/Allo boiler and dryer; Khuwa making machine, cardamom dryer, sisno Dryer; tea/ginger dryer;soap making) and for electric cooking	• Some 2,543 PUE enterprise have received some form of assistance (1480 with AEPC subsidy; 1063 from RERL survey) • Guidelines for Commercial Operation of MHP formulated; • Enhanced sustainability of micro-hydro and solar mini-grids
Component 4	*Enhanced capacities and skill of various stakeholders in the RE sector*	
Capacity development	• 168 engineers and technicians trained on different aspects of survey and design of mini hydro, large micro hydro and large-scale solar PV systems • 5 local engineering firms trained for manufacture, fabrication and repair maintenance of mini-hydro, large micro-hydro and large-scale solar PV system • 215 engineers and technicians trained for installation of mini hydro, large micro hydro and large-scale solar PV systems	Apart from enhanced capacity and skills of individuals, the technical capacity of a number of companies has been strengthened (Preesu Electronics, Techno Village; Hydro Energy Concern, SuryaPower) on grid connection, on PUE (e.g. SunWorks, Sisno dryer) and strengthened MHP management (e.g. Darna Cooperative)

Subject	RERL inputs provided	Shorter and longer-term impacts
	• 563 people trained for the operation of mini hydro, large micro hydro and large-scale solar PV systems	
Gender and social inclusion (GESI)	• Women received training on house wiring, entrepreneurship, development business management, selected technical skills development, financial literacy, cooperative management and various income-generating activities • Special projects targeting marginalized communities promoted with financial support from UNDP and other partners; ○ Solar Mini Grid for Santhal community in Morang and Dalits in Parsa ○ Power backup for 9 snakebite treatment Centres in the Terai and 12 health posts/birthing centres in remote districts ○ Solar solutions for better lighting, clean water supply and operating micro industries for 46 Chepang families in Dhading	• Over 1000 women are engaged in saving and credit schemes in different RE projects enhanced to manage cooperatives; • Capacity of women and members of marginalized communities enhanced to benefit from access to electricity and clean energy; • Capacity of women enhanced to manage cooperatives • Additional income and access to finance for women to engage in income-generating activities

Note:
in addition to these GEF-financed activities, the RERL team carried out assignments funded by other donors. For example, a Rapid Assessment and Gap Analysis (RAGA) on clean energy access in Nepal was carried out for SE4ALL (Sustainable Energy for All). World Bank's ESMAP is monitoring country performance under multi-tiered framework (MTF) and has recently studied clean energy access in Nepal.

Summary of ratings

1. Monitoring and Evaluation	*rating*	2. IA& EA Execution	*rating*
M&E design at entry	S	Quality of UNDP Implementation	S
M&E Plan Implementation	S	Quality of Execution - Executing Agency	HS
Overall quality of M&E	*S*	*Overall quality of Implementation / Execution:*	*HS*
3. Assessment of Outcomes	**rating**	**4. Sustainability**	**rating**
Relevance	R	Financial resources:	L
Effectiveness	HS	Socio-economic & stakeholder capacity	L
Efficiency	S	Institutional framework and governance:	L
Overall Project Outcome Rating	*HS*	Environmental:	L
		Overall likelihood of sustainability:	L

Ratings for Outcomes, Effectiveness, Efficiency, M&E, IA&EA Execution

6: Highly Satisfactory (HS): no shortcomings
5: Satisfactory (S): minor shortcomings
4: Moderately Satisfactory (MS)
3. Moderately Unsatisfactory (MU): significant shortcomings
2. Unsatisfactory (U): major problems
1. Highly Unsatisfactory (HU): severe problems

Additional ratings where relevant:
Not Applicable (N/A)
Unable to Assess (U/A)

Sustainability ratings:

4. Likely (L): negligible risks to sustainability
3. Moderately Likely (ML): moderate risks
2. Moderately Unlikely (MU): significant risks
1. Unlikely (U): severe risks

Relevance ratings

2. Relevant (R)
1. Not Relevant (NR)

Impact Ratings:

3. Significant (S)
2. Minimal (M)
1. Negligible (N)

Conclusions

RERL was originally designed to support implementation of the Government of Nepal's umbrella project on renewable energy – Nepal Rural Renewable Energy Programme (NRREP), implemented by AEPC with multi-donor funding. During the reporting period, the project witnessed major changes, to which AEPC/RERL in mostly responded positively, such as the closure of NRREP (2017), the devastating 2015 earthquake, political issues and border blockades, and the new Constitution (2015) giving Nepal a federal structure. Amidst the challenges and changes, RERL has performed well, turning challenges into opportunities. The Evaluators also noticed excellent coordination and cooperation with a range of stakeholders in national government and local government entities, RE importers, manufacturers and vendors, banks and financial institutions, communities and community leaders, as well as with various development partners and international NGOs. One good example is the partnership with ADB SASEC programme, in which RERL provides technical assistance and SASEC the necessary grant and loan funding. Implementation, therefore, is considered as '*highly satisfactory'.*

In the end, RERL has achieved and in many cases, over-achieved project targets and has been able to provide an array of service areas ranging from policy instruments, guidelines and standards, inputs into legislations, innovative financing options, capacity building of the local community members, developers and banks, empowering women, creating conducive environment for enterprise development, scaling up RE technologies and piloting new avenues such as grid-connection of RE systems. In short, RERL has managed to bring about fundamental transformational changes in thinking about rural and decentralised RE in Nepal at community and local level, private sector and banking and at national level. The Evaluators consider the final project outcome as *'highly satisfactory'.*

The partnership RERL-SASEC will continue (with part of RERL project funding provided by SASEC through UNDP) until December 2021. RERL will also work closely with other AEPC-implemented projects, such as World Bank's Private Sector-led Mini-grid, the GIZ RERA Project, and the SNV project on health posts and centres. CREF will be further boosted with funding from the NREP (DFID-funded) project (GBP 10 million).

Recommendations

Knowledge dissemination

- *(RERL project Team).* The Project has generated a lot of information and knowledge, which is however scattered over a multitude of progress and quarterly reports, videos and small case studies. Masked by facts and factoids it is difficult for the occasional reader to search for and digest the wealth of information. One suggestion is to make a good colour-printed publication to be distributed widely. This should summarise not only the info available in various documents and reports, but also provides insight into what works and what does not. Rather than describing just results and best practice examples on a RE project-by-project basis, it is interesting to know *how* results were achieved and by which mechanisms.
- *(UNDP CO).* Such a publication on scaling up (off-grid) RE in Nepal could be followed by a general UNDP publication on mini-grids and large RE systems, incorporating experiences in other countries as well. First, this will increase UNDP's visibility in this field internationally, and second, it can be a valuable source of knowledge for UNDP staff.
- *(UNDP Hqs.)* UNDP has a 'Community of Practice' on energy and environment so that information and data are conserved.However, being part of UNDP's Intranet, the wealth of information on projects, past experiences, designs and work planning, is not easily accessible for 'outsiders'. However, such results and lessons learned from past and ongoing would be of high interest for practioners that frequently do assignments for UNDP, such as evaluators, design consultants or technical experts. A suggestion is to make part of UNDP's knowledge network on rural and renewable energy accessible for practitioners that frequently work with UNDP. Such a network could function as a depository of information (reports, documents on rural RE and mini-grids), relevant UNDP documents (UNDP reports, project documents, evaluation reports, Terms of reference), and as a forum to exchange information and views.

Rural and renewable energy planning

- *Grid connection (AEPC, RERL Team).* While grid-connection of off-grid systems has been pioneered by RERL, it is still in an infant stage. Regulations permit the off-grid system to sell power to the grid under an agreed PPA, i.e. as a

small power producer. here are other modalities possible, e.g. continue as small power distributor (or subcontracted by NEA for this purpose) or as retailer, or a combination of modalities, which should be investigated further.

- *Least-cost rural renewable energy options (AEPC, RERL Team).* While "private sector-led, upscaled" mini-grids have the focus attention of the development partner community, it should not be forgotten that these provide a niche area in electrification between grid extension and small rural RE systems. There will be still many communities that are either too far or with households to widely dispersed or are too poor to have everyone connected to the main grid or a mini-grid. It is important that the Municipal Energy Plans to be formulated have a holistic view, and consider grid connection, alongside smaller RE options (micro-hydro, solar home systems) and larger RE system (mini-hydro, solar mini-grids) and potential grid connection, as appropriate given size, distance, transportation barriers, and PUE opportunities of the area/community concerned. Here, the assistance of the RERL team will be very much needed.
- *Viability of micro hydro minigrids (AEPC).* There are over 1700 micro hydropower plants installed with inconsistent success rate; many face operation and maintenance issues, rehabilitation of such systems remains important as well as stimulating demand by promoting PUE opportunities and establishing an adequate local RE system governance. These micro facilities still will play an important role (until or even after the grid arrives) and, in the drive for scaling up RE systems, should not be forgotten in AEPC's programming. Post-installation support has successfully been supported by RERL but needs more internalization into the RE systems in Nepa, especially in the community owned and managed systems.
- *Continuation of RERL.* RERL will continue under UNDP-AEPC with ADB/SASEC support until the end of 2021. It is important to have a longer-term plan for AEPC's rural and renewable energy activities and the role of a team like RERL therein. Embedded in AEPC structure, the RERL Project has been able to advuice and convince government decision-makers, while, on the other hand, its more autonomous role as a 'project' has enabled the team to work as an honest broker with private sector and non-government entities.
- *Future UNDP-supported rural renewable energy activities.* UNDP might consider supporting the above-mentioned areas in a new post-RERL activities. The purpose of such a new project would not be to repeat what RERL has done. In terms of technology innovation we can argue that RERL has been instrumental in bring larger RE off-grid technology from the stage of 'demonstration' to 'deployment'. The next step in the technology innovation cycle is to bring it to the next level, i,.e. from 'deployment' to larger-scale dissemination'.

Lessons learnt

The importance of RERL is in demonstrating that barriers to promote larger and lesser disseminated RE technologies including mini-hydro, grid interconnection, solar mini-grid and solar pumping, can be lowered. One can say that RERL has initiated a market change in which private sector and local communities increase investments in larger RE, run existing micro mini-grids more efficiently, policy decision-makers at national and local level engage in building an enabling environment (with appropriate policy instruments and incentives) and in which BFIs recognize the economic potential of larger and grid-connected RE and make finance available.

Some lessons learnt are:

- An autonomous agency (such as AEPC in Nepal) is important in drafting rural and RE policy document, formulation of regulation and guidelines, coordination with donor agencies and development partners as well as for information dissemination and knowledge management.
- To avoid conflicts of interest and reduce transaction, the management of financial incentive scheme (CREF) is subcontracted to a local financial institution, in which AEPC provides technical assistance and CREF the financial assistance (subsidy and a portfolio of financing instruments, such as soft loan, guarantee schemes, project insurance, vendor financing).
- Grants will continue to be widely used given the high investment cost of decentralized rural electricity options. However, these should be carefully designed to ensure project sustainability over the lifetime (not only at project initial investment) and to leverage equity and capital from local and other national sources.
- From local entrepreneurs to national equipment providers, there is growing interest from the private sector in the development, financing, operation, and management of mini-grids. Combining technology with new business and financing models, the private sector is interested in and can deploy mini-grid solution.
- In order to do so, (local) private sector must have the legal right to generate, distribute and sell electricity to (rural) consumers.

- Unexpected arrival of the main-grid is a major risk faced by mini-grid operators. Appropriate interconnection and/or compensation mechanisms allay risks associated with main grid arrival.
- Access to electricity has substantial forward linkages for rural development, marked by considerable improvements in productivity, income, and livelihoods, all of which produce spill-over effects. Therefore, policymakers should not only examine the opportunities that mini-grid solutions offer for electrification but to other facets of sustainable development. At the same time, rural development in the form of productive uses will stimulate demand for power and the additional revenue stream adds to the RE system's profitability.

1. INTRODUCTION

1.1 Purpose of the Terminal Evaluation and objectives

1.1.1 Background

Renewable Energy for Rural Livelihood (RERL) is funded by the Global Environmental Facility (GEF) and the United Nations Development Programme (UNDP). RERL is developed as an integral part of the Alternative Energy Promotion Centre (AEPC)'s rural and renewable energy programme, which is supported by donors and the government in an integrated way. Specific components, particularly on mini/micro hydro and large solar PV systems are included in the GEF-UNDP RERL project baseline activities.

The main objective of RERL is to support AEPC to remove barriers for scaling up promotion of less disseminated renewable energy systems such as mini-hydro, large micro-hydro and large-solar PV systems (e.g. solar mini-grids or solar irrigation). RERL intends to provide incremental support to AEPC's rural and renewable energy programme by providing technical assistance for developing sustainable implementation modalities.

1.1.2 Purpose of the Terminal Evaluation (TE)

With RERL ending in July 2019, a Terminal Evaluation needs to be undertaken of the project in accordance with the UNDP and GEF Monitoring and Evaluation (M&E) policies and procedures. The TE has to be carried out by independent consultants, i.e. not previously involved in project design or implementation. In a competitive process, two experts were chosen to undertake the TE, Mr. Johannes (Jan) van den Akker (Netherlands) and Mr. Dhruba Gautam), hereafter referred to as the "Reviewers".

The evaluation has assessed the performance of RERL, based against expectations set out in the Project Logical Framework/Results Framework, which provides performance and impact indicators for project implementation along with their corresponding means of verification. The evaluation has covered the criteria of relevance, effectiveness, efficiency, sustainability and impact. The TE then assessed the key financial aspects of the project, including the extent of co-financing planned and realized. It assessed the extent to which the project was successfully mainstreamed with other UNDP priorities, including poverty alleviation, improved governance, the prevention and recovery from natural disasters, and gender. The evaluators also looked at to the extent to which the project is achieving impacts or progressing towards the achievement of (intended or unintended) impacts...

1.2 Scope and methodology

Evaluation criteria

The terminal evaluation is based on the OECD-DAC[2] criteria of *relevance, effectiveness, efficiency, sustainability, and impact*. The rating has taken place according to the evaluation criteria using the rating scales recommended in the UNDP *Guidance for Conducting Terminal Evaluation of UNDP-supported, GEF-financed Projects* (2012)[3] and given in Box 1 Rating and rating scales for evalution criteria in UNDP/GEF projects.

[2] Organisation for Economic Cooperation and Development (OECD) – Development Assistance Committee (DAC)

[3] Other guidelines consulted are those presented in the UNDP *Handbook on Planning, Monitoring and Evaluating for Development Results*, *Updated Guidance on Evaluation* (2012), the UNDP Discussion Paper: *Innovations in Monitoring & Evaluating Results* (2013) and the GEF *Review of Outcomes to Impacts (ROTI) Handbook* (2009). Regarding gender aspects, the evaluation refers to the *Guide to Gender Mainstreaming in UNDP Supported GEF Financed Projects* (2016).

Box 1 Rating and rating scales for evalution criteria in UNDP/GEF projects

1. Monitoring and Evaluation	*rating*	2. IA& EA Execution	*rating*
M&E design at entry		Quality of UNDP Implementation	
M&E Plan Implementation		Quality of Execution - Executing Agency	
Overall quality of M&E		*Overall quality of Implementation / Execution:*	
3. Assessment of Outcomes	**rating**	**4. Sustainability**	**rating**
Relevance		Financial resources:	
Effectiveness		Socio-political:	
Efficiency		Institutional framework and governance:	
Overall Project Outcome Rating		Environmental:	
		Overall likelihood of sustainability:	

Ratings for Outcomes, Effectiveness, Efficiency, M&E, IA&EA Execution

6: Highly Satisfactory (HS): no shortcomings
5: Satisfactory (S): minor shortcomings
4: Moderately Satisfactory (MS)
3. Moderately Unsatisfactory (MU): significant shortcomings
2. Unsatisfactory (U): major problems
1. Highly Unsatisfactory (HU): severe problems

Additional ratings where relevant:
Not Applicable (N/A)
Unable to Assess (U/A)

Sustainability ratings:

4. Likely (L): negligible risks to sustainability
3. Moderately Likely (ML): moderate risks
2. Moderately Unlikely (MU): significant risks
1. Unlikely (U): severe risks

Relevance ratings
2. Relevant (R)
1. Not Relevant (NR)

Impact Ratings:
3. Significant (S)
2. Minimal (M)
1. Negligible (N)

The ratings in this report have been determined based on the project progress reporting and the analysis the Reviewers carried out of the available information and comparing these with observations from the mission (interviews with stakeholders and site visits) and checking with information presented in project technical reports and policy and background documents. To gather empirical data and information relevant to project, the evaluators carefully designed several instruments. They included simple and concise tools and technique and checklists and guide questions for use in collecting primary information. All tools were designed to address the key questions (grouped according to the before-mentioned OECD-DAC criteria) that were part of the Inception Report of the evaluation assignment. Annex D gives the matrix of evaluative questions.

Approach

The TE has been based on the following *sources of information*:

- Desk review of progress reports and project documents (listed in Annex C),
  - CEO Endorsement Request (CEO ER) and annexes; annual progress reports (PIRs, project implementation reviews); other progress reporting and PowerPoints;
  - Mid-term review (MTR) report
  - Overview of budget expenditures and realized co-financing; annual work plans
  - Project technical reports and description of outputs;
  - Project or counterparts' websites; PowerPoints
  - National policy documents on (renewable and rural energy) as well as other relevant reports, PowerPoint presentations, and documents from counterpart organizations.
- An evaluation mission of 10 working days (including a five-day field visit) to meet UNDP, AEPC, and the Project Team and to hold interviews with project partners and stakeholders. A list of project partners and stakeholders met is provided in Box 5. The meetings and interviews helped the reviewers to obtain in-depth information on impressions and experiences and to explore opinions about the Project and their understanding and identify opportunities
- A presentation of the initial findings was made at the end of the evaluation mission (on 15/06/2019).

Box 2 Evaluation method and approach

Regarding *data analysis and methods for analysis*, many relevant reports and documents were collected (where possible before the mission). The review of project and background documents (listed in Annex C) provided the basic facts and information for developing the terminal evaluation report, giving basic insight into progress (target vs. progress) and reasons for under and over achievements were explored.

The evaluation mission (1-15 July 2019) served to verify these basic facts, get missing data and to learn the opinions of stakeholders. The mission basically consisted of two parts, a) meeting stakeholders based in Kathmandu (see Annex B), and b) field visits to selected sites that have received RERL support. In Kathmandu, key informant interviews were made with the representatives of different sectors viz. (i) government ministries: Ministry of Finance and Ministry of Energy, Water resources and irrigation; (ii) AEPC: senior management and component heads; (iii) non-government sector: Winrock international, Practical Action, SNV, PEEDA; (iv) financial sector: Civil bank, NMB Bank, CREF officials; (v) projects: RERA/GIZ, NREP/DFID, SASEC/ADB, Nepal Mini Grid/WB; (vi) UNDP, (viii) private sector: SunFlower Pvt Ltd, Pressu Pvt Ltd, and SEMAN, etc.

To get the empirical data, the evaluators visited (i) Tarakhola Hydro Company Limited, Tarakhola, (ii) Brother Noodle Factory, Kharbang, (iii) Baglung Kalika Metal Workshop, Kharbang and (iv) Girindi Khola Micro-Hydro Cooperative Ltd in Baglung district. Similarly, the evaluation team visited (i) Solar pumping for commercializing vegetable farmers, (ii) Marangburu Solar Mini Grid, Jahada Rural Municipality Ward 7, and (iii) Solar water pumping system promoted by Sunflower Pvt. Ltd, (iv) Snakebite Treatment Center and (v) Ramitekhola Solar Mini-grid (30kWp) in Morang and Sunsari districts. In Baglung, Morang and Sunsari districts, the team carefully discussed with the real beneficiaries of the project.

Thus, information has been collected using participatory tools and techniques like focus group discussions (FGDs), key informant interviews, competency analysis (to assess the projects' strengths, weaknesses, opportunities, and threats), most significance change, observation, site visits, and walks. In order to acquire personal and detailed opinions about projects interventions, a total of four FGDs (field visits), 32 key informant interviews (Kathmandu and field visit), and four competency analyses (field visits; summarised in Annex E) were conducted. Key informants in the field included ward and municipality office-bearers, leaders of people's organizations, teachers, and representatives of political parties. Special care was taken that gender-related issues were properly addressed and that people interviewed had a fair representation of women and socially disadvantageous groups. In addition to these, evaluators also interacted with relevant RERL staff at Kathmandu and the field to validate the information collected from the different sources.

Triangulation (interviews, focus group discussion, and document analysis) have allowed validation of information through cross verification from two or more sources. In appraising the result-wise effectiveness of the program's major interventions, evaluators thoroughly assessed targets against progress. To supplement this information, the evaluators used information provided by the Project Team[4] and later cross-checked during the field visits. All these process and methods helped evaluators to gather plenty of evidence about the outcomes of the project. Along with collecting qualitative information, evaluators managed quantitative data from the PPts and progress reports (annual progress reports and PIRs) and interpreted where relevant. The evaluators then tabulated, synthesized, and analysed the primary, secondary, qualitative and quantitative data collected in order to arrive at their preliminary findings,

[4] PowerPoints, RERL Achievements, annual progress reports

conclusions, and recommendations that were shared at a meeting of the Project Executive Board. A draft report was shared with RERL/UNDP in the agreed format and the report was finalized after incorporating feedback and suggestions.

1.3 Structure of the TE report

This report contains the report body, executive summary, and annexes. The body of this report is structured around the following chapters; it starts with an introduction to the objectives, scope, and methodology of the terminal evaluation (Chapter One), description of the project context and a summary of project facts (such as start date, duration, the context in which the project started), its objectives and stakeholders (Chapter Two).

The assessment and formulation of the "findings" have been guided by the questions of the "evaluative matrix", of which a final draft was formulated at the inception stage of the assignment (see Annex D)[5]. The report follows the outline for terminal evaluations of UNDP/GEF projects[6] but has split the suggested chapter on "Findings" in three parts for practical reasons due to the chapter size and to permit a more reader-friendly presentation of the information. Findings on relevance, design, and formulation are in Chapter Three. Findings on project implementation and monitoring are presented in Chapter Four. An overview of progress regarding the achievement of outcomes and outputs is given in Chapter Five, which ends with a presentation of findings regarding replication effects and sustainability. Chapter Six presents the conclusions, recommendations, and lessons learned from the project. These include actions that might be taken (by the Government) to help ensure the sustainability and continuity of project achievements, as well as steps that can be taken by UNDP (and GEF) to help improve the design and implementation of future projects.

In development projects, 'results' are the describable or measurable development change resulting from a cause-and-effect relationship. These results include project outputs, short- to medium-term outcomes, and longer-term impacts, (including global environmental and development benefits).

The achievement of the results and the longer-term sustainability thereof is influenced by the:

- way project was formulated and designed (discussed in Chapter 3);
- way the project was implemented by the various project partners (discussed in Chapter 4);
- occurrence and impact of internal and external risks (discussed in Chapter 5).

Annexes at the end of the report include the Terms of Reference (Annex A), field visit details and list of organisations and people interviewed (Annex B), documents collected and bibliography (Annex C), evaluation questions and methodology (Annex D), and, summary of field visits (Annex E).

[5] See the *Inception Report* of the Terminal Evaluation (June 2019)

[6] See Annex F, 'Evaluation Report Outline' in the UNDP *Guidance for Conducting Terminal Evaluations* (2012)

2. PROJECT DESCRIPTION AND BACKGROUND

2.1 Context and problems that the project sought to address

Nepal's electricity grid is very dependent on large hydropower. In 2018, about 968 MW out of the installed capacity of about 1,021 MW hydropower, of which 527 MW of hydropower generation is owned by the Nepal Electricity Authority (NEA), and the remaining 441 MW by independent power producers (IPPs)[7]. Despite vast hydropower resources in Nepal, there is still a general shortage of electricity. Demand for electricity outstrips supply; peak demand was estimated at 1,385 MW and increases about 7.9% annually. To bridge the supply-demand gap, Nepal increasingly imports electricity from India, about 18%. In 2016, electricity requirements were 6,920 GWh, while total supply was 5,100 GWh (including 1,758 GWh of imports from India) leaving a supply shortage of 1,820 GWh. Furthermore, most of the hydropower facilities are run-of-the-river, implying large seasonal fluctuations in power generation. Thus, the country's current dependence on large centralised hydropower is especially obvious during the dry season (or winter months) when hydropower generation is lowest and electricity demand highest, forcing the Nepalese Electricity Authority to massive scheduled power cuts[8].

In 2010/11, when GEF RERL was conceptualized, only 60% of the population had access to electricity. In 2011, about 15% of (rural) households were provided with solar PV electricity (7.5 MW), and by pico and micro-hydro (up to 100 kW) with a total capacity of about 18.7 MW. By 2016, about 75% of Nepalis have access to electricity, with 97% for the urban population in rural areas the figure drops to 61% Large hydro development has high costs per unit installed due to topography and unfavourable hydrology and geology. At the same time, the purchasing power of rural consumers is often very low. Therefore, off-grid renewable energy systems are seen as a key means of reaching the 40% of the rural population still lacking access to electricity. There is a large potential to develop small-scale hydropower (> 180 MW) and solar PV in rural areas[9].

Donor support has played a leading role in the development of off-grid renewable energy systems in Nepal over the past 17 years. In 1996, UNDP initiated large-scale donor support in the sector with the launch of its Rural Energy Development Program (REDP), implemented during 1996-2011, to support rural energy system development, including micro-hydro, through a community mobilization and enhanced livelihood approach. REDP achieved a total installed capacity of 7.5 MW of micro-hydro.

Denmark and Norway supported the Energy Sector Assistance Program (ESAP) during 1999-2012, which also substantial emphasis on micro-hydro. The Renewable Energy Project (REP), a joint effort by the European Union and the Government of Nepal (GoN) focused on the provision of solar energy systems in rural areas. ESAP, REDP and REP were combined with the aim of having a single modality, the NRREP (National Rural and Renewable Energy Programme (2012-2017).

AEPC was established in 1996 under the Ministry of Science, Technology and Environment (MOSTE) and is now under the Ministry of Energy, Water Resources and Irrigation (MoEWRI). AEPC is the key government body responsible for off-grid systems. The Alternative Energy Promotion Centre (AEPC) was the executing agency for NRREP. The NRREP programme had three components:

- Central Renewable Energy Fund (CREF), responsible for delivery of subsidies and credit support;
- Technical Support, to accelerate renewable energy service delivery with better quality, comprising various technologies, to remote rural households, enterprises, and communities.
- Business Development for Renewable Energy and Productive Use of Energy, through the promotion of micro, small, and medium-sized enterprises (MSME) in rural areas.

The NRREP represents the collective baseline activities in the country on renewable energy. However, it was realised that a number of barriers might prevent the Programme from achieving its targets. In comparison with previous years,

[7] Retrieved https://kathmandupost.com/opinion/2018/03/18/hydro-powered-dreams-20180318082906. Thermal plants: 53 MW

[8] ADB *Nepal Energy Sector Assessment, Strategy and Road Map* (2017)

[9] Statistics taken from UNDP RERL *Project Document* and ADB *Nepal Energy Sector Assessment, Strategy and Road Map* (2017)

the pace of installations needed to be ramped up. Financial sustainability of systems has been an issue with revenues often not enough to cover the annual cost of operation, repair, and maintenance. Domestic manufacturing has focussed on smaller systems and facing difficulties in lowering the cost of equipment. Private sector and banks have been hesitant in investing in off-grid systems in view of commercial viability issues. It was realised that there was a niche for developing off-grid electrification with larger systems than had been the focus in past decades. For example, while mini-hydropower has a relatively significant share (15 MW), relatively few mini hydropower projects (> 100 kW) have been added in recent years due to technical and organisational challenges. In comparison with micro-hydro or individual solar home systems (SHS), larger mini-hydropower and village-scale PV systems offer better economies of scale (lower per unit cost), higher load utilisation potential (accommodating larger productive applications), and better revenue flows. Thus, these larger systems may be able to attract private sector investment and financing.

However, barriers for moving to larger RE systems, have been the high up-front cost of renewable energy technologies and. To this can be added, that the private sector generally has experience and know-how of smaller RE off-grid systems (micro-hydro; individual solar PV), but less so with larger systems (mini-hydro, solar mini-grids) and face capacity constraints. Moving to larger systems, implies an expansion of production capacity and hiring of external knowledge for which financing is needed. However, risk perception of banks and financial institutions to invest in rural areas to be very high. BFIs question the financial sustainability of rural energy projects due partly to low utilization factor and limited technical capacity for smooth operation.

For this reason, the RERL project was formulated to support AEPC to remove barriers for scaling up of interventions which promote less disseminated larger renewable energy systems such as mini hydro, large micro hydro and large solar PV systems. NRREP's five-year target is to add 25 MW from micro and mini-hydropower facilities which forms the baseline for RERL. The value added of RERL intervention is that a bigger proportion of NRREP's off-grid installed capacity targets will be met by larger renewable energy systems of at least 12.5 MW (of which 8 MW of mini hydro, 2 MW of larger micro hydro and 2.5 MW of large-scale solar PV). By employing larger off-grid hydropower systems, it is hoped that NRREP's five-year 25 MW target will achieve a much higher level of sustainability.

2.2 Project description and strategy

2.2.1 Objective, outcomes and indicators

The RERL is funded by Global Environmental Facility (GEF) with a USD 3.00 million contribution and the United Nations Development Programme (UNDP) with USD 2.00 million, and co-financing by Government of Nepal (GoN) contributions of USD 30.31 million (total project budget of USD 35.31 million) and expected leveraged funding from private sector, local government and others of USD 20.49 million.

RERL became operational after the GoN and UNDP signed the project document in July 2014. The inception workshop was organized in December 2014. Following the Gorkha earthquakes of April/May 2015 and hundreds of aftershocks that caused large-scale destruction in 14 districts of central Nepal, some of the project interventions were aligned as part of the Relief and Rehabilitation Package based on renewable energy solutions for the affected communities and individuals. A Mid-Term Review (MTR) of Project was commissioned in January 2017 to (i) evaluate the progress towards the attainment of project objectives and outcomes as specified in the Project Document, (ii) assess early signs of project success or failure with the goal of identifying the necessary changes, and (iii) review project's strategy and challenges to its sustainability. As the project is completing its implementation cycle, planned to be operationally closed by end July 2019, a Terminal Evaluation (TE) has to be undertaken as per GEF and UNDP procedures.

The **objective** of the project is "Removal of barriers to increased utilization of renewable energy resources in rural Nepal in order to support the economic, environmental, and social development of people in the rural areas and to reduce GHG emissions". The core strategies of RERL with an emphasis on demonstration projects, private sector involvement for financing and attainment of financial sustainability through the promotion of productive use of renewable energy are driven towards the following specific four Outcomes:

Outcome 1: The RERL Project focusses on strengthening the legal, institutional and policy environment for renewable energy promotion in the country. It supports the formulation of a private-sector investment-friendly policy following public-private partnership (PPP) models, supporting district development process by integrating larger systems in their planning process, providing training cum orientation to government officials and relevant stakeholders on planning and policies. It is expected that removing barriers in the policy and institutional arrangements will help promote mini-hydro and large solar PV systems by attracting private investment and financing.

Outcome 2: To demonstrate financial attractiveness and technical viability of larger renewable energy (RE) systems, RERL provides technical assistance to promote mini-grids powered by mini-hydro (and micro-hydro), and larger solar PV demonstration projects in different parts of the country. Once demonstration projects are completed, it is expected that the private sector will be encouraged to investing in renewable energy in rural areas and will be willing to develop projects that will benefit rural population with access to modern energy systems.

