ZE-Gen Market Deep Dive: Nepal

Market report, 24 October 2024

intellecap
AAVISHKAAR GROUP

Executive summary

Nepal's current energy profile: Nepal relies on RE for ~100% of electricity needs. C&I (22%) and agriculture (8%) sectors are the main consumer of fossil fuels (after transportation)

- **Historical dependence on DG/FFGs –** Pre-2017, Nepal faced ~14-18 hr/day power outages due to limited capacity, poor grid infrastructure & limited import agreements -> high penetration of FFGs among residential and C&I sector as quasi-primary source of electricity
- **Issues that have sustained dependence on diesel gensets:**
  - **Post-2017** – Power outages reduced to 2-10% annually; however, outages more frequent C&I customers & regions away from Kathmandu valley
  - **Seasonality of hydropower:** Hydropower generation reduces by 30% for 5-6 months per year -> ↑ dependence on DGs & electricity import from India
  - **Poor grid infrastructure** – Old & outdated grid with frequent voltage fluctuations; frequent cause of concern for C&I customers
  - **Challenging terrain & climate conditions** – Hilly & mountainous geography have led to dependence on gensets for off-grid application & reduced access to grid
- **National developmental goals** – GoN wants to increase solar capacity by 20x & overall capacity by 5x by 2030 to meet rising demand & increase the electricity usage; rationalize fuel imports that account for USD 1.6 Bn (9% of imports)

Key segments for alternate solutions:

- **C&I:** Highest WTP, 15-20% electricity cost savings, early adopters & fast-growing segment, availability of subsidies
- **Irrigation:** Heavily supported by GoN, potential for gender-related co-benefits, intervention in key Nepal economy sector

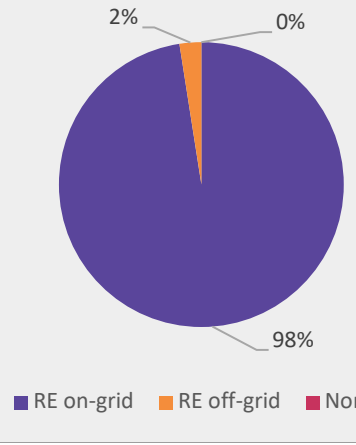
	Type of use	Genset fleet size (# units)	Genset capacity (MW)	Daily use (hr)	National GHG emissions share (%)	Solution pathways
C&I	Back-up	~4,000 – 10,000	~1000	1 – 3	46.3%	Solar + BESS
Irrigation	Primary	80,000 – 100,000	N/A	3	3.2%	SPIPs

Sources: The Himalayan Times; IEA

What is the as-is power situation in Nepal?

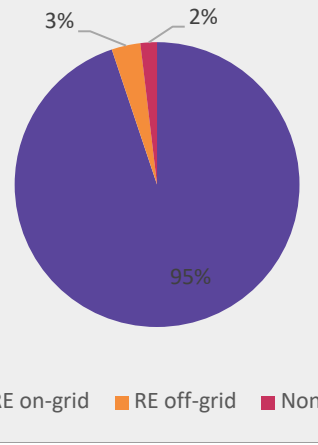
Nepal's electricity is ~100% clean but there is high seasonality due to over-reliance on hydropower

10,000 GWh of electricity generated (~100% from RE sources)



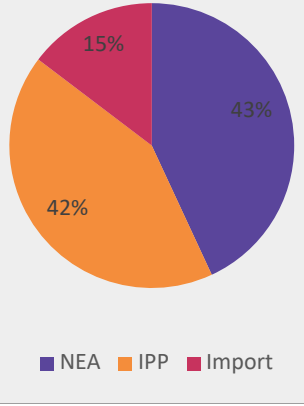
1. ~97% of electricity generated comes from on-grid hydropower sources
2. Solar (on-grid & off-grid) accounts for 1% of all electricity generated in Nepal

