NEPAL RENEWABLE ENERGY PROGRAMME

AN NREP POLICY BRIEF: MACRO-ECONOMIC IMPACT OF DISTRIBUTED RENEWABLE ENERGY DEVELOPMENT WITH VGF-BASED FINANCIAL ASSISTANCE

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TABLE OF CONTENTS

1. BACKGROUND & OBJECTIVES

In Year 3 of the Programme, NREP plans to catalyze the Distributed Renewable Energy (DRE) market in Nepal by providing Viability Gap Funds (VGF)-based or needs-based Financial Awards through its Sustainable Energy Challenge Fund. The Programme's market assessment and development experts has prepared a pipeline of over 70 DRE projects in three Provinces, in advance of its VGF-based Financial Assistance offerings to be made available in June 2021 which include a highly favorable assessment of PPPs.

The Programme has also been developing an evidence base to help decision-makers make informed decisions that will help Nepal diversify its generation profile to make the country more resilient and self-sufficient. NREP believes that major changes in the renewable energy sector—as a result of federalism, ambitious national economic development and low-carbon environmental goals, dramatic changes in cost of solar PV, changing international development financing scenario, and end-user project financing preferences—creates an investment climate that will catalyze private sector investments in DRE that will scale up to meet energy mix, 15th Plan, hydro/solar seasonal complementarity, and long-term strategies leading to zero emissions status by 2050 goals. As one example, NREP market analysts estimate that Nepal will need USD 1 Billion for implementation of to install 125 MW of solar PV by 2024, as planned in GoN's 15th Plan. The recent Nepal's Nationally Determined Contribution 2020 submitted to UNFCCC targets to install RE between 750 MW to 1500 MW by 2030 whereby estimating a total of USD 28.4 billion required for the implementation of all conditional and unconditional targets. SECF VGF can support realize 15th plan targets and gradually scale up to support the NDCs as well and hence can help close both short- and mid-term financing gaps.

This paper is the beginning of a build-up of an evidence base and planned dialogue to help decision-makers make informed decisions that will help Nepal diversify its generation profile to make the country more resilient and self-sufficient. NREP believes that major changes in the renewable energy sector—as a result of federalism, ambitious national economic development and low-carbon environmental goals, dramatic changes in cost of solar PV, changing international development financing scenario, and end-user project financing preferences—creates an investment climate that will catalyze private sector investments in DRE that will scale up to meet energy mix, 15th Plan, hydro/solar seasonal complementarity, and long-term strategies leading to zero emissions status by 2050 goals.

The main objectives of this paper are:

- To posit the role of distributed renewable energy (DRE) in Nepal to help the country diversify its energy mix and achieve other tangible benefits from non-hydro renewable energy sited near energy loads
- To compare and contrast subsidy and Viability Gap Funding financial assistance approaches to catalyzing the distributed energy market sector in Nepal and thereby attracting additional funds from private and Development Partner sectors.
- To lay out the macro-economic impact of large-scale distributed renewable energy impacts in Nepal.
- To clear a path forward toward achieving the benefits of large-scale, affordable, clean and reliable distributed renewable energy.

- To make policy recommendations in the to enable Nepal to take advantage of this unique opportunity to use proven VGF approaches in driving DRE deployment, leveraging private and Development Partner funds.

Both primary and secondary information were used as data sources, including discussions with DRE industry experts and governmental agencies, published papers and reports footnoted throughout this paper, and internal Nepal Renewable Energy Programme intelligence gathered over the course of the Programme’s inception and implementation.

2. THE ROLE OF DISTRIBUTED RENEWABLE ENERGY IN NEPAL’S ENERGY SECTOR

2.1 CENTRALIZED HYDROPOWER & DISTRIBUTED RENEWABLE ENERGY SEASONAL COMPLEMENTARITY

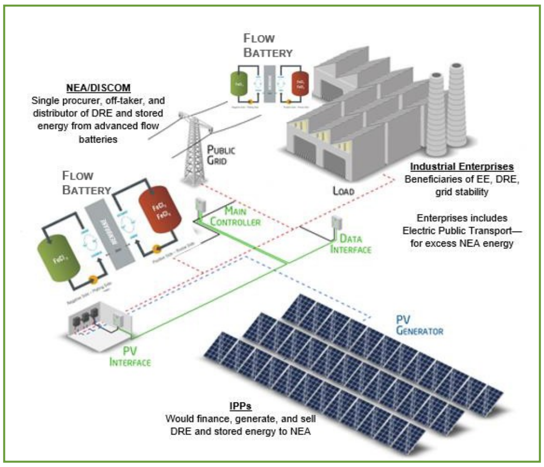
2.1.1 Centralized Hydropower

Nepal is blessed with plentiful large-scale hydropower during the country’s wet seasons. Electricity generated from moving water is generated by the quasi-public Nepal Electricity Authority (NEA) and by private sector Independent Power Producers (IPPs) and sold to NEA in a “centralized” power paradigm with one energy procurement entity. NEA delivers the electricity over its national transmission and distribution (T&D) power grid to meet electricity demand across the country.

The Government of Nepal’s (GoN) energy plans also call for non-hydropower energy to increase its “energy mix” (or, to diversify its energy generation resource base). The 15th Plan, e.g., has set non-hydro renewable energy (RE) goals including a High Growth target of 135.4 MW (125.4 MW from Solar and 10 MW from Wind) by 2024. Of this target, a total of 18.5 MW was connected to the grid during the plan period. With less than 2 fiscal years to reach the end of 15th plan period, majority of the projects are still at some stages of licensing process. Private sector investment will be needed to meet 15th Plan goals as the NREP trend analysis shows that the public finance can allocate a maximum of NPR 52 billion over the plan period while rest of the financing should come from a mixture of private finance and development funds.