Outcome 3: To enhance the availability of RE financing through establishing financing instruments for manufacturers and developers and ensuring sustainability, RERL has supported AEPC in setting up the Central Renewable Energy Fund (CREF) to develop innovative financing mechanisms such as soft credit, credit guarantee, credit insurance and vendor financing in order to reduce the risks of the banks and financial institutions (BFIs) to invest in RE projects. One of the major reasons for lack of private investment in RE sector is the low return and the project recognizes the importance of stimulating demand by promoting productive use of electricity to enhance financial sustainability of RE investment which will increase utilization of electricity and thereby revenue. In addition, RERL has been supporting women and marginalized communities to benefit from electricity by establishing enterprises and income-generating activities.

Outcome 4: For sustainability, enhancing technical capacities and skills for the related technologies at different levels is required. RERL supports capacity building for design and manufacture of mini-hydro and large solar systems and capacity for installation, management, and operation of these technologies. Besides, RERL has supported the strengthening of in-house capacity at AEPC and of other relevant government officials to promote sustainable RE systems.

The project started in 2014 to be implemented over a five-year period (ending July 2019). A summary of the project framework with **objective, outcomes, outputs, and indicators** is provided in the Box below.

Box 3 Summary of the project objective, outcomes, and outputs

Project objective: Removal of barriers to increased utilization of renewable energy resources in rural Nepal in order to support economic, environmental, and social development of people in the rural areas and to reduce GHG emissions	1) Total installed capacity of renewable energy-based power generation projects implemented by end-of-project (EOP). *Target:* 12.5 MW (comprised of 10 MW off-grid hydro (8 MW mini-hydro & 2 MW large micro-hydro); and 2.5 MW of large-scale solar PV systems) 2) Electricity generated annually for livelihood and quality of life improvement (GWh/yr) by EoP. *Target:* 26.795 GWH/yr (comprised of 23.76GWh/year from additional mini-hydro, and 3.035GWh/year from large solar PV System) 3) Annual GHG emission avoided by EoP. *Target:* 35,375 tCO_2 per year 4) No. of households benefitting from lighting, productive end-use services and employment due to electricity supply by EoP. *Target:* 50,000

Outcomes and indicators	Output and activities
Outcome (Activity result) 1: Strengthened legal, institutional and policy environment to support RE and other low-carbon technology development and utilization *Indicators:*	**Output 1.1:** Policy in place operationalizing PPP model for mini-hydro, large-scale solar PV development, productive end-use applications including fiscal incentives and adaptability for possible changes in Nepal government structure (to a federal system) *Activities* 1. Support preparation and adoption of a policy that enables PPP model for mini-hydro, micro-hydro mini-grid, and large-scale PV development, thus attracting the private sector to such projects 2. Support preparation and adoption of a policy for future grid connection of off-grid mini-

Outcomes and indicators	Output and activities
5) No. of RE-based power generation projects that were proposed and developed as influenced by the strengthened policy regime on RE and low carbon development by EoP. *Target:* 50 6) No. of district energy plans developed that include mini-hydro and large-scale solar PV power generation installations by Year 3 *Target:* 15 7) No. of policies and legal frameworks that are supportive of RE-based energy production were approved and enforced by Year 3 *Target:* 2	hydro, micro-hydro mini-grid, and large-scale solar PV systems **Output 1.2:** Methodology and database developed and made available for incorporating mini-hydro and large-scale solar PV systems into district RE plans *Activities* 1. Prepare methodology for integrating mini-hydro projects and large-scale solar PV system into district energy plans. 2. Preparation and publication of reports on mini-hydro resource and large-scale solar PV needs assessment for districts based on the above methodology **Output 1.3:** Completed training and awareness programme for relevant government agencies and stakeholders on mini hydro and large-scale solar PV systems development and productive end-use *Activities* 1. Identify and prepare case studies for mini-hydro and large-scale solar PV systems 2. Completed training and awareness programs for relevant government agencies and stakeholders on mini hydro and large -scale solar PV system 3. Interaction with CSIDB for RE based MSME Promotion
Outcome (Activity Result) 2: Increased investment in RE *Indicators:* 8) No. of local financial institutions that provide loans for feasible RE-based energy projects in the remote areas of Nepal by Year 3 *Target:* 10 9) No. of RE-based energy projects developed and proposed for financing from local financial institutions by EoP *Target:* 50 10) Total installed large RE-based power generation capacity funded by local financial institutions by EoP *Target:* 1.8 MW 11) Total installed capacity of renewable energy-based power generation projects achieving financial closure by EoP *Target:* 12.5 MW	**Output 2a.1:** Commissioned mini-hydro demonstration projects totaling 1 MW through PPP model *Activity:* 1. Updating of the feasibility study of the selected Mini-hydro demonstration projects to make it bankable 2. Provide financial support to the demonstration mini-hydro projects, as per government policy, through the CREF **Output 2a.2:** Commissioned mini-grid demonstration projects totaling 300 kW *Activity:* 1. Provide financial support to the demonstration mini-hydro projects, as per government policy, through the CREF **Output 2a.3:** Commissioned large-scale solar PV demonstration projects totaling 500 kW *Activity:* 1. Provide financial support to the demonstration of large-scale solar PV projects, as per government policy, through the CREF **Output 2b.1:** Demonstrated PPP models facilitating cooperation between the private sector, public sector, and local organizations through the establishment of Special Purpose Vehicles (SPV) in three selected mini-hydro projects (1 MW) *Activities:* 1. Update the feasibility study of the selected Mini-hydro demonstration projects to make it bankable 2. Support to establish and strengthen suitable institutional arrangement for development and management of mini-hydro projects including SPV model 3. Securing of licenses, clearances, and permits for the implementation of mini-hydro demonstrations 4. Preparation of detailed project reports (DPR) and bid documents 5. Assist in achieving financial closure based on PPP model 6. Provide technical assistance for construction of the project 7. Setting up of O&M modalities 8. Documentation of UNDP-GEF RERL demonstration project learning

Outcomes and indicators	Output and activities
	Output 2b.2: Demonstrated financially sustainable and reliable mini-grids connecting 10 micro-hydro systems (300 kW) *Activities:* 1. Conduct of feasibility study of potential demonstration projects 2. Establishment of a Special Purpose Vehicle; 3. Support for piloting grid connection of 2 MHPs 4. Preparation of detailed project reports (DPR) and bid documents 5. Document and disseminate lessons learned 6. Provide technical assistance for construction of the project 7. Setting up of the O&M modalities 8. Documentation and dissemination of lessons learned from demonstrations
	Output 2b.3: Demonstrated financially sustainable and reliable large-scale solar PV system (300 kW) *Activities:* 1. Prepare a shortlist of potential project sites selected based on a set of criteria and select sites 2. Conduct detailed feasibility study (DFS) of selected demonstration projects 3. Support establishment of suitable institutional arrangement for development and management of large solar PV projects including SPV model 4. Provide technical assistance for installation of the project; securing permits 5. Preparation of detailed project reports (DPR) 6. Negotiations on the financial closure 7. Provide technical assistance for the installation of the project 8. Setting up of O&M modalities 9. Document and disseminate lessons learned
	10. Support for EQ relief and rehabilitation for Solar - Mobile Charging - Monitoring and supervision of installed solar solutions for public institutions - Solar solution for public institutions (VDC, health post, schools, communication, PVPS)
	Output 2b.4: Operationalized 2 MW of off-grid large micro hydro (over 60 kW) power projects demonstrating cost advantage feasibility, productive end-use, and best practice through technical assistance *Activities:* 1. Assist NRREP to implement the projects 2. Assist AEPC/NRREP for DFS 3. Assist AEPC/NRREP for monitoring of energy consumption pattern of mini/micro hydro projects
	4. Relief and Rehab package for micro hydro - Rapid assessment of micro hydro damaged by earthquakes - Repair and maintenance of micro hydro damaged by earthquakes - Commercial operation of micro hydro damaged by earthquakes - Support CREF in preparing RE Business plan - Support CEREF to develop RET vendor financing manual and training documents
	Output 2b.5: Completed financial closure of 7 MW of off-grid mini- hydropower projects replicating PPP model through establishment of SPVs, demonstrating cost-advantage, feasibility, productive end- uses, and best practice through technical assistance *Activity:* 1. Assist AEPC to implement the projects 2. Support the RE project developers (SPVs) in preparing business plans for promoting productive use of electricity 3. Conduct exploration study for identifying potential and feasible enterprises in the project area

Outcomes and indicators	Output and activities
	Output 2b.6: Completed financial closure of 2 MW of large-scale solar PV systems, demonstrating cost advantage over smaller PV systems, feasibility, productive end-uses, and best practice through technical assistance *Activity:* 1. 1Implementation of the large scale solar PV demonstration projects
Outcome (Activity Result) 3a: Improved availability of financial investment support for rural RE and other low-carbon technology applications *Indicators:* 12) No. of RE financial instruments developed, funded and operationalized by EOP *Target:* 2 13) No. of local financial institutions implementing the new RE financial instruments and have RE loan portfolios *Target:* 10	**Output 3a.1:** Established a wholesale financing instrument to incentivize Banking and Financial Institutions (BFIs) for financing domestic manufacturers to meet growing orders and be cost-competitive *Activity:* 1. Establishment of the wholesale financing instrument for financing manufacturers
	Output 3a.2: Established a wholesale financing instrument to incentivize Banking and Financial Institutions (BFIs) to promote commercial financing for mini-hydro and large-scale solar PV projects *Activity:* 1. Establishment of wholesale financing instrument to incentivize BFIs for commercial financing of Mini-hydro and large-scale solar PV projects
Outcome (Activity Result) 3b: Improved design and packaging of investment support mechanisms for rural RE and other low-carbon technology applications *Indicators:* 14) No. of new and improved RE financial instruments for supporting rural RE and low carbon technology applications designed by EoP *Target:* 2 15) Total amount of funds allocated by the GoN and the local financial sector for the new RE financial instruments by EoP *Target:* USD 30.25 million 16) Total load factor including contribution of productive use by EoP *Target:* 50% 17) No. of productive use enterprises from RE projects funded through	**Output 3b.1:** Designed and provided technical support for financing platforms and services for promoting commercial financing for domestic manufacturers *Activity:* 1. Design of the wholesale financing package for Mini-hydro manufacturer and selection of fund administrator 2. Design and finalization of wholesale financing packages for supporting manufacturers of mini-hydro 3. Establishment of wholesale financing package in at least two financing institutions through CREF
	Output 3b.2: Designed and provided technical support for financing platforms and services for promoting commercial financing for mini-hydro and large-scale solar PV projects *Activities:* 1. Design of the commercial financing instruments for Mini-hydro and Large-scale solar PV projects and select fund administrator
	Output 3b.3: Developed training materials on mini-hydro and large- scale solar PV projects for financing institutions *Activities:* 1. Design training materials for bankers to understand challenges and opportunities in Mini-hydro and Large-scale solar PV projects 2. Support CREF banks for exposure on mini-hydro and large-scale solar PV projects 3. Support project developers to prepare bankable business plans and other loan documents for mini-hydro and large-scale solar PV projects
	Output 3b.4: Created a matchmaking platform for mini-hydro and large-scale solar PV developers, financing institutions, and equity investors, and productive end-users *Activities:* 1. Organize appropriate events to bring together Mini Hydro developers and Large-scale solar PV Projects, equity investors, and potential lenders

Outcomes and indicators	Output and activities
the new RE financing instruments by EoP *Target:* 300	2. Follow up work on business matchmaking events 3. Develop a web-based portal that allows developers, lenders, and investors to interface and exchange information
	Output 3b.5: Established functional enterprises adopting productive use of electricity *Activity:* 1. Prepare guidelines for identifying and assessing existing and potential enterprises 2. Support the RE project developers (SPVs) in preparing business plans for promoting productive use of electricity 3. Develop locally based Enterprise Development Facilitators (EDFs) and Business Development Service Providing Organizations (BDSPOs) 4. Support existing entrepreneurs for switching to electric energy 5. Conduct exploration study for identifying potential and feasible enterprises in the project area 6. Conduct of business promotion campaigns 7. Conduct of capacity building work for prospective entrepreneurs to create new enterprises 8. Provide capacity-building support to existing entrepreneurs for the smooth operation of the business, business expansion/growth and productivity improvement 9. Document and showcase successful enterprises for replication
	Output 3b.6: Operationalized mechanism to promote financial products for entrepreneurs/end users *Activity:* 1. Assessment of existing financing services and identification of existing institutions (non-formal mechanisms e.g. credit saving group) for potential upgrading into micro-finance institutions or cooperatives 2. Establishment of formal micro-finance institutions out of existing non-formal mechanisms (e.g. saving credit group) in Mini-hydro areas lacking FIs (banks and MFIs) or needing more MFIs and support building capacity of the MFIs 3. Development and dissemination of tools for promoting commercial financing of productive use of electricity linking as far as possible with CleanStart activities in Nepal.
	Output 3b.7: Ensured women and marginalized/vulnerable groups own 33% of the functional electricity-based enterprises established *Activity:* 1. Provide financial support training/orientation to potential women and marginalized entrepreneurs to switch to electricity and to establish new enterprises 2. Study on impact of PEU on women
Project Outcome 4: Enhanced capacities and skill of various stakeholders in the RE sector *Indicator:* 18) No. of persons trained on survey and design of mini-hydro, large micro-hydro and large-scale solar PV systems by EOP *Target:* 105 19) No. of local engineering firms trained for manufacture, fabrication and repair maintenance of mini-hydro, large micro-hydro and large-scale solar PV system by EoP	**Output 4.1:** Established database of technical specifications for the design, manufacture of micro-hydro (60+ kW) and mini-hydro installations and after-sales service in micro-hydro (60+ kW) and large-scale solar PV systems *Activity:* 1. Conduct a study on Identification of technical challenges and opportunities in design, manufacture, installation and after-sales service for Mini-hydro and Large-scale solar PV systems 2. Quality Assurance Mechanism for mini-hydro and large solar PV developed
	Output 4.2: Fully trained skilled and technically capable people available for project identification, feasibility studies and detail design of mini-hydro projects *Activity:* 1. Development of manuals on project development, system design and integration manuals for large-scale solar PV systems 2. Conduct of capacity building trainings for developers, consulting firms, and relevant service providers for Mini-hydro projects 3. Support NRREP in developing project development, system design and integration manuals for large-scale solar PV systems

Outcomes and indicators	Output and activities
Target: 5 20) No. of persons trained for installation of mini-hydro, large micro-hydro and large-scale solar PV systems by EoP *Target:* 100 21) No. of persons trained for operation of mini-hydro, large micro-hydro and large-scale solar PV systems by EoP *Target:* 300	4. Support NRREP in conducting capacity building trainings for consulting firms, systems integrators, and relevant service providers for Large-scale solar PV projects
	Output 4.3: Fully trained, skilled and technically capable mini-hydro manufacturers in identified areas with after-sales services *Activity:* 1. Support AEPC/NRREP to organize training for the installation of large micro hydro 2. Collaborate with and support Mini-hydro manufacturers in acquiring new technologies 3. Quality assurance procedures, training curriculum, and manuals for Mini-hydro manufacturing and development 4. Conduct quality assurance and standardization training
	Output 4.4: Fully trained, skilled and technically capable construction and installation teams within companies to improve quality of installed mini-hydro projects and large solar PV system *Activities:* 1. Development of training curriculum and manuals for quality assurance procedures, pre-qualification criteria and methodology of certification for construction and installation of Mini-hydro projects 2. Support AEPC in developing pre-qualification criteria and methodology of certification for the installation of Large-scale solar PV systems 3. Support AEPC/NRREP to organize training for the installation of large micro hydro
	Output 4.5: Fully trained, skilled and technically capable people available for operation, maintenance and business management of mini-hydro projects and large-scale solar PV systems *Activities:* 1. Development of O&M training curriculum and manuals for Mini-hydro and conduct training based on these. 2. Develop O&M training curriculum and manuals for large-scale solar PV systems and conduct training 3. Develop O&M training curriculum and manuals for large-scale solar PV systems and conduct training 4. Develop business management training curriculum and manuals for mini/ micro-hydro and large-scale solar PV systems 5. Conduct O&M training for large-scale 60kW+ micro-hydro plants

2.3 Project partners and stakeholders

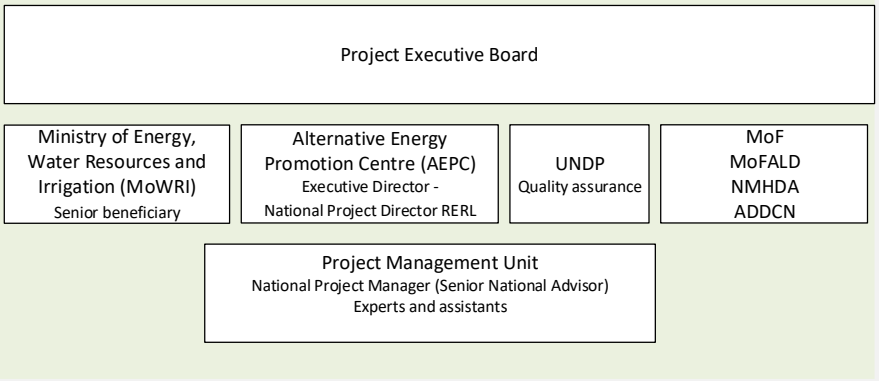
2.3.1 Main project partners and project implementation arrangement

RERL is implemented by the Alternative Energy Promotion Centre (AEPC) of Nepal under the Ministry of Energy, Water Resources and Irrigation (MoEWRI). It should be noted that before 2018 AEPC was under the Ministry of Population and Environment (MoPE). NRREP Project Steering Committee used to be the apex decision-making body for the overall programme management and providing overall guidance, which was chaired by the Secretary of MoPE and UNDP participating as a member. In this structure, a Project Executive Board (PEB) was set up to facilitate smooth and effective implementation of project activities with responsibility for taking management decisions. After the phasing out of external development partner support in NRREP in 2017, RERL Project Executive Board has also been the decision-making body for the project.

The PEB is chaired by the Executive Director of the AEPC who serves as the National Project Director (NPD) of the RERL Project. The NPD is responsible for overseeing overall project implementation and ensuring that the project objective and outcomes are achieved. PEB members are:

- United Nations Development Programme (UNDP)
- Ministry of Energy, Water Resources and Irrigation (MoEWRI)
- Ministry of Finance (MoF)
- Ministry of Federal Affairs and General Administration (MoFAGA)
- Nepal Micro Hydro Development Association (NMHDA)
- Association of District Coordination Committees of Nepal (ADCCN)

Box 4 Project management structure



The RERL project is led by a National Programme Manager (NPM) who reports to NPD and provides expert technical guidance to RERL Project Team (see Box 8 in Section 3.2) and ensures that the RERL project outcomes are met, and that RERL's activities are integrated in AEPC's overall programme.

2.3.2 Stakeholders

Box 5 List of project stakeholders

Category	Stakeholders
Government and semi-government institutions	• Ministry of Energy, Water Resources and Irrigation (MoEWRI) • Ministry of Finance (MoF) • Ministry of Agriculture and Livestock Development (MoALD) • Alternative Energy Promotion Centre (AEPC) • Central Renewable Energy Fund (CREF)
NGOs	• Winrock International Nepal • Practical Actions Nepal (PA) • People, Energy and Environment Development Association (PEEDA) • National Association of Community Energy Users (NACEUN)
CBOs	• Micro Hydro Developers/Cooperatives • User/Management Committees
Programmes and projects	• Clean Start - UNCDF • South Asia Sub-regional Economic Cooperation (SASEC) - ADB • Renewable Energy for Rural Area (RERA) – GIZ • Nepal Mini-Grid Project – World Bank
Development partners	• United Nations Development Programme (UNDP) • Asian Development Bank (ADB) • Kreditanstalt für Wiederaufbau (KfW) • Gesellschafft für International Zusammenarbeit (GIZ) • SNV Netherlands Development Organisation • UK Department for International Development (DFID)
Association and private Companies	• Nepal Micro Hydro Development Association (NMHDA) • Solar Equipment Manufactures Association of Nepal (SEMAN) • Suryodaya Urja P. Ltd.

	• Hydro Energy Concern P. Ltd. • Techno Village P. Ltd.
Banks and financial Institutions (BFIs)	• National commercial and development banks (NIBL, Civil) • Micro financing institutions and Cooperatives • Nepal Bankers' Association • Nepal Microfinance Bankers Association
Local Government and Associations	• Rural Municipalities • Association of District Coordination Committees of Nepal (ADCCN) • National Association of Rural Municipalities in Nepal (NARMIN)

In addition, RERL has been working with a number of **private sector companies**, such as Hydro Energy Concern, Techno Village P. Ltd, and Suryodaya Urja P. Ltd.).

Relief and rehabilitation. Source: RERL

Solar PV. Source: RERL

3. FINDINGS: PROJECT DESIGN AND STRATEGY

Next in this report follows an overview of the evaluation findings. Due to the size of the main text it has been divided over three chapters that cover a) project design & formulation, b) project implementation, and c) project results and sustainability. The findings are based around a number of evaluative criteria and questions (originally formulated in the Inception report and slightly re-formulated). Here, the reader can make a link between what was asked and what was found. The questions in the orange-coloured boxes in this and in other Chapters, are taking from the Evaluative matrix (Annex D) as these correspond to a particular section in this report.

Chapter 3 looks first at the project relevance and country drivenness (at project design), and links with national and development. Second, it looks at the design logic (in the framework of outcomes and objectives to reach the objective) and how the design framework was formulated, including the definition of indicators and target values for outcomes and outputs.

3.1 Relevance and design

Country priorities and relevance

- Have project outcomes been contributing to national development priorities and plans and take into account national realities (status and challenges of off-grid RE; enabling environment)?
- Consistency with the GEF focal areas in Climate Change/operational program strategies of the GEF CC and with the UN and UNDP country programming in Nepal
- Is the Project addressing the needs of the target beneficiaries? Is the design responding to real needs and priorities of the targeted communities and private sector in the context of the project district/VDCs and private/financial sector? Relevance of the project's objectives, outcomes and outputs to the different target groups of the interventions. Have relevant gender issues been raised in the project design?

Relevance

Rural and renewable energy development.
The population of Nepal is predominantly rural and many villages and settlements across the country do not have access to electricity due to limited generation capacity as well as practical difficulties in constructing transmission and distribution networks.

Over the past two decades, the Government of Nepal, with assistance from external funding partners/agencies had built a considerable number of decentralized micro-hydro projects and solar home systems (SHS) for village electrification. The SHS and micro-hydro plants are primarily used for lighting and powering some low-capacity household gadgets (e.g., mobile chargers, radio). Even though some small village enterprises connect to micro-hydro facility, they suffer from low load factor (about 20-25%), and often the resulting revenues are lower than the cost of operation and maintenance, let alone to cover bigger emergency repairs. It was envisaged that moving towards bigger sized systems (mini-hydro and large-scale solar PV systems) would bring economies of scale, foster progress, and wider coverage. Bigger systems offer better financial and commercial viability and greater opportunity for enterprise development and private sector involvement.

Policy
The project has been formulated in line with the provisions spelled out in Rural Energy Policy (2006) and Nationally Determined Contributions (NDC, 2016), On its turn, the RERL has contributed the formulation of national policies and planning viz. National Plans,), White Paper of Ministry of Energy, Water Resources and Irrigation (2018), Renewable Energy Policy (2017), Renewable Energy Subsidy Policy (2017) and Delivery Mechanism (2018), and the draft Renewable

Energy Development Board Act (2018), as will be explained in more detail in Section 5.1 In this respect, it can be mentioned that RERL has been instrumental in designing a new financing approach (with equity and loans) in addition to the traditional dependency on subsidy and grants in off-grid electrification. In short, the relevance of RERL has been functioning as RE policy knowledge management hub within AEPC.

Constitution and administrative divisions
In 2015, Nepal got a new constitution, which changed Nepal practically into a federal democratic republic. Power has been devolved to the lower levels of government. Nepal now consists of seven provinces, that each are composed of 8 to 14 districts. The districts are composed of municipalities (6 metropolitan, 11 sub-metropolitan, 293 urban and 460 rural municipalities[10]). The new structure has had important implications for energy planning, as municipalities are now responsible for making Municipal Energy Plans (MEPs). The RERL Project has supported this process by developing a methodology for MEP preparation (see Section 5.1).

AEPC and rural renewable energy
After the closure in 2017 of NRREP, the RERL Project has been very important in filling the technical capacity gap (in AEPC on rural renewable electricity). RERL has been functioning as a technical knowledge hub; it particular by working in tandem with ADB with the latter providing financial support through its SASEC project and RERL associated technical assistance. This partnership will continue after GEF funding ends in July 2019 with a bridging phase (until 2019) and UNDP continuing RERL (with SASEC funding for its technical assistance).

GEF and UNDP programming
The RERL results framework in the ProDoc refers to the following Outcome as defined in the Country Programme: "Vulnerable groups have improved access to economic opportunities and adequate social protection: (Output: Vulnerable groups have increased access to energy services and sustainably managed natural resources) with the Outcome Indicator "Number of households in remote areas connected to micro-hydro or mini-hydro energy services. Number of new job holders". The project falls within the GEF-5 programme area "GEF Climate Change Mitigation; CC3-Favorable policy and regulatory environment created for renewable energy investment, and Investment in renewable energy technologies increased.

Gender and social inclusion
The ProDoc specifically gives one Output (3b7, see Box 3) that is especially dedicated to providing technical and financial assistance to "feasible enterprises owned by single woman, widow, and vulnerable-community, backward, disaster victim, poor and endangered ethnic groups". "This investment support, available only to enterprises at demonstrations projects, is geared towards the speedy establishment of new electricity-based enterprises and switching of existing enterprises to electricity".

Sustainable Development Goals
The project document (ProDoc) does not explicitly refer to the SDGS, maybe because it was not a requirement to do so at the of ProDoc formulation. However, as evaluators we can confirm that the project addresses a number of SDGs both directly as well as indirectly, as indicated in Box 6.

[10] Source: en.wikipedia.org (Nepal)

Box 6 Sustainable Development Goals

Sustainable Development Goals	Linkage with renewable energy and rural electrification
Sustainable energy:	
7.1 Ensure universal access to affordable, reliable, and modern energy services 7.2 Increase substantially the share of renewable energy in the global energy mix	
Other sustainable development:	
1. End poverty in all its forms everywhere	Access to basic energy services is a requirement for poverty eradication
3. Ensure healthy lives and promote well-being for all at all ages	Basic energy services are required to deliver health services
4. Ensure inclusive and equitable quality education and promote life-long learning opportunities for all	Basic energy services are required to deliver education
5. Achieve gender equality and empower all women and girls	Basic energy services are required for women-led rural enterprises and activities
6. Ensure availability and sustainable management of water and sanitation for all	Energy is needed to supply clean water to rural communities
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	Productive uses of energy can make a rural energy system more viable by adding demand (and revenues) other than lighting for households. On its turn, the availability of power enables rural production (micro-businesses, agro-processing, tourism, rural manufacturing, other)
9. Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	Resilient infrastructure and public-private partnerships are required to ensure access to energy for all
10. Reduce inequality within and among countries	Access to electricity in rural areas brings potential to genuinely bring energy for all, including in remote rural areas, thus reducing inequalities
12. Ensure sustainable consumption and production patterns	Renewable energies are a key part of a future in which there is sustainable consumption.
13. Take urgent action to combat climate change and its impacts	The carbon-intensive energy sector (based on fossil fuels) is a key driver of climate change. Renewable energy substitutes fossil fuels (zero emission)
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	Linking small hydro and biomass-based projects with natural resources management (e.g., watershed protection; sustainable biomass production)

3.2 Conceptualization and results framework

- Were lessons from other relevant projects (NRREP, or earlier projects, such as REDP) properly incorporated in the project design? Were the partnership arrangements properly been identified and the roles and responsibilities negotiated prior to project approval?
- Has the project's design (logframe) been adequate to address the problems at hand?
- Was the project internally coherent in its design (logical linkages between expected results and design (components, choice of partners; scope, use of resources)? Were any (major) amendments to the assumptions or targets been made or planned during the Project's implementation?
- Were adequate project management arrangements in place at project entry? Was there any steering or advisory committee?

Integration with rural and renewable energy planning

RERL was developed as an integral part of Alternative Energy Promotion Centre (AEPC)'s National Rural and Renewable Energy Programme (NRREP), a donor-supported single framework and thus, has assisted in meeting its ambitious targets (see Box 7). In this setup, the RERL Team has been an integrated part of AEPC (see Box 8) to provide capacity building support and helping it to meet the goals of AEPC. RERL has supported AEPC with the revision and formulation of new policies, implementation of new models of large-scale solar mini-grids with private developers, and the design of financial mechanisms to mobilise Central Renewable Energy Fund (CREF) through the CREF Secretariat and private sector banks. RERL has helped in increasing livelihood opportunities for the village communities that are being served through mini-and micro-hydro projects.

Box 7 AEPC-NRREP targets

Technologies	Targets
Mini and micro hydropower	25 MW
Solar home systems (SHS)	600,000 systems
Institutional solar PV and solar pump systems	1,500 systems
Improved water mills	4,000
Improved cooking stoves	475,000
Biogas	130,000 household systems 1,000 institutional; 200 community plants

Source: ADB (2017); MoPE (2016)

By embedding RERL into the AEPC/NRREP donor-supported framework, this has ensured close coordination with other donor-supported initiatives undertaken by multilateral and bilateral development partners, such as ADB, Denmark, DfID, GIZ, Norway, KfW, UNCDF, UNDP, and WB.

Analysis of the project results framework (logical framework or logframe)

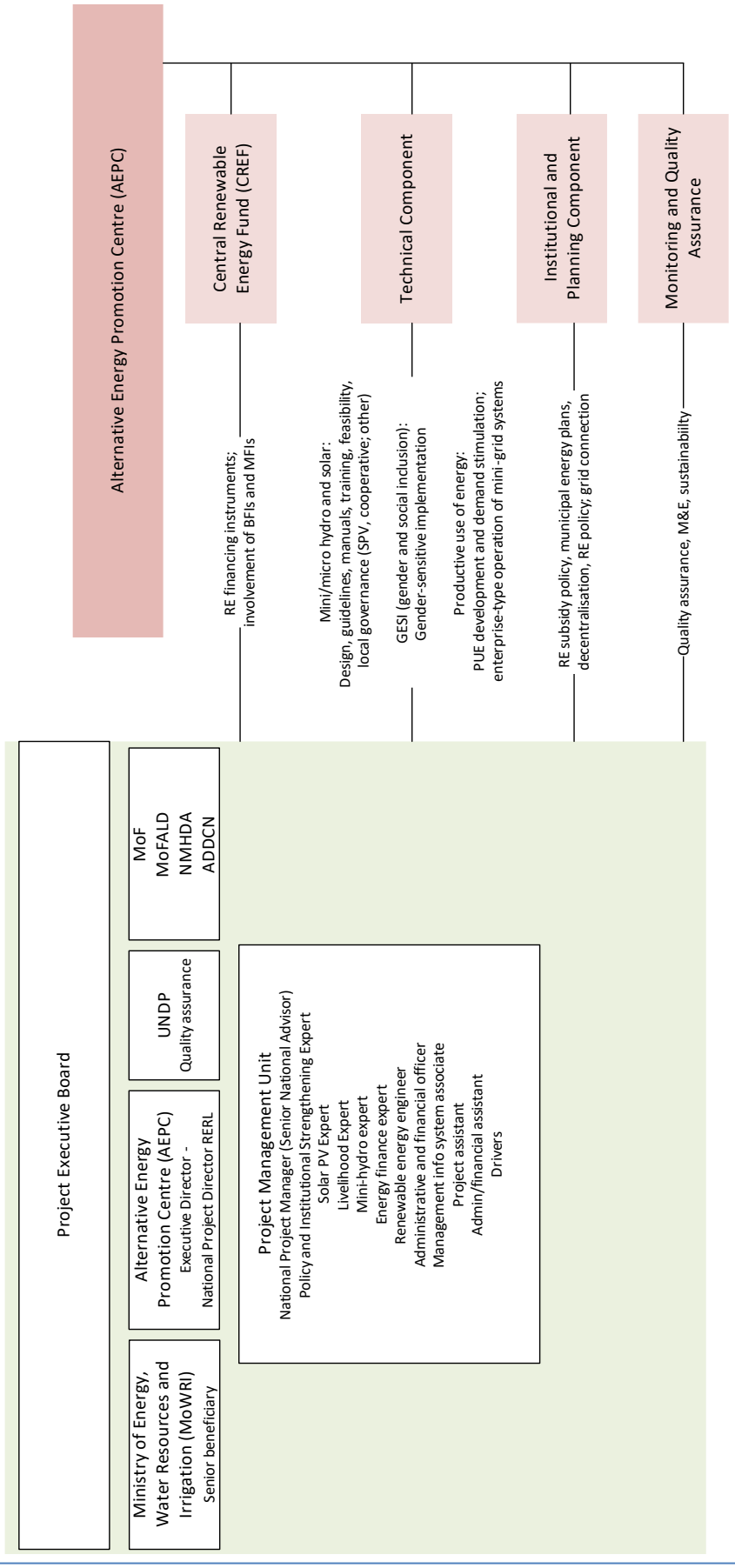
The project design, as described into the Project Document, takes into consideration the barriers that impede the investments in rural off-grid renewable energy technologies and inhibit the livelihood and income-generating opportunities. It provides arguments for the value-addition being provided by RERLby demonstrating the following:

- Investments in mini-hydropower project to demonstrate investment in public-private- partnership mode;
- Mini-power grid system that interconnect existing micro-hydro stations and/or connect to the national grid to showcase the implementation of financially sustainable power distribution systems;
- Off-grid large micro-hydro power generation projects to showcase increased load factors through increased productive end-uses and better local management which help to improve the quality of life and livelihood;
- Investment in large-scale PV systems showcasing advantage over smaller SPV based home lighting systems for providing options for income generation and productive end-use;
- Increasing confidence and experience of private banks in lending to decentralised power projects which are implemented in public-private partnerships.