Nepal has 3.2 GW (97% RE) of installed power capacity



1. On-grid solar has grown at a rate of 51% since 2019 to nearly 60 MW in 2023
2. Off-grid RE has been relatively stable growing at 1%; Non-RE capacity has seen zero growth

Nepal relies on ~1,500 GWh of imports to meet energy shortfalls



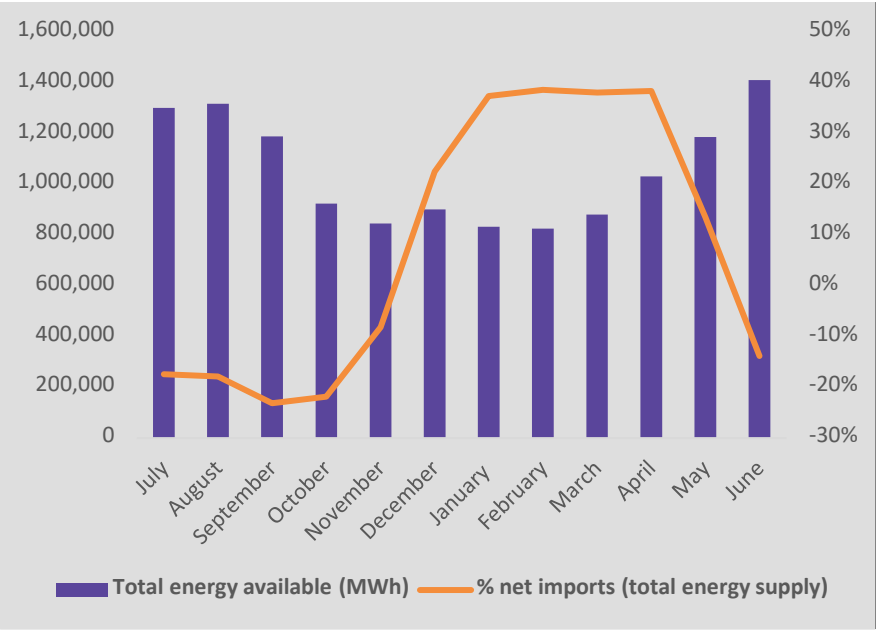
1. ~97% of electricity generated comes from on-grid hydropower sources
2. Annually there are 2% interruptions in power due to shortages & power outages

Sources: IRENASTAT; NEA.

~100% reliance hydro leads to seasonality in power supply for 6 months; energy imports, RE installations & FFG fill this gap

ZE Gen relevance: Fossil fuel gensets (FFG) are the current cure to the seasonality of electricity supply right now (especially for C&I users); installation of solar + storage is the ideal pathway to de-risk from seasonality of hydropower

Annual electricity supply mix; heavy import dependence in dry season

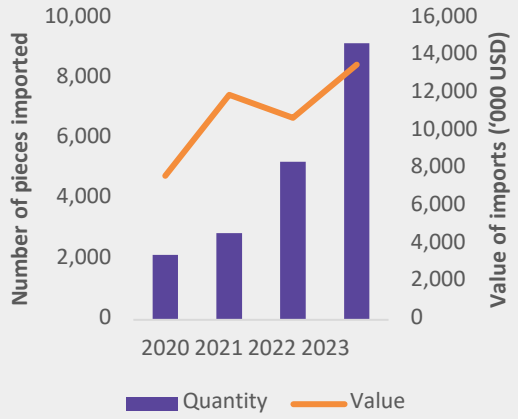


1. **Very limited storage:** ~80-90% of installed hydro is ROR (run-on-the-river) which has which has high seasonality in the dry season (Oct – Apr) with ~30% less availability
2. **Imports manage the shortfall:** Nepal relies on imports from India (up to 40%) to meet shortfall in electricity needs during the dry season; fossil fuel gensets are still prevalent in C&I uses to account for load shedding
3. **2017 was an inflection point:** In the decade prior to 2017, Nepal regularly faced ~18 hrs of load shedding a day; load shedding imposed annual economic costs of USD 1.6 Bn in the decade
4. **Imports are not the final solution:** Imports from India are not reliable (instances where they meet 25% of needs); power cuts are still prevalent especially for C&I users
5. **Limitations of the current energy mix:** Singular dependence on hydro for power needs leads to issues with managing variances; limited PROR (peaking run-on-the-rive) can at best handle ToD (time-of-day) variances but not seasonal supply