2.1.2 Distributed Renewable Energy

Distributed Renewable Energy (DRE) projects—sited at or near electricity loads—from industries, businesses, institutions, or homes—owned and operated by the end-user or third parties, can help the GoN meet this 120 MW shortfall[1].



Nepal has considerable installed capacity potential for solar photovoltaics (PV) energy generating systems—which, in tandem with downward trending prices and short-term deployment requirements—makes solar PV the most appropriate DRE system for large-scale market development in Nepal.

Following this "decentralized" or "distributed" approach in the same way energy authority has flowed from the Federal to Subnational governments, DRE conveys several benefits to its adopters at the local level, including:

- Energy mix diversification: DRE diversifies and makes more resilient Nepal's energy mix by increasing non-hydropower options—which may become increasingly important in the face of climate change. By supporting "seasonal complementarity" of hydropower in the wet season and solar energy in the dry season, DRE investment can reduce the amount of imported high-carbon content energy needed to keep Nepal's economy energized year-round.
- Cost savings to the Government of Nepal. Investment in DRE a much more cost-effective approach to meeting GoN 15th Plan RE goals, e.g., compared to the traditional centralized generation, transmission and distribution approach. According to NEA, NPR 247 billion is the capital infusion requirement for the 15th Plan period with a traditional, hydro-based, centralized approach. In contrast, a DRE approach requires only NPR 133 billion[2] to meet all targets for the plan period. And, since DRE is sited near the energy load, electricity line losses are negligible.
- Cost savings to the end-user. Reduction in utility bills, as levelized cost of electricity (LCOE) of the solar is lower than the current tariffs paid by the industries and commercial establishments. For 11 kV ToD meter users, Industries pay a price of about 8.55 Rs/kWh and Commercial customers pay 11.10 Rs/kWh (Tariffs from 5am-5pm). Other costs saving can result from:
    - Reduction of diesel fuel cost; reduction of electricity tariff (kWh)
    - Reduction in capacity charge (kW)
    - Help reduce the peak load of DG and help in reduction of backup diesel fuel expenses
    - During the day, when customers produce more electricity than their operations can consume this surplus electricity can be sold to the grid

Local economic opportunity & self-sufficiency: DRE can create value locally in terms of local tax revenues, local industries and local services. DRE makes Nepal's economy less vulnerable to disruption and allows provincial and local governments and their communities to have more control over their energy future.

▪

[1] The shortfall depends on what we consider. If construction & survey licenses are not considered, then 125.4 – 18.5 = 106.9 MW. If construction licenses are considered, then 125.4 – 18.5 – 91.97 = 14.93 MW (much closer to NREP targets). If construction and survey licenses are considered, then 125.4 – 18.5 – 91.97 – 598.32

[2] Calculation is based on NREP analysis of 15th Plan annualized and disaggregated cost of implementation of 24 types of RE projects from FY 2018/19 to FY 2023/24.

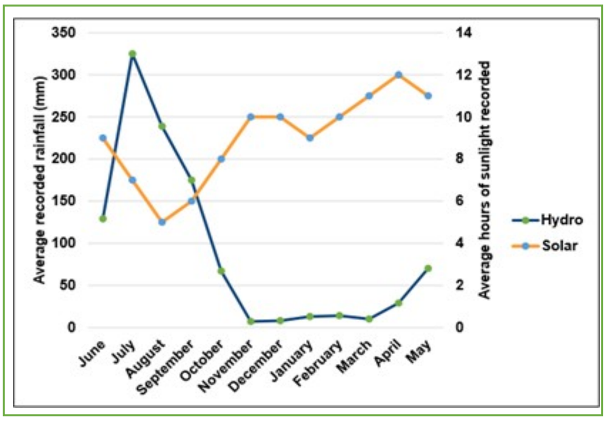
2.1.3 Hydropower/Solar Energy Seasonal Complementarity

Nepal's economy is heavily dependent on hydropower to meet its energy needs, but according to hydropower experts, hydropower plant construction is becoming more and more expensive to install as developers are forced to building in harder-to-access areas. With the looming threat of climate change, hydropower may become increasingly vulnerable to reduced precipitation as well.

While Nepal may benefit from increased hydropower capacity in coming years, even enough to supply domestic energy needs during the dry season, it is unclear when that hydropower would come online, and whether or not there is sufficient T&D infrastructure to efficiently deliver the power to electricity loads.

In any event, if another dry season renewable energy resource could be developed to offer a steady supply of year-round energy, this hybrid energy supply would decrease the need to import high carbon content energy from India and increase the economic viability of exported electricity to Bangladesh or other neighbouring countries.

Solar energy is the perfect dry season renewable energy resource to complement hydropower. In stark contrast to the trend of increasing costs of hydropower, solar PV arrays are becoming less and less expensive to install—with India reporting solar energy generation pricing, at scale, of 1.9 Indian Rupees/kWh—causing the International Energy Agency to declare solar energy the cheapest large-scale energy source on Earth.



Solar PV arrays can be sited on a multitude of surfaces too: on building and industrial plant rooftops, parking lot canopies, sloped hillsides, canals, ground mounts, and even farmland—which can yield multiple revenue streams from solar energy, from sheep that can graze under and around the PV panels, and from shade-tolerant herbs and plants such as turmeric.