The logframe of outcomes, outputs, and indicators, described in **Box 3**, has been quite appropriate to achieve the above. We have the opinion these are to the point and SMART (i.e., specific, measurable, achievable/attributable, relevant, time-bound/trackable). Furthermore, it has been built on the experiences of previous rural renewable energy programmes (including UNDP's REDP). It has helped that project staff, including the Project Manager, have continued from earlier AEPC programmes and their expertise has been continued in RERL's design and implementation phase, to the benefit of the Project. The Outcome Indicators (Box 3) are, according to the Evaluators, realistically formulated. Some indicators and target values were adapted in the Inception phase.

When analysing progress and achievements, it was not always to distinguish between Outputs 3a1 and 3a2, between Outputs 2a2 and 2a3, between Outputs 2b3 and 2b6, between Outputs 3a1 and 3a2, between Outputs 3b1 to 3b4, as well as between Outputs 4.2 and 4.3 and 4.4 and 4.5.

Box 8 Integration of RERL in AEPC framework



Even in RERL's own reporting, description of one Output sometimes overlaps with another. In Section 5 of this report, when reporting on the individual outputs, some Outputs are grouped together. In this way, the description of results regarding mini hydro is one place, micro hydro in another, grid connection is together as well as solar PV, finance and productive uses. If Outputs had been organised in this way from the onset, it would have been easier to digest for the occasional reader rather than digging through the long list of Outputs.

It should be noted that since the formulation of the logframe (designed in 2013), a number of changes and events happened, such as the creation of CREF, the severe 2015 earthquake, and latest the decentralisation as part of Nepal's new constitution. This implied that annual targets of the project activities needed to be revised and project budget re-allocated. Nonetheless, the overall indicators of the project objective and outcomes have remained the same.

3.3 Ratings for project design

The UNDP/GEF rating requirements and criteria for TEs do not include a '**rating on project design and formulation**', except for the item "M&E at design". This is surprising because we think that the 'design' is one of the main factors, alongside 'implementation' and 'external factors' that determine the achievement of 'results'. We believe that the good results of RERL (as described in Section 5) is partly based on the quality of the design.

In the rating for 'design' of the RERL Project using a six-point rating scheme:

- Highly satisfactory (HS), no shortcomings
- Satisfactory (S), minor shortcomings
- Moderately satisfactory (MS), moderate shortcomings
- Moderately unsatisfactory (MU), significant shortcomings
- Unsatisfactory (U), major shortcomings
- Highly unsatisfactory (HU), severe shortcomings
- U/A = unable to assess.

Box 9 Evaluation ratings of project design and relevance

Evaluation item	Corresponding section	Rating
Design logic and approach; assumptions and risks	Section 3.2	HS
Formulation of the log-frame (outcomes/oututs; choice and values of indicators)	Section 3.2	S
Relevance	Section 3.1	R
M&E at design and entry	Section 4.1	S

The rating for the design logic and approach is **highly satisfactory** with its translation into the logframe of outcomes/outputs and progress indicators as **satisfactory**. The design has allowed addressing various barriers (policy and regulations, private investors and bank scepticism, lack of local governance and community capacity; need for demand stimulation; grid connection options; public-private partnerships and need for financial mechanism additional to traditional grants) in an integrated way.

Regarding '**relevance',** rating is on a two-point scale with "R" meaning 'Relevant' and "NR" stands for 'not relevant'.

4. FINDINGS: PROJECT IMPLEMENTATION

This part of the Evaluation Report describes the assessment and rating of the quality of the execution by the GEF Implementing Agency (IA), UNDP, and by the Executing Agency AEPC. An assessment is made of the partnerships established and stakeholder interaction during implementation and the important role of adaptive management. The Evaluation Report presents an assessment and rating of the project monitoring and evaluation (M&E) at implementation. A special section is dedicated to the budget, expenditures, and co-financing of the RERL Project.

4.1 Implementation and management

4.1.1 Management arrangements and adaptive management

- How have the project management systems, including progress reporting, administrative and financial systems and monitoring and evaluation system been operating as effective management tools aid in effective implementation and provide sufficient basis for evaluating performance and decision making? Was the information provided by the M&E system (annual work plans, PIRs, other) used to improve performance and to adapt to changing needs; Are there any annual work plans?
- Did UNDP and Project staff identify problems in a timely fashion and advice to the project? If so, has the project practicing adaptive management e.g., (approve modifications in time)? If so, how effective was the adaptive management practiced under the project and lessons learnt?

Management arrangements

The project management arrangement has been described in the previous Section 3.2. It is important to mention that RERL has been functioning an integral part of AEPC's operations (and of NRREP until its end in 2017).

Apart from managerial and financial oversight and operational support, UNDP has substantively contributed through its participation in PEB meetings, project exchange events, monitoring of project activities and conducting financial audits, and by promoting synergy with other development programmes, such as of World Bank and Asian Development Bank. The project has followed UNDP-GEF guidelines on reporting and UNDP and AEPC have ensured a detailed progress reporting which can be downloaded and checked from the website http://www.aepc.gov.np/rerl/public/

The Executive Director of the AEPC has been serving as the National Project Director (NPD) of RERL Project. The NPD has been responsible for overseeing overall project implementation and ensuring that the project objective and outcomes are achieved. The NPD has also been responsible for coordinating with other AEPC programmes to maintain achievement of results, exchange of knowledge and expertise from RERL to AEPC and vice versa. The RERL project has been led by a National Programme Manager (NPM) who reports to NPD and provides expert technical guidance to RERL team and ensures that the RERL project outcomes are met. The members of the project team have been assigned to different tasks that correspond with the AEPC components such as micro-mini hydro, solar, end-use promotion, policy and institutions, and financing (see Box 8).

Adaptive management

In 2015, Nepal faced a number of challenging situations that affected the Project and had to be adaptively managed. An earthquake in April 2015 (with 7.8 magnitude, followed by various aftershocks in May) with its epicentre in Gorkha District, killing about 9,000 people and injuring almost 22,000. The earthquake destroyed homes and heritage sites, flattening entire villages in a number of districts. It also damaged energy infrastructure.

RERL supported AEPC in carrying rapid assessments of 42 solar PV pumping projects and provided assistance to AEPC to carry out a detailed feasibility study for the rehabilitation of 45 micro-hydro plants (MHPs) damaged by the earthquakes[11]. RERL reallocated USD 1 million in 2015 for relief and rehabilitation of renewable energy systems in earthquake-affected areas (out of the budget which was meant for financially supporting demo projects). Under relief and rehabilitation activities, during 2016-17 AEPC rehabilitated nine solar PV pumping systems (with technical assistance by RERL and funding from the GEF/UNDP budget, KfW and other donors) and has supported the installation of 258 solar PV systems in public buildings (district and village offices and centres, health posts and as well as (temporary) schools and learning centres. Similarly, with technical assistance rural communities brought back 104 MHPs to operation (partly funded by RERL project and AEPC funds) generating 3,102 kW and benefitting about 15,000 households that had ceased to get electricity after their plants were damaged by the earthquakes (see Boxes 20, 21 and 22).

The humanitarian crisis that followed after the earthquake was compounded further by political factors as result of an unofficial blockade by India (in September-October 2015) of fuel and other supplies. This negatively affected RERL's operations. However, the fuel shortage has also led to re-thinking at government level and reduce dependency on energy imports by promoting and developing indigenously available energy resources, such as solar energy and small-scale hydropower.

After the start of RERL, marked by the signing of Prodoc in July 2014, the project underwent some changes in Outputs, activities, and budget. The project budget was revised again in mid-2015 to accommodate the requirement of relief and rehabilitation of renewable energy systems, as described above, which were destroyed or damaged by the two severe earthquakes in April and May 2015. RERL programme activities were modified in consultation with GEF. Although the Outcome level target in terms of installed capacity remained unchanged, it was agreed that the target of 500 kW from large SPV and 2000 kW from micro-hydro will be achieved from relief and rehabilitation through grant support from the GEF budget[12].

Risk management and mitigation

The overall risk assessment indicated in the ProDoc is 'moderate'. During the project's design and inception stages, a number of major risks were identified that are related to the external investment scenario and political environment, the response of the private sector and banks to the opportunity to invest in off-grid community renewable energy electrification projects, natural factors and calamities, as well as to stakeholder and co-financing coordination under AEPC. The table in Box 10 gives a summary of the risk mitigation interventions made by RERL project to address identified risks.

4.1.2 Monitoring and evaluation

M&E: design at entry

At Inception, a total of USD 110,585 was allocated, about 2% of the total GEF budget, which is deemed sufficient for this type and size of the Project. Project activities are monitored at several levels, project staff visit fields and prepare reports, AEPC and UNDP officials also make field visits to monitor progress on a periodic basis. The performance of RERL is monitored and assessed according to the goals defined and agreed in the AWPs, with outcomes and outcome indicators (which are based on the logframe of the Project Document) and outputs. The ProDoc also gives a 'standard-type' of M&E Plan with an inception activity (workshop, report), annual reporting (PIRs), project steering committee meetings, periodic status, financial and progress reporting, as well as audits, field visits, and mid-term review and final evaluation reports.

[11] Progress Report 2015

[12] GEF funding (NPR 106 million, about USD 1 million) has been used to support institutional solar PV (realised 673 kW) and off-grid micro hydro systems (realised 1626 kW) as part of relief and rehabilitation. See details in Box 22 and Box 24).

Box 10 Risks and risk mitigation actions taken

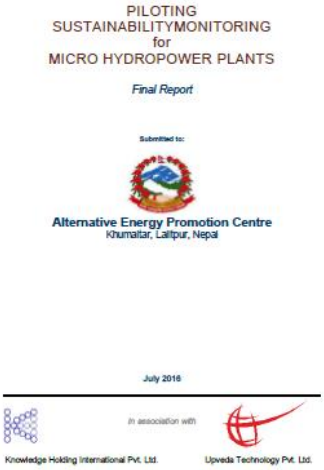
Risk	
Political changes and instability at local, regional or federal level	The decentralisation in recent years has affected project activities, e.g. Small scale RE and hydro falls under the jurisdiction of municipalities rather than at federal level. The project has turned this challenge into an opportunity. RERL has been actively working with with AEPC and other governmental agencies to define roles and responsibilities of institutions at different levels of governance viz. municipalities, provinces and federal. The Project has been providing technical assistance to municipalities that often do not have the human resources and capacity to carry out the new responsibilities
Unfavourable subsidy policy for private sector and larger PV systems; delays in approval of RE subsidy policy	Several advocacy and lobbying activities were carried out by RERL that were aimed at securing the approval of the proposed RE Subsidy Policy (revised in 2016). In the past, subsidy focussed on community micro hydro and solar home systems. Now, private sector is eligible for subsidy. Projects up to 1 MW (i.e. including mini hydro and larger PV systems) are now eligible for subsidy.
Private developers are reluctant to invest	Various ownership-operation models are used with local entrepreneurs, cooperatives, local government or combination thereof in special purpose vehicles (SPV). This makes it attractive for entrepreneurs to invest, helped by eligibility for subvention. The option of grid connection is an insurance that the hydro or PV facility will continue to operate (and generate revenues) until after the grid arrives.
Inadequate interest of local community to adopt productive energy uses	RERL has provided trainings, exposure visits and raised awareness on the commercial operation of MHPs. Community is willing to adopt PUE if there is a market for products. Investments in PUE are encouraged by small loans and micro-finance. A new element is government subsidy for demand stimulation through PUE
Inadequate interest of BFI in off-grid RE projects	The banks still perceive investment in community-level energy projects as risky and consequently adopt a conservative approach. This has delayed financial closure and development of mini hydro projects. To overcome this situation, AEPC/CREF decided to broaden its banking partners beyond its existing 7 partner banks by making all 28 Class 'A' and 'B' banks eligible to invest in RE projects. RERL activities include training of and outreach to banks (in coordination with CREF) to make them aware of potential commercial viability of projects that can be financed with a range of instruments partially supported by CREF (credit guarantee, soft loans, project insurance, vendor financing). A number of solar and hydro mini-grids have been financed this way.
Limited exposure in larger systems (mini hydro, mini grid and larger solar PV)	Outreach to private sector. The first private MHP or solar PV grids assist in demonstrating commercial viability to other private sector parties. Increasing load factor through PUE and grid connection, increased BFI financing availability, and careful planning (water resources and flow) boost viability of MHP facilities and increases investors' confidence
Project funding to be leveraged will not become available	The RERL was designed as a project within NRREP to support in scaling up of the RE technologies such as mini hydro and larger solar PV systems for institutions, mini grid and solar pumping for drinking water and irrigation. However, NRREP, the baseline project of RERL, phased out on 30 June 2017 creating uncertainties in resource allocation for demonstration projects. Thereafter, the RERL team discussed with AEPC, UNDP and development partners to have an adequate budget for financially supporting MHP and larger solar PV (from SASEC) with RERL providing technical assistance. This has secured co-financing and, through agreement with ADB, has secured continuation of RERL after 2019, being linked with ADB's SASEC project.
Natural calamities	Due to the higher frequency and magnitude of landslides and floods (induced from climatic variability) in the project area, some mini hydro civil structures have been adversely affected requiring additional time for repair and reconstruction.

Source of info:
PowerPoint "Terminal Evaluation" (2019), PIR (2018), PIR (2017), stakeholder interviews

Reporting

UNDP and AEPC have ensured that RERL progress is reported extensively and regularly, in three PIRs (2016, 2017, 2018), annual progress reports (2014, 2015, 2016, 2017, 2018) and in Project Executive Board minutes of meeting. The PEB has met on a regular, where possible quarterly, basis. In addition, the project team made available a set of technical project deliverables (reports, PowerPoints) and a good summary in PowerPoint on project progress (per component) for the Evaluation Team.

Sustainable framework



RERL coordinated with the Monitoring and Quality Assurance Unit of AEPC to prepare a sustainability framework for micro hydro. The framework identifies all relevant dimensions for sustainability, measurable indicators, software to record and analyze and make evidence-based decisions. Similarly, RERL has supported AEPC to prepare a Quality Assurance Mechanism to monitor mini-hydro and large solar PV system.

RERL provided advice to AEPC on updating the Power Output Verification (POV) Guidelines for micro and mini hydropower In the process, 25 Independent POV Inspectors (including a woman) were provided orientation and training on the updated POV Guidelines.

Internal communications

With the RERL Project office being located within the premises of AEPC's, there are frequent communications with the other AEPC staff and other AEPC programmes. The project has also strong communication lines with the UNDP Country Office. Regular communications have taken place between AEPC, RERL and UNDP and project partners.

4.2 Stakeholder involvement and relations

- How efficient have partnership arrangement been for the project? Did each partner have assigned roles and responsibilities from the beginning? Did each partner fulfil its role and responsibilities?
- To what extent were partnerships/linkages between institutions/ organizations/private sector encouraged and supported?

External communication

RERL has conducted a number of orientations, trainings and seminars on topics related to mini-hydro and solar PV off-grid systems (for details see Section 5.1.3). The RERL project team has published some articles in the local newspapers and monthly magazine and short video clips in 'YouTube'.

Information on RERL can be found at http://www.aepc.gov.np/rerl/public/. The AEPC and RERL webpages provide general info on AEPC; info on upcoming and past events; statistics on RE technologies; resource center (downloadable reports, policy documents, standards, guidelines, and manuals), and AEPC-implemented programmes[13]. The RERL webpage presents a number of success stories (mentioned below) and videos.

RERL organized an 'Investor's forum' in August 2015 to showcase potential RE projects to prospective investors. The project has been making presentations on its modalities and lessons learnt in various forums both in Nepal and abroad.

[13] Apart from RERL, SASEC, RERA, Urban Solar Programme, and SREP/Extended Biogas

RERL has developed 'Nepal Solar Calculator' a mobile phone application to help people get an estimate of the size of the solar PV systems and its approximate cost and contact detail of solar installers (see also Section 5.1.4).

A Pilot Initiative: Solar PV System for Health
Sep 30, 2018

An Exemplary Case of Darna MHP as an Enterprise Model
Jun 06, 2018

Fuel Switching Technology: Electric Boiler
Dec 15, 2016

Stakeholder engagement

The Project has successfully facilitated partnerships with many stakeholders
. Since the beginning, the Project has made progress in developing partnerships with stakeholders, including the government functionaries at the district level, private sector consulting firms, banks, project developers, state-owned electricity authority and village-based user group and industry association. Private sector stakeholders are actively participating in various project activities such as conducting feasibility studies of mini- and micro-hydro project, eventually leading to investment in projects with different types of PPP and ownership models (described in the next Section 5). Apart from AEPC/CREF, the Project has worked together successfully with other government agencies (notably Nepal Electricity Authority, and the Department of Electricity Development, DoED) as well as with international NGOs (Winrock, Practical Action, PEEDA) and development partners (ADB, World Bank, GIZ, KfW, DFID, UNESCAP,

Box 11 Overview of RERL partnerships

Development partners and I/NGOs	
World Bank	PEEDA
Asian Development Bank (SASEC project)	Jeevan Bikash Samaj
KfW	Sahara Nepal
GiZ	Small Farmers Cooperative Association
DFID	
Practical Action	**Academic institutions**
Winrock	Tribhuvan University- Institute of Engineering, Kathmandu
Gyeonsangbuk-do, South Korea	Engineering College, King's College
Coca Cola Foundation	Kathmandu University
WISION, Germany	Pokhara University- Handung University South Korea
SNV	Duke University USA
UNESCAP	University of Bristol UK
UNCDF	Fraunhofer ISE, Germany
SEforALL- Norwegian Embassy	University of Prince Edward Island (UPEI) Canada
FINIDA/RVWRMP	

Source: PowerPoint "Terminal Evaluation"

UNCDF). The reader is referred to the Box 11 and Box 11 for more information on RERL partnerships.

North-South-South collaboration

In addition to development of micro-hydro interconnected mini-grids, the connection of individual MHP with the national grid was accomplished for the first time in Nepal in January 2018. it has been found that there is a necessity to innovate, design and develop technology for both MHP to MHP interconnection and MHP and grid interconnection. Thus, to develop appropriate and robust technology, RERL approached research institutions in Indonesia, China, Canada, Germany, UK and USA for collaboration. Institutions such as Duke University, University of Prince Edward Island (UPEI) and University of Bristol have indicated their interest.

Box 12 Description of selected RERL partnerships

Asian Development Bank: RERL is providing technical assistance to AEPC to implement ADB funded SASEC (South Asia Sub-Regional Economic Cooperation). The Project intends to support rural communities to install 4.3MW of mini hydro and 500kW of solar mini grids. The budget is USD 15.3 million (USD 6.5 million, MHP grant; 4.10 million MHP loan; 2.8 million, solar grants and USD 1.9 million for consulting and management) with USD 7.3 GoN co-financing and mobilising USD 2.82 million local government and USD 4.23 private/community funding (equity and bank loans). By 2019, 2,598 kW of mini hydro had been installed with SASEC finance (with RERL technical assistance) as well as about 1 MW of solar and solar-wind mini-grids. In 2018, ADB and AEPC agreed to continue RERL TA support from 2019 to 2021 under a cost sharing agreement with UNDP.

The World Bank: RERL has been supporting AEPC to implement Renewable Energy Component of Kabeli Transmission Project in Taplejung. In 2018, 90kW Chimal MHP was interconnected with the national grid. This project will be completed once the 500kW Middle Phawa MHP is interconnected in the mini grid and the entire system is grid connected. Another Project is the WB Private Sector-led Mini-grid Project of which AEPC is the implementing agency. Private entities and cooperatives will be mobilized to provide electricity services to rural areas as "energy service companies (ESCOs). WB budget: USD 7.61 million; GoN: USD 6 million; mobilized private sector financing: USD 3.6 million. The Project has two Components. Component 1 will make available USD 5.61 million grant and loan financing to the GoN and intermediated by AEPC/CREF will make available through partner banks to eligible ESCOs and their RE mini-grid projects (hydro, solar, hybrid; grid connection). Individual RE projects will receive up to 60% GoN subsidy, 30-50% loan and at least have 10% equity. Component 2 consist of management and capacity building (USD 2 million). The Project has a target of 3.8 MW by the end of year 5 (and are expected to generate 27.5 GWh a year).

GIZ/RERA: RERL is working closely with GIZ's Renewable Energy for Rural Area (RERA) project to promote renewable energy in the federal context. RERA supports AEPC to develop frameworks, modalities, guidelines and manuals for promotion of RE projects in the new federal structure, with capacity strengthening of provincial and local governments, and working with private sector, civil society and banking institutions. In this regard, RERL and RERA finalized methodology for preparation of municipal energy plans. RERA will supplement RERL initiatives by supporting preparation of 14 MEP in Provinces 1 and 7 under same framework and methodology.

German Development Bank (KfW): RERL supported AEPC to install 50 solar PV pumping systems in drinking water projects funded by KfW (budget of USD 640,909). In 2018, 9 projects were completed. After the installation of PV pumping systems 430 households have easy access to tapped drinking water.

ICIMOD: ICIMOD is working in Dhungentar, Nuwkot district to help build low cost houses for households belonging to marginalized cast groups. AEPC provided solar solutions to these households in 2018 with RERL technical assistance.

Private Sector: in 2018, RERL provided support to Hydro Energy Concern to help strengthen its management. Hydro Energy Concern is supplying and installing electro mechanical equipment of 3 mini hydro projects funded by SASEC. Another significant RERL support for the private sector capacity development includes Preesu Electronics Pvt. Ltd and Techno Village Pvt. Ltd in both grid connections of MHP and MHP to MHP interconnection. RERL provided extensive technical support to both companies to successfully complete grid connection of 4 MHPs and establishment of Taplejung Mini Grid interconnecting 4 MHPs.

Salleri Chialsa Electricity Company (SCECO): In 2018, a MoU was signed by AEPC and Salleri Chialsa Electricity Company (SCECO), owner of Salleri Chialsa Mini Hydro Project. As per the MoU, AEPC will procure SCECO services for capacity development of AEPC supported mini hydro project personnel for smooth operation and management. RERL in collaboration with Practical Action Consultancy (PAC) had prepared a case study of mini hydropower projects in Nepal in July 2017, covering 8 projects managed by Nepal Electricity Authority, community and private companies. The study identified the governance and management of the 603kW Salleri Chialsa Mini Hydropower Project, which has been in operation since 1989, as the best in the country.

UNESCAP: Under Pro-Poor Public Private Partnership (5P) Modality, 18 kW Baidi Solar Micro Grid has been installed in Dubung, Tanahun benefiting 140 household. This project is the first one in Nepal developed by a SPV owned by beneficiary community and a private company. RERL helped the SPV to prepare business plans of 20 enterprise. RERL is also supporting AEPC to promote Solar PV based water supply systems in Raksirang VDC of Makawanpur district under 5P project by leveraging UNESCAP financial assistance.

UNEP/Practical Action Consulting Ltd.: With technical assistance from AEPC/RERL and financial assistance from UNEP, Practical Action Consulting Ltd. carried out a case study of mini/small hydropower (both off- and on-grid) in Nepal to support AEPC in formulating policies and implementation framework to promote mini hydro projects in Nepal. The case study documents and shares experiences of different business models for both 'on and off-grid' mini hydro development; and explored various enablers and stakeholder roles to create an enabling environment.

UNDP/Norway/SE4All: RERL has assisted UNDP to implement SE4ALL activities in Nepal during 2015-17. Government of Norway has provided financial assistance (USD 378,000) to carry out different activities under SE4ALL, including preparation of Gap Assessment and Country Action Plan has been prepared and shared with different stakeholders. The Country action agenda was shared with the **SE4ALL Global Facilitation Team (GFT**) to obtain feedback on the document/

South Korea: USD 99,269 was mobilized from Gyeonsangbuk-do, South Korea to provide Solar PV solutions for lighting, water supply and operating micro industries in extremely marginalized Chepang village in Dhading district

UNCDF: RERL and Clean Start of UNCDF in collaboration have been supporting CREF to prepare its Business Plan that will help to chart the way forward. Likewise, RERL and UNCDF are preparing Vendor Financing Manual to promote small RE systems through private sector involvement.

Source: RERL Achievements; PowerPoint Terminal Evaluation (2019); SASEC PowerPoint (2019); World Bank PAD

Likewise, RERL also approached private companies both in Nepal and abroad to collaborate. Aspin Kemp & Associates (AKA), Canada, Renerconsys, Indonesia and Entec AG, Switzerland have also shown interest. Duke University is mainly working on Automatic Voltage Regulator (AVR) and Automatic Power Factor Controller (APFC) for grid interconnection of MHP. AKA and UPEI are working on MHP to MHP interconnection technology whereas Bristol University shall be supporting on grid compatible ELC. As RERL/AEPC has now successfully connected four MHPs with the grid and has built two MHP-interconnecting mini-grid systems, practitioners from the Aga Khan Rural Support Programme (AKRSP) have approached RERL for technology transfer to establish a micro/mini hydro interconnected grid in northern Pakistan.

In addition, RERL has been working with a number of international networks on the transfer and dissemination of grid connection and mini-grid technologies throughout South and South East Asia by Hydro Empowerment Network (HPNET). Hydro Power Empowerment Network (HPNET) is a forum mainly of practitioners, policymakers, and regulators of South and South-East Asia. Knowledge exchange works in both directions; Nepal learned from other countries and now shares its own experiences. Beside supporting HPNET to prepare Frequently Asked Questions (FAQ) focusing on various misconception on grid connection of MHP, RERL and HPNET have collaborated to share the experiences of Sri Lanka and Indonesia on grid interconnection with Nepali professionals. The workshop organized by HPNET in Sri Lanka in January 2016 helped Nepali policymakers to understand the system as well as benefits of connecting MHP to the grid[14].

In 2018, UNDP Country Office China coordinated with country offices in Belt and Road area to submit proposals for China South-South Cooperation Assistance Fund (SSCAF). RERL submitted a proposal for providing renewable energy solution mainly solar PV and clean biomass in 10 rural municipalities of border districts[15].

4.3 Project finance and co-financing

- Breakdown of actual project costs by activities compared to budget (variances), financial management (including disbursement issues)
- If there was a difference in the level of expected co-financing and the co-financing actually realized, what were the reasons for the variance? Did the extent of materialization of co-financing affect project outcomes and/or sustainability, and, if so, in what ways and through what causal linkages?

The financial resources that were requested and made available by GEF and the actual expenditures (until end of 2018) are summarised in *Hydro facility*

[14] Information based on PIR (2018) and RERL Achievements (2019)

[15] Progress Report 2018

Box 13. Basically, at the end of five years, the GEF funding has been spent, while UNDP has actually made available more funding from its resources than the USD 2 million originally planned. More co-financing has been mobilised than the USD 54.81 million originally committed (Government) or planned (leveraged private sector and other financing). The amount of (cash) co-financing mobilised is linked with the investments in generating capacity of micro-hydro, mini hydro and larger solar systems, as indicated in Box 17, Box 20, Box 22, and Box 24 Solar PV systems supported during the RERL Project.

Hydro facility

Box 13 UNDP/GEF budget and actual expenditures and co-financing data

Project funding	Planned	Actual (Aug 2019)	Disbursements (USD) 2014	2015	2016	2017	2018	2019
GEF	3,000,000	3,000,000	144,846	737,836	1,325,606	420,502	223,591	147,619
UNDP	2,000,000	2,210,307	66,945	355,601	297,019	796,624	583,286	110,832
TOTAL	**5,000,000**	**5,210,307**	**211,791**	**1,093,437**	**1,622,625**	**1,217,126**	**806,877**	**258,451**
Co-financing								
AEPC-GoN	30,312,500	42,276,000	GoN: USD 26.976 million; ADB-SASEC: USD 15.3 million					
Private sector/community	19,601,710	18,214,000	Includes bank loans taken out by private/community; Approx. USD 2.263 million (Civil, USD 100,000; NIBL USD 163,410; MBL USD 600,000; ADBL, USD 1 million; CYC Microfin USD 400,000)					
Local government	4,647,890	4,081,000						
Other	244,930	1,332,000	Includes Norway (SE4All, 2015-17, USD 378,000) and S.Korea (2015-16, USD 99,269)					
TOTAL	**54,807,030**	**65,903,000**						

Project budget	Planned (USD) ProDoc	Inception	Post 2015 EQ	Disbursements (USD) 2014	2015	2016	2017	2018	2019	Total
Outcome 1	212,320	273,500	293,740	34,039	76,245	47,775	64,066	81,573	35,731	339,429
Outcome 2	1,626,442	2,315,262	2,684,939	54,501	594,620	1,175,125	831,040	214,586	83,505	2,953,377
Outcome 3	1,416,118	666,118	608,156	21,979	91,828	96,153	86,979	89,771	19,272	405,982
Outcome 4	668,804	668,804	353,032	28,333	58,324	25,610	61,907	46,512	28,569	249,255
PM and M&E	1,076,316	1,566,028	1,359,992	69,942	257,159	259,297	181,660	375,831	91,374	1,235,263
Exchange rate gain/loss				2,997	15,261	18,665	-8,526	-1,396		27,001
TOTAL	**5,000,000**	**5,489,712**	**5,299,859**	**211,791**	**1,093,437**	**1,622,625**	**1,217,126**	**806,877**	**258,451**	**5,210,307**

Note: The data are compiled from the *UNDP ProDoc* and data provided by RERL Project Team. Co-financing consists of grants (government), loans (from bank sector) and equity investment. For details see also Boxes 17, 20, 22 and 24). For details on UNDP-GEF expenditures the reader is referred to reports carried out by independent auditors.