Sources: Business Standard; SAARC; Nepal Economic Forum; NEA; World Bank; KathaPana

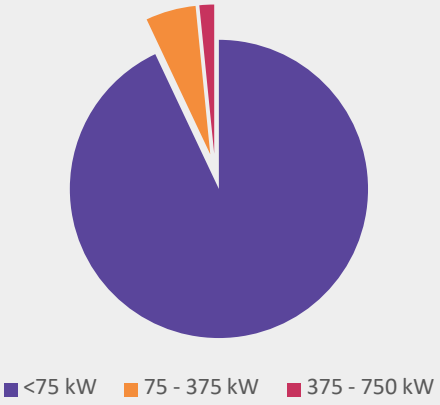
Nepal is actively working to reduce genset use via a proposed green tax on fossil fuels; yet users spend nearly USD 18 Mn annually on FFGs

Nearly ~USD 18 Mn worth of FFGs imported in 2023



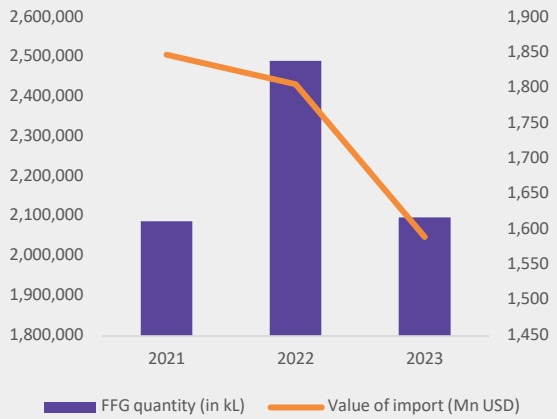
1. Nepal's generator imports have nearly doubled in quantity & value in the last year
2. India is the leading supplier of gensets; suppling ~90% of gensets in the last year

5% of genset imports account for 95% of trade value



1. 93% of gensets are "small" capacity (< 75 kW) typical for small C&I uses
2. 75 – 375 kW gensets account for 95% of import values; the buyers of these gensets would be ideal customer segment

Nepal imports 2.4 Mn kL of FFG annual (~8 – 10% of imports by value)



1. GoN wants to reduce FFG consumption with a proposed green tax on petroleum products
2. Before 2016, 40% of diesel imports were used for electricity; now it's ~10 – 15%

Sources: Nepal Trade Information Portal; XE.

Genset suppliers import gensets from India & provide end-to-end service; potential partners for ZE Gen for BESS installations

How are gensets sold?

New and second-hand gensets are primarily sold through dealers that serve customers on three touch points:

- Genset import & related services
- Installation-related services
- Servicing through AMC (in India brands like Cummins would service themselves)
- Each brand does not have 1 designated dealer

There are 50+ genset brands in Nepal; with most being imported from India

KATHMANDU DIESEL CONCERN

- Official dealer for Jakson-Cummins
- Provides installation, servicing & scheduled maintenance services

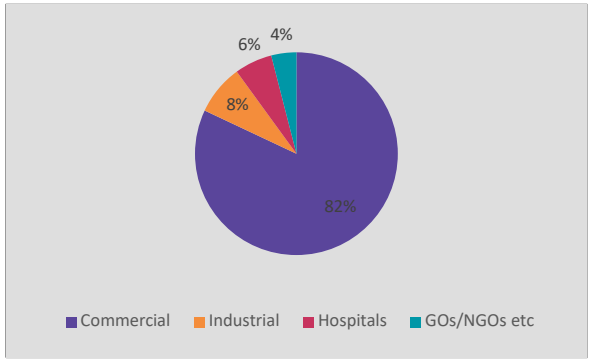
HIMAL TRADE LINK PVT. LTD.