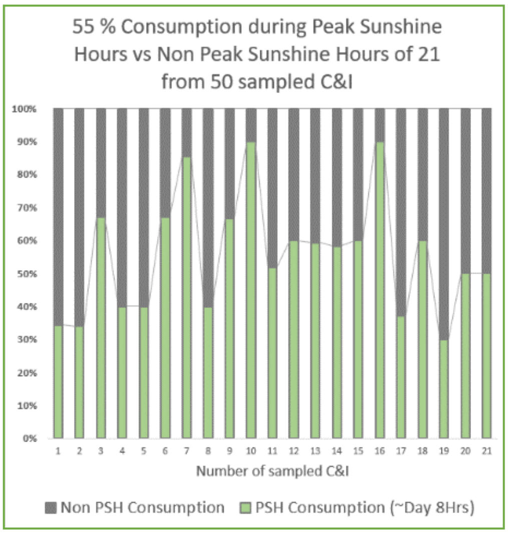
Hydropower Independent Power Producers (IPPs) report that solar energy generation in the dry seasons allow them to avoid generation shortfall penalties—which is driving some of these IPPs to invest in their own large-scale grid-connected solar PV farms.

3. DISTRIBUTED RENEWABLE ENERGY POTENTIAL

3.1 NATIONAL DRE POTENTIAL

3.1.1 Matching Supply & Demand

Solar PV can meet a significant amount of a Commercial, Institutional & Industrial (CI&I) end-user's energy needs in Nepal. A Nepal Renewable Energy Programme analysis, shown at right, shows considerable overlap of solar radiation availability, during peak sunshine hours, which could meet CI&I market electricity loads, thus displacing grid power or power from backup diesel gensets which are often used as prime movers to achieve power reliability in Nepal.



The question becomes: Does Nepal have enough DRE resource (e.g., solar irradiation) potential to diversify the country's energy generation mix?

3.1.2 An Abundance of Solar Energy Resources

Nepal's installed capacity of hydropower in 2021 is approximately 1,400 MW**;** if the GoN wanted to have an equal amount of installed hydro and solar capacity, it would need assurance that the country had at least that same amount of potential, although seasonal variations and energy storage capabilities would have to be factored in.

A recent World Bank report using GIS [3] has indicated that Nepal has an abundance of distributed solar energy installed capacity potential.

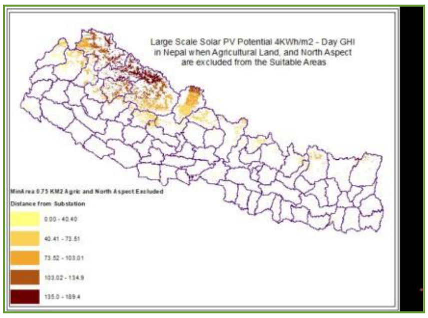
The small-scale solar PV installed capacity potential is 55,088 MW (when agricultural land and north aspect are excluded, and 30% of the land is utilized), as the potential map and tabular data below demonstrate. A more conservative estimate, using only 10% of the land, shows an estimate of 28,565 MW of installed capacity potential.

Province	Number of Areas	Total Area Available (km2)	Total Generation Potential (MWh)	Total Installed Capacity (MW)
P-1	9,972	1,119	4,817,725	3,358
P-2	**4,252**	**471**	**2,150,058**	**1,412**
P-3	9,326	1,125	4,880,201	3,376
P-4	10,383	3,529	17,348,153	10,588
P-5	**11,271**	**1,291**	**6,020,865**	**3,874**
P-6	**21,941**	**8,492**	**40,524,082**	**25,476**
P-7	10,115	2,335	10,492,390	7,004
TOTAL	**77,260**	**18,363**	**86,233,474**	**55,088**

Table 1: World Bank Estimation of Small-Scale Solar PV Installed Capacity Potential

[3] *Identifying Solar & Wind Opportunities in Nepal through GIS Final Findings: Nepal: Strategic Environmental and Social Assessment of Renewable Energy Project*; World Bank; August 2020

Another World Bank report output is the larger-scale solar PV installed capacity potential is 46,409 MW (based on the assumptions that no agricultural land or North Aspects are used, and 30 percent of the identified land is used to site solar PV arrays) as the potential map and tabular data below demonstrate. A more conservative estimate, based on only 10% of the identified land being utilized, shows 18,226 MW of installed capacity potential.



Province	Number of Areas	Total Area Available (km^2)	Total Generation Potential (MWh)	Total Installed Capacity (MW)
P-1	315	590	2,537,543	1,948
P-2	**120**	**178**	**814,250**	**588**
P-3	342	656	2,811,986	2,166
P-4	1,103	2,987	14,927,268	9,858
P-5	**341**	**648**	**2,988,204**	**2,138**
P-6	**3,108**	**7,319**	**34,982,495**	**24,154**
P-7	800	1,684	7,435,885	5,556
Total	**6,129**	**14,063**	**66,497,631**	**46,409**

Table 2: World Bank Estimation of Large-Scale Solar PV Installed Capacity Potential

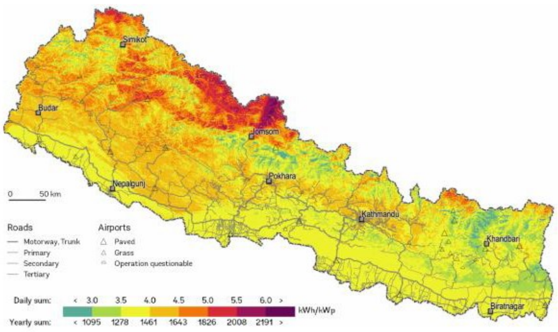
It is apparent that Nepal has sufficient solar energy resources to commercialize and scale up solar energy over the next few years, which can diversify the country's energy generation mix and add seasonal complementarity to its abundant hydropower.

3.1.3 Solar Resource Geographic Availability

Solar PV project developers and investors require high accuracy solar resource and meteorological data to develop solar PV projects, before and during the projects' operation of typically 25 years. The World Bank's Energy Sector Management Assistance Program (ESMAP) uses *SolarGIS* software to collect solar radiation data, specifically Global Horizontal Irradiance (the most appropriate solar resource data for PV systems, that includes cloud cover, seasonal variability, pollution, terrain, etc.) for grid-connected PV, mini-grid PV systems, and off-grid PV systems.