4.4 Ratings of project M&E and project implementation/execution

In assessing 'implementation and adaptive management' of the RERL Project, a six-point rating scheme is used:

- Highly satisfactory (HS), Implementation of all components, 1) management arrangements, work planning, reporting, project-level monitoring and evaluation, 2) stakeholder engagement and communications, 3) finance and co-finance, is leading to efficient and effective project implementation and adaptive management. The project can be presented as "good practice".
- Satisfactory (S), implementation of most of the components is leading to efficient and effective project implementation and adaptive management except for only few that are subject to remedial action
- Moderately satisfactory (MS), implementation of some of the components is leading to efficient and effective project implementation and adaptive management, with some components requiring remedial action.
- Moderately unsatisfactory (MU), implementation is not leading to efficient and effective project implementation and adaptive, with most components requiring remedial action.
- Unsatisfactory (U), implementation of most of the components is not leading to efficient and effective project implementation and adaptive management.
- Highly unsatisfactory (HU), implementation of none of the components is leading to efficient and effective project implementation and adaptive management.
- U/A = unable to assess.

Box 14 Evaluation ratings of project implementation and execution

Evaluation item	Corresponding report section	Rating
Quality of UNDP implementation (adaptive management; finance)	4.1, 4.3	S
Quality of execution (AEPC), coordination; adaptive management; stakeholder involvement	4.1, 4.2, 4.3	HS
Overall UNDP implementation and implementing partner execution		**HS**
M&E plan implementation	4.1	S

In our opinion, the Project has been executed by AEPC in general and by the Project Team in particular in a **highly satisfactory** manner**.** The Project has faced several challenges during the implementation period (2014-2016), including natural calamities (the 2015 earthquake), political upheavals (protests against the new 2015 Constitution and blockade of the border with India in 2015-16), decentralisation and new responsibilities of municipalities in energy planning; end of NRREP programme and associated co-financing). What we appreciate is that RERL has managed not to only to continue despite these events but turned challenges into new opportunities. We also noticed a very good cooperation with a range of stakeholders in the national government, local government, RE importers, manufacturers and vendors, banks and financial institutions, communities and community leaders, as well as with various development partners and international NGOs. Of the GEF/UNDP financial resources available for investment support, USD 1 million had to be diverted for relief and rehabilitation efforts after the earthquake (and USD 600,000 has been used to help set up CREF financial support mechanism). By cleverly associating with other development partners, AEPC/RERL have managed to mobilise sufficient funds to invest in mini hydro, micro hydro and larger solar PV. One good example is the partnership with ADB SASEC programme, in which RERL provides technical assistance and SASEC the necessary grant and loan funding, a partnership that will continue after UNDP/GEF ends with UNDP/ADB support until the end of 2021. UNDP has been quite instrumental in making such partnerships happen, and we rate the UNDP implementation as **satisfactory,** therefore.

5. FINDINGS: PROGRESS TOWARDS OUTCOMES

5.1 Introduction

- What outputs has the project achieved (both qualitative and quantitative results, comparing the expected and realized end-project value of progress indicators of each outcome/output with the baseline value)? To what extent have the expected outcomes and of the project been achieved?
- Have results been achieved within the planned timeframe? Was the project time sufficient? Were there any unplanned effects? Which external factors have contributed or hinder the achievement of the expected results?
- Has the project produced results (outputs and outcomes) within the expected time frame Is the project proactively taking advantage of new opportunities, adapting its theory of change to respond to changes in the development context? Are there any unaddressed barriers remaining?

Chapter five presents progress towards results. For each of the five project components, as mentioned in paragraph 1.2, this section assesses the progress in the implementation of the project's outcomes and outputs, following the 'project results framework' format and as reported by the Project Team in the annual UNDP/GEF Project Implementation Reports (PIRs) 2016, 2017 and 2018, annual progress reports (APR, 2014, 2015, 2016, 2017, 2018) as well various PowerPoint presentations presented by the Project Team to the Evaluators and interviews with stakeholders. Section 5.2 describes the progress achieved in outputs and activities for each Component/Outcome, following the outline of outcomes and outputs of Box 3. Section 5.2 tries to provide a quantitative and descriptive overview of the achievements of outputs and outcomes.

Section 5.3 provides an assessment of results in terms of attainment of the outcomes and outcome indicators. The baseline and target values of the indicators are taken from the project's logical framework (as reported in the Inception Report and PIRs), while the achievements (i.e. indicator value at project's end, is compiled from PowerPoint presentations made by the project team for the TE mission), supplemented by additional info obtained during the mission (provided by the Project Team) and analysis of the outputs and reports produced during 2015-2017. The greenhouse gas emissions reported have also been reviewed; these are discussed in Section 5.3.3. Section 5.3 ends with a summary of the Evaluators' ratings towards results. Section 5.4 discusses sustainability and replicability.

5.2 Progress in achieving outputs and outcomes

5.2.1 Outcome 1 Strengthened legal, institutional and policy environment to support RE and other low – carbon technology development and utilization

Output 1.1	**Approved and enforced policy that enables PPP model for mini hydro and large scale solar PV development, including fiscal incentive and sustainability for possible changes in Nepal government structure (to federal system)**
Achievements: • Rural renewable energy mainstreamed in energy policy-making in Nepal through: ○ RE in 15th Periodic Plan of Nepal ○ Concept Note on Energy Security submitted to GoN ○ White Paper of MOEWRI ○ RE in Local Government Operation Act 2017 ○ RE Subsidy Policy & Delivery Mechanism 2016 ○ Draft Renewable Energy (RE) Policy ○ Draft AEPC Bill	

- Nepal Rastra Bank (Central Bank) directive increasing limit for RE investment under Deprived Sector Lending from NPR 20 million to NPR 50 million
- PPP guidelines
  - PPA with 4 MHPs
- Grid connection and net metering:
  - Technical Specifications for Grid connection of MHP
  - Guidelines for Utility Scale Solar PV Development
  - TA for 64 MW grid connected solar PV systems (NEA)
  - TA for Net Metering Standard (NEA)

Description

Policy documents

- *15th Periodic Plan*

The Project provided inputs into the 15th Plan of the Government to include aspects, such as the a) commercial operation of MHPs and post-installation support, b) promotion of electric cooking for optimization and sustainability of MHP, c) institutionalisation of Municipal Energy Plans (MEPs), d) carbon taxes.

- *RE Subsidy Policy (2016) and RE Subsidy Delivery Mechanism (2017)*

In 2014, RERL supported AEPC/NRREP to prepare a draft document on **Renewable Energy Policy**. RERL extensively supported the drafting of the **Renewable Energy Subsidy Policy 2016**, which opens opportunities for private participation in RE development. The policy specifically discusses the public-private partnership (PPP) model for developing RE projects in the country. Subvention itself is moving away from initial investment support, to grants for energy services based on least-cost RE option (best available technology[16]). Here, the role of the private sector is not just that of technology vendor, but is enhanced to the role as service provider. To enable this, RERL has also been working with CREF to design and operationalize financial instruments such as soft credit, credit guarantee, vendor financing, and credit insurance to foster private sector confidence in RE investments (see Section 5.2.3). It also opens the scope for more technology, e.g. larger systems (mini-hydro and solar mini-grids) get mainstreamed, while subsidy is now also provided for solar irrigation (before only for drinking water)

- *RE in Local Government Operation Act 2017*

The Constitution of Nepal 2015 mandates local governments to develop renewable energy and hydropower projects up to 1000 kW. In the changed federal context, RERL extensively helped AEPC to reposition itself by drafting Transition Paper detailing its roles and responsibilities. RERL also helped to detail out the roles and responsibilities of municipalities in promotion of renewable energy and hydropower vis-à-vis the roles of provincial and federal government. It should be noted that RERL drafted detailed roles and responsibilities of federal, provincial and local governments that were incorporated in the recently enacted **Local Government Operation Act**.

- *White Paper of MoEWRI (2018; Draft AEPC Bill (2018)*

The **White Paper** will be the guiding document for the RE sector. Furthermore, in 2018 AEPC was brought under MoEWRI's jurisdiction, and MoEWRI has taken initiative to draft AEPC's Act that will ensure AEPC's autonomy and clarify its roles and responsibilities at federal, provincial and municipal levels and will boost the role of AEPC as a 'centre of excellence' regarding rural and renewable energy. RERL helped AEPC to draft its **Transition Paper** reflecting the new context and provided inputs on **Draft AEPC Bill** to be submitted to Government of Nepal. The Bill, currently under discussion at MoEWRI, brings greater representation of local and provincial governments in AEPC governance, together with the establishment of local and provincial energy units and dedicated funds.

[16] Best Available Technology (BAT): least cost option/s (Best Available Technology) for given energy services/set of services. Technologies include both on-grid and off-grid solutions, for example cooking energy could be biogas or fuel wood used in an Improved Cooking Stove (ICS) or grid/off-grid electricity or a combination of these energy sources depending on the demand and supply. This is lifetime cost of all available technological options; not only the upfront cost but also operation and maintenance cost, insurance, cost for replacement /renovation, efficiency and losses, etc

RERL helped AEPC to develop the **Support Package for Local and Provincial Governments** for promotion of RE in Nepal. Support package includes model RE policy, a methodology for MEP preparation, forms and formats for subsidy processing, etc. AEPC has signed separate MoUs with all 7 provincial governments to jointly promote renewable energy activities. In fiscal year 2018/19, AEPC has provided Conditional Grant to all 753 local and 7 provincial governments to support RE projects and activities. RERL supported this by organising orientations to officials of provincial governments and municipalities in Provinces 1, 2, 4, 6 and 7.

- *Public-private partnership guidelines*

RERL prepared **Public-Private Partnership Framework Guidelines** for mini-hydro promotion in Nepal which includes formation of a legally established 'energy service company (ESCO)', a cooperative, private enterprise of a Special Purpose Vehicle (SPV), as an essential institutional arrangement where participation is open to the governments, beneficiary households, local entrepreneurs, cooperatives and firms. Having a legal entity is a condition for getting commercial loans. RERL organized several orientation programs for rural communities and the private sector (Nepal Micro Hydro Development Association; NMHDA) on this ESCO/SPV model. Some MHDA members have started to identify suitable projects to develop with their and beneficiaries' equity along with government subsidy and bank loan.

AEPC and the World Bank agreed in 2019 to launch the Private Sector-led Nepal Mini-Grid Project to promote mini/micro-hydro and solar mini-grids through ESCO model. AEPC, CREF, and RERL personnel provided extensive inputs to conceptualize and prepare the Nepal Mini-Grid Project.

- *Grid connection*

There about 3,000 pico/micro/mini-hydro plants that provide some 500,000 households. as soon as the national grid reaches the catchment area of an isolated/ standalone system, the people generally switch over to the grid and these plants are abandoned, which essentially means a loss of capital (and subsidy). RERL and AEPC coordinated with NEA to prepare the **Micro Hydro Projects Interconnection Equipment Standards and Specifications** (compliant with the grid code) which was endorsed by NEA Board in July 2014. The tariff received for grid connection is the posted tariff for hydropower from 100kW to 25MW, which are 4.8/kWhr (USD cents 4.3/kWhr) for dry season (mid-April through Mid-December) of 8 months and NRs 8.4/kWhr (USD cents of 7.6/kWhr) for wet season of 4 months. For greater than 25MW, rates are fixed by negotiations. The first PPA was concluded in February 2016 for the 23kW Syaurebhumi MHP, Nuwakot (see Box 15).

Similarly, RERL supported in 2017 the development of **guidelines with NEA for the connection of utility-scale solar PV,** that were approved in 2018. The guidelines will help both developers and regulators to align their expectations and come to a common understanding on forms, formats, legal requirements, etc. for the development of utility-scale solar PV systems. Corresponding training was organised for government, Telecom and private sector

With RERL support, power purchase agreements (PPAs) were prepared for four MHPs to get grid-connected (see Section 5.3.2). Similarly, the Project has helped with the formulation of Request for Proposal (RfP) for developing utility-scale solar PV projects of cumulative capacity of 64 MW (up to now, two developers have signed a PPA). NEA is now in a

Box 15 Case study, grid connection: Syauribhumi

Mr. Sudarshan Budathoki, a resident of Sikre VDC, Nuwakot district adjoining the Kathmandu Valley, is a rural entrepreneur who installed the 10kW Syaurebhumi Micro Hydropower Plant (MHP) in his village in 1998 with his own resources and distributed electricity to fellow villagers. Over time, it expanded to 23 kW, serving nearby villages as well, by means of personal investment of NPR 600,000 and a loan of NPR 3.8 million from the Nabil Bank. However, when the national grid arrived, most households got connected to the main grid, leading to a substantial drop in revenues and inability to repay the loan. Attempts to sell surplus power to the grid was met bureaucracy, and bankruptcy loomed. Finally, with RERL supporting the technical negotiations with NEA, a PPA was concluded. The MHP now sells to NEA (at NPR 4.8/kWh in wet season and NPR 8.4/kWh in dry season, under prevailing rates for plants < 25 MW). The MHP now makes NPR 60,000/month which Mr. Budathoki can use to repay the loan (which will take 10 years approximately). The story is exemplary of the fear of many private investors or developer in off-grid systems (not only in Nepal): What will happen with my investment in the mini-grid system when the national grid arrives?

position to prepare future Requests for Proposals (RfPs) and PPA documents including connection agreement and operating procedures,

With RERL support, experts from the Institute of Engineering and a local company fabricated a digital electronic load controller (digital ELC) and successfully tested it in the laboratory. This has paved the way, technically, for grid connection of micro hydro, and economically, at reduced cost (local manufacture rather than import of ELCs). The device is now also sold in neighbouring countries (see also Section 5.1.3)

Output 1.2	**Adequate information available for incorporating mini-hydro and large-scale solar PV systems into district RE plans**
Achievements: • Methodology for preparation of District Electrification Master Plans (DEMPs) • Methodology for Municipal Energy Plans (MEPs) prepared o MEP of 7 rural municipalities prepared and submitted o MEP of 16 municipalities prepared by GIZ-supported RERA • Tools and software: o Geo-coded map of energy infrastructure o Training on the use of GIS for desk study of potential RE projects for AEPC/NRREP/RERL organized. o Mobile phone apps for survey tool & rooftop solar calculation	

RERL has initiated activities related to the preparation of District Electrification Master Plans (DEMP); for example. Gorkha District was supported with its DEMP formulation, going beyond usual energy plans by incorporating larger RE systems and grid extension to optimize resource utilization on a least-cost basis. RERL provided orientation to 18 DDCs on the methodology for preparing DEMP (Dec 2016).

The new Constitution has brought new powers to the local governments. However, many municipalities have limited technical and managerial capacities to effectively carry out their roles related to rural and renewable energy. Thus, RERL prepared a methodology to develop MEP, with inputs from key stakeholders like municipalities, and partner organizations including GIZ and ICIMOD. The MEP focuses on the provision of clean cooking and lighting solutions, energy for community services such as health centres and schools and for enterprises. The methodology will help to identify the least-cost solutions considering the lifecycle cost of different renewable energy technologies. RERL worked closely with Palungtar Municipality, Gorkha and Mahankal Rural Municipality to prepare their MEPs. The Renewable Energy for Rural Areas (RERA) project of GIZ will help 16 municipalities in Provinces 1 and 7 under the same framework. Municipalities are not only participating as subsidy providers in these projects but as investors/developers. Thus, RERL's pilot initiatives have contributed to mobilizing partners in local energy planning mechanisms. Now, other municipalities have approached AEPC/RERL to help them prepare their MEPs.

The subsidy mechanism is subject to the decentralisation in Nepal as well. AEPC has developed a **Support Package for Local and Provincial Governments** for promotion of RE in Nepal. The Support Package includes model RE policy, the methodology for MEP preparation, forms and formats for subsidy processing, etc. AEPC has signed separate MoUs with all 7 provincial governments to jointly promote renewable energy activities. In fiscal year 2018/19, AEPC has provided conditional grants to all 753 local and 7 provincial governments to support RE projects and activities[17]. This allocated amount will be used to prepare municipal energy plans. In future, such conditional grants to local governments will be based on their MEPs. Interestingly, municipalities are not participating as subsidy providers in these projects but as investors/developers and their capacities are also improving along the way.

RERL provided technical support to the World Bank and AEPC on the implementation of Anchor-Business-Customer (ABC) projects. It has provided Geo-coded information of energy infrastructure projects in Nepal and helped select candidate sites for implementation. The World Bank is also considering grid interconnection of RETs under the project.

[17] For example, in 2018, AEPC provided conditional grant of USD 8,906,165 to 753 local governments for renewable energy development at the local level, out of which, a total of USD 1,819,642 was allocated for policy, planning, management and administration of the overall activity.

Box 16 Main elements of the Renewable Energy Subsidy Policy (2016)

The new policy mainly focuses on gradually replacing subsidy by credit in the long-term. Similarly, it focuses on further scaling up of RETs and achieving the objectives of the UN's "Sustainable Development Goals" and "Sustainable Energy for All (SE4All). Subsidy will be provided to renewable energy technologies (RETs) on the basis of availability and appropriateness of natural resources, willingness of beneficiaries to procure and socio-economic benefits of the technology. Although subsidy amount differs according to technology and region, subsidy amount generally covers 40% of the total costs. Out of the remaining amount, around 30% from credit and around 30% from private sector investment or community or households in kind and/or cash can be mobilized. Least-cost to energy output from among the available technologies gets subsidy prioritization. Subsidy can be provided to different RETs (such as mini/micro hydropower, improved water mill, solar energy, biogas, biomass energy, wind energy, etc.), of which this text box discusses mini/micro hydro and solar PV.

Mini/micro hydropower

Subsidy for off-grid community/cooperative/private/public private partnership owned mini/micro hydropower from 10 kW up to 1000 kW projects, depending on the choice of the project developer to opt for subsidy on the basis of actual power generation or actual energy consumption.

Subsidy Category	**Subsidy Amount in Rs.**			
	Humla, Dolpa and Mugu districts where goods transport is only possible by air	**Category "A" Regions except Humla, Dolpa and Mugu Districts**	**Category "B" Regions**	**Category "C" Regions**
A) Subsidy on the basis of project				
Distribution (per HH)	35,500	32,000	30,000	28,000
Generation – Equipment (per kW)	125,000	95,000	85,000	80,000
Generation – Civil (per kW)	80,000	30,000	25,000	20,000
But, the maximum subsidy amount per kW for generation and distribution will not exceed Rs. 382,000; Rs. 285,000; Rs. 260,000 and Rs. 240,000 for Humla/Dolpa/Mugu, Category "A", Category "B" and				
Category "C" regions respectively. Distribution subsidy will be provided to a maximum 5 households per kW but distribution to household is not a requirement to qualify for generation subsidy.				
B) Subsidy on the basis of energy consumption	55%	50%	45%	40%
Subsidy for energy consumption will be paid to the concerned project operator over a period of five years only based on actual energy consumption.				

Category "A", Category "B" and Category "C" regions refers to Very Remote, Remote and Accessible areas as mentioned in Annex-1 of this policy.

Solar mini grid

The subsidy for community/cooperative/private/public private partnership owned solar electrification projects up to 1000 kWp in areas not connected through national grid or other sources, depending on the choice of the project developer to opt for subsidy on the basis of actual power generation or actual energy consumption.

Subsidy Category	**Subsidy Amount in Rs.**		
	Category "A" Regions	**Category "B" Regions**	**Category "C" Regions**
A) Subsidy on the basis of project			
Distribution (per HH)	32,000	30,000	28,000
Generation – Equipment (per kWp)	175,000	165,000	150,000
But, the maximum subsidy amount per kW for generation and distribution will be maximum of 60% of the system costs but not exceeding Rs. 495,000; Rs. 465,000 and Rs. 430,000 for Category "A", Category "B" and Category "C" regions respectively. Distribution subsidy will be provided to a maximum 10 households per kW.			
B) Subsidy on the basis of energy consumption			
Energy Consumption (kWh)	60%	60%	60%
Subsidy for energy consumption will be paid to the concerned project operator over a period of five years only based on actual energy consumption. However, irrespective of whatever is stated above, financial support more than the subsidy amount mentioned above can be provided for pilot projects as per the understanding between GoN and DPs.			

Source: *Renewable Energy Subsidy Policy*, Government of Nepal (2016)

Box (cont'd) Main elements of the Renewable Energy Subsidy Policy (2016)

Other elements:

- Maximum subsidy amount of up to 65% of the total systems cost but not exceeding Rs. 500,000 will be provided for solar photovoltaic system to be installed in public institutions in rural areas particularly for operating computers and other electrical equipment in schools, for operating vaccine refrigerator and other electrical equipment and lighting purposes in health posts, government and community hospitals.
- Maximum subsidy amount of up to 60% of the total costs but not exceeding Rs. 1,500,000 per system will be provided for PV pumping system for drinking water managed by community or private company.
- Maximum subsidy amount of up to 60% of the total costs but not exceeding Rs. 2,000,000 per system will be provided for PV pumping for irrigation of agricultural land managed by community or private company.

Additional subsidy

An additional subsidy of Rs. 4,000 per household will be provided to "targeted beneficiary groups" for new mini/micro hydropower and solar mini grid constructions. "Targeted beneficiary groups" refers to "women-led households with dependent children, earthquake victims from earthquake affected districts, endangered indigenous community identified by GoN and Dalit".

Incomplete old micro hydropower projects

Micro hydropower projects in remote areas that have not been completed due to lack of financial resources or technical reasons by the time of approval of this policy will be provided one time subsidy, including regular subsidy and additional subsidy, of up to 80% of the cost for ensuring its completion. However, projects that have already received additional subsidy previously will not receive additional subsidy through this policy.

Other selected provisions

- In order to access subsidy for project with capacity larger than 10 kW, either a minimum of 20% credit should be mobilized from banks and financial institutions or alternately should have financial closure of the project within 6 months. In order to be eligible for subsidy to manage and operate institutional and community owned other renewable energy schemes, either a minimum of 10% credit should be mobilized from banks and financial institutions or alternately should have financial closure of the project within 3 months;
- Implementation:
  - AEPC will be responsible for providing technical assistance, evaluating subsidy applications forms or documents of different renewable energy systems and projects, selecting RETs companies for manufacturing, supply and installation of RE related material and equipment, monitoring installed systems and standardizing equipment and materials related to RETs.
  - At the Centre, Central Renewable Energy Fund (CREF) is established for mobilization of subsidy amount. CREF will be managed by an "A class" commercial bank selected by GoN through competitive basis (*note:* further detailed in Box 25 Central Renewable Energy Fund (CREF)
  - At the local level, the local bodies will be responsible for the promotion, demand collection, on-site monitoring and disbursement of the subsidy for RETs as mentioned in the subsidy delivery mechanism.

Note: Subsidy for various renewable energy technologies or systems and for productive end uses will be provided in simple, effective and transparent way through a subsidy delivery mechanism to be prepared by AEPC (with inputs from the RERL Project) and implemented after approval from the Ministry

Output 1.3 Completed training and awareness programs for relevant government agencies and stakeholders on mini-hydro and large-scale solar PV systems development and on productive end use

Achievements:
• RE Capacity Need Assessment with World Bank
• Policy discussion on RE in Energy Mix and Energy Security
• Overview of functional status of ISPS (institutional solar PV) and PVPS (solar pumping) prepared
• Training, events, workshops:
  ○ RE Exhibition after the 2015 Earthquake
  ○ Concept paper on RE in Federal structure prepared and orientation to Provincial and Municipal officials provided

- Organized orientation to DoED (Dept. of Electricity Development, MoWRI) and NEA engineers and Regional Service Centre personnel on large scale solar PV (mini grid, institutional, pumping) & Mini/Micro Hydro (with participation of Telecopm, NEA and AEPC staff)
- Support for Environmentally friendly Local Governance Framework (EFLG) provided
- Organized on training on detailed feasibility studies (DFS) of mini hydropower projects for AEPC/NRREP/RERL
- Orientation on Productive Energy Use development provided to Cottage and Small Industries Development Board (CSIDB) officers from 48 districts.
- Organize a fair-trade exhibition in collaboration with CSIDB to promote small and medium-sized enterprises operated by mini and micro hydro

- Case studies and papers:
  - Case studies of mini and micro hydro prepared
  - Case studies of large solar PV systems have been prepared

An important **case study** of small and mini-hydro projects funded by UNEP in collaboration with Practical Action Nepal. The study looked at eight NEA, Users' Committee and privately managed projects. Specifically, the governance and management of the 603kW Salleri Chialsa Mini Hydropower Project, which has been in operation since 1989, as a 'best practice'. The Salleri-Chialsa (private company) model is best-suited for governance and management of community-owned mini-hydro projects in the country. AEPC signed a MoU with Salleri Chialsa Electricity Company (SCECO). AEPC will procure SCECO services for capacity development of AEPC supported mini-hydro project personnel for smooth operation and management. SCECO provided orientation on their operation and management system to personnel of various mini-hydropower projects funded by AEPC/SASEC as well as the recently constructed Simrutu Khola and Tara Khola mini-hydro facilities.

Energy security

Interconnection of RE facilities and connection with the main grid got a boost after the economic blockade of the border with Nepal by India in 2015-16. This forced policymakers to look into the issue of energy security. A task force was formed under the leadership of the Secretary of Ministry of Energy to investigate possibilities of grid-connecting renewable energy technologies. RERL along with AEPC provided inputs to the recommendations given by the task force to the government. It was recommended that 15% of the total installed capacity in the national grid could be connected to intermittent sources like wind and solar energy. This recommendation opened up space for preparation of subsequent policy, guidelines and technical standard for grid connection of solar PV and small hydropower system systems together with net metering guidelines.

5.2.2 Outcome 2 Increased investments in RE

Mini hydropower

Output 2a1 Commissioned mini hydro demonstration projects totalling 1 MW through PPP model
Achievements: • USD 7 million grant and USD 5 million loan budgeted by AEPC/ADB under SASEC to develop 4.3MW Mini hydro Projects

Output 2b1	Demonstrated PPP models facilitating cooperation between private sector, public sector, and local organizations through establishment of Special Purpose Vehicles (SPV) in selected mini-hydro projects (1 MW)
• Developed framework for commercial operation of MHPs and supported 25 MHPs ○ Cooperative model ○ SPV- Public Limited Company model ○ Private enterprise ○ Community private partnership (CPP) – lease out model	

Narrative:

With the closing of donor funding for NRREP, AEPC has facilitated collaboration between RERL and Asian Development Bank (ADB)-funded South Asia Sub-regional Economic Cooperation (SASEC) programme to jointly promote mini-hydro and solar mini-grid projects. In this arrangement, SASEC provides financial assistance (both loan and subsidy) to develop these projects and RERL provides technical assistance necessary for project identification, feasibility study, engineering design, financial closure, procurement, construction supervision and capacity development for operation and management of the projects. RERL and SASEC, through CREF, supported the identification, detailed feasibility study and design and financial closure of several mini-hydro facilities.

Box 17 gives an overview of the mini-hydro projects, by July 2019, that have been completed (with SASEC and AEPC funding), are under construction and Box 18 mini-hydro projects that are planned post-project (with AEPC, World Bank and SASEC funding).

Box 17 Mini-grid systems that have received RERL support

Project Output No.	Type of RE system *Mini HPs*	No. of households	Installed capacity kW	Total Investment NPR million	Financing					
					Grant funding		Community/private		Loan funding	
					Source	Amount	Source	Amount	Source	Amount
2a1	**Completed**									
2b1	Juddi Khola (Bajura District)		200	75.36	AEPC	61.05	Comm./Private	14.31		
	Simrutu Khola (Rukum District)	1386	200	85.70	SASEC	57.00	Community	18.70	Civil	10.00
	Tara Khola (Baglung District)	2200	382	175.29	AEPC	91.20	Community	44.09	CYC Micro Fin	40.00
	Subtotal		*782*							
2a1	**Under construction**									
2b1	Giri Khola (Jumla District)	1840	200	101.54	SASEC	57.00	Community	28.20	NIBL	16.34
	Phawa Khola (Taplejung District)	2093	500	153.66	SASEC	108.18	Community	15.47	MBL	30.00
	Lower Bom Khola (Solumkhumbu D.)	620	300	143.49	SASEC	63.01	Community	30.48	ADBL	50.00
	Khatyad Khola (Mugu District)	3200	500	265.85	SASEC	103.78	Community	132.07	MBL	30.00
	Patrasi Chukeni (Jumla District)	5653	998	467.59	SASEC-AEPC	284.43	Community	133.16	ADBL	50.00
	Junbesi (Solukhumbu District)	615	250	86.35	AEPC	66.55	Community	19.80		
	Total		*2748*							
	Total	**17607**	**3530**	**1,554.84**		**892.20**		**436.29**		**226.34**

Source: Based on data provided by Project Team; Progress Reports; RERL Achievements

Community-managed (and owned) off-grid systems are considered as highly risky (see Section 5.2.3) from a financial-economic point of view. All SASEC funded projects are being developed by a legal entity (public company, private company, cooperatives or a mix thereof in the form of a SPV). These projects have been developed under public-private-partnership (PPP) modality with a financial contribution by the government, commercial banks, municipalities, and beneficiary communities. It is expected that these projects will not only generate enough revenue to hire professionals for day-to-day operations but also pay back their loans on time reducing the perceived risk of investing in community-owned renewable energy systems in remote locations.

Establishment and strengthening of cooperatives/companies with clearly outlined governance and management systems is the key to sustainability and attracting finance from banks. RERL has been supporting the communities to establish a cooperative or a company to develop and manage mini-hydropower projects. Capacity development

activities are already initiated and will be continued until each project is able to operate smoothly and ensure revenue generation to pay off the loan.

Output 2b5	**Completed financial closure of 7 MW of off-grid mini-hydropower projects replicating PPP model through establishment of SPVs, demonstrating cost-advantage, feasibility, productive end-uses, and best practice through technical assistance**
Note: post-project demonstration	

Box 18 Pipeline of mini hydropower projects

Project Output No.	Type of RE system *Mini*	No. of households	Installed capacity kW
2b5	Saniveri Khola	1500	1000
	Tap Khola II	2671	303
	Taman Khola	1137	360
	Ghami Khola	1000	500
	Theso Khola		250
	Hepka Khola		400
	Manjo		500
	Lung Khola		500
	Kailash Khola		700
	Daram Khola	2500	990
	Darudi Khola		900
	Imja Lake		300
	Chuwa Khola		1000
	Pangboche		950
	Ankhe		750
	Total Post Project-Mini Hydro		**9403**

Source:
Financial support will be provided by AEPC, ADB-SASEC and WB-Minigrid Project.
Source: RERL Achievements; and additional info provided by Project Team

RERL technical assistance for smooth operation and sustainability of all mini-hydropower projects will be continued after GEF support ends by mid-2019 with financial support from ADB (SASEC programme) and in cooperation with the World Bank's Nepal Mini-grid Project. RERL has developed a support package for building up the capacities of developers, operators, and managers. Establishment and strengthening of cooperatives/companies with clearly outline governance and management systems is the key for sustainability and RERL has been supporting the communities to establish such legal entities to develop and manage mini-hydropower projects. The list of pipeline projects (that have a detailed or pre-feasibility study completed) is given in Box 18.

Box 19 Ownership-operation models

Up to recently, the success of mini-grid systems has been inconsistent. On one hand, about 1700 micro hydro plants were installed throughout Nepal, most of them community-owned. On the other hand, many systems are facing a number of challenges. Often, these are not commercially run with gaps in efficient operation and maintenance (O&M), flat and inflexible tariff structures, low utilisation factors (and corresponding low revenues). Investment is characterised by high dependency on subvention (60% of capital cost) and absence of commercial equity and debt financing[*)]

Therefore, the Government of Nepal (GoN) has chosen to encourage greater private sector management and commercial financing through public-private partnerships (PPP). Investors as well as banks and financial institutions (BFIs) and prefer ownership, operation and management in the hands of clearly defined legal entity, sometimes referred to as an ESCO, an energy services company. This can be a cooperative, a private sector enterprise (developer, locally based entrepreneur) or a Special Purpose Vehicles (SPV).