- Official dealer for Kirloskar
- Also carry Cummins & Escorts products
- Dealers provide batteries & UPS as well

AGNI MOTOINC PVT. LTD.

- Deals in Mahindra Powerol
- Part of broader Agni Group that has business interests in Mahindra vehicles

C&I main users of FFGs in Kathmandu



What is the relevance for ZE Gen?

Updated standards that are not adhered to: New generators must meet Bharat Stage III standards, while in-use generators adhere to Bharat Stage II; however, Indian manufacturers are not required to comply to standards

End-to-end solution that takes less time to implement: FFG dealers provide purchase, installation & service support; time to installation for DGs is lower as imports are from India rather than China (main source for RE imports)

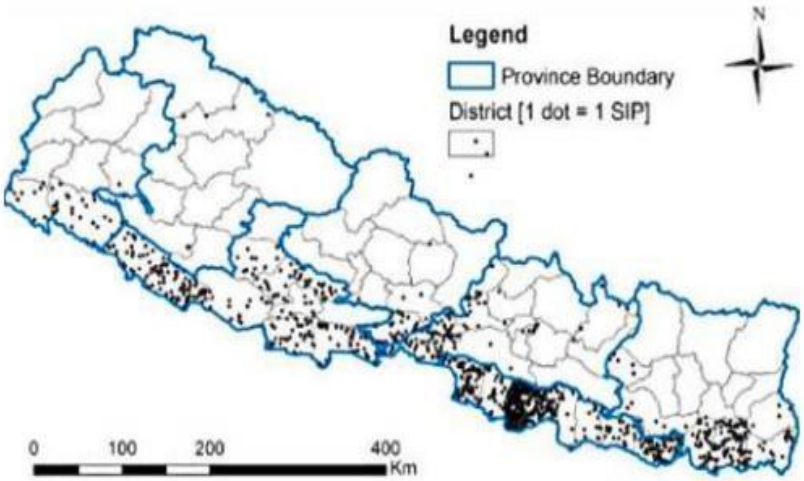
Diversified businesses that can be partners: FFG dealers have business interests beyond gensets with some providing power solutions like batteries; such enterprises could be potential partners for ZE Gen for BESS solutions

Source: Technical Scenario for 100% Renewable Energy in Nepal by 2050

Agriculture sector employs ~65% of the workforce but lacks access to reliable irrigation which limits the sector to subsistence farming

ZE Gen relevance: Interventions focused on Solar Powered Irrigation Pumps (SPIPs) would be ideal as they align with GoN's interests & address a national problem of lack of irrigation access

As of July 2022, AEPC has financed and installed around 2,433 subsidized SPIPs with approximately 80% located in Tarai districts