Solar PV developers and investors may be most interested in the data shown below, as they can be used to calculate both technical and economic potential of solar PV across Nepal—as output data can be directly leveraged in pre-feasibility and detailed feasibility studies to estimate cashflow, return on investment (ROI), payback periods, and other economic metrics.

- *Map 4.17* shows the average daily total of specific PV electricity output from a typical open-space PV system with a nominal peak power of 1 kW, i.e. the values are in kWh/kWp. Calculating PV output for 1 kWp of installed power makes it simple to scale the PV power production depending on the size of a power plant.
- Table 4.7 provides annual performance parameters of a PV system with modules fixed at optimum angle.



Map 4.17: PV electricity output from open space fixed-mounted PV system with PV modules mounted at an optimum tilt and a nominal peak power of 1 kWp. Long-term averages of daily and yearly totals.

Table 4.7: Annual performance parameters of a PV system with modules fixed at optimum angle

	Simikot	Budar	Jomsom	Pokhara	Nepalgunj	Kathmandu	Khandbari	Biratnagar
PVOUT Average daily total [kWh/kWp]	4.40	4.14	5.07	4.22	3.96	4.19	3.84	3.62
PVOUT Yearly total [kWh/kWp]	1609	1513	1852	1539	1445	1531	1401	1321
Optimum angle	34°	31°	30°	29°	26°	28°	26°	23°
Annual ratio of DIF/GHI	41.9%	47.8%	34.8%	48.4%	52.2%	50.0%	54.5%	58.7%
System PR	85.1%	78.0%	84.4%	78.9%	76.4%	79.2%	79.6%	76.8%

PVOUT - PV electricity yield for fixed-mounted modules at optimum angle; DIF/GHI – Ratio of diffuse/global horizontal irradiation; PR - Performance ratio for fixed-mounted PV

3.1.4 The Land Availability *Non*-Issue

Land availability is often cited as a constraint to solar PV development; in reality**,** if solar PV arrays were sited on the rooftops in just ten of Nepal's municipalities, the potential installed capacity would be over 1,600 MW, as detailed below. DRE systems could of course be sited across the country—in municipalities as well as rural communities, on rooftops or parking lot canopies or even canals, where they could help to meet local electricity loads, as determined by factors such as the need for high reliability electricity, desire to save energy costs, the opportunity to shave peak loads, etc.

Assumption: 320 Wp panel and associated BOS needs 20 sq. ft based on dimensions of 320 W panel from Trina Solar https://static.trinasolar.com/sites/default/files/PS-M-Datasheet_AllmaxM%20Plus_DD05H%28II%29_NA_2019_A.pdf

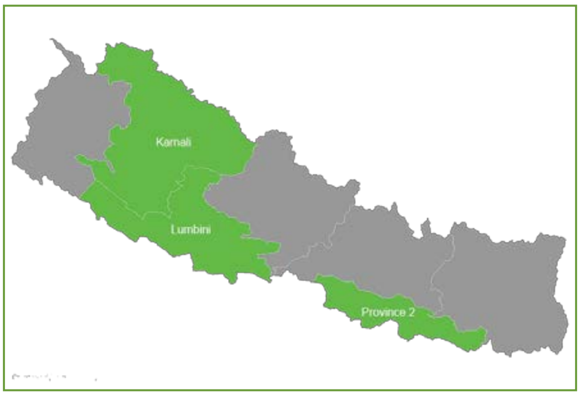
Assumption: 107.739 sq. ft can accommodate 1 kWp based on assumption by Shrestha and Raut

							1kWp plus BOS in 10 sq.m		320 Wp panel plus BOS in 20 sq.feet	
No	Municipality	Number of buildings	Total rooftop area (sq m)	Rooftop area (sq ft)	Available Rooftop area (sq.meter) [High = 24%]	Available Rooftop area (sq.meter) [Low = 19%]	MW [High]	MW [Low]	MW [High]	MW [Low]
1	Kathmandu	107,338	11,593,484	124,791,099	2,782,436	2,202,762	278	220	479	379
2	Pokhara Lekhnath	113,266	9,861,632	106,149,618	2,366,792	1,873,710	237	187	408	323
3	Bharatpur	79,591	6,208,722	66,830,058	1,490,093	1,179,657	149	118	257	203
4	Lalitpur	38,329	4,581,466	49,314,443	1,099,552	870,479	110	87	189	150
5	Biratnagar	45,506	3,882,144	41,787,012	931,715	737,607	93	74	160	127
6	Dhangadhi	38,427	3,265,890	35,153,716	783,814	620,519	78	62	135	107
7	Itahari	37,809	3,008,909	32,387,596	722,138	571,693	72	57	124	98
8	Hetauda	40,664	2,978,677	32,062,178	714,882	565,949	71	57	123	97
9	Godawari	31,536	2,671,446	28,755,176	641,147	507,575	64	51	110	87
10	Nepalgunj	26,235	2,494,037	26,845,561	598,569	473,867	60	47	103	82
	Total	558,701	50,546,406	544,076,458	12,131,137	9,603,817	1,213	960	2,089	1,654

Table 3: World Bank Estimation of Available Roof Space for Solar PV in Top 10 Municipalities

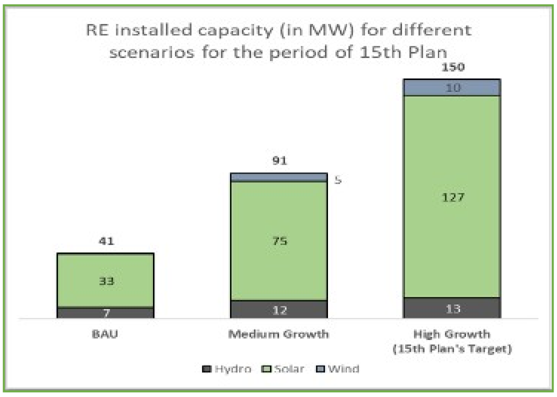
3.1.5 NREP Province DRE Market Assessment

The Nepal Renewable Energy Programme (NREP) is a Government of Nepal programme dedicated to increasing private sector investment in distributed renewable energy (RE) and increasing universal energy access, while facilitating a policy, planning, legal construct, and regulatory environment conducive to both enabling and sustaining progress in RE market development and universal energy access. The Programme operates in Province 2, Lumbini and Karnali.