- An (electricity) Cooperative provides (electricity) services to its members (individuals or corporations) and is owned by the users of the service (although not all users need to be members), and can range in size from mini/micro hydro to larger power cooperatives. As per the Cooperative Act, at least 25 Nepalis willing to do electricity business can establish such a cooperative.
- A standard SPV in the Nepalese context is a Limited Liability Company that promotes PPP model facilitating cooperation between the private sector, public sector (municipality) and local organizations
- Another model is the Community-Private Partnership model, in which the community leases out the electricity facility to a (local) private company for the day-to-day operation and maintenance against a fee.

[*)] World Bank, Nepal Mini-Grid PAD; RERL Progress Reports

Output 2a2 Commissioned mini grid demonstration projects totalling 300 kW

- MHPs with a total capacity of 326kW have already been grid-connected and 500kW Phawa Khola will be grid-connected by the end of 2019. USD 500,000 was mobilized from the World Bank and USD 300,000 from GoN to complete Taplejung Mini Grid interconnecting 6 mini/micro hydro plants of cumulative capacity of 826 kW. The whole system will be then connected to the national grid.
- USD 66,000 was mobilized from ISE Fraunhofer and WISION Germany to connect 135kW and 83kW MHPs in Gulmi district.
- USD 100,000 mobilized from GoN for the grid interconnection of 4 MHPs of total capacity 253kW

Output 2b2 Demonstrated sustainable and reliable mini-grid connecting micro-hydro power plant totalling 300 kW

- **Taplejung Mini Grid**
  - Interconnecting 6 mini/micro hydro plants of cumulative capacity of 826 kW.
  - MHPs with total capacity of 326 kW have already been interconnected and 500 kW Phawa Khola will be interconnected by the end of 2019. The whole system will be then interconnected to the national grid.
- **Gulmi Mini Grid**
  - Interconnect 135 kW and 83 kW MHPs in Gulmi district of total 218 kW
- **Grid connection**
  - Grid connection of 4 MHPs of total capacity 253kW.
  - Detailed feasibility studies (DFS) of 24 MHPs for grid connection completed with GoN funding

Another barrier for mini-grid development has been in inadequate mechanisms to properly utilize mini-grid assets after the arrival of the national electric utility grid. Many have been shut down as soon as the national grid did arrive. As explained under Outcome 1, NEA and AEPC have agreed on guidelines for **connection** of existing mini-grids to the main grid. This is expected to reduce the risk associated to grid arrival in the mini-grid areas and increase revenues. The 23kW Syaurebhumi MHP of Nuwakot, the first grid-connected MHP of less than 100kW, was successfully synchronized with the national electricity grid in 2017. After the breakthrough achievement of grid connection of 23kW Syaurebhumi MHP in Nuwakot, RERL assisted to connect Leguwa Khola MHP, Dhankuta, Chimal MHP, Tapjejung, and Midim Khola MHP, Lamjung with the national grid in 2018. With the grid interconnection, the load utilisation factor of Syaurebhumi MHP has increased to 65% from an average of less than 10% before interconnection[18]. Rather than abandoning the off-grid facility, it has boosted its financial sustainability with the higher load factor (see Box 15). It also contributes to a reduction of transmission and distribution losses to some extent and enhances system reliability of the rural feeder line.

Box 20 Grid connecting and interconnected micro/mini hydropower systems

Project Output No.	Type of RE system *Inter- or grid-connected MHPs*	No. of plants	Installed capacity kW	Cost of connection NPR million	Financing			
					Grant funding Source	Amount	Others Source	Amount
2a2	Syaurabhumi (Nuwakot District)	1	23	2.90	AEPC	2.90		
2b2	Luguwa Khola	1	40	3.00	AEPC	3.00		
	Chimal	1	90	3.40	AEPC	3.40		
	Midim Khola	1	100	4.20	AEPC	4.20		
	Tapiejung MHPs interconnected	5	326	8.00	AEPC-World Bank	8.00		
	Gulmi MHPs interconnected	2	218	14.63	WISIONS-AEPC-GIZ	5.69	Others	8.94
	Total		**797**	**36.13**		**27.19**		**8.94**

Source: Based on data provided by Project Team; Progress Reports; RERL Achievements

One advantage of i**nterconnecting** nearby micro/mini hydropower plants is better management of demand and supply of electricity by serving the deficit in catchment area of one MHP with the surplus of another, thus increasing the load utilisation factor of plants. For example, the Gulmi Mini Grid Project interconnects 2 AEPC supported MHPs, namely the 135kW Paropakar Cooperative MHP and the 83 kW Daram Khola MHP[19]. Similarly, the Taplejung Mini-Grid Project interconnects 5 MHPs and 1 Mini Hydro with an installed capacity of 326kW. The 500 kW Phawa Khola Mini Hydro will also be connected in the Taplejung Mini Grid and total capacity will then be 826 kW.

[18] Progress Report 2018

[19] With financial support from Interconnected Mini-Grids for Intensive Rural Electrification in Nepal (IMIREN) of WISIONS (Germany)

Output 2b4 Operationalized 2 MW of off-grid large micro-hydro (over 60 kW) power projects demonstrating cost-advantage, feasibility, productive end-uses, and best practice through technical assistance	
• MHPs (micro hydro), over 60 kW ○ 46 MHPs ○ 4,324 kW ○ 37,145 households	• Relief & Rehabilitation ○ 104 MHPs ○ 3,102 kW ○ 22,195 households

To demonstrate the financial viability of micro-hydro plants (MHPs), RERL has been supporting 46 MHPs with the total capacity of 4,324 kW benefiting 37,145 households in for commercial operation. RERL support has included community mobilization, institutionalization of MHPs and verification of documents submitted by POV Inspectors. Another important aspect is demand stimulation by promoting productive uses of energy (PUE; discussed further as part of Outcome 3). Micro hydro should not only be seen as a social infrastructure but also as a commercially feasible enterprise that should raise sufficient revenues to cover operation, management and maintenance cost.

Under rehabilitation activities after the 2015 earthquake, RERL provided technical and financial support to 104 MHPs for rehabilitation with a total capacity of 3,102 kW and benefiting 22,195 HHs have been brought back to operation. This also implied that part of the original budget meant for demonstration projects was used for relief and rehabilitation efforts (see Box 22).

Box 21 Making micro hydro viable operation

After RERL intervention, the monthly revenue collection of 83 kW Darna MHP in one of the most remote districts of Nepal (Achham) has increased five folds from a meagre NPR 25,000, due to regular tariff payment and electricity export to a nearby village (Kalagaun). With RERL advice, two cooperatives were formed. This intervention also shows that with more reliable services, customers are willing to pay even increased tariffs and with proper incentives, staff is willing to work better. In the case of the 29 kW Simli MHP another business model was chosen, in which the community leased out operation and management to a local entrepreneur (CPP model, see Box 19). Before the income of about NPR 20,000 a month was not enough to cover the operating cost. The new management focused on stimulating demand by increasing the number of enterprises to increase revenues. The Simli MHP is now powering 100+ enterprises, including 60 enterprises in the local bazaar, as well as eateries, lodges, jewellery stores, beauty parlour, mechanical workshop, as well as a health post. Revenues increased to NPR 75,000 per month of which NPR 7,000 per month is paid to the community as per the lease agreement

*) RERL Achievements, Progress Report 2018

Box 22 Larger micro hydro systems supported during the RERL Project period

Project Output No.	Type of RE system *Off-grid large micro hydro*	No. of plants	Installed capacity kW	Cost of connection NPR million	Financing			
					Grant funding Source	Amount	Others Source	Amount
2b4	Larger micro HPs (>60 kW)	46	4324	1,923.44	AEPC	879.18	Community	1,044.26
	Relief and rehabilitation-AEPC	50	1476	200.00	AEPC	100.00	Community	100.00
	Relief and rehabilitation-RERL	64	1626	6.35	GEF	6.35		
	Total		**7426**					

Source: Based on data provided by Project Team; Progress Reports; RERL Achievements

Off-grid solar PV

Output 2a3 Commissioned large-scale solar PV demonstration projects totalling 500kW
• Under the Credit Guarantee Mechanism and Vendor Financing Instrument established at CREF, RERL in collaboration with UNCDF, WINROCK, Sahara Nepal, Small Farmers Cooperative Ltd., over 100 solar PV pumping systems have been established. • AEPC provided USD 272,727 as soft credit to establish 1MWp Captive Solar plant at Bishnu Priya Solar Farm, Nawalparasi to power MK Paper Mill. RERL provided technical assistance to interconnect the system with the grid. • USD 99,269 was mobilized from Gyeonsangbuk-do, South Korea to provide Solar PV solutions for lighting, water supply and operating micro industries in extremely marginalized Chepang village in Dhading district. • USD 3 million grant budgeted by GoN/ADB under SASEC to develop 500kWp solar minigrid projects. • USD 640,909 mobilized from KfW to install 50 solar PV pumping systems

Output 2b3 Demonstrated sustainable and reliable large-scale solar PV systems (500 kW total)

• Supported to install a total of 7.929 MWp Solar PV Systems
  ○ PVPS - 3,196kWp
  ○ ISPS - 1,627 kWp
  ○ Solar mini-grid – 790 kWp
  ○ Grid-connected system – 2,317kWp

Unlike solar home systems, larger-scale solar PV systems such as solar mini-grid, institutional solar for schools and health posts, are relatively new in Nepal. Water pumping system have seen an expansion from drinking water supply to include irrigation. To promote solar PV based systems, RERL has been working with AEPC but also with different other organizations ranging from Nepal Army (in particular, snake bite treatment centres) and government agencies, such as Nepal Oil Corporation[20] and Department of Irrigation, development partners, private sector to local non-governmental organizations. In this way, it is expected that the systems continue to receive financial and technical support (for maintenance) after the installation.

RERL provided technical assistance (included demand collection, environment and social safeguard screening, feasibility study, design and installation to AEPC to install 50 photovoltaic pumping systems (PVPS) funded by KfW in Baglung, Kaski, Tanahun, Pancthar, Rukum, Salyan, Acchaam, Dadeldhura, Ramechaap, Chitwan, Tanahun, Dailekh, Palpa and Gulmi and 23 more PVPS are under construction[21].

RERL is supporting AEPC and SASEC to develop solar mini-grid projects, including site selection, finalization of feasibility studies, bid document preparation particularly technical specifications and on-site monitoring during the installation. Sometimes, solar mini-grids must find a balance between investment cost (supply) and demand. In some instances, it has been a struggle to meet the increasing demand of the community. In this context, RERL has been exploring options to promote hybrid (solar-wind) systems. A 25 kW wind-solar hybrid system was installed with AEPC's support in 2016[22]

The Project has provided financial and technical support for institutional PV systems in schools, health posts and snakebite centres. RERL provided 1.5 kWp solar PV backup systems at Snake Bite Treatment Centers in Letang, Morang, Itahari, Sunsari and Charali, Jhapa. The systems provide continuous electricity to power refrigerators to store snakebite anti-venom vaccines at between 2˚C and 8˚C, fans, lights, and nebulizers. Even when connected to the main grid, blackouts have often implied that vaccines go to waste; a solar PV backup can provide 24/7 electricity. On average, more than 1,500 snakebite cases were treated by the centres each year. After knowing the

[20] In 2017, RERL prepared the concept note on using Solar PV to power Fuel Pump Stations. The concept note was submitted to the Nepal Oil Corporation under the Ministry of Commerce and Supplies (Progress Report 2017)

[21] Progress Report 2018

[22] Progress Report 2016

huge impact of solar systems, AEPC has planned to support PV backup system in 25 more Snakebite Treatment Centres (through Government treasury).

In 2018, RERL worked with SNV Nepal to install 3kWp solar PV systems in 2 health posts in Rukum and Salyan districts, and in four Birthing Centres established with UNICEF funding in Mugu district and three health posts in Surkhet and Makawanpur districts to power medical equipment supplied through the afore-mentioned institutions.

To give some examples on RERL's financial and technical support to solar irrigation systems, we mention the 4kWp solar PV system installed in Telkuwa Solar Irrigation Project in Bara. Telkuwa Krishi Company, a Special Purpose Vehicle owned by beneficiary farmers and a private company, owns the system. In 2017, RERL provided financial assistance to the company to work on various aspects of the vegetable value chain. This will help improve the revenue generation of the project. Similarly, RERL, with the financial support from UNESCAP, has installed solar pumping systems for water supply and irrigation through an SPV at the Chepang Community of Raksirang, Makawanpur.

CREF provided Credit Guarantee and Grant support (see Section 5.2.3 for info on CREF) to the company SunFarmer to install 5 household sized solar irrigation systems in Chitwan district. Through the initial support, SunFarmer has already installed 36 such system in Chitwan and is planning to expand its activities in other districts as well[23].

Box 23 Contribution to earthquake recovery

As a result of the devastating earthquakes of April/May 2015 in Nepal, RERL has primarily focused part of its activities during 2015-2017 in relief and rehabilitation effort and diverted USD 1 million of its project funds from its originally planned activities. Immediately providing 28 mobile phone charging systems in Dolakha district for quick recovery of communication network and conducting a rapid damage assessment of 156 MHPs and 45 solar water-pumping systems supported by AEPC. For immediate relief and rehabilitation of the earthquake-affected areas, RERL has installed 8 kW large solar PV systems in 40 institutions. RERL worked closely with AEPC to prepare Post Disaster Needs Assessment (PDNA) related to renewable energy for the National Planning Commission (NPC). Then, RERL focused on providing electricity to government offices, health posts, birthing centres, schools and temporary learning centres, and also provided technical support to implement other AEPC, supported relief activities funded by DFID. In total, RERL has provided support on the rehabilitation of 230 such institutional PV systems and 64 MHPs (with a total installed capacity of around 1.63 MW; see table below). With these supports, 180,486 households have benefitted from overall energy services, including 13,143 from MHP and 53,403 from institutional PV systems.

	RERL	AEPC
Health posts and birthing centres	144 solar PV systems (300 W_p each)	
Mobile charging	28 systems (40 W_p each)	
Schools	47 solar PV systems (300 W_p each)	150 systems (700 kW total)
Public offices	39 solar PV systems (300 W_p each)	
Drinking water	9 PV pumping systems rehabilitated	
Micro hydro systems	64 systems rehabilitated (1626kW total)	50 systems (1476 MW)

Source: RERL Achievements, Progress Report 2017

Solar PV grid connection and large-scale solar PV

Output 2b6	**Completed financial closure of 2 MW of large-scale solar PV systems, demonstrating cost advantage over smaller PV systems, feasibility, productive end-uses, and best practice through technical assistance**
• Assisted Department of Electricity Development & NEA to prepare policy, guidelines, technical assessment, etc. for development of large solar systems in the country. • 24 MW utility-scale solar PV systems being developed with Viability Gap Funding (VGF) mechanism	

[23] Progress Report 2017

Upon the request of DoED and NEA, RERL and AEPC drafted Guidelines for Utility-Scale Solar PV Projects in 2017 for the systematic development of the sector which was finalized through wide stakeholder consultation, including the private sector. The final guidelines were submitted to MoEWRI in 2018 for endorsement and implementation.

NEA has prepared Net Metering Guidelines and connected several PV systems to its grid. AEPC provided financial and technical support for the installation of 15kWp grid-connected solar PV system at Nepal Engineers Association building in Lalitpur. RERL provided financial and technical assistance to grid interconnect a 1 MWp captive solar plant in Nawalparasi district. This is the first example in Nepal where a captive solar plant has been connected to the national grid.

RERL and AEPC actively supported in preparing the recommendations for **Policy for Grid Connection of Renewable Energy Technologies**. The Task Force has recommended injecting 15% of the total connected power from renewable resources along with limits of power injection at various voltage levels. Once these recommendations are adopted in the policy, Nepal Electricity Authority (NEA), the national electricity utility, will go for Power Purchase Agreement (PPA) for renewable resources at a higher rate than conventional sources. In this regard, RERL provided assistance to NEA to prepare technical specifications and bid document for procurement of **64 MW grid-connected Solar PV** to be installed at different substations around the country (out of which 24 MW is being developed with ADB financial support).

Box 24 Solar PV systems supported during the RERL Project period

Project Output No.	Type of RE system	No. of systems	Installed capacity	Cost of connection	Financing			
					Grant funding		Others	
	Larger solar PV systems		kW	NPR million	Source	Amount	Source	Amount
2a3	Solar pumping systems	1415	3202	720.46	AEPC	403.50	Other	316.96
2b3	Institutional solar PV	956	824.1	541.09	AEPC	441.39	Loc. Gov+Comm	99.70
	Instit. solar PV- Relief and Rehab	258	802.9	141.31	GEF	101.17	Community	40.15
	Solar mini-grid	22	673	483.02	SASEC, AEPC, GEF, UNDP	370.15		112.87
	Grid-connected PV systems	9	2317	451.44	GoN	238.44	Private	213.00
	Total		**7819**	**2,337.32**		**1,554.65**		**782.68**

5.2.3 Outcome 3a Improved availability of financial investment supports for rural RE and other low-carbon technology applications

Outcome 3b Improved design and packaging of investment support mechanisms for rural RE and other low-carbon technology applications

Output 3a1	**Established financing instrument to incentivize Banking and Financial Institutions (BFIs) for financing domestic manufacturers to meet growing orders and be cost-competitive**
Output 3a2	**Established a financing instrument to incentivize Banking and Financial Institutions (BFIs) to promote commercial financing for mini-hydro and large-scale solar PV projects**
Output 3b1	**Designed and provided technical support for financing platforms and services for promoting commercial financing for domestic manufacturers**
Output 3b2	**Designed and provided technical support for financing platforms and services for promoting commercial financing for mini-hydro and large-scale solar PV projects**
Output 3b3	**Developed training materials on mini-hydro and large- scale solar PV projects for financing institutions**
Output 3b4	**Created matchmaking platform for mini-hydro and large-scale solar PV developers, financing institutions, and equity investors, and productive end-users**

- A detailed study on why BFI are reluctant to finance community-owned RE projects in rural areas.
- RERL has provided USD 600,000 to establish the following financial instruments at CREF;

- Soft Credit- Project Developer and Private Sector
- Credit Guarantee
- Project Insurance
- Vendor Financing and Vendor Challenge Fund
- LFI Financing

- Prepared CREF business plan in collaboration with UNCDF
- Prepared Vendor Financing Manual
- Organized several Match Making Platforms
- RERL and CREF prepared training materials for orientation of bank officials and organized training on mini hydro and large-scale solar PV
- CREF Website developed

RERL has been working with Central Renewable Energy Fund (CREF) of AEPC to establish financial instruments such as credit guarantee, vendor financing, credit insurance, etc. to attract private investment in renewable energy projects, such as mini/micro hydro, larger solar PV (grid, irrigation) and productive uses of energy). RERL provided GEF fund of USD 600,000 to CREF to establish and operationalise financial instruments to attract bank financing for MHP and solar PV projects.

Box 25 Central Renewable Energy Fund (CREF)

AEPC is a development institution established to support rural and renewable energy projects with funding coming from GoN and development partners. Initially, funding from project was mainly provided through subsidies. To facilitate a shift to credit-based funding the Central Renewable Energy Fund (CREF) was established under AEPC. The idea is that AEPC itself focusses on technical aspects, policy formulation, promotion and awareness, while CREF takes care of channelling credit and subsidy. A 'handling bank' that will operationalise the three core functions: i) wholesale lending to partner banks; ii) subsidy fund management; iii) investment management; and iv) fund administration (CREF Secretariat). NMB Bank is currently the 'handling bank'. CREF is overseen by an Investment Committee (with participation of AEPC, Ministries, a representative from the Nepal Bankers' Association and a private sector representative). In a competitive procurement procedure, a number of partner banks have been selected (BOK, CEDB, Civil, NIBL, SBL, MBL, ADBL, other). CREF acts as a 'wholesale bank' to its partner banks that utilise CREF's credit as 'retail banks' for investment in the RE sector. RERL has been working closely with CREF to identify prospective incentive packages for BFIs to finance not only RE projects but also manufacturers and installers to acquire modern technologies related to mini hydro and large solar PV systems.

Source: PPt Terminal Evaluation; Progress Reports; CREF interview

De-risking RE investment

In Nepal, finance in renewable energy mostly flows in the form of grants/subsidies. The government uses public finance tools to determine the subsidies and channels and mechanisms for communities and developers to access these funds to develop renewable energy projects. Very few RE off-grid projects have been financed by the private sector. One reason to set up **Centre Renewable Energy Fund (CREF)** was to have a financial intermediation mechanism to mobilize credit. Nonetheless, project developers have struggled to achieve financial closure on time as subsidy and their equity is not enough to cover the total project cost and bank financing is difficult to access. When available the cost of financing is high as the financing institutions themselves seek different forms of assurance to avoid actual and perceived risks. For this reason, a detailed study was carried out by RERL in February 2016 to identify the reasons why Banks and Financial Institutions (BFIs) were reluctant to finance RE projects in rural areas and the kind of support they require to make the investment less risky. The study recommended design and operationalization of financial instruments such as soft credit, credit guarantee and project and loan insurances AEPC on top of the available subsidy to help reduce actual and perceived risks of BFIs and training and orientation for BFI personnel on mini-hydro and solar PV projects.

Based on the recommendations, a number of mechanisms (interest subsidy, soft credit, credit guarantee) for financing mini-hydro demonstration projects and solar PV systems were established and operationalized by CREF with RERL support. For example, the **Credit Guarantee Mechanism** has proved to be crucial in this regard. So far, 9 mini-

hydropower projects have received credit approval letters from commercial banks amounting NPR 130 million. Some examples are given in the Box below

Box 26 Examples of mini hydro projects with bank financing

Project	Capacity (kW)	Project cost (NPR million)	Bank loan + bank (NPR million)	Tenure (yrs)	Interest rate (%)
Simrutu Khola	200	85.70	10.00 (Civil)	5.0	BR+3.25%
Giri Khola	200	101.54	16.34 (NIBL)	7.0	BR+1.75%
Phawa Khola	500	153.66	30.00 (Civil)	4.0	BR+1.75%
Khatyad Khola	500	265.85	30.00 (MBL)	9.0	BR+3.25%
Bagaume Khola	91	30.12	3.00 (Mega)	0.5	15%

Source: RERL Achievements; additional data provided by Project Team

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RERL and UNCDF jointly established the **RE Vendor Challenge Fund** at CREF in 2017 with the main objective of supporting RE vendors to test, develop and scale up innovative business models in Nepal. The fund supports a maximum of 50% of the total NPR 19.67 million budget. The CREF has entered into performance-based agreements (PBA) with three vendors, Astha Engineering Solution Pvt. Ltd., JBS Urja Pvt. Ltd., and Gham Power Nepal Pvt. Ltd., selected under the stringent procurement rules laid down in the Vendor Finance Operation Manual. Up to now, Ghampower Pvt. Ltd has installed seven PVPS for aquaculture (fish farming) in Bardiya, Kailali, Dang and Sarlahi districts.

Box 27 Disbursements of Vendor Finance Challenge Fund

Applicant	Activity	Budget (NPR) (Grant, NPR)
Aastha Engineering Solution Pvt Ltd	Introduction of innovative drying technologies in Nepal and value addition in cash crops	5,556,600 (2,778,300)
Gham Power Nepal Pvt Ltd	Off-grid bazaar for selling solar water pumping systems	6,752,660 (2,696,330)
JBS Uria Pvt Ltd	Implementation of PAYG technology in solar energy devices system	7,359,480 (3,205,780)

Source: Progress Report 2018. Note: Actual disbursements by end-2018 were NPR 2,170,102

Banks and larger financial institutions in Nepal have a general idea of processes and risks associated with development and operation of larger hydropower projects (>1MW) built by Independent Power Producers but have limited exposure to mini-hydro and other renewable energy projects. RERL assisted CREF to design training materials for BFIs on financing mini-hydro and solar PV projects and organized several orientation programs including site visits. The training material includes technical aspects of mini/micro-hydro and solar PV systems, the role of AEPC and development partners in promoting these technologies, subsidy policy, and subsidy delivery mechanism, case studies of successful and unsuccessful micro-hydropower projects, risks and challenges in financing these technologies and financial instruments. RERL also helped organize several Investment Forums (matchmaking events) in collaboration with Winrock International and ADB where potential developers presented their projects to banks.

Productive uses of energy

Output 3b5 Established functional enterprises adopting productive use of electricity **Output 3b6 Operationalized mechanism to promote financial products for entrepreneurs/end users** **Output 3b7 Ensured women and marginalized/vulnerable groups own 33% of the functional electricity-based enterprises established**
• Extensive input provided to prepare AEPC's guidelines, forms, formats, mechanisms for productive end-use promotion; Enterprise based approach; Support the entire value chain • Innovative Technologies for fuel switching

- *Lokta/Allo* Boiler in collaboration with Pokhara University
- *Lokta* Paper Dryer
- *Sisno* (Nettle leaves) Dryer
- Cardamom Dryer
- Tea/Ginger Dryer
- *Khuwa* Making Machine
- Herbal Soap Making
- Electric Cooking in Collaboration with University of Bristol, UK and PEEDA Nepal.
- Micro Hydro Operated Lift Irrigation (MHOLI)

- Targeted activities for women (90 women) and marginalized groups for enterprise development- skill development, marketing, packing, entrepreneurship, etc.; Women-led micro finance activities-women owned mini-hydro plants

One of the main barriers for attracting private investment in RE projects in rural areas is the perceived high risks Banking and Financial Institutions (BFIs) have of community-owned and managed systems. Another major reason for the lack of private investment in RE sector is low returns. To enhance revenue generation from RE projects, RERL has been working closely with AEPC to develop mechanisms for the promotion of productive energy uses. This will help attract private sector actors to develop and operate renewable energy projects. RERL provided technical assistance to PEUC/AEPC to prepare 45 business proposals for small enterprises powered by MHPs. The business plans have been submitted to AEPC for government subsidy.

RERL is working on electric cooking and space heating with electricity generated by micro hydropower plants as recommended by the MTR. One of the major hindrances in this regard is the limited power of MHPs – it is not possible to provide electricity to all beneficiaries as the designed power allocation to each household is only 200W, which is not enough for electric cooking nor space heating. RERL is testing low wattage cooking, modification of commercially available stoves and demand-side management to promote electric cooking.

RERL supported other innovative projects that help fuel switching from firewood to electricity. RERL helped to locally design and fabricate an electric *lokta* bark boiler and install it at a Nepali paper factory in Ghandruk, Kaski. After comments from the Ghandruk entrepreneur, RERL further modified the design and fabricated a prototype and tested it. Based on the new design a *lokta* bark boiler was fabricated and installed in Ramechhap district by a local entrepreneur with financial assistance from the Rapid Enterprise and Livelihoods Recovery Project (RELRP) supported by UNDP. Similarly, RERL is supporting to design and fabricate a nettle leaves dryer (Sisno dryer). The dryer has been fabricated and transported to Baglung. The *Sisno* dryer will be managed by the Nisi Sisno Powder Udhyog owned by 15 women entrepreneurs. The enterprise will be providing employment opportunity for 15 very poor women during collection time.

- Has the project had any impact on gender equality and economic empowerment for women and other marginalized groups? Was it intended to?

Gender and social inclusion

The objective of RERL project with regards to gender equality, women's empowerment and social inclusion is to build an equitable and gender-inclusive society by ensuring equal rights to women of all castes, creed, and regions. In the current context, the project is equally emphasizing on the empowerment of women to engage in energy and non-energy-based enterprises. Women have been encouraged to own and manage businesses and to be involved in all stages of production and marketing by providing them additional grant/subsidy and other positive discrimination in capacity development activities. This is even more important given the fact that a large number of men have migrated abroad for earnings. Therefore, gender sensitization is sought after by the project at every step of the value chain by awareness creation, capacity development, business establishment and operation, and marketing. In promoting energy-based enterprises for the sustainability of mini-hydro and large-scale solar projects, GESI is integrated through at least 33% participation of women and other disadvantaged groups in decision making, capacity development opportunities, businesses establishment, and employment opportunities.

AEPC has been promoting GESI at the policy level. For example, the revised subsidy policy and delivery mechanism provide additional financial assistance to single women-headed and disadvantaged households (see Box 16).

RERL has given further thrust by provisioning access to finance to women and marginalized groups in all demonstration projects through microfinance activities. For example, in Simrutu Khola Mini Hydro Cooperative Ltd., 900 women and 70 men members from 43 different micro-finance groups (MFG) are involved in regular saving and credit activities. Trainings on "financial literacy, leadership, and microfinance operation were provided to 96 women members of the Cooperative for the smooth operation of their MFGs. RERL initiated such saving and credit schemes involving mainly women in other mini-hydro and solar PV projects. It is expected that these microfinance groups and cooperatives will eventually take over the responsibility of revenue collection and loan repayment. Boosting local financial management skills will also help convince BFIs that revenues (and thus loan repayment) will be carried out in a timely manner. RERL organized several "Business Management Training to Women Entrepreneurs" events in which 90 women entrepreneurs participated. The main objective of the training was to impart knowledge on business management particularly on entrepreneurship, bookkeeping, and marketing of their businesses[24].

RERL has also been supporting marginalized communities to benefit from electricity by establishing enterprises and income-generating activities. With financial assistance of UNDP and rural municipalities, RERL supported the extremely marginalized and poor Musahar, Dom and Santhal communities to install solar Micro Grids in Morang and Parsa districts benefiting 163 households. In 2017/18, RERL worked with communities in Jumla, Rukum, Baglung, Solukhumbu and Taplejung districts to support them with access to electricity from mini-hydro and solar PV systems. Another GESI activity has been the Dhading Solar Project both in terms of resource mobilization for improving access to modern energy services to the disadvantaged Chepang community of Dhading district. These projects will directly benefit members of indigenous communities living in the project areas. Likewise, RERL is currently working with Chepang community, one of the most marginalized and endangered ethnic groups in Nepal, in Makwanpur RERL is further supporting these communities to operate and manage their systems and to engage in income-generating activities in collaboration with RERA/GIZ[25].

5.2.4 Outcome 4 Enhanced technical capacities and skills in design, manufacture, installation, and operation, management of rural RE projects planning, assessment and monitoring

Output 4.1	**Established database of technical specifications for the design, manufacture of micro-hydro (60+ kW) and mini-hydro installation and after-sales service in micro-hydro (60+ kW) and large scale solar PV systems**
Output 4.2	**Fully trained skilled and technically capable people available for project identification, feasibility studies and detail design of mini-hydro projects**
Output 4.3	**Fully trained, skilled and technically capable mini-hydro manufacturers in identified areas with after-sales services**
Output 4.4	**Fully trained, skilled and technically capable construction and installation teams within companies to improve quality of installed mini-hydro projects and large solar PV system**
Output 4.5	**Fully trained, skilled and technically capable people available for operation, maintenance and business management of mini-hydro projects and large-scale solar PV systems**

- The study on gap analysis for development of mini-hydro in Nepal completed.
- Quality Assurance Framework for Solar PV and Mini Micro Hydro is prepared
- Sustainability Framework for MHP prepared and piloted in 11 MHPs
- Remote monitoring of Solar PV system developed & installed
- Training on "Certification of Micro Hydro Installation" with CTEVT (Council for Technical Education and Vocational Training
- Guidelines/Manuals

[24] Progress Report 2016, RERL Achievements

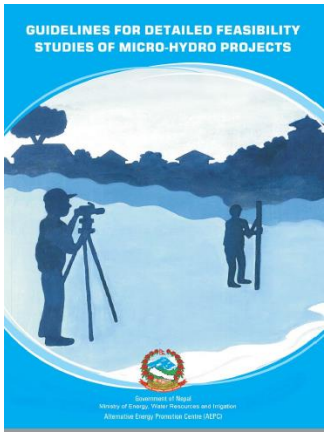
[25] RERl Achievements, PIR$ 2018, progress reports

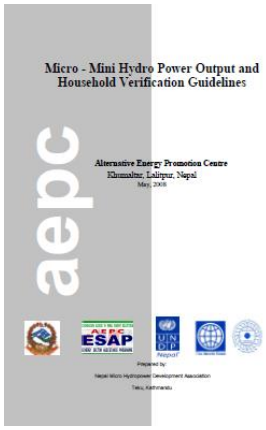
- Mini Hydro Detailed Feasibility Study (DFS) guidelines (> 100 kW)
- Mini Hydro Tariff Fixation, Operation Guidelines
- Mini Hydro Development Guidelines
- Guidelines for Commercial Operation of MHP
- Power Output Verification guidelines for mini/micro hydro revised
- Solar-Wind Mini Grid Design Guideline
- Utility-Scale Solar PV Development Guideline

- Trainings
  - POV training for Engineers
  - Large Scale Solar PV Design Training
  - Micro Hydro Operation Training of Trainers
  - Decentralized Micro Hydro Training
  - House Wiring Training
  - Mason Training
  - Electrical Safety Training for users
  - Mini Hydro Management Training
  - Micro Hydro Installation Training
  - Orientation on productive uses of energy
  - Orientation on Tariff Fixation and Operation Guidelines for the Management of Mini Hydro Power
  - Women business management training

RERL is working on the development of capacities of various stakeholders at all levels for the promotion s mini hydro, large micro hydro, mini-grid and large solar PV. In 2014, RERL undertook a study to identify gaps in survey design, fabrication, system integration, installation, and after-sales services. This study came with recommend potential solution measures along with time and cost required and has formed a basis for the support to the private companies involved in mini/micro hydropower and solar PV promotion and development by AEPC. RERL/AEPC worked with National Academy of Science and Technology (NAST) in 2016 to prepare Capacity Needs Assessment (CNA) of the RE sector with World Bank funding. A study on total quality assurance mechanism for mini-hydro and large solar PV was also carried out.