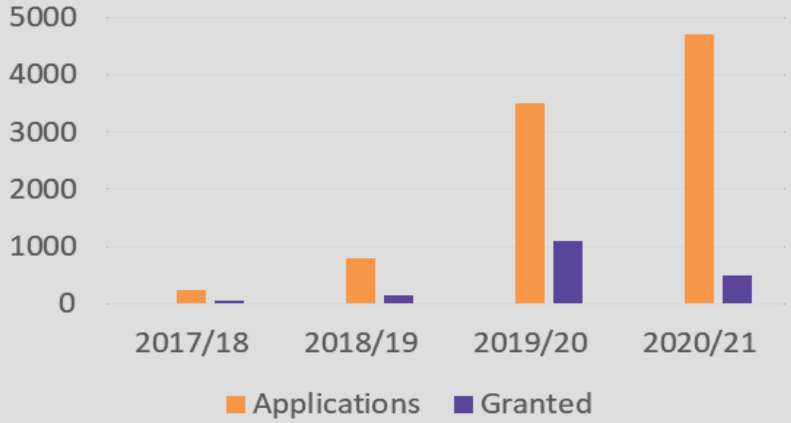


1	**Basic irrigation infrastructure lacking:** Nepal has 2.6 Mn ha of arable land, however, only 1.6 Mn ha has basic irrigation infrastructure
2	**Diesel consumption is highly prevalent:** In Tarai districts, there are ~30,000 diesel pumps with the agriculture sector account for 10.5% of all diesel consumption; diesel pumps have the advantage of mobility over solar pumps
3	**Access to irrigation is a social equity issue:** Nepalese farmers, especially small-hold farmers, are limited to subsistence farming earning which limits earning potential (USD 370 vs national average of USD 3,400)
4	**SPIPs are the solution proposed by GoN:** GoN is installing SPIPs via subsidies through AEPC (Alternative Energy Promotion Centre) with support from several DFIs; however, installations are not meeting demand & limited to one region
5	**Ease of use & mature supply chain sustain diesel dominance:** SPIP supply chains are not yet as mature as diesel supply chains & there is lack of skilled technicians which hampers installations & after-sales support

Source: Kafle et al. 2022, IWMI 2022

GoN has made efforts to install SPIPs but ~80% of demand is unmet due to lack of funding for subsidies

AEPC's SPIP approval rate over time; demand significantly outweighs ability to service it



The requirement for land ownership proof for SPIP eligibility exclude marginal, tenant, and landless farmers, limiting their access to subsidies

- **Subsidy-driven installations**: AEPC offers a 60% subsidy for installing SPIPs; most SPIPs installed are driven by subsidies
- **AEPC unable to meet demand**: Between 2016 and 2021, 9,100 farmers applied for solar pumps; 21% of applicants, primarily from the Tarai region, received them
- **AEPC's programs target marginalized groups**: The applicant pool mainly consisted of **male farmers from upper castes**. However, AEPC allocated more pumps to smaller landholders, and 22% of beneficiaries were women
- **Tarai is the region of focus:** Higher approval rates in three Tarai provinces: Province 1, Madhesh, and Lumbini

ZE Gen Relevance

Private sector leads SIP applications: Over 80% of SPIP applications come from private sector providers; potential for ZE Gen to collaborate with these providers

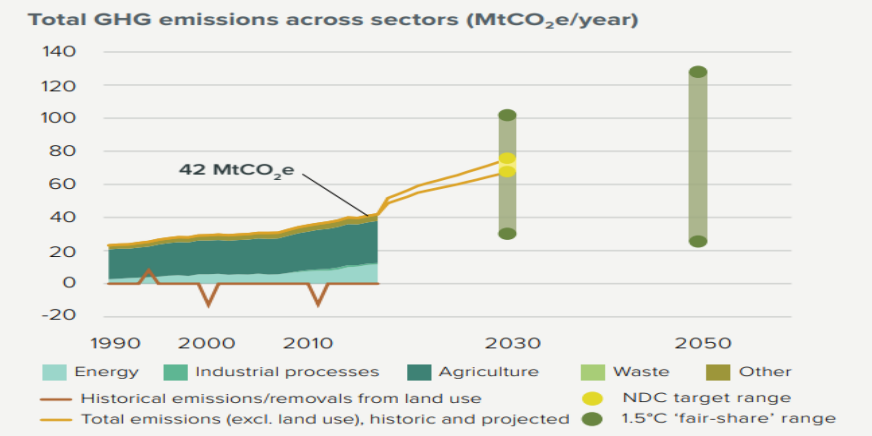
Subsidy distribution equity: Primarily benefit farmers over 0.6-acre land, leaving smallholders undeserved; ZE Gen can look to address this

Lack of O&M knowledge of SPIPs among farmers: ZE Gen's immediate interventions can target demonstration & trainings which will also stimulate demand

Nepal's NDC are rated stronger than India & Maldives; focus on increasing energy consumption is an opportunity for non-hydro RE