In Years 1 and 2 of the programme, NREP has been conducting Detailed Feasibility Studies (DFS), pre-feasibility studies, simulation modelling (e.g., PV Syst, HOMER, PSS/E), land siting and DRE sizing studies, and other measures to assess the technical and economic feasibility of DRE projects. The Programme has also been developing an evidence base to help decision-makers make informed decisions that will help Nepal diversify its generation profile to make the country more resilient and self-sufficient.

NREP DRE market analysts estimated that with business as usual policy and approaches, the gap in installed capacity as planned in 15th Plan can be as high as 107 MW, according to NREP estimates.



To meet part of this goal, NREP has assessed the following market potential data in Province 2, Lumbini and Karnali—categorized by market sector. NREP collected data from various sources, and used averaging techniques, but the point remains that there is sufficient technical potential.

Market Sectors & Subsectors	Number of DRE Projects Identified	Potential Installed Capacity (MW)
Industrial (including Agriculture)		
▪ Metal	13	19.5
▪ Pharmaceutical	36	7.2
▪ Cement	30	30.0
▪ Food, Beverage, and Tobacco	76	15.2
▪ Textile and Leather	25	3.0
▪ Agriculture/Irrigation Pumps	100,000	75
▪ Subtotals	***100,180***	***149.9***
▪ Commercial		
▪ Retail/ Centralized Cold Chain Storage	3	0.5
▪ Retail/Shopping Malls	3	3.0
▪ Tourism/Hotels	52	15.6
▪ Tourism/Homestays	16	0.4
Subtotals	***74***	***19.5***

Institutional		
▪ Health/Health Posts	1,017	5.1
▪ Health/Primary Health Care Centers	47	0.5
▪ Health/Hospitals	41	4.1
▪ Health/Urban Health Centers	87	1.7
▪ Health/Community Health Units	69	3.5
▪ Health/Non-public Health Facilities	234	2.3
▪ Health/Other Health Facilities	10	0.2
▪ Education/Educational Facilities	372	18.6
▪ Rural and Urban Municipalities	316	20.3
Subtotals	***2,193***	***56.3***
TOTALS	**102,447 DRE Projects**	**225.7 MW**

Table 5: NREP DRE Market Assessment in Commercial, Institutional, and Industrial Markets

4. CATALYZING THE DISTRIBUTED RENEWABLE ENERGY MARKET WITH VIABILITY GAP-BASED FINANCIAL ASSISTANCE

4.1 SUBSIDIES

Renewable energy technologies were introduced in Nepal during the early seventies with government recognizing water mill, micro hydro, wind, solar, biogas, organic manures and geothermal as renewables (the Fifth Plan). The government initiated formulating policies for multi-purpose projects connecting renewable energy with irrigation and drinking water (the Sixth Plan). During early Eighties, the government linked rural energy with productive end uses, women empowerment and investment (the Seventh Plan). During late 80s, Agriculture Development Bank was already providing agricultural credit on concessional interest, under Asian Development Bank credit assistance, to farmers for installation of improved stoves and biogas. For example, biogas companies were investing 75 percent of the total cost with only 25 percent of the cost received from government in the form of grants. A basic model of the Market was already there. This was also the era where most of the government owned assets were disfranchised and private sector thrived, allowing the RE market to benefit as well.

It was during the period of the Eight Plan (1990-1995) that the government declared the need to make dedicated RE programs and mobilize DDC, VDC, NGOs and private sector for technical and financial support. A basic PPP model was also there. It was also during the Eight Plan period that the government declared to mobilize private sectors and NGOs by allocating 50 percent grant for mid hills and 75 percent grant for Himalayan regions. Subsidy/Grant increased from 25 percent to 50 – 75 percent.

In 2021, the subsidy allocated for all RETs can be normalized around 70 percent. But frequent repair, maintenance and operational support has significantly increased the support/grant from government to existing projects. E.g., the *Karnali Ujyalo Program 2020* focuses on rehabilitating and completing the incomplete micro hydro projects. However, these projects have already received initial grants of nearly 60 percent from the regular subsidy policy. Specific policy measures were derived during early 2010 to give additional grant to these projects through a separate mechanism. The latest *Karnali Ujalyo Program 2020* was objectively formulated to support the incomplete micro hydropower plants. So, a three-fold increase in subsidies/grants can be assumed to have mobilized in these projects but it is still uncertain whether they will be rehabilitated properly; the choices when the grid is accessible will make the uncertainty even higher. But the same uncertainty is pushing Subnational Governments to advocate for additional funding to make the projects more feasible and bankable.

One issue that is difficult to assess is the actual installed cost of RE projects. This is explicitly true for rural off-grid projects where proportion of the tasks are allocated for community (esp. civil construction, canal/water diversion) while majority of the community mobilization are led by development partners and NGOs. DPs and AEPCs are primarily responsible for survey, feasibility, engineering specifications and transactions. If all these costs are added, the true cost of project will be even higher. Additionally, Nepal is not a manufacturing country so small businesses and developers always seek for guarantee against imported technologies and investment that are new to them, the users and the financing agencies. Unlike India and China, the manufacturers/industries of DRE themselves stand as a guarantee of their projects and can handle a large enough credit for them, the wholesalers and retailers.