Several guidelines and manuals have been elaborated as mentioned in the table above.





A number of training were organised. These included in 2017-2018: 1) computerized accounting system and financial management, 2) demand collection and subsidy processing for productive end-uses (PUE) promotion, 3) mini/micro hydro operation trainings, 4) training cum exposer visit for mini-hydro developers and officials of rural municipalities, 5) orientation on formation of SPV for development of the MHP, 6) monitoring training, In 2015, RERL worked with AEPC and Practical Action to provide training of trainers to 20 MH operators and 20 installers from the private sector (with the objective of using them later to train other MHP operators).

RERL has provided several orientation and training to engineers from AEPC and different governmental agencies such as Ministry of Energy, Water Resources and Irrigation (MoEWRI), Water Energy and Commission Secretariat (WECS), Department of Electricity Development (DoED), Nepal Electricity Authority (NEA), Nepal Telecom and the private sector on project conception, survey, design, financing, etc. Likewise, RERL provided training on grid connection of MHP and solar PV. At the local level, potential entrepreneurs with a particular focus on women-led businesses have been strengthened and supported as a result of RERL interventions

RERL supported Monitoring and Quality Assurance Unit (MQAU) of AEPC to Piloting of Sustainable Framework for monitoring of micro-hydro. RERL supported updating Power Output Verification (POV) Guidelines and training Power Output Verification Inspectors (POVI). POV is an important monitoring mechanism to ensure the quality of works done by contractors, which is required before the release of the final instalment of subsidy for completed MHPs.

Development of various financial instruments after consultations with BFIs and the continuous orientation and exposure about RE systems to the BFIs has enhanced the capacities of banks and financing partners to gain more confidence in investing into large commercial RE systems. The interest shown by some banks in flowing credit into mini-hydro projects in Baglung, Taplejung and Jumla is an evidence of the growing confidence although final approvals of such lending are yet to be realized particularly due to lack of CREF funding availability as committed during the whole formation process. Similarly, the discussions and awareness-raising activities targeted at potential energy service providers have been on-going with some progress noticed at operating energy as a business. This is expected to bring about commercialization into the sector thus ensuring financial and technical sustainability of the promoted systems

5.3 Progress towards the objective

5.3.1 Progress indicators

The following table provides an overview of progress against the indicators reported in the project's results framework and a subsequent PIRs.

Box 28 Development progress (outcome indicators)

Outcome indicator	EoP target	Realised	Comment
Outcome 1 (see narrative in Section 5.2.1)			
Number of municipal energy plans* developed that include mini-hydro and large-scale solar PV power generation installations by Year 3	15	23	Originally: district energy plans. Replaced by MEPs according to RERL-prepared methodology (RERL: 7; RERA/GIZ: 16 municipalities)
No. of policies and legal frameworks that are supportive of RE-based energy production were approved and enforced by Year 3	2	7	RERL helped drafted policy-legal frameworks: - Concept Note on Energy Security submitted to GoN - White Paper of MoEWRI - RE in Local Government Operation Act 2017 - RE Subsidy Policy - RE Subsidy Delivery Mechanism 2016 - Draft Renewable Energy (RE) Policy - Draft AEPC Bill
Outcome 2 (see narrative in Section 5.2.2)			
Total installed mini-hydro demonstration project capacity funded by local financial institutions by EOP, MW	1		0.78 MW completed 2.75 MW under construction (see Box 17)
Total installed mini-hydro post-project demonstration projects capacity funded by local financial institutions by EOP, MW	7		9.4 planned (see Box 18)
Total installed mini grid capacity by EOP, MW *Note:* grid-connected or MHP interconnections	0.3	0.80	Gulmi, 0.2 MW; Taplejung, 0.3 MW (see Box 20) 0.25 MW planned under construction

Outcome indicator	EoP target	Realised	Comment
Total installed, large solar PV power generation capacity by EOP, MW	0.5	7.82	Mini-grids: 0.7 MW; institutional PV (schools, clinics, offices): 1.63 MW; solar pumping: 1 MW (see Box 24) Planned: 0.23 MW
Total installed, large micro hydro (60kW+) power generation capacity by EOP, MW	2	4.32	See Box 22
Total installed capacity of renewable energy-based power generation projects achieving financial closure by end-of-project (EOP), MW	10	15.6	Mini hydro: 3.53 MW, micro hydro (60 kW+): 4.32, large solar: 7.82. Planned : 4.33 MW
Total installed capacity of renewable energy-based micro-hydro and Solar PV systems supported by grant for relief and rehabilitation by end-of-project (EOP), MW	2.5	3.90	Solar PV: 0.80 MW, micro hydro: 3.10 (Box 22 and Box 24)
Outcome 3 (see narrative in Section 5.2.3)			
No. of RE financial instruments developed, funded and operationalized by EOP	4	6	Credit guarantee, Soft credit, Vendor financing for solar Vendor Challenge Fund (with UNDCF) Project insurance Local financing and micro-finance
No. of new and improved RE financial instruments for supporting rural RE and low carbon technology applications designed by EOP	2	6	
No. of local financial institutions implementing the new RE financial instruments and have RE loan portfolios by EOP	10	23	Civil Bank, NIBL, ADBN, NMB, Machhapuchhre, Mega Bank Prabhu Bank, Sahara Coop; CYC Coop (Baglung); Simrutu Coop and 13 Small Farmers Coop
Total amount of funds allocated by the GoN and the local financial sector for the new RE financial instruments by EOP, US$ million	30.25	36.95	Subsidy and credit (co-financing)
Total load factor including the contribution of productive use by EOP	50%	30%	The more productive use, the more the load utilisation factor will increase. In addition, grid connection boosts the load factor 60-80%
No. of productive use enterprises from RE projects funded through the new RE financing instruments by EOP	300	2543	1,480 received AEPC subsidy (of which 1063 that were part of RERL survey)
Outcome 4 (see narrative in Section 5.2.4)			
No. of people trained on survey and design of mini-hydro, large micro-hydro and large-scale solar PV systems by EOP	100	168	
No. of local engineering firms trained for manufacture, fabrication and repair maintenance of mini-hydro, large micro-hydro and large-scale solar PV system by EOP	5	8	Preesu Electronics and Techno Village for grid interconnection of MHP; Hydro Energy Concern for management strengthening; Surya Power for grid interconnection of utility scale solar PV; SunWorks for design and fabrication of automatic Sisno (Nettle leaves) Dryer; Pasupati Refrigeration and General Mechanical Works for Lokta/Allo Boiler; Enhanced capacity of Darna MHP Cooperative to provide repair & maintenance services to other MHPs
No. of people trained for installation of mini-hydro, large micro-hydro and large-scale solar PV systems by EOP	100	215	60 MHP installers representing different companies were trained
No of people trained for operation of mini-hydro, large micro hydro and large-scale solar PV systems by EOP	300	563	

Source:
Based on PIR 2018, PowerPoint "II PEB 2019" and additional info provided by the Project Team

In most cases, the end-of-project (EoP) value of the outcome indicator surpasses the target value. In the case of mini-hydro, despite facing numerous challenges such as earthquake, blockade and uncertainties after the promulgation of

the new federal constitution, the project was able to achieve 0.78 MW installed capacity of mini hydro against the target of 1 MW. Based on the current stage of the mini hydro projects under construction and continuation of RERL through ADB SASEC and UNDP funding, the physical target of 1 MW is expected positively to be achieved by the end of December 2019 and additional 2.75 MW by end of SASEC project in December 2021. Further, 4.7 MW of mini hydro projects studied by RERL will be developed through SASEC or Nepal Mini Grid Project. In this way, both the demonstration and post-demonstration targets of cumulative 8 MW will be achieved..

5.3.2 Objective and indicators

- How did the project contribute to GHG emissions reduction within the project implementation cycle and beyond?

Box 29 gives an overview of the installed capacity of RE systems (mini hydro, micro hydro, solar PV) that received technical support by the RERL project (financed by AEPC/GoN, RERL/GEG/UNDP, and other sources, as indicated in Box

Box 29 Planned installed capacity and GHG targets and achievements

PLANNED (ProDoc)	Target kW	EoP kW	Target tCO2 Lifetime	Post-project kW
Mini hydro (0.1-1 MW)	8,000	1,000	228,096	7,000
Minigrid (>0.1 MW)	300	300	57,024	
Micro hydro	2,000	2,000		0
Solar PV	2,500	500	44,762	2,000
- village electrification	700	100	12,731	600
- institutional	800	100	13,833	700
- PV pumping	1,000	300	18,198	700

REALISATION Installed capacity	Target (kW)	Completed EoP (kW)	Beneficiary households	Under construction	Post-project (kW)
Mini hydro (0.1-1 MW)	8,000	782	5,936	2,748	9,403
Minigrid (>0.1 MW)	300	797		500	
Micro hydro (> 60 kW)	2,000	4,324	31,444		
Micro hydro - relief		3,102	15,510		
Solar PV	2,500	7,819	305,103		
- village electrification	700	673		230	
- institutional	800	1,627			
- PV pumping	1,000	3,202			

REALISATION Lifetime savings	Completed systems			Under construction		
	EoP (in kW)	MWh	tCO_2	kW	MWh	tCO_2
Mini hydro (0.1-1 MW)	782	25,337	20,269	2,748	89,035	71,228
Minigrid (>0.1 MW)	797	51,646	41,316	500	32,400	25,920
Micro hydro > 60kW	4,324	140,098	112,078			
Micro hydro - relief	3,102	100,505	80,404			
Solar PV	7,819	174,168	172,427	230	5,123	5,072
TOTAL		**491,753**	**426,494**		**126,558**	**102,220**

Post-project minihydro	**9,403**	**304,657**	**243,726**

Source: data on installed capacity (kW) and beneficiary households provided by Project Team; Progress Report 2018; RERL Achievements. Status of installed capacity as per 20 July 2019

Assumptions for solar PV: 4.5 sunshine hours a day; emission of 0.99 tCO_2/MWh (page 18, Annex 4; RERL ProDoc); 300 operational days a year; lifetime of installed equipment of 15 years

Assumptions for small-scale hydro: plant load factor 30% (except for grid-connected: 60%); emission factor 0.8 tCO_2/MWh; 330 operational days a year; lifetime of equipment: 15 years

13) and the corresponding energy generation and greenhouse gas emission reduction. Box 30 is summary thereof, giving the end-of-project (EoP) target of electricity generation and GHG emission reduction, and the realised value (as per 20 July 2019).

Box 30 Development progress (objective indicators)

Objective indicators	EoP target	Realised	Comment
Total installed RE capacity	3.5*)	20.3	Completed: 16.8 MW (hydro and solar), under construction: 3.5 MW. *(note: p*ost-project (feasibility phase): 9.4 MW)
Electricity generation by end-of-project (EoP) in GWh/year	26.8	41.2	From completed RE systems and systems under construction
Total annual GHG emission avoided by EOP (by EoP)	35.38	35.2/yr	Installed: 28.4 tCO_2/yr; Expected from systems under construction: 6.8 tCO_2/yr (*note*: the annual GHG emission avoided will keep on increasing as post-demo projects come online)
Cumulative energy savings (in GWh) (assuming technology lifetime of 15 yrs)	401.9**)	618.3	Completed: 491.8 GWh. Under construction: 126.6 GWh (*note:* post-project: 304.7 GWh will be added)
Cumulative GHG emissions (kiloton of CO_2)	321.5**)	528.7	Completed: 426.5 GWh; Expected reduction systems under construction: 102.2 GWh (*note:* post-project, 243.7 $ktCO_2$ will be added)
No. of households benefitting from lighting, productive end-use services and employment due to electricity supply by EoP	50,000	357,393	See Box 29

Notes:

*) 1 MW mini hydro, 2 MW large micro and 2.5 MW solar PV. Post-project: 9 MW (7 MW hydro+2 MW solar)

**) According to GEF Tracking Tool: 356.4 GWh from hydro and 45.5 GWh from solar PV

5.3.3 Ratings of progress of the results (objective, outcomes)

The table below gives a summary of the ratings of the 'progress towards results', based on the findings presented in this and previous Chapters. In assessing the progress towards results, a six-point rating scheme is used:

- Highly satisfactory (HS), no shortcomings
- Satisfactory (S), minor shortcomings
- Moderately satisfactory (MS), moderate shortcomings
- Moderately unsatisfactory (MU), significant shortcomings
- Unsatisfactory (U), major shortcomings
- Highly unsatisfactory (HU), severe shortcomings
- U/A = unable to assess.

At the end of the UNDP/GEF project (July 2019), most components have been on track with good progress, in fact mostly achieving or surpassing endo-of-project targets. The project has successfully mobilized partners and financial institutions in effectively leveraging financial contributions and resource mobilization from local banks and development partners (development banks, bilateral partners and international NGOs).

Other notable achievements are in RE policy and regulations, such as the agreement between AEPC and NEA on standards for grid connection, formulation of RE Subsidy Policy and Delivery Mechanism and responding to the new decentralization by providing inputs into local government legislation and supporting municipalities with their energy planning. The project's assistance in the preparation of various technical and financial guidelines (mini-hydro, large solar mini-grids and grid connection of RE systems) has immensely helped AEPC in achieving its renewable energy targets.

Box 31 Evaluation ratings of progress towards results

Evaluation item	Rating	Comment / correspondence with sections in the report
Relevance	R	See Section 3.1. RERL was designed to contribute to rural renewable energy policy and planning and demonstrate the viability of larger RE (mini-hydro and solar PV mini-grids; solar PV for irrigation) in combination with private sector and bank financing, promotion of productive uses of energy and grid connection. RERL has served a knowledge hub within AEPC on rural renewable energy.
Efficiency	HS	See Chapter 4 (implementation). RERL reacted very proactively to challenges that occurred in 2015-16, such as the earthquake (rehabilitation of affected rural energy systems), and decentralization (following Nepal's new Constitution; e.g. supporting local governments with their municipal energy planning). The Project has successfully facilitated partnerships with many stakeholders (government entities, private sector, local stakeholders, banks), international development partners (e.g., ADB, KfW, GIZ), international NGOs and networks.
Effectiveness:	HS	Chapter 5 (progress towards results)
• Outcome 1	HS	Section 5.2.1 RERL has provide crucial inputs in policy and regulation formulation (RE subsidy, grid connection, local energy planning) and related capacity strengthening of government staff and awareness creation of government staff and decision-makers
• Outcome 2	HS	Section 5.2.2 About 3.5 MW of mini-grid systems have been installed or are under construction with a pipeline of 9.4 MW (financed with GoN, GEF and ADB-SASEC support, bank financing and community/private sector equity); about 0.8 MW of mini/micro hydropower systems have been (inter)connected to the grid; support provided to larger micro-hydro systems (4.3 MW with better local governance and demand stimulation); post-earthquake relief and rehabilitation (incl. 3.1 MW micro hydro, and solar PV); larger solar PV systems with a total of 7.9 MW (irrigation, institutional, mini-grid systems and grid-connected),
• Outcome 3	S	Section 5.2.3 RERL has helped to demonstrate of the role of financial instruments (credit guarantee, soft loans, credit insurance) in attracting commercial financing institutions. Productive use of energy support (technical assistance, training, financing) has been an important element to stimulate demand (increasing revenues for the energy system and contributing to local economic and social development)
• Outcome 4	S	Section 5.2.4 Training, capacity strengthening and awareness creation of a range of stakeholders in government (at federal and local level), private sector, banks and financial institutions, and local beneficiaries, with attention to gender and social inclusion
• Attainment of the objective	HS	Section 5.3 The RERL project has met the original targets or in many cases, surpassing. The importance of the RERL lies in having successfully demonstrated that investing and developing off-grid (renewable) can be a viable endeavour for which it is possible to attract local investors and commercial financing that supplements grant financing, in a business model that integrates local engagement with sound management, stressing the role of demand stimulation.
Overall project outcome	HS	Overall project outcome and attainment of the objective

RERL has been working closely with CREF to attract commercial credit in RE projects through design and operationalization of innovative financial instruments such as credit guarantee, vendor financing, and interest subsidy to help in reducing perceived risks. Through the designed financial instruments, financial closure of three mini-hydropower projects has been achieved that serve as demonstration example for other projects.

RERL is also working towards the promotion of productive energy use and livelihood improvement for up-scaling and sustainability of energy systems. The impacts of the on-going activity on commercial operation of 25 micro-hydro plants are slowly been seen at the project level. It has been observed that the plants are performing better both technically and financially with the revenue generation and better local administration.

In short, RERL's has played a crucial role in helping AEPC to overcome barriers to promote larger and lesser disseminated RE technologies including mini-hydro, grid interconnection, solar mini-grid and solar pumping. One can say that RERL has initiated a market change in which private sector and local communities increase investments in larger RE, run existing micro mini-grids more efficiently, policy decision-makers at national and local level engage in building an enabling environment (with appropriate policy instruments and incentives) and in which BFIs recognize the economic potential of larger and grid-connected RE and make finance available. Hence, we have rated the overall project outcome as **highly satisfactory.**

5.4 Sustainability and replication

- To what extent are there financial, institutional, social-economic, and/or environmental risks to sustaining long-term project results? How sustainable (or likely to be sustainable) are the outputs and outcomes? Is there an exit strategy that is well planned? What could be done to strengthen exit strategies and ensure sustainability of interventions made?
- What impact has the project had on policy, legal and institutional frameworks relating to uptake of low-carbon technology?

Sustainability is generally considered to be the likelihood of continued benefits after the project ends. Consequently, the assessment of sustainability considers the risks that are likely to affect the continuation of project outcomes (discussed in detail in Section 4.1.1). In fact, many risks are in one way or another related to the "barriers" mentioned in the Project Document). The occurrence of the "risks" and failure to implement risk mitigation, implies that it will be more difficult to lower corresponding "barriers" substantially, thus negatively affecting the likeliness of "sustainability" of the project's interventions. The critical "assumptions" then is that the "internal risks" (i.e. risks that can be mitigated or managed by Project management), and 'external risks' have a low incidence and/or impacts, in such a way that sustainability remains (moderately) likely. The quality of adaptive management (mentioned in Section 6.1) is determined by the mitigation response of Project management to these external and internal risk factors as these manifests themselves more intensely and/or more frequently than expected.

In assessing the 'sustainability' of the RERL, a simple rating scheme is used:
- Likely (L): negligible risks to sustainability;
- Moderately Likely (ML): moderate risks to sustainability;
- Moderately Unlikely (MU): significant risks to sustainability; and
- Unlikely (U): severe risks to sustainability; and
- U/A = unable to assess.

Five main areas are considered in this section and then rated as to the likelihood and extent that risks will impede sustainability.

Governance and institutional sustainability

RERL project was designed as an integral part of National Rural and Renewable Energy Programme (NRREP) to support AEPC to remove barriers in upscaling RE technologies such as mini hydro and large solar PV systems. The Government of Nepal (GoN) has given high priority to promotion of renewable energy for both rural development and fossil fuel substitution and energy security The Government's priority to RE is reflected in its periodic plans, the MoEWRI White Paper 2018, the recent RE Subsidy Policy (2016) and Subsidy Delivery Mechanism (draft) as well as in the various programmes that are on-going with development partners (RERL, SASEC, SREP, RERA) or have recently started (such as the Nepal Renewable Energy Programme of DFID, Nepal Mini-Grid Project of the World Bank, etc.). RERL helped AEPC

and GoN to draft these (draft) policies, guidelines, concept papers, etc. related to renewable energy development in Nepal. Among the most prominent contribution of RERL was to provide inputs to draft Local Government Operation Act (LGOA) 2017. As the Constitution of Nepal 2015 gives the overall right to develop renewable energy, small hydropower projects, irrigation, and drinking supply systems and other local services to municipalities, RERL provided extensive inputs to elaborate their responsibilities that was incorporated in LGOA 2017, which has given rights to development of renewable energy, hydropower plants up to 1MW and electricity distribution system to municipalities. After the enactment of LGOA 2017, RERL is working with AEPC to build up capacities of municipalities for planning, project identification, implementation, monitoring and post-installation support related to RE projects. RERL also prepared a methodology for municipal energy planning and piloted in 2 municipalities. The methodology thus developed is replicated by GIZ supported RERA project in preparing 16 Municipal Energy Plans (MEP) in Provinces 1 and 7. Further, it is envisaged that DFID supported Nepal Renewable Energy Programme will help to prepare MEPs in remaining provinces.

RERL has also provided essential support in positioning AEPC as RE Center of Excellence. The draft AEPC Bill, which incorporates these ideas, has been submitted to GoN for endorsement and approval from the Parliament. AEPC has already established its units within the Department of Energy, Ministry of Infrastructure of Provinces 1 and 7. Provinces are responsible to support municipalities to carry out their activities and also to develop provincial level RE projects. The AEPC units work closely with provincial officials to help build up their capacity in planning, implementation, monitoring, quality assurance, and standardization, resource mobilization and allocation, etc. for development of RE projects both at provincial and local levels.

RERL supported to prepare standards/guidelines for grid interconnection of MHP and large solar PV systems, while the standards for MHP-Grid Interconnection has been approved by NEA Board and 4 such systems have been implemented, the guidelines for development and grid connection of utility-scale solar PV systems have been submitted to MoEWRI for approval.

Given the above, the Evaluators have the opinion that the institutional and governance risks are relatively small; and sustainability is rated as likely (L).

Financial risks

RERL was the first AEPC project to come up with the concept of attracting private investment in RE projects and made interventions in three areas as discussed above and has been able to establish conducive policy environment, innovative financing instruments and demonstrate the financial viability of larger Re projects. This modality has been more-or-less adopted in other AEPC projects like SASEC and the World Bank funded Private Sector-led Mini-Grid Project.

RERL is working closely with CREF to attract private investment in off-grid renewable energy projects in rural areas. Banks and Financial Institutions (BFIs) in general see investment in community-owned and managed RE projects in rural areas as highly risky and are reluctant to put their money. Similarly, the private sector developers also find rural energy projects not beneficial. In such circumstances, RERL supported CREF to establish and operationalize financial instruments such as soft credit, credit guarantee and vendor financing for renewable energy projects to provide assurance to BFIs to invest in rural RE projects. SASEC projects are also supported through these mechanisms to complete financial closure. These facilities are available for all AEPC supported projects. Furthermore, the innovative financing instruments have been internalized within BFIs and service providers. The interest shown by some banks in flowing credit into mini-hydro projects in Baglung, Taplejung and Jumla is evidence of the growing confidence of the BFI sector.

At this stage, the evaluation Team rates the financial sustainability as likely (L).

Socio-economic sustainability; business models and capacity of private sector and communities

At the community level, RERL's focus is on developing technical and managerial capacities of end-users to sustainably operate and manage RE projects and maximize benefits. AEPC/RERL has identified the Salleri Chialsa Electricity Company (SCECO) model as a suitable one for the operation and management of mini hydropower projects. In order to replicate the successful governance and management system in Salleri Chialsa, AEPC and SCECO have signed an MoU to support

institutional strengthening of SASEC mini-hydro projects. However, many communities are reluctant to go for private ownership and prefer the cooperative model. Thus, RERL has prepared and is implementing comprehensive packages for the establishment and strengthening of both cooperative and company models. In both models, the renewable energy systems are seen not only as social assets but also commercially viable investment and community/beneficiaries are thus oriented. In the Cooperative Model, extensive support is provided to the communities to engage in micro-financing activities so that women and members of marginalized communities can maximize benefits from access to electricity for household consumption but also utilize it for establishment of productive enterprises. Furthermore, to bring efficiency in the management of large micro/mini hydropower/solar irrigation projects, RERL is also promoting "Community Private Partnership" (CPP), where the community owns the power plant and leases it out for private management.

For continuity of RERL's best practices and implementation of recommendations from lessons learnt is to internalize them in AEPC itself and in other relevant organizations. For this, RERL has had the capacity development component targeting governmental agencies, particularly AEPC, private sector and end-users (communities and community-based organisations). the progression of phases from demonstration to post demonstration has been carefully taken into account during individual project planning and implementation. It is also expected that after completion of these RE projects, the expertise will have been internalized fully within AEPC.

The Evaluators rate the capacity-related risks have been significantly lowered during RERL's implementation and socio-economic and capacity sustainability as likely (L).

Environmental sustainability

At the moment of RERL formulation, an environmental impact assessment (EIA) was not required. However, AEPC has prepared Social and Environmental Safeguards documents based on ADB's Guidelines that are mandatory for all RERL supported projects that receive financial assistance from SASEC, they have to adhere to ADB Guidelines that involve design practices taking into account environmental impacts of RE resource preparation and utilization. Items of some concern may be the recycling of batteries, and the diversion of surface water and some downstream impacts of the hydro systems. In general, environmental impacts and risks associated with specific project activities are considered low to moderate. As part of on-going innovations in the sector, the project is working towards promoting electric cooking in micro-hydro catchment areas and switching from fuelwood in certain rural industries. This will have a beneficial environmental impact.

Environmental sustainability is likely (L).

Replication and scaling up

RERL is leading the way in promoting new business model and financing concepts and modalities through demonstration projects that have wider scale promotion potentials showing the way for future RE sector direction. Ensuring scaling up and replicability of the activities has been a major focus during the project design. It has been attempted to ensure scaling up and replication in various ways:

- Firstly, the project is completely aligned with the objectives and priorities of the Government and integrated into the Government's single programme modality under NRREP. After NRREP ended, AEPC coordinated with the Asian Development Bank (ADB) so that SASEC, a joint project of GoN and ADB, would provide financial support and RERL technical assistance to promote mini-hydro and solar mini-grid projects. This arrangement will continue after the UNDP/GEF project operationally ends in 2019 with ADB funding provided through UNDP for the RERL to continue providing technical assistance until 2021 (when SASEC ends).
- Secondly, the project has supported and assisted in the formulation of national policy documents, the establishment of financing mechanisms, capacity building and focused on productive energy uses. RERL is helping to demonstrate that off-grid mini-hydro development as a viable sector for private-public partnerships. The project has supported AEPC in revising policies or regulations in areas where there is a need for revision. The revision of the RE Subsidy Policy is one such attempt to incorporate the changing scenarios of RE needs and demands.
- Thirdly, the project is promoting private-led project development and operation under PPP modality through the formation of SPV. Since all financial transactions are market-based, the modality is both sustainable and replicable.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 General conclusions

RERL was designed to support implementation of the Government of Nepal's umbrella project on renewable energy – Nepal Rural Renewable Energy Programme (NRREP) by providing technical assistance in the policy, institution building, scaling up of renewable energy technologies, grid connection of RE systems, demand stimulation via productive uses of energy, and introducing innovative financing solutions to help in removing barriers in the process of scaling up.

During the implementation period, the project witnessed major changes, to which AEPC/RERL in mostly responded positively; turning challenges into opportunities:

- NRREP was closed in 2017 putting in doubt Government of Nepal co-financing. However, this has been followed by the mobilisation of additional potential resources from development partners and funding agencies. Notably, an agreement was reached with ADB in which RERL teams up with the SASEC project, which RERL providing technical assistance in the design, formulation and implementation of RE projects and ADB-SASEC financial resources (grants and loans made available through AEPC/CREF to project proponents and banks). Additional financial grant resources have been mobilised from World Bank, Germany, South Korea and other development partners and (international) NGOs;
- After the devastating earthquakes of 2015, RERL re-oriented part of its activities towards rehabilitation packages for mainly cleaner lighting solutions through solar PV and micro-hydropower in the affected areas. RERL also played a critical role in preparing Post Disaster Need Assessment (PDNA) of renewable energy systems. Fund reallocation decision by the project, AEPC, UNDP and GEF was immediate and prompt and the major significance of RERL and UNDP support towards earthquake response was in the form of immediate relief (solar PV for lighting, mobile charging and supporting immediate operation of public services) just after the disaster as well as gradual rehabilitation efforts (MHP, solar pumping rehab) when most other institutions and agencies were not able to provide such services due to procurement and other operational issues.
- The rehabilitation activities, unfortunately, were hampered by a blockade at the Indian border in 2015/16 as system imports were delayed, thus delaying prompt installation. During this period, the project focused most of its activities in the regions that were less affected. The blockade, in a strange twist, has also offered an opportunity, by making government decision-makers more susceptible to energy security argumentations. Traditionally, government officials and politicians have viewed large hydro as the means to meet Nepal's power, which has now shifted towards considering indigenously available resources, such as solar and small-scale hydropower;
- A new Constitution was adopted in 2015 which puts in place three tiers of governance and governments (federal, provincial, local). Aligned with the Local Government Operational Act (2017), RERL supported AEPC in orienting the local governments and provincial assemblies and governments on general awareness among the local and provincial governments on the policy instruments, financing instruments and the renewable energy technologies; RERL has successfully prepared a methodology for Municipal Energy Plans, which has been implemented in four municipalities, and now AEPC is replicating in other parts of the country. The RERA programme of GIZ is also implementing the methodology in its programme municipalities

Amidst the challenges and changes, RERL has performed well and achieved and in many cases, over-achieved project targets and has been able to provide an array of service areas ranging from policy instruments, guidelines and standards, inputs into legislations, innovative financing options, capacity building of the local community members, developers and banks, empowering women, creating conducive environment for enterprise development, scaling up RE technologies and piloting new avenues such as grid-connection of RE systems.

The rating in the last Project Implementation Review (PIR) 2018, carried out in July 2018, gives the rating of 'satisfactory' or implementation/execution and development results (project outcomes). Given the findings presented in this Terminal Evaluation Report, the Evaluators propose to give ratings of **'highly satisfactory"** for both.

The main reason for such a high rating is that RERL has managed to bring about fundamental transformational changes in thinking about rural and decentralised RE in Nepal at community and local level, private sector and banking and at national level. The decades before RERL has seen the development of community-oriented smaller-scale RE for rural electrification, micro hydro and solar home systems. Successful in being able to provide electricity to the unserved, these systems also have been accompanied by governance issues and financial sustainability of the systems. RERL has been instrumental in exploring and following new pathways:

- Achieving better economies of scale by developing larger systems (mini-hydro, solar mini-grids, solar irrigation);
- Augmenting revenues of RE systems by stimulation local demand (through promotion and supporting productive uses of energy, PUE) and advocating grid connection (when the national grid arrives);
- Ensuring better governance of existing micro hydro facilities (replacing user group model with a business model that have clear legal status, such as cooperative, limited liability company and/or special purpose vehicles)
- Securing that relevant policies are in place (MoWRI White Paper; RE Subsidy Policy and Delivery Mechanism) and regulations and standards (grid connection regulations)
- Actively involving banking sector and financial institutions (BFIs) by establishing innovative financial mechanisms (at CREF) that back up bank lending and by matchmaking of lenders with investment opportunities in larger RE systems.