4.2 VIABILITY GAP FUNDING

4.2.1 Customized and Competitive

Viability Gap Funding (VGF) schemes are designed to make marginally feasible projects economically feasible by providing enough financial assistance to close the gap between non-feasibility and feasibility. For example, if a DRE project met a 15% ROI criterion, but had a 7-year payback period, a VGF award would buy down the gap between a 7-year payback and a 4 or 5-year payback, meeting current investor threshold criteria.

The Sustainable Energy Challenge Fund, as explained in more detail below, will make VGF awards to the most competitive Concept Note or Full Applications, for project showing the greatest Value for Money as measured by the highest ratios of, e.g., installed capacity/VGF amount. This approach contrasts with a set subsidy tariff that does not allow for customization of the funding or the element of competition.

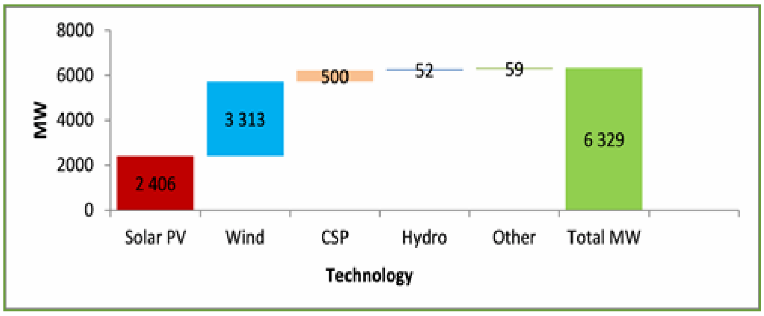
The role of competition in making awards to DRE projects under the SECF is critical in driving down costs, as evidenced from similar programmes around the world. South Africa's Renewable Energy Independent Power Producer Procurement Program (REIPPPP) is illustrative. REIPPP has demonstrated over time in South Africa that the price of bid windows has decreased over time, which has driven installed capacity.

Due to the competitive bidding process, innovation and cost reductions, bid window prices have recorded steep decreases with every cycle. As a result, South Africa is now producing renewable energy at some of the lowest tariffs in the world.

- Solar PV bid prices decreased from 329c/kWh to 82c/kWh.
- REIPPPP has attracted R209.4 billion in committed private sector investment, 24% of which is foreign direct investment.[4]

[4] REIPPP comes of age. Luzuko Nomjana, Investment Analyst @Futuregrowth, February 2020.

As of June 2018, total investment in REIPPPP assets was R 201.8 billion, of which R 48.7 billion was from foreign investors and financiers. A total of 6,329 MW of renewable energy has been procured, as seen at right.[5]



4.2.2 VGF Origins

India's Viability Gap Funding (VGF) approach originated with the 2005 Scheme for Financial Support to Public Private Partnerships (PPPs) in Infrastructure, designed to be administered by India's Ministry of Finance. The Scheme's provisions include:

- CAPEX grant. VGF under this scheme will normally be in the form of a CAPEX grant at the stage of project construction.
- Private sector-driven. In order to be eligible for VGF, a PPP project has to be developed, financed, constructed, maintained and operated for the project term by a private sector company selected by the GOI through a process of open competitive bidding.
- 20-40% Financial Assistance cap. The VGF under India's scheme could not exceed 20% of the total project cost but could include an additional 20% on a case-by-case basis.
- PPP. The Government of India (GOI) was committed to promoting Public Private Partnerships (PPPs) in infrastructure projects that may not always be financially viable because of long gestation periods and limited financial returns, and to bridging the financial viability of such projects with VGF and by so doing, attract private sector capital.

VGF for Indian energy projects was deemed to be the CAPEX percentage required to achieve the target Average Power Purchase Cost, so it was designed as a CAPEX subsidy to attract more private investors to participate PPPs. The VGF grant will be disbursed at the construction stage itself but only after the private sector developer makes the equity contribution required for the project. Local Government can contribute to the provision of this support after obtaining the approval of Local Parliament. Simply put, VGF is a way of promoting PPP models by Federal and Subnational Governments and distributing blended finance funds to build infrastructure more efficiently and cost-effectively.

In Nepal, VGF was established by Nepal's Private Partnership and Investment Act 2019, stating that the Government of Nepal "shall establish a Viability Gap Fund for construction, operation and expansion of the projects that yield positive returns in the long run and are important from infrastructure structure but could not yield reasonable financial returns immediately." GoN's definition of PPP was recently updated in a 2019 document as "an arrangement of project implementation for construction, operation, restoration, of infrastructure structure of delivery of public service in collaboration with government or public body and private having allocated or bearing the cost of resources returns or risks through any of the methods referred to in sub-section 2 of section 17."

[5] https://futuregrowth.co.za/insights/reippp-comes-of-age/

4.2.3 Viability Gap Funding / Public Private Partnership Synergies

NREP believes that PPPs can de-risk public sector investments by combining public and private resources to increase utilization of DRE in Nepal in a manner that makes DRE development sustainable more sustainable. In PPPs, the project responsibilities and risks transferred to the private party—such as design, construction, financing, operations, and maintenance—may vary from contract to contract, but in all cases the private party is accountable for project performance and bears significant risk and management responsibility. PPP contracts typically allocate each risk to the party that can best manage and handle it. Most PPPs include additional services, including the full operation and maintenance over the long term. PPP participants can, if their projects are well-selected and their PPPs carefully structured, design and implement projects that optimize cost effectiveness and social well-being by aligning private partner profit objectives with public sector service objectives that support the public interest.

Additional benefits of a PPP model include:

- A reorientation of public sector procurement policy from buying assets to buying services or service delivery
- Shifting from a public finance balance sheet model to a financing model with partner financial institutions providing debt and equity financing
- Revising payment modalities from short-term, frequent infrastructure payments to longer term payments based on service delivery, which improves public finance cash flow constraints
- Concerns as to the commitment of private sector organizations in adhering to environmental standards are mitigated by safeguarding measures, and stronger protocols can be introduced as required.

4.2.4 NREP VGF-based Sustainable Energy Challenge Fund

NREP believes that major changes in the renewable energy sector—as a result of federalism, ambitious national economic development and low-carbon environmental goals, dramatic changes in cost of solar PV, changing international development financing scenario, and end-user project financing preferences—creates an investment climate that will catalyze private sector investments in DRE that will scale up over to meet energy mix, relevant 15th Plan targets, hydro/solar seasonal complementarity, and long-term strategies leading to zero emissions status by 2050 goals.

In Year 3 of the Programme, NREP plans to catalyze the DRE market in Nepal by providing needs-based awards. NREP has provided technical assistance to over 70 projects and prepared a pipeline of over 40 DRE projects, needing financial assistance as well in three Provinces, in advance of its VGF-based Financial Assistance offerings to be made available on or before June 2021.

In May 2021, the Ministry of Energy, Water Resources and Irrigation (MoEWRI) approved the Alternative Energy Promotion Centre (AEPC)'s Sustainable Energy Challenge Fund (SECF) mechanism within the Centre's Central Renewable Energy Fund (CREF) with many similarities to the Indian precedent. The SECF will operate under the guiding principles and practices illustrated in the accompanying diagram which are also in line with CREF's current guidelines for Vendor Finance Challenge Fund, i.e.:

- The Fund will provide VGF to marginally viable DRE projects—to buy down high upfront costs and to de-risk the investments—to make attract private sector investment which will realize significant return over the typical 25-year Expected Useful Life of the projects.
- The Fund will encourage Public-Private Partnerships which will leverage the profit motive of the private sector to meet public sector interests.
- The Fund will encourage innovative approaches to address problems, barriers, challenges and support creative problem-solving.
- The Fund will encourage DRE projects which can scale up and be sustainable beyond the Fund's support.
- The Fund will support DRE projects that address the "triple bottom-line," or that have a positive impact on society, the environment, and the economy.
- maximize energy access and energy security, despite its need the sector is highly subsidies which created a struggle to develop the market.
- The Fund will favour DRE projects that maximize value for money and that leverage resources from private or public sources.
- The Fund will measure progress of all funded projects on milestones jointly prepared with the partner institution prior to signing of the Performance Based Agreement (PBA) with the selected awardees.
- The Fund will place a high value on DRE project which advance and accelerate Gender and Social Inclusion.
- The Fund will act to incentivize DRE projects using competitive and cost-effective VGF-based financial assistance—for projects that provide the highest levels of installed capacity with the least amount of SECF funding.

5. MACRO-ECONOMIC IMPACT OF SCALING UP DISTRIBUTED RENEWABLE ENERGY

5.1 SECF AS FIRST STEP TOWARD ENERGY SECTOR TRANSFORMATION

AEPC and NREP envision the SECF concept as a fund that delivers transformational change across the energy sector and aligns with wider governmental goals including driving private sector to provide increased efficiency in delivery and developing sustainable export revenue streams. Through SECF, we can deliver a facility for Nepal that offers the structured provision of support to attract private sector funding to the "missing middle" commercial, institutional and industrial (CI&I) markets. The Fund has the potential to be both 1) an autonomous vehicle working with project developers, financing institutions, and development partners and 2) the brand to promote increased external financing (such as the Green Climate Fund).

The SECF concept brings additionality to current Rural Energy (RE) policy—including the proposed Renewable Energy Development and Promotion Bill, the Electricity Bill being discussed in Parliament, and the upcoming Nepal Renewable Energy Policy—and is a vital support mechanism for the Government to scale up policy provisions and diversify beneficiaries – leading to Nepal accessing more financing and leveraging larger investment.

For the SECF to become a sustainable mechanism in the longer term, the operational autonomy of the Central Renewable Energy Fund (CREF) is critical. The SECF also offers a modality where the government can utilise funding to drive private sector performance, as challenge funds are a method of accomplishing development through triggering a search for smart and cost-effective solutions, with innovation at the heart of the challenge fund concept and provide mechanism that allows for directly working with commercial players without creating market distortions to deliver sustainable, market outcomes. Thus, with challenges in public finances (with £1.5 billion currently planned in capital investment into transmission and distribution by 2024), encouraging the private sector to engage offers the potential of generating a catalytic impact through subsidy provision whilst still maintaining control of the direction of energy policy throughout Nepal. With a functional private sector energy market led by public sector policy, government resources can be reallocated to help support other priorities.

There will also be the need to address demand-side challenges, through the implementation of strategies to rebuild investor confidence in the SECF, and NREP's facilitatory role which will include:

- Garnering Ministerial support for CREF's operational autonomy
- Addressing bank and Financial Institutions' DRE lending concerns
- Increasing the awareness and utilization of Public-Private Partnerships
- Enhancing NREP's policy and technical capabilities.

5.2 SHORT-TERM CATALYSIS OF PRIVATE SECTOR INVESTMENT IN DRE

SECF and its VGF offer a mechanism that allows the evolution of Nepalese government support from a pure subsidy model to a model that provides temporary support in stimulating a market response and mobilizing investment in DRE that drives efficiency in the private sector over time, increasing the impact of government spending.

In addition, SECF offers a model that can be adapted in the future through future windows. to increase the commercialization and up-scaling of the sector. As government policy provision develops, then this can include a range of emerging asset options including non-asset-based options.

The proliferation of DRE usage across Nepal through a) private sector engagement in de-risked business models and b) public sector improvements to the enabling environment and investment climate, offers a direct pathway to increasing economic development and subsequent job creation. On a wider impact level, creating jobs in accordance with sustainable infrastructure development that has clean environment benefits aligns with Nepalese government aims (supported by international Development Partners) for the Green Recovery to COVID-19, while also building future shock resilience.