All these efforts have been accompanied by awareness creation and capacity strengthening at a local level (end-users, including women and marginalised groups), private sector (developers, vendors, financiers) and at various levels of government. Another argument providing an overall 'highly satisfactory' rating is that there is a clear exit strategy. The partnership RERL-SASEC will continue (with part of RERL project funding provided by SASEC through UNDP) until December 2021. RERL will also work closely with other AEPC-implemented projects, such as World Bank's Private Sector-led Mini-grid, the GIZ RERA Project, and the SNV project on health posts and health centres. CREF will be further boosted with funding from the NREP (DFID-funded) project (GBP 10 million). At the policy level, these efforts will be supported by the new Subsidy Delivery Mechanism that AEPC is in the process of revising.

6.2 Recommendations

Knowledge dissemination (RERL project team)

1) RERL has generated a lot of interesting cases and lessons learnt. The experiences regarding scaling up, private and financial sector involvement, and local governance of RE systems should be disseminated widely for the benefit of decentralised rural and renewable energy development in other parts of the world. The Project has generated a lot of information and knowledge, which is however scattered over a multitude of progress and quarterly reports, videos and small case studies. Masked by facts and factoids, it is difficult for the occasional reader to search for and digest the wealth of info. It is recommended to make a good colour-printed publication, that should summarise not only the info available in various documents and reports, but also provides insight into what works and what does not. Rather than describing just results and best practice examples on a RE project-by-project basis, it is interesting to know how results were achieved per technology type, business model and by what mechanisms. The general publication could be accompanied by small technical reports on thematic issues, such as local governance (ownership-business models), policy enabling environment (RE policy, RE subvention and delivery), figures on investment and lifecycle costs of RE systems, revenue streams; as well as on how to engage the financial sector.

Knowledge dissemination (UNDP Country Office)

2) Such a publication on scaling up (off-grid) RE in Nepal could be followed by a general UNDP publication on mini-grids and large RE systems. First, this will increase UNDP's visibility in this field and will add to the international discussion and general knowledge on experience with mini-grid electrification.

Knowledge dissemination (UNDP Hqs.)

Over the years, UNDP has had many projects on mini-grid development in various countries in Latin America, Africa, and Asia and Pacific. Project websites disappear after projects end; project staff leave for other jobs and even UNDP staff is often on contracts of limited duration and or rotate to other positions. Thus, slowly the information and knowledge gathered vanishes and the institutional memory fades away. Internally, UNDP has a 'Community of Practice' on energy and environment so that (part of) information and data are maintained.

However, part of UNDP's Intranet, the wealth of information on projects, past experiences, designs and work planning, is not easily accessible for 'outsiders'. Such results and lessons learned from past and ongoing are of great interest for practioners that frequently do assignments for UNDP, such as evaluators, design consulants or technical experts. Maybe one idea is to make part of UNDP's knowledge network on rural and renewable energy accessible for practitioners that frequently work with UNDP. Such a network could function as a depository of information (reports, documents on rural RE and mini-grids), relevant UNDP documents (UNDP reports, project documents, evaluation reports, Terms of reference), and as a forum to exchange information and views.

Programme continuation (AEPC)

3) While RERL will continue in the bridging phase until the end of this year and thereafter until the end of 2021, it will be necessary to discuss priorities in the rural and RE sector over a longer period of time to ensure longer-term sustainability and the role of RERL in this. One option is that the RERL and staff are just absorbed into AEPC after 2021. We noticed that one advantage of having a body such as RERL is that it stands in one leg in the energy institutional setup in Nepal; being integrated with AEPC has implied being able to converse with and influence government policymakers. However, being externally funded staff has also implied standing with one leg outside the AEPC structure and in this role the RERL project team has been able to function as an 'independent broker' between government (and government bodies as AEPC) and banking and private sector. One stakeholder mentioned to the Evaluators, that RERL staff in this way have been more easily accessible than if they would have been regular AEPC staff. Given the results of RERL, this setup seems to have worked well in Nepal. With scaling up just starting, Nepal may still need a 'go-between' entity such as RERL until larger scale RE is really mainstreamed in the eyes of government and private sector decision-makers.

Rural renewable energy planning (AEPC: RERL Team)

4) While grid-connection of off-grid systems has been pioneered by RERL, it is still in an infant stage. Right now, regulations permit the off-grid system to sell power to the grid under an agreed PPA, i.e. as a small power producer. In this case, NEA is responsible for distribution and power sales. There are other modalities possible, e.g. continue as small power distributor (or subcontracted by NEA for this purpose) or as a retailer, or a combination of modalities, in which the mini-grid continues and sells surplus to the grid and purchases in case supply cannot meet demand. The pros and cons in the Nepalese context of these modalities should be investigated further.

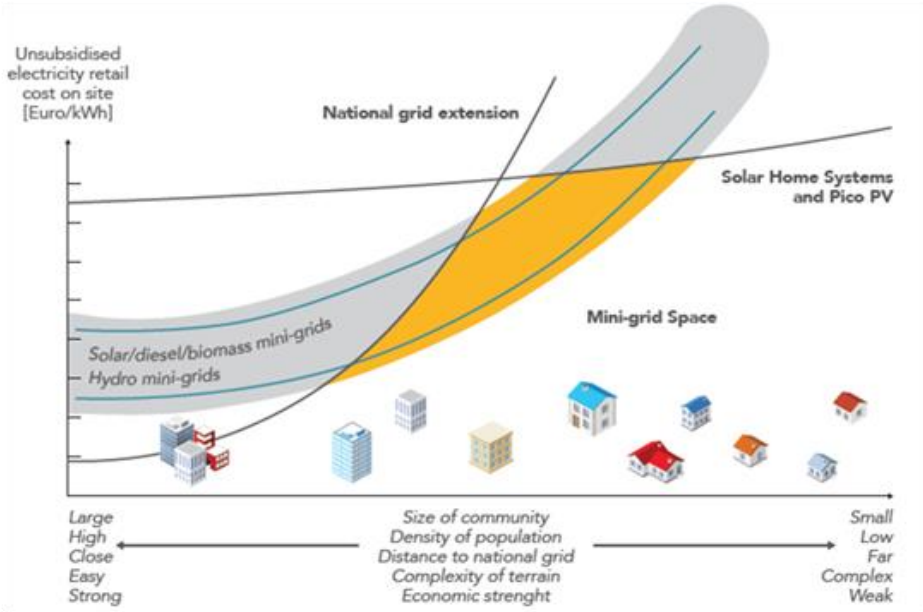
5) While "private sector-led, upscaled" mini-grids have the focus attention of the development partner community, it should not be forgotten that these provide a niche area in electrification, as indicated in Box 32 (mini-grid space). There will be still many communities that are either too far or with households to widely dispersed or are too poor to have everyone connected to grid systems. Also, in many, so-called 'electrified' areas, many communities or households are not be connected to the grid. This is the case, for example, the Mahaburung solar mini-grid; given the proximity of the main grid, the community might have been connected straight away[26], but to poor and not being able or willing to pay connection fees, such communities appear to be outside the scope for connection.

It is important that the Municipal Energy Plans to be formulated have a holistic view, and consider grid connection, alongside smaller RE options (micro hydro, solar home systems) and larger RE system (mini hydro, solar mini-grids)

[26] If high connection charges have prevented the marginalised santhal community to get connected; it might have been better to investigate how this can be remedied (e.g. by being able to pay connection fees over time) rather than using donor money for a mini-grid. It is laudable that local authorities have lobbied to get the community electrified, but if the

and potential grid connection, as appropriate given size, distance, transportation barriers, and PUE opportunities of the area/community concerned. Here, the assistance of the RERL team will be very much needed.

Box 32 Opportunities for grid extension, mini-grids and small RE systems

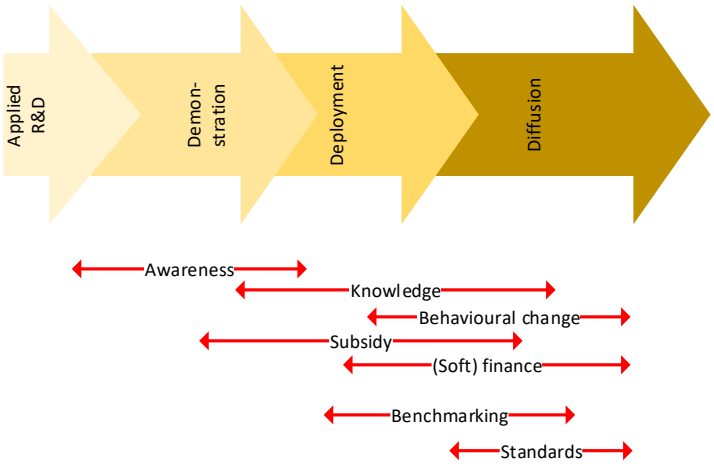


6) There are over 1700 micro hydropower plants installed with inconsistent success rate; many face operation and maintenance issues, ranging from lack of staff (trained locals may move to urban areas) to insufficient revenue generation. The older they get, the more maintenance becomes an issue, exacerbated when natural calamities (floods, landslides) have affected the system. Rehabilitation of such systems remains important as well as stimulating demand by promoting PUE opportunities and establishing an adequate local RE system governance. These micro facilities still will play an important role (until or even after the grid arrives) and, in the drive for scaling up RE systems, should not be forgotten in AEPC's programming. Post-installation support has successfully been supported by RERL but needs more internalization into the RE systems in Nepal, especially in the community owned and managed systems. In this respect, insurance of RE systems is an issue that needs to be looked into further.

<u>UNDP Country Office</u>

7) UNDP (in cooperation with other development partners, as appropriate) might consider to set up a new project (with GEF funding from the new GEF-7 cycle) that specifically addresses the above-mentioned points 4 to 6, i.e. strengthening the role of mini-hydro and larger PV with the government-enabled and market-bases approach; further capacity building of local authorities, while not neglecting the role that smaller systems (micro hydro, individual PV has played in electrification) by improving their operation and improving revenue streams.

Box 33 Mini-grid technology innovation



The purpose of such a new project would not be to repeat what RERL has done. In terms of technology innovation we can argue that RERL has been instrumental in bring larger RE off-grid technology from the stage of 'demonstration' to 'deployment'. The next step in the technology innovation cycle is to bring it to the next level, i,.e. from 'deployment' to larger-scale dissemination' (see Box 33).

6.3 Lessons learnt

Scaling up rural and renewable energy; mini-grids

Off-grid electricity supply has long been the domain of efforts by Government, development and international NGOs providing small, off-grid (renewable) energy systems with a very large grant or subsidy part, sometimes up to 100%. When formulating SE4All (and later SDG-7) goals, many in the international community realised that with the limits on government or donor funding being available for either grid extension or small off-grid solutions public sector funding would not be enough to have the universal electricity access goal by 2030. This has renewed attention in mini-grid systems as an alternative between individual or small solutions (pico hydro, solar PV systems) and grid extension. It was realised that additional funding needed to be mobilised from local sources as well as private developers and financiers.

However, mini-grid systems have often been regarded negatively by planners, as having too many bad characteristics of small isolated systems (high cost) and too little of the good characteristics (24/7 supply) the main grid can bring. These have been avoided by private and financial sector, seen as not commercially viable, often worsened by bad local administration and small energy demand with revenues not even able to cover annual operation cost. In recent years, the international community has undertaken efforts to revive the mini-grid (and other off-grid solutions) concept by scaling these up to larger sizes (giving lower lifecycle cost due to economies of scale), increase revenues by energy demand stimulation (productive use supplementing demand for lighting and small household appliances), provide adequate local governance in business models that combine community engagement with private initiative, and are able to attract bank financing. The fear of equity providers and financiers of being knocked out of business when the national grid arrives is soothed by compensation package or the option to continue as small power producer, distributor, power retailer, or a combination thereof.

The IEA estimates that 36 percent of total investments toward achieving universal access by 2030 will be targeted toward mini-grid efforts, between USD 4 to 50 billion annually, with the vast majority (over 90 percent) coming from renewable energy generation[27]. Despite the opportunities with mini-grids, their penetration remains low in most developing countries, and most are diesel based. Maybe some 5 million people are provided power from, on renewables-based mini-grids (usually powered by micro-hydro) worldwide with primary markets in China and a few other countries (Bangladesh, Cambodia, China, India, Mali, Nepal, and Morocco). The huge potential for access of mini-grids is hindered by numerous challenges, including inadequate policies and regulations, lack of proven business models that combine community engagement with commercial roll-out, and lack of access to long-term finance.

Against this background, the RERL Project was formulated in 2012-14 aimed to address to further development, replication and scaling up of off-grid rural RE systems. The importance of RERL is in demonstrating that barriers to promote larger and lesser disseminated RE technologies in Nepal (including mini hydro, grid interconnection, solar mini grid and solar pumping) can be lowered. One can say that RERL has initiated a market change in which private sector and local communities increase investments in larger RE, run existing micro mini-grids more efficiently, policy decision-makers at national and local level engage in building an enabling environment (with appropriate policy instruments and incentives) and in which BFIs recognize the economic potential of larger and grid-connected RE and make finance available.

Some lessons learnt are:

- An autonomous agency (such as AEPC in Nepal) is important in drafting rural and RE policy document, formulation of regulation and guidelines, coordination with donor agencies and development partners as well as for information dissemination and knowledge management.
- To avoid conflicts of interest and reduce transaction, the management of financial incentive scheme (CREF) is subcontracted to a local financial institution, in which AEPC provides technical assistance and CREF the financial assistance (subsidy and a portfolio of financing instruments, such as soft loan, guarantee schemes, project insurance, vendor financing).

[27] World Bank (2017), based on 2011 IEA information

- Grants will continue to be widely used given the high investment cost of decentralized rural electricity options. However, these should be carefully designed to ensure project sustainability over the lifetime (not only at project initial investment) and to leverage equity and capital from local and other national sources.
- From local entrepreneurs to national equipment providers, there is growing interest from the private sector in the development, financing, operation, and management of mini-grids. Combining technology with new business and financing models, the private sector is interested in and can deploy mini-grid solution;
- In order to do so, (local) private sector must have the legal right to generate, distribute and sell electricity to (rural) consumers;
- The unexpected arrival of the main-grid is a major risk faced by mini-grid operators. Appropriate interconnection and/or compensation mechanisms allay risks associated with main grid arrival;
- Access to electricity has substantial forward linkages for rural development, marked by considerable improvements in productivity, income, and livelihoods, all of which produce spill-over effects. Therefore, policy-makers should not only examine the opportunities that mini-grid solutions offer for electrification but to other facets of sustainable development. At the same time, rural development in the form of productive uses will stimulate demand for power and the additional revenue stream adds to the RE system's profitability,

ANNEX A. TERMS OF REFERENCE (TOR)

Nepal ToR.pdf

ANNEX B. ITINERARY OF THE EVALUATION MISSION

Day	Date	Morning			Afternoon		
Tuesday	**02/07/2019**	9:00-10:00 AEPC ED & Directors, AEPC	10:00 -11:00 AEPC Component Manager, AEPC	11:30-1:00 AEPC-SASEC AEPC	2:00-3:30 UNDP,Pulchowk		4:00-5:00 Mr. Surendra B. Mathema, Pressu Pvt. Ltd., Tahachal
Wednesday	**03/07/2019**	10:00-1:00 CREF +Banks			2:00-3:30 Mr. Pushkar Manandhar, ADB, Utterdhoka, Kathmandu		4:00-5:00 Mr. Nabin Bhujel Kiran,SEMAN, SEMAN office, Maharajung
Thursday	**04/07/2019**	9:00-10:00 Practical Action, Lazimpath	10:30-11:30 Mr. Ram P. Dhital, Electricity Commision, Sanogaucharan	12:00-1:00 Mr. Biraj Gautam, PEEDA, Mid Baneshwor	2:00-3:00 Mr. Badri Baral/Resha Piya, Winrock, New Baneshwor	3:30-4:30 Mr. Abhishek Malla, Sunfarmer, RERL Office	
Friday	**05/07/2019**	9:30-10:30 NMG-Santosh Rai, AEPC, Small Meeting Hall)	10:30-11:30 Mr. Prem Sagar Subedi, NREP, AEPC (Small Meeting Hall)	12:00-1:00 RERA ,GIZ Khumaltar		2:00-3:00 Mr. Ashish Aryal, Ministry of Finance, Singadurbar	3:00-4:00 Mr. Nabin K. Singh, MoEWRI, Singadurbar
Saturday	**6/07/2019**	Fly to Pokhara; Travel to Baglung; Visit to Tara Khola Hydro, Baglung and night stay at Baglung					
Sunday	**07/07/2019**	Visit to Kharbang – Hydro and PUE; Travel to and night stay at Pokhara					
Monday	**08/07/2019**	Travel to Kathmandu and Fly to Biratnagar; Solar irrigation; Marangburu solar mini-grids					
Tuesday	**09/07/2019**	Solar water pumping, Sunflower; Snake Bite Treatment Center, Itahari, Sunsari; Travel and visit to Ramite Khola,SMG, Morang					
Wednesday	**10/07/2019**	Stay night at Morang, and Back to Kathmandu				4:00-5:00 SNV- Mr. Biplov Kafle, SNV (Himalayan Hotel)	

List of people met

PEB meeting members participated in brief presentation (Jul 15, 2019)

1. Mr. Madhusudhan Adhikari, ED&NPD, AEPC&RERL
2. Mr. Mazen Gharzeddine, DRR a.i., UNDP Nepal
3. Mr. Sagar Raj Gautam, Under Secretary, MOEWI
4. Mr. Krishna Chandra Neupane, ESG, ADCCN
5. Ms. Shanti Karanjit, Portfolio Manager, UNDP Nepal
6. Dr. Narayan Prasad Adhikari, Director, AEPC
7. Mr. Pushkar Manandhar, Project Officer (Energy), ADB
8. Mr. Subas Kunwar, Livelihood Expert, RERL
9. Mr. Shreeram Shrestha, AFA, RERL
10. Mr. Jiwan Kumar Mallik, Solar Power Expert, RERL
11. Mr. Bal Ram Paudel, Program Management Analyst, UNDP Nepal
12. Ms. Geetanjali Rai, Program Associate, UNDP Nepal
13. Ms. Srijana Limbu, HR Assistant, UNDP Nepal
14. Mr. Dinesh Bista, RBM Analyst, UNDP Nepal
15. Ms. Kalpana Sarkar, Portfolio Manager, UNDP Nepal
16. Mr. Gomba Sherpa, Portfolio Associate, UNDP Nepal
17. Mr. Astha Aryal, Consultant, CREF

18. Mr. Muhan Maskey, Policy and Institutional Strengthening Expert, RERL
19. Ms. Prerana Lama, UN Trainee, UNDP Nepal
20. Mr. Saroj Deo, UN Trainee (RR), UNDP Nepal
21. Dr. Dhruba Gautam, Evaluator (National Consultant)
22. Mr. Jan van der Akkar, Evaluator (Team Leader)
23. Ms Sabita Awale, PA, RERL
24. Mr. Satish Gautam, NPM/SNA, RERL

Evaluation Kick-off meeting participant at AEPC (Jul 3, 2019)

1. Mr. Madhusudhan Adhikari, ED&NPD, AEPC&RERL
2. Mr. Nawa Raj Dhakal, Director, AEPC
3. Dr. Narayan Adhikari, Director, AEPC
4. Mr. Rana Bahadur Thapa, Sr. Officer, AEPC
5. Mr. Mukesh Ghimire, Sr. Officer, AEPC
6. Mr. Santosh Rai, Engineer, AEPC
7. Mr. Sunder Bahadur Khadka, Energy Officer, AEPC
8. Dr. Kundan Pokhrel Majgaiiya, Monitoring Officer, AEPC
9. Mr. Subas Kunwar, Livelihood Expert, RERL
10. Mr. Shreeram Shrestha, AFA, RERL
11. Mr. Jiwan Kumar Mallik, Solar Power Expert, RERL
12. Mr. Muhan Maskey, Policy and Institutional Strengthening Expert, RERL
13. Dr. Dhruba Gautam, Evaluator (National Consultant)
14. Mr. Jan van der Akkar, Evaluator (Team Leader)
15. Ms Sabita Awale, PA, RERL
16. Mr. Satish Gautam, NPM/SNA, RERL
17. Ms. Sunita Khatiwoda, Environmental Expert, AEPC
18. Ms Anusuya Joshi, Environmental and Social Expert, AEPC
19. Mr. Madan Shrestha, Procurement Expert, SASEC
20. Mr. British Singh, Mini Hydro Expert, SASEC
21. Mr. Nagesh Singh, Civil Engineer, SASEC
22. Mr. Shiva Hari Budhathoki, Social Safeguard Expert, MGEAP
23. Mr. Tilak Limbu, Mini Hydro Expert, RERL
24. Mr. Dipesh Shrestha, Solar Wind Expert

Meeting with relevant stakeholders

UNDP Nepal

1. Mr. Mazen Gharzeddine, DRR a.i., UNDP Nepal
2. Ms. Shanti Karanjit, Portfolio Manager, UNDP Nepal

Ministries

1. Mr. Sagar Raj Gautam, Under Secretary, MOEWI
2. Mr. Ashish Aryal, Section Officer, MoF
3. Mr. Sanjib Ray, MoEWI

Bilateral

1. Mr. Pushkar Manandhar, Project Officer (Energy), ADB
2. Mr. Prem Sagar Subedi, Deputy Team Leader, NREP/DFID
3. Mr. Christian Liedtke, GIZ/RERA

Private sector

1. Mr. Surendra Mathema, Managing Director, Preesu Electronics P. Ltd.
2. Mr. Yub Raj Guragain, Country Head, Micro Banking, Civil Bank Ltd
3. Ms. Astha Aryal, Consultant, CREF
4. Ms. Bhumika Acharya, Consultant, CREF
5. Mr. Manu Binod Aryal, Head, CREF
6. Mr. Susan Pandey, CREF
7. Mr. Shiva Ram Rawat, CREF
8. Mr. Sudarshan Budhathoki, Chairperson, Syaurebhumi Micro Hydro

Networks member

1. Mr. Nabin Bhujel, Patron Solar Electric Manufacturers Association, Nepal
2. Mr. Purna N. Ranjitkar, CEO, Solar Electric Manufacturers Association, Nepal

National Electricity Regulatory Commission (NERC)

1. Dr. Ram Prasad Dhital, Member, Nepal Electricity Regulatory Commission

I/NGOs

1. Ms. Pooja Sharma, Thematic lead (Energy), Practical Action
2. Mr. Biraj Gautam, CEO, PEEDA (NGO)
3. Ms Resha Piya, Senior Programme Officer, Winrock
4. Mr. Badri Baral, Country Director, Winrock
5. Mr. Abhisekh Malla, CEO, SunFlower
6. Mr. Biplov Kafle, RE Advisor, SNV

Baglung field visit

Tarakhola Hydro Company Limited, Tarakhola

1. Mr. Dhan Bahadur BK (Himal), Chairperson
2. Mr. Tirth Singh Thapa, Member
3. Mr. Kul Bahadur Roka, Member
4. Mr. Naresh KC, Member
5. Mr. Jeet Bahadur Khatri, Member
6. Mr. Dil Bahadur Gharti, Member
7. Mr. Padam Bahadur Khatri, Member
8. Mr. NirajBagale, Member
9. Mr. Durga Bahadur Karki, Member
10. Mr. Ram Bahadur Roka, Advisor
11. Mr. KaladharSubedi, Advisor
12. Mr. Man Bahadur Lamichhane, Advisor
13. Mr. Amar Bahadur Chantyal, Advisor

GirindiKhola Micro-Hydro Cooperative Ltd

1. Mr. Nim Bahadur Bhujel, Manager

Brother Noodle Factory, Kharbang, Baglung

1. Mr. Drona Ban, Manager

BaglungKalika Metal Workshop, Kharbang, Baglung

1. Mr. Chandra Bahadur BK, Manager

Morang field visit

Solar pumping for commercializing vegetable farmers, Morang

1. Mr. Jay Ram Sapkota, Manager, Hitkari Krishi Farm, Morang

Marangburug Solar Mini Grid, Jahada Rural Municipality Ward 7, Morang

1. Mr. Kailash Prasad Mandal, Chairperson, Jahada Rural Municipality
2. Mr. Gyanadra Singh, Engineer, Dhanpalthan Rural Municipality
3. Ms. MeenaTudu, Solar Mini Grid Chairperson
4. Ms Phatima Hemram, Solar Mini Grid Operator

Solar water pumping system promoted by M/s SunFarmer and M/s Sahara

1. Mr. Babu Raja Shrestha, Independent, Renewable Energy Expert, Morang

Snakebite Treatment Center, Itahari, Sunsari

1. Mr. Raju Thapa, vice-chairperson, Snakebite Treatment Center

Ramitekhola Solar Mini-grid (30kWp), Morang

1. Mr. Parbat Rai Chairperson
2. Mr. Sharan Gajmer, Vice-chairperson
3. Ms. Bimala Rai, Member
4. Mr. Purna Rai, Member

ANNEX C. LIST OF DOCUMENTS COLLECTED AND REVIEWED

Project design documents and progress reports

UNDP Project Document and Annexes:
Annual Progress Reports (2014 to 2018)
Project Implementation Reviews (2016, 2017, 2018)
Mid-Term Review Report (Jan. 2017)
Inception Report (March 2015)
PIMS 4522 NEP RERL Tracking Tool
Key support areas by RERL for AEPC and the RE sector in general (Project Attribution)
Achievements and Lessons, RERL, 2014-18

PowerPoint Points:
- RERL, Terminal Evaluation (July 2019)
- AEPC/SASEC Project, Review Mission Kick-off Meeting (June 2019)'
- A Glimpse of AEPC/WB Nepal Mini-Grid Project
- GEF RERL, II QTR 2019 & Closing PEB Meeting (July 2019)
- Mini-Grid Financing: Enabling the Role of Local Banks (NMB Bank, by D. Dulal)

AEPC and RERL manuals, reports and guidelines

- Guidelines for Detailed Feasibility Studies of Micro-Hydro Projects (2018)
- Guidelines for Detailed Feasibility Studies of Micro-Hydro Projects (2014)
- Micro - Mini Hydro Power Output and Household Verification Guidelines (2008)
- Guidelines for Cooperative Model of Mini/Micro Hydro Projects (2014)
- Report on Effectiveness and Impact Study on Business Management Training to Women Entrepreneurs (2016)
- Establishing Sustainable Model for Financing Community-based Micro-hydro Projects through Local Financial Institutions (2017)
- Reference Micro-Hydropower Standard (2005, 2014)
- Summary Report, Developing an Enabling Policy Environment to Accelerate Development of Clean Energy through Mini and Small Hydropower in Nepal (Practical Action, 2016)
- Piloting Sustainability Monitoring for Micro Hydropower Plants (2016)
- Vendor Finance Challenge Fund, Operational Manual (2017)

National policy and planning documents

- National Renewable Energy Framework (Nov. 2017)
- Renewable Energy Subsidy Policy (May 2016)
- Rural Energy Policy (2006)
- CREF Financial Intermediation Mechanism (2013)
- Nepal Energy Sector Assessment, Strategy and Road Map (ADB, 2017)
- Nepal, Nationally Determined Contributions (Dec 2016)
- SE4All, Nepal, Rapid Assessment and Gap Analysis (2013)

ANNEX D. QUESTIONNAIRE AND EVALUATION MATRIX

Contents	Model evaluation criteria and/or questions	Indicator(s)	Means and sources of information	Sources of verification
1. Findings: Relevance and design • Relevance and country drivenness • Stakeholder involvement • Assessment of logframe and M&E design	**Relevance:** • Have project outcomes been contributing to national development priorities and plans and take into account national realities (status and challenges of off-grid RE; enabling environment)? • Consistency with the GEF focal areas in Climate Change/operational program strategies of the GEF CC and with the UN and UNDP country programming in Nepal • Is the Project addressing the needs of the target beneficiaries? Is the design responding to real needs and priorities of the targeted communities and private sector in the context of the project district/VDCs and private/financial sector? Relevance of the project's objectives, outcomes and outputs to the different target groups of the interventions. Have relevant gender issues been raised in the project design? **Design:** • Were lessons from other relevant projects (NRREP, or earlier projects, such as REDP) properly incorporated in the project design? Were the partnership arrangements properly been identified and the roles and responsibilities negotiated prior to project approval? • Has the project's design (logframe) been adequate to address the problems at hand? Was the project internally coherent in its design (logical linkages between expected results and design (components, choice of partners; scope, use of resources)? Were any (major) amendments to the assumptions or targets been made or planned during the Project's implementation?	**Relevance:** • Extent to which Project supports national energy priorities, policies and strategies • Extent to GEF climate change focal area is incorporated • Degree to which the project supports aspirations and/or expectations of stakeholders (see Annex D) and beneficiaries (incl. females) • Adequacy of project design and implementation to national realities and existing capacities **Design:** • Degree of involvement of government partners and other stakeholders in the Project design process • Coherency and complementarity with other national and donor programmes • Number and type of performance measurement indicators (SMART indicators)	• Desk review of project design and technical documents; Documents from GEF; national policies and strategies; • Interviews with project staff management, project partners (incl. former staff), stakeholders (local and national government entities, private sector, universities/NGOs) and UNDP staff	• Interviews with project partners and stakeholders and analysis thereof • Document and report analysis*

Contents	Model evaluation criteria and/or questions	Indicator(s)	Means and sources of information	Sources of verification
4. Findings: Results and effectiveness • Assessment of outcomes and outputs (cf. with baseline indicators) • Effectiveness • Global environmental and other impacts	**Results and effectiveness** • What outputs has the project achieved (both qualitative and quantitative results, comparing the expected and realized end-project value of progress indicators of each outcome/output with the baseline value)? To what extent have the expected outcomes and of the project been achieved? • Have results been achieved within the planned timeframe? Was the project time sufficient? Were there any unplanned effects? Which external factors have contributed or hinder the achievement of the expected results? • Has the project produced results (outputs and outcomes) within the expected time frame Is the project proactively taking advantage of new opportunities, adapting its theory of change to respond to changes in the development context? Are there any unaddressed barriers remaining?	**Results and effectiveness:** • Level of achievement (as laid out in the logframe) • Achievement of outputs (qualitative, quantitative) and description of activities • Evidence of adaptive management and/or early application of lessons learned	• Desk review of project design and technical documents other relevant docs • Interviews with project staff management, project partners (incl. former staff), stakeholders (local and national government entities, private sector, universities/NGOs) and UNDP staff • Interviews with project experts (national and international)	• Interviews with project partners and stakeholders and analysis; • Document and report analysis* • Check with publicly available information
5. Findings: implementation, processes and efficiency • Management and administration; role of UNIDO • Monitoring and evaluation systems • Stakeholder engagement and communications • Budget, expenditures and co-financing; procurement	Implementation and management • Were adequate project management arrangements in place at project entry? Was there any steering or advisory committees put in place and how often have these committees met? • How have the project management systems, including progress reporting, administrative and financial systems and monitoring and evaluation system been operating as effective management tools aid in effective implementation and provide sufficient basis for evaluating performance and decision making? Was the information provided by the M&E system (annual work plans, PIRs, other) was used to improve performance and to adapt to changing needs; Are there any annual work plans? • Did UNDP and Project staff identify problems in a timely fashion and advice to the project? If so, has the project practicing adaptive management e.g., (approve modifications in time)? If so, how effective was the adaptive management practiced under the project and lessons learnt? Assessment of M&E system • Was the information provided by the M&E system was used to improve	**Implementation and management** • Extent to which project partners committed time and resources to the project • Extent of commitment of partners to take over project activities • Evidence of clear roles and responsibilities for operational and management structure **M&E** • Actual use of the M&E system to change or improve decision-making/adaptive management • Share of M&E in the budget • Quality and quantity of progress reports **Stakeholders and communications**	• Desk review of project design and technical documents (incl, PIRs; data on budget; other relevant docs; media coverage, official notices and press releases • Interviews with project staff management, project partners (incl. former staff), stakeholders (local and national government entities, private sector, universities/NGOs) and UNDP staff • Interviews with project experts (national and international)	• Interviews with project partners and stakeholders and analysis thereof • Document and report analysis*