5.3 PLAYING THE LONG GAME

A desired end-state of scaled-up DRE installed capacity from public and private sector investment, catalyzed by SECF, is the ability of the Government of Nepal to:

- Decrease the need to import high-carbon content energy from India during Nepal's dry season, thereby mitigating the long-term effects of climate change; and
- Increase its capacity to export hydropower and solar energy to neighbouring countries such as Bangladesh and Bhutan, thereby increasing the country's cross-border trade potential over the coming decades.

As a part of the 2015 Paris Agreement, Nepal will submit a long-term low carbon economic development strategy also known as Long Term Strategy (LTS) in 2021 to the UNFCCC Secretariat. NREP have begun an analytical task to project electricity demand, supply, generation, and trade up to 2050 under three different scenarios using three scenarios against GDP; project carbon emissions reductions from electricity trade; and identify cleaner electricity trade options including increased RE mix. This task specifically intends to project emission associated with electricity trading as part of Nepal's LTS.

The LTS will set out a clear pathway for a transition toward net-zero emissions and climate-resilient economic strategies based on the review of best available information and scenario analysis of existing sector emission datasets, per IPCC 2006 guidelines for GHG inventory.

6. POLICY RECOMMENDATIONS

The authors of this paper recommend the following activities to allow Nepal to realize the benefits of a widely deployed distributed renewable energy installed base that has been cost-effectively catalyzed with a Viability Gap Funding financial assistance approach.

6.1 CREATE AN ENABLING ENVIRONMENT TO DE-RISK AND THEREBY ATTRACT PRIVATE SECTOR INVESTMENT TO DRE

6.1.1 Provide Technical Support to DRE-Related Policies and Regulations

NREP should provide further analysis of the Renewable Energy Development and Promotion Bill, with the aim to strengthen AEPC's role in creating ecosystem to harmonize National Renewable Energy Policy across all the country. These policies should reinforce the AEPC Strategic Business Plan which would firstly promote national coherence in DRE policies, regulations, and standards among all Local and Provincial Governments, by assisting in the enactment and implementation of policies, legislations, and regulations.

The recent Grid Connected Karyabidhi 2021 has given the Electricity Regulatory Commission (ERC) full responsibility for tariff setting of renewable energy projects of all sizes and types, even those associated with Electric Vehicle charging. The recent Nepal Electricity Authority report also has covers tariffs for EV Time of Day-based charging. NREP should thus add resources to better support the ERC on net metering technical requirements and rates, electric vehicle charging tariff and methodology analysis, non-hydro DRE generation pricing rates and terms & conditions, and DRE project selection criteria for PPP designation and negotiation, and other measures which would de-risk, send stable market signals, and otherwise attract private sector investment in DRE.

6.1.2 Define & Enhance the Role of Provinces in Developing DRE

NREP should help align the interests of Provincial Electricity Distribution Companies (DisComs) with those of Provincial Governments, e.g., on the generation, procurement, transmission and distribution (T&D) of DRE. Provincial DisComs could be instrumental in facilitating larger solar farms that could serve local electricity loads and support NEA's national T&D grid, e.g. to seasonally complement hydropower.

6.2 DESIGN SECF FINANCIAL ASSISTANCE TO ACHIEVE SHORT-TERM FUND SUCCESS IN YEAR 3 + LONG-TERM IMPACT IN YEAR 4+ WITH ADDITIONAL FUNDING

NREP should prioritize the planned GBP 1.8M in SECF Financial Assistance to the 70+ CI&I DRE projects already assessed, in Year 3 of the NREP programme (April 2021-March 2022). This prioritization would leverage the pre-feasibility and detailed feasibility studies already completed by NREP in Years 1 and 2 of the programme and mitigate travel and meeting constraints that COVID may impart to DRE project developers, investors, lending institutions, and Subnational Governments.

In Year 4 and beyond, NREP should plan to disburse SECF Financial Assistance on a much larger scale, for a much larger impact, from a greater amount of funds, including GBP 7.5M from BE-K. Additional potential funds could come from KfW, Asian Development Bank, and European Union. To achieve greater impact with its SECF, NREP should:

- <u>Expand the scale</u> of SECF awards to include DRE projects over 1 MW cap in installed capacity to projects up to 20 MW, in line with the Provincial Government-mandated cap
- <u>Expand SECF Funding Windows to include straightforward CAPEX awards</u> at the stage of project construction, with a 20-40% Financial Assistance cap—in line with India's VGF Programme
- Expand the geography of SECF Financial Assistance to include all seven Nepali Provinces
- <u>Expand the scope to include energy storage technologies</u> that would add peak-shaving and grid stability attributes to a wider DRE paradigm.

6.3 CONDUCT INTEGRATED RESOURCE AND RESILIENCE PLANNING TO PLAN THE COUNTRY'S LONG-TERM ENERGY GENERATION DIVERSIFICATION AND CROSS-BORDER TRADE SCENARIOS

A consortium of energy planning-related GoN Ministries—including the MoEWRI, AEPC, WECS, NPC, and NEA—should conduct Integrated Resource & Resilience Planning (IRRP) to allow governments, utilities, international Development Partners, IPPs, project developers and investors, and lending institutions to benefit from strategic, long-term energy planning.

Nepal's IRRP elements should include, at a minimum:

- Projected electricity demand
- Energy efficiency in Nepal's CI&I markets
- Centralized and distributed energy generation mix to meet demand projections
- Climate change vulnerability, i.e., in hydropower supply surety
- Grid-integration analysis of variable renewable energy
- Long-term Strategy to achieve Net Zero Emissions status by 2050, in part from cross-border electricity trade and/or the incentivization of an E-mobility paradigm met with a balanced mix of hydropower and solar energy
- Economic development implications.