Contents	Model evaluation criteria and/or questions	Indicator(s)	Means and sources of information	Sources of verification
	performance and to adapt to changing needs; Are there any annual work plans? • Was M&E was sufficiently budgeted for at the project planning stage and whether M&E was adequately funded and in a timely manner during implementation. • Was the information provided by the M&E system (annual work plans, PIRs, other) was used to improve performance and to adapt to changing needs; Are there any annual work plans? Partnership arrangements and stakeholder involvement • How efficient have partnership arrangement been for the project? Did each partner have assigned roles and responsibilities from the beginning? Did each partner fulfil its role and responsibilities? • To what extent were partnerships/linkages between institutions/ organizations/private sector encouraged and supported? **Financial planning and procurement** • Did the project have appropriate financial controls, including reporting and planning, that allowed management to make informed decisions regarding the budget and allowed for timely flow of funds? Specifically, the evaluation will also include a breakdown of actual project costs by activities compared to budget (variances), financial management (including disbursement issues) • If there was a difference in the level of expected co-financing and the co-financing actually realized, what were the reasons for the variance? Did the extent of materialization of co-financing affect project outcomes and/or sustainability, and, if so, in what ways and through what causal linkages?	• Extent to which project partners committed time and resources to the project • Extent of commitment of partners to take over project activities **Financial planning** • Extent to which inputs have been of suitable quality and available when required to allow the Project to achieve the expected results; • Timely delivery of funds, mitigation of bottlenecks. • Level of satisfaction of partners and beneficiaries in the use of funds **Effectiveness**		
6. Findings: sustainability • Risks and external factors • Replication	**Sustainability** • To what extent are there financial, institutional, social-economic, and/or environmental risks to sustaining long-term project results? How sustainable (or likely to be sustainable) are the outputs and outcomes? Is there an exit strategy that is well planned? What could be done to strengthen exit strategies and ensure sustainability of interventions made? • *Financial risks.* Are there any financial risks that may jeopardize	**Sustainability** • Extent to which risks and assumptions are adequate and are reflected in the project documentation • Extent to which project is likely to be sustainable beyond the	• Desk review of project design and technical documents (incl, PIRs; other relevant docs) • Interviews with project staff management, project partners (incl.	• Interviews with project partners and stakeholders and analysis thereof • Document and

Contents	Model evaluation criteria and/or questions	Indicator(s)	Means and sources of information	Sources of verification
	sustainability of project outcomes? What is the likelihood of financial and economic resources not being available once GEF assistance ends? • *Sociopolitical risks*. Are there any social or political risks that may jeopardize sustainability of project outcomes? What is the risk that the level of stakeholder ownership (including ownership by governments and other key stakeholders) will be insufficient to allow for the project outcomes/benefits to be sustained? Do the various key stakeholders see that it is in their interest that project benefits continue to flow? Is there sufficient public/stakeholder awareness in support of the project's long-term objectives? • *Institutional framework and governance risks.* Do the legal frameworks, policies, and governance structures and processes within which the project operates pose risks that may jeopardize sustainability of project benefits? Are requisite systems for accountability and transparency, and required technical know-how, in place? • *Environmental risks.* Are there any environmental risks that may jeopardize sustainability of project outcomes? • *Capacity risks.* **H**ave partners and stakeholders successfully enhanced their capacities and do they have the required resources to make use of these capacities? **Impact** • How did the project contribute to GHG emissions reduction within the project implementation cycle and beyond? • What impact has the project had on policy, legal and institutional frameworks relating to uptake of low-carbon technology? • Has the project had any impact on gender equality and economic empowerment for women and other marginalized groups? Was it intended to?	project; • Extent to which main stakeholders plan to provide sustainability to the project's results in the future, including commitment of financial resources • Extent to which partners and stakeholders are applying new ideas outside of the immediate project context	former staff), stakeholders (local and national government entities, private sector, universities/NGOs) and UNDP staff	report analysis* • Check with international practices and publicly available information

Contents	Model evaluation criteria and/or questions	Indicator(s)	Means and sources of information	Sources of verification
7. Conclusions and recommendations • Conclusions on attainment of objectives and results • Lessons learned • Recommendations	• Evaluation conclusions related to the project's achievements and shortfalls (comprehensive and balanced statements which highlight the strengths, weaknesses and results of the project, including summary of evaluation criteria: ○ Relevance: How does the project relate to the main objectives of the GEF focal area, and to the environment and development priorities at the local, regional and national levels? ○ Effectiveness: To what extent have the expected outcomes and objectives of the project been achieved? ○ Efficiency: Was the project implemented efficiently and cost-effectively, in line with international and national norms and standards? ○ Sustainability: To what extent are there financial, institutional, social-economic, and/or environmental risks to sustaining long-term project results? ○ Impacts: Are there indications that the project has contributed to, or enabled progress toward, reduced environmental or other impacts? • What lessons can be learnt from the project regarding efficiency • What recommendations, if any, can be made to o follow up or reinforce initial benefits from the project; Proposals for future directions related to the main objectives	• Ratings of evaluation criteria • Lessons that have been learned regarding achievement of outcomes and efficiency (implementation) • Recommendations for post-project and future actions	• Interviews with project staff and partners • Desk review of project docs and reports as well as external policy and other docs	• Interviews with project partners and stakeholders and analysis thereof • Document and report analysis

ANNEX E. DESCRIPTION OF PROJECT SITES VISITED

Baglung is known as the district of suspension bridges because of the large number of bridges. It is a hilly district, most of the population settled in the sides of the rivers. Fertile planes situated at both sides of the rivers are used for farming. Headquarter of Baglung (Baglung Bazaar) is also situated on the bank of the Kaligandaki River. Like Nepal itself, Baglung is also diverse in religion, culture, ethnicity, altitude, temperature, etc. Hinduism and Buddhism are the major religions. Magar, Chhetri, Bramhan, Newar, Gurung, Chhantyal and Thakali are the main ethnic groups living in Baglung. The altitude of Baglung varies from about 650 meters at Kharbang to about 4,300 meters in Dhorpatan.

Tarakhola Hydro Power Limited, Baglung

Technical features

General
Name of the project: Tara Khola Samudayik Mini Hydropower Project
Name of the river: Tara Khola and Mophesh Khola
Type of scheme: Run of River
Project location: Tara VDC, Baglung
Number of households: 2200
Latitude: 83°22'15" E to 83°23'02" E
Longitude: 28°19'48" N to 28°20'17" N

Access
Baglung Bazaar to Tara Khola: 40 km
Baglung to Bihun (Rijal Chowk): 20 km
Rijal Chowk to Tara Khola: 20 km

Hydrology
Catchment area: 24 km^2
Long term average flow: 1.954 m^3/s
Minimum monthly flow: 0.229 m^3/s
Design discharge: 0.422 m^3/s

Weir
Type: Concrete gravity type
Length: 12 m
Crest elevation of weir: 2055 m

Intake
Type: Orifice type (both intakes)
No. of openings: 1 (both intakes)
Design discharge (Tara Khola): 0.331 m^3/s
Design discharge (Mophesh Khola): 0.091 m^3/s

De-sander
Type: Single chambered
No. of units: One (Tara Khola); One (Mophesh Kh.)
Length: 10 m
Size (width x depth): 3 m x 3 m
Design discharge: 0.349 m^3/s for both streams
Particle size to be settled: >0.2 mm

Headrace canal
Type: Rectangular lined stone masonry
Length: 920 m from Tara Khola and 172 m from Mophesh Khola to Forebay
Size (width x depth): 800 mm x 750 mm
Design discharge: 0.422 m^3/s (both Khola)
Special feature: 25 mm RCC crossing

Forebay
Size: 13 m x 3 m x 3 m
FSL at forebay: 2051.55 m

Road crossing
Type: Trapezoidal lined stone masonry
Length: 13.43 m (first crossing) and 10 m (second)
Size: 600 mm dia. MS pipe, 5 mm thickness buried

Penstock
Type: Buried, steel
Length: 1165 m
Internal diameter: 600 mm
Thickness: 5-8 mm
Design discharge: 0.422 m^3/s
Penstock bifurcation diameter: 425 mm (2-10 m long pipes)

Powerhouse
Type: Surface
Size: 18.4 m x 10.22 m
Powerhouse floor level: 1933.94 m
FSL in tailrace at powerhouse: 1932.4 m

Turbine
Type: Francis turbine
Number of units: 2 nos.
Turbine axis level: 1935.9 m
Turbine rated capacity: 2 x 214 kW
Gross head: 119.16 m
Rated turbine efficiency: 91.5%

Generator
No. of units: Two
Type: 3-phase, synchronous, vertical shaft
Rated power: 300 kVA
Rated voltage: 0.4 kV
Rated frequency: 50 Hz
Rated power factor: 0.8 (lagging)
Rated speed: 1500 rpm
Rated efficiency: 93.5%
Stator and rotor insulation class: F
Stator connection: Star with neutral earthed
Direction of rotation: Clock-wise as viewed from top of the unit
Short circuit ratio: not less than 1.1
Excitation system: brushless

Tailrace canal
Type: Rectangular
Size: 1.5 m x 1 m
Length: 15 m
Invert level of tailrace at powerhouse: 1932.4 m

Main transformer
Number of units: 1
Rating: 600 kVA
Type: 3-phase, oil immersed
Type of cooling: ONAN
Number of phase: 3
Frequency: 50 Hz
Rated voltage:
Primary (LV side): 0.4 kV
Secondary (HV side): 11 kV
Vector group symbol as per IEC 60076: YNd11
Tap changer: Off load at high voltage winding, +/- 2 x 2.5%
Percentage impedance at rated MVA base: 5%

Transmission line (local supply)
Transmission voltage: 11 KV
Distribution voltage: 0.4/0.23 kV
No. of transformers: 12 (6-50 kVA, 1-35 kVA and 5-25 kVA)
Households to be electrified: 2200

Power and energy
Installed capacity: 380 kW
Dry season energy: 0.517 GWh/year
Wet season energy: 1.203 GWh/year
Total energy: 1.720 GWh/year
Construction period: 18 months

Economic and social indicators

Project cost (considering subsidy as investment): NRs. 169.48 million
Cost per kW: NRs. 430,159.26
NPV (at 9% discount rate w/o considering subsidy as investment): NRs. 8.16 million
IRR (w/o considering subsidy as investment): 9.95%
Debt equity ratio: 57:43
Interest rate on loan: 10%
Loan repayment period considered: 10 years
Regular subsidy (household): NRs. 16,000 x 2200 = NRs. 35.2 million
Regular subsidy (power generation): NRs. 70,000 x 394 = NRs. 27.58 million
Total estimated subsidy: NRs. 62.78 million
Note:
Subsidy not considered as investment in Financial Analysis

Observations by the Evaluators

Strengths	Things to improve/action
Social-organisational: • The MHP provided 240 households with power (at test phase) which will expand as the transmission-distribution network is expanding; reaching mostly poor	• Need safety bar/fencing in headworks to safe children and livestock (as they are open) • The west side of powerhouse is landslide-prone, hence suitable treatment is required

households (and majority from *janajati* and *dalit* communities); • People are willing to use more power; besides lighting, cooking, warming, this includes cottage industries (many stone factories already in operation), etc.; • Users were aware of business model options before choosing the company model (user group model, cooperative model, company model, and lease-out model) • The MHP employs three staff: a site engineer, social mobilizer and a part-time electrical engineer **Technical:** • Out of 13, nine transformers are recharged, and 80% distribution line completed and by September all the task to be completed, load test okay • Civil works and hydro-mechanical part are okay • Headworks (2), one closed to powerhouse can be used only during the monsoon season (headwork is at the distance of 1100m) • Generated local employment directly and indirectly • RERL prepared operational guideline, Local economic development committee guideline, guideline for mini-hydro, commercial operation of the mini grid	• Start with the formulation and conclusion of PPA (after having a quick study) to sell power to NEA • Increase the women in-board to heard women's voices • Registration of all small cottage industries with local government • Build the capacity of board and staff as the RERL TA role is slowly reducing • Continue to build the technical capacity of local operators and provide genuine salary to retain (trained) operators (current staff may leave at one point in time) • Retain the interest of users: out-migration in increasing that may affect future sustainability of the project **Sustainability** Institutional structure, proper governance structure and good operation and maintenance are important for the sustainability of the mini hydro project. An ESCO in the form of a Ltd company model is in place. For proper management, capacity building activities to operators, managers, and management team has been provided. Community mobilization guidelines have been prepared. These activities are expected to make the project sustainable in the long run.

Brother Noodle factory, Kharbang, Baglung (Mr. Drona Ban, factory owner)

Strengths	Things to improve/action
• Provided (only) Rs 75,000 grants to establish his noodle factory • Scaled up, now the owner has a total of three noodle factories • Used to produce 80 kg noodle from one factory • Profitable: Rs 8,000 (net income) per day from three factories • Support of RERL led to paradigm shift for him • Generated local employment • Simple technology	• Need to calculate costs and benefits for those who wish to start a similar type of scheme, identify emerging challenges and mitigation approaches • Produce simple leaflet or flyer to accommodate these issues in pictorial form for learners

Baglung Kalika Metal Workshop, Kharbang

Strengths	Things to improve
• Provided (only) Rs 104, 000 grants to establish noodle factory • Generated local employment (6 people) • Very lucrative business: in some months, they can earn up to earn Rs 60,000-250,000 (based on the season of house construction, etc.)	• Need to calculate costs and benefits for those who wish to start a similar type of scheme, identify emerging challenges and mitigation approaches • Produce simple leaflet or flyer to accommodate these issues in pictorial form for learners

Girandi Khola Micro-hydro Cooperative Ltd

Technical features	
River flow (measured): 1,303 litres per second	Design discharge: 356 litres per second Gross head: 43 metres Installed capacity design: 75 kW

Headrace: 1,572 m Penstock: 98 m Tailrace canal: 7 m HT line: 5,226 m LT line: 20,540 m One 100 kVA step-up transformer Two 50 kV step-=down transformers (0ne 25 kV is planned)	**Socio-economic features** Established in 2018, Girandi Khola MHVEP is a community-based project, now benefitting 68 households. Community mobilisation has been supported by SO, Swayamsshakt and the DDC, Baglung.

Observations by the Evaluators

Strengths	Things to improve/action
. • The Cooperative has been able to pay back all loan and started to provide dividend to its users • Demand is stimulated by the existence of 39 PEUs, • Management with a computerized billing and transaction system • The Coop makes additional revenues from saving and credit business	• Develop contingency plan for when the national grid will arrive (is currently expanding in the catchment area) • Summarise management practice, cost and benefits in a flyer as info for other similar schemes • Develop the strategy to deal with the problem of (permanent) migration out of the region

Solar pumping for irrigation and organic vegetable farming (Commercializing vegetable farmers), Morang District

Mr. Jay Ram Sapkota and his wife started commercial farming of organic vegetables in 2015 when they moved to Morang. The farm also has a fishpond, ducks, turkeys, and chicken with their feed generated from the farm itself. Rather than chemical fertilizer vermicompost is used. The produce has expanded from tomato, cauliflower, lady's finger (making about NPR 600,000 from these crops) to rotational crops such as mustard, paddy and wheat. With electricity grid not being extended to some of the fields, he resorted to solar pumping. With NRP 100,000 support from Winrock, the project was implemented by RERL. The solar pumps produce about 180,000 litres of water a day and Mr. Sapkota plans has extended to tunnel farming and drip irrigation.

Observations by the Evaluators

Strengths	Things to improve
• Solar pump is beneficial as no, 25 years' warranty in panel. With no monthly operation cost (apart from occasional maintenance), solar pumping is cost-effectiveness in long run, and, unlike power from the grid does not suffer from voltage fluctuations with no risk of accidents from 220 V electric shock • The farm is now frequently visited by interested farmers from the east part of Nepal (that before had to go to the central part of Nepal • Despite being more expensive, there is demand for organic products in the local (super)market • The technology is replicated by, e.g. (i) Aviyant Agro-farm Pvt Ltd and (ii) Devnara Agro-Pvt Ltd.	• Registration as organic farm is hampered by bureaucracy. International organic product organizations require a 300m peripheral area around the farm which is free from chemical fertilizer and pesticides as a condition for registration. Given the size of the plot and adjacent location of farms like this one, this condition is not possible to meet. • There is bureaucracy also in the registration process to get the subsidy for solar irrigation (see Box 16 Main elements of the Renewable Energy Subsidy Policy (2016) • Measures to safe the poly house from windstorm (currently can withstand wins of 80 km/h) • A small entry fees could be charged to study groups to contribute to the operation cost

Marangburu Solar Mini Grid-5kWp (Sirsiya,NayaBasti, Jahada Rural Municipality Ward 7, Morang)

Technical Specification: Solar Module Capacity: 250kWp No of Solar Module: 20 Total Solar Array Capacity: 5kWp No. of PV module in Series: 2 System Voltage: 48VDC No. of PV module in Parallel: 10 Single Battery capacity: 800Ah/2V@C10 No. of Battery: 24 Battery Bank capacity: 38.4kWH No. of series: 24 Brand: Volta	Single Phase Inverter**:** 5kVA/48VDC, (Inbuilt MPPT Charge Controller 4kW) Output: 220VAC, 50Hz Brand: RENERGY Distribution Line: No. of Pole: 25; Size of cable: 2 core 35mm^2 ABC cable: 400m No. of Households (HH): 30 Installed by SuryodayaUrja Pvt. Ltd, Kathmandu Date of Commissioning**:** 30 December 2018

Observations by the Evaluators

Strengths	Things to improve
• Reaching very poor 30 *Santhal* HHs (ethnic minority) • Streetlighting helps in children's education and avoiding the problem of snake bites, • Women can work from very early and until late evening with lights • Used ABC (earlier ACER) technology hence there is no risks to power cuts (even when a distribution pole falls, while avoiding theft by illegal hooking to the lines • Access to means of info and entertainment: TV and radio • Collaboration with RERA/GIZ for post-installation support and PEU through BoA (business opportunities assessment) • The tariff (Rs 100-120 per month) is lower than previous expenditures on kerosene lamps (Rs 100-120 per month) • Institutionally strong, users are very active	• Power for lighting; small PUE should be encouraged • Some members (5 out of total 28 families) do not monthly tariff (sanctions should be imposed on defaulters) • Share the progress with Rural Municipality • Increase capacity of the women operator(s) that run the system • Increase the O&M fund from multiple sources to sustain the mini-grid • With RERA/GIZ support, promote and install ICS-improved cooking stoves to reduce the indoor air pollution

Discussion with Mr. Babu Raja Shrestha about solar water pumping system promoted by SunFarmer Pvt.Ltd

SunFarmer markets solar water pumping systems the size of 0.2 hp and above for irrigation. With RERL support a demonstration was organized Demonstration od PVSP was done SWP on site for 10 days and conducted demonstration

Strengths	Things to improve
• Solar water pumps are more attractive than diesel pumps (in areas where the grid has not arrived). Even when the grid is available, supply can be unreliable. • A good market is the mid-hill areas of Nepal, where solar pumping can be competitive with alternatives. As the market expands, cheaper solar pump sets become available on the Nepalese market	• It is very hard for Solar Water Pumping Systems to compete with the cost of operating electric water pumps powered by the NEA grid. The PVSP (PV solar pumping system) costs NPR 60,000 and even with the subsidy of Rs 20,000 from RERL the Rs 40,000 difference means to high investment cost in comparison with the price of electric pumps of only Rs 8,000. • Thorough market assessment is required and study lifecycle cost and benefits of different options before prescribing any technology. • Rather than relying on import, home-grown technology could be developed • For more cost-effective use, pump application should go hand-in-hand with innovative farming (efficient irrigation techniques)

Snakebite Treatment Center, Itahari, Sunsari RERL/AEPC in coordination with Nepal Army

Anti-snake venom serum is an integrated part of snakebite treatment process. This is very sensitive to changing temperature and should be stored in a temperature between 2°C to 8°C continuously and can then be stored for 2 to 5 years. However, with prolonged blackout period, it rapidly loses its effectiveness and needs to be disposed of.

Treatment centres (and health clinics) in electrified areas do not qualify for government support for solar PV. Consequently, centres have opted for diesel backup systems, which may be relatively cheap to purchase (in comparison with solar) but are costly to operate (high fuel cost) and maintain. In view of the unreliable grid supply in recent years, this has been a major challenge of treatment centers.

Snakebite is a well-known life-threatening medical emergency commonly seen in farmers, plantation workers, herders, fishermen, snake restaurant workers, and other food producers. A poisonous snakebite can cause severe paralysis that may suffocate the victim and cause excessive bleeding, kidney failure, severe local tissue destruction, and chronic disability. And, in the case of untimely treatment, the victim may die. A large number of rural people seek help first from local shamans or traditional healers which generally worsens their condition by delaying getting proper medical treatment. In Nepal, a total of 70 species of snake have been reported so far, in which 20 are poisonous. The highest incidence of venomous snakebites in Asia (162 annual deaths per 10,000 population) is in southeastern Nepal[28]. In fact, actual cases may be much higher, because many victims never reach primary care facilities, and therefore unreported

	Watt	Number	Hrs/day	Total Watt-hr per day
Refrigerator	250	1	24	2000
LED lights	5	4	6	120
Ceiling fan	60	2	8	960
Suction machine	700	1	0.25	175

Total demand estaimated: 3,255 Wh per day. The 1.5 kW system can provide up to 7 kWh per day. System further consists of six 12V 200Ah lead-acid batteries (designed for 2 days of autonomy) and a 1 KVA inverter.
Cost of the system is about NPR 450,000 (of which 80% provided by AEPC/RERL, covering equipment cost, transport, installation and 2 years of O&M).

A snakebite treatment centre is a specialized facility where a trained medical team takes care of the snakebite victims by strictly following the Snakebite Treatment Procedure, which clearly specifies the symptoms of the patient that may develop depending on the type of the snake.

Solar PV would be an appropriate technology to provide reliable electricity solution at Snake Bite Treatment Centres in Nepal, mainly during the outage of the grid, not only to preserve refrigerated vaccines but also to be able to operate essential machines, such as nebulizers and suction machines. RERL, in installed solar PV in the at Snakebite Treatment Centres[29] in three different places Letang Morang, Charali Jhapa, and Itahari Sunsari The solar panels system supported by RERL are of 1.5vkWp, enough to run two refrigerators that store anti-snake venom and light 12 bulbs for two continuous days with uninterrupted electricity supply, as well as some electrical appliances.

This renewable technology is found to be very effective to provide reliable and uninterrupted power supply which is contributing to saving the lives of many snakebite victims. There are more demands from other treatment facilities as well. Looking at the impact, AEPC has allocated subsidy fund to support Solar PV system for 25 similar centers in 2019.

[28] Quoted in "Snakebite Treatment Center, Saving Lives with Renewable Energy Technology", by RERL project team

[29] Managed by the benefitting communities, the centres are owned by the Nepalese Army that also makes medical specialists available

Ramitekhola Solar Mini-grid (30kWp), Morang

Polycristalline solar PV: 30 KWp
VRLA tub gel batteries (2V): 240 KWh
Max battery DoD: 75%; 2 days autonomy
Esimatyed max peak load: 20 kW
DC/AC 3-phase inverter: 30 kW

Transmission and distribution:
T&D, 3-phase: 1380 m (400 Volt)
T&D, 1-phase: 1570 m (230 Volt)
Max voltage drop : 10%
35 9m poles and 42 8 m poles
MCB for households: 75 of 230 V, 1 Amp
Energy meter: 75 pre-paid (5 amp)

Estimated demand: 88 kWh (incl. 25% PEU and 5% future growth)
Est. 5 peak sunshine hrs per day

Cost: NPR 16,133,545 (excl VAT, 9%)
ADB/SASEC: NPR 14,529,190.5
Community equity: 1,613,334.5
VAT (NPR 1,454,000) paid by AEPC
Additional RERL subsidy on PEU: NPR 319,029

Observations by the Evaluators

Strengths	Things to improve
• The system currently serves 68 HHs (total houses are 73), and PEU demands (12 clients) as well as 10 street lights • Majority of households are ethnic and poor communities • RERL support: DFS, preparation of bid document, TRC-technical review committee, manage social mobilizer, business opportunities assessment, business plan preparation for PEU • Tariff collection: prepaid metering system and computerized billing system • Good selection of PEU and people are fetching good income	• Longer-term sustainability of the scheme is questionable as the national grid is getting very close (at a distance of 4-5 km); Plan B for grid connection may then be needed • Sophisticated technology; O&M may be challenge for local people

ANNEX F. CONSULTANT CODE OF CONDUCT FORM

Evaluators/reviewers:

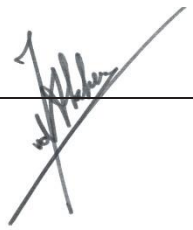
1. Must present information that is complete and fair in its assessment of strengths and weaknesses so that decisions or actions taken are well founded
2. Must disclose the full set of evaluation findings along with information on their limitations and have this accessible to all affected by the evaluation with expressed legal rights to receive results.
3. Should protect the anonymity and confidentiality of individual informants. They should provide maximum notice, minimize demands on time, and respect people's right not to engage. Evaluators must respect people's right to provide information in confidence, and must ensure that sensitive information cannot be traced to its source. Evaluators are not expected to evaluate individuals and must balance an evaluation of management functions with this general principle.
4. Sometimes uncover evidence of wrongdoing while conducting evaluations. Such cases must be reported discreetly to the appropriate investigative body. Evaluators should consult with other relevant oversight entities when there is any doubt about if and how issues should be reported.
5. Should be sensitive to beliefs, manners, and customs and act with integrity and honesty in their relations with all stakeholders. In line with the UN Universal Declaration of Human Rights, evaluators must be sensitive to and address issues of discrimination and gender equality. They should avoid offending the dignity and self-respect of those persons with whom they come in contact in the course of the evaluation. Knowing that evaluation might negatively affect the interests of some stakeholders, evaluators should conduct the evaluation and communicate its purpose and results in a way that clearly respects the stakeholders' dignity and self-worth.
6. Are responsible for their performance and their product(s). They are responsible for the clear, accurate and fair written and/or oral presentation of study limitations, findings, and recommendations.
7. Should reflect sound accounting procedures and be prudent in using the resources of the evaluation.

Evaluation/reviewer Consultant Agreement Form

Agreement to abide by the Code of Conduct for Evaluation in the UN System

Name of Consultant: J.H.A. VAN DEN AKKER (Team Leader)
Name of Consultancy Organization (where relevant): _____
I confirm that I have received and understood and will abide by the United Nations Code of Conduct for Evaluation.

Signed at Westerhoven, Netherlands
Signature: _____



ANNEX G. ABOUT THE REVIEWERS

Mr. Jan van den Akker is a technology management scientist with a Master's degree from Eindhoven University of Technology (Netherlands), specializing in international development cooperation. He is an expert on sustainable energy policy and technologies. Mr. Van den Akker specializes in studies and analytical work, project design and development, project coordination and implementation, project monitoring and evaluation, knowledge management, capacity strengthening and public-private partnerships in the field of sustainable energy strategies, energy efficiency, energy technologies and supply, climate change and the Clean Development Mechanism. He has lived and worked abroad for over 7 years in Zambia, Mexico, and Thailand. In addition, has undertaken numerous short missions to about 45 countries in Africa, Latin America, and Asia & the Pacific.

In 2003/2004, he founded ASCENDIS, as an independent office, and has been providing consultancy on sustainable energy and climate change, specializing in development issues. ASCENDIS is based in Westerhoven, Netherlands, but offers services in Africa, Asia and the Pacific, Europe and Latin America & the Caribbean, often by associating itself with local freelance experts, professionals, and organizations. As a long-term expert with the United Nations system, Mr. Van den Akker has provided advice to governments and organizations on the design of investment and capacity building programs for UNEP, UNDP and UNIDO (mostly in GEF-funded activities), UNFCCC, European Commission and for NGOs/consultancy companies (e.g., Practical Action Consulting, Winrock, GFA) in the area of renewable energy, energy efficiency and sustainable transportation.

As an independent consultant, he has reviewed and evaluated about 30 GEF-funded sustainable energy projects and assisted in the design of about 36 sustainable energy projects. He worked as UNDP Regional Technical Advisor on climate change mitigation (in Eastern and Southern Africa) during 2007-2009 and as Key Expert in the European Union Technical Assistance Facility for Sustainable Energy for All (2015-16). He also worked as Technical Advisor in the implementation of individual projects in Guatemala, Peru, and in Malawi.

Mr. Dhruba Gautam received his Doctorate in 'Disaster Governance'/Development Sociology in 2010 and also holds an M.A. in Development Sociology with specialization in natural resource management (1998), an M.Sc. in Applied Mathematics (1993), and a B.Sc. with Geology (1990).

Over the last 26 years, Dhruba's work has focused mainly on emergency preparedness and response, DRM, CCA, urban resilience, sustainable livelihoods, WASH, humanitarian work and institutional development during which time he acquired much empirical experience in the execution of development projects and programs. He has contributed much to the literature in terms of independent evaluation, multidisciplinary research, and good practices and knowledge management of areas like vulnerability analysis, multi-hazard risk analysis, emergency preparedness and response, early warning systems, and post-disaster recovery and reconstruction. He has engaged in applied research and evaluations at the intersection of DRM, CCA, social development, livelihood resilience and WASH in South Asia and Southeast Asia, particularly in the countries of Nepal, India, Bhutan, Bangladesh, Sri Lanka, Afghanistan, Thailand and Myanmar. He has thorough knowledge and understanding of institutional set up for emergency response mechanisms in the South East and South Asian Countries.

Between 2002 and 2019, Gautam evaluated over 150 programs and projects, including those funded by the World Bank, UNDP, GEF, DfID, USAID, ADB and many INGOs. Many of these were complex and multi-country. Prior to becoming an independent evaluator and consultant in 2002, he worked for PACT International/USAID (1991-1993) as training officer, Plan International (1995-1997) as livelihood and education coordinator, MRMG/The Ford Foundation (1998-1999) water governance specialist, and Bagmati integrated watershed management project/the European Union (2000-2001) as senior DRM Specialist.

Gautam's empirical skills include those related to project design and management, policy analysis and monitoring and evaluation. In particular, serving as an intermittent consultant, he helped to establish the M&E systems of UNDP-GEF/Small Grants Programme (2004-2016), Plan International (2007), LWF (2008), UN-HABITAT (2011) and NAP Agriculture/ADS/UNDP (2019). He was one of the researchers at the Nepal Water Governance Project (2002-2005) with funding from DfID. Between 2008 and 2011, he occasionally worked as a researcher for ActionAid/Institute of Development Studies UK and Sahakarya/IIED UK and saw his research papers published. He has also worked with UK-based consulting firms like MottMacDonald, HR Wallingford Ltd., and Oxford Policy Management; the US-based Mitchel Consulting Groups; and the Finland-based IMPACT, FIANT and HANNU, contributing both evaluations and research. He has been hired on multiple occasions as a consultant for the UNDP, WHO, FAO, DfID, USAID, AusAID, and many other INGOs as well as research institutions including Stockholm Environmental Initiative. He has had research partnerships with Lutheran World Relief/Yale University in the USA and work as adjunct fellow at Western Sydney University in Australia.