ZE Gen relevance: Nepal's target of de-risking from hydro & simultaneously increasing per capita energy capacity is an opportunity for technologies like solar

Nepal's NDC targets visualized; unconditional targets are 1.5°C compatible



	2015 NDC	2020 Updated NDC
Target for 2030	1. No specification of GHG emission reduction	1. 68 – 81% above 2010 emissions by 2030
Quantitative sectoral targets (of ZE Gen relevance)	1. Activity-based targets and policy targets in key sectors	1. Conditional target: 2.25 GW (10-15% of 15 GW) of RE (excluding large-hydro)

Sources: Climate Transparency; WWF; Climate Action Tracker; World Bank

1. **Progression in NDC:** The 2020 NDC is more ambitious than the 2015 target as it expands on targets for energy & AFOLU (agriculture, forestry and other land use) targets while adding targets for transport, residential & waste sectors; 2020 target also has economy-wide sectoral coverage

2. **1.5°C Paris Agreement compatible:** Climate Action Tracker rates Nepal's unconditional target as "Almost Sufficient" & compatible with Paris Agreement (unlike India's targets)

3. **De-risking from large-scale hydro:** Nepal plans to increase its **total capacity by nearly 5x to 15 GW** by 2030 & plans to have 10-15% of that capacity come from solar, wind, mini and micro-hydro, and bio-power

4. **Driving energy equity:** Increasing energy capacity is closely linked to improving living standards and unlocking Nepal's economic potential. Currently, the average Nepalese consumes only **1/20th of the global average** and 1/5th of the South Asian average

5. **Need for finance from international community:** Estimates suggest that Nepal needs **USD 3.4 Bn** to meet its unconditional targets & **USD 25 Bn to meet its conditional targets**

Nepal needs prioritization on coordination & capacity building within its Federal structure for effective RE development

Policies relevant to RE	Policy directives	ZE Gen Relevance
Rural Energy Policy, 2006	• Targets rural electrification by the installation solar lights to replace kerosene lamps	• Potential to use RE technology expertise to support local governments in capacity building
Constitution of Nepal, 2015	• Mandates government protection and promotion of RE resources. RE is managed at central, provincial, and local levels, with the energy ministry overseeing provincial efforts	• ZE Gen's intervention involving regulatory approval will have to interface with multiple levels of government
RE Subsidy Policy, 2016 & Subsidy Delivery Mechanism, 2013	• Focusses on off-grid applications, including mini/micro hydropower and solar energy systems • Subsidy amounts vary by technology and region • Higher subsidies are available for remote regions	• ZE Gen interventions can overlap with targeted interventions listed by these subsidies to utilize benefits • Need for capacity building among targeted farmers for O&M of subsidized equipment
National Renewable Energy Framework (NREF), 2017	• Helped 250,000 people gain access to electricity • Planned to give access to modern energy services to 33 social institutions and 1,000 SMEs to by 2018	• Interventions by other DFIs involve BMZ and other DFIs as key Implementation Partner • Includes the CREF (Central Renewable Energy Fund), which is responsible for delivering subsidies and credits to the RE sector
The white paper of Moewri, 2018	• Electricity projects to be implemented with a capacity of up to 15,000 MW within next 10 years • Each province to launch one large hydropower or solar project	• Under this, GoN plans to develop policies to connect the excess energy from the solar into the national grid
National Climate Change Policy (2019)	• Revised in 2019 to reduce GHG emissions, enhance climate adaptation and resilience of local communities	• Likely relevant in national-level interventions

Source: Rural Energy Policy, Constitution of Nepal 2015, RE Subsidy Policy, Subsidy Delivery Mechanism, NREF, White Paper, National Climate Change Policy

ZE Gen's interventions should be wary of frequent policy changes in Nepal's electricity-related subsidies & schemes

Policy shortcoming	Why is it a problem?	Why does this matter to ZE Gen?
Limited capacity across government levels	• Nepal has a federalist structure with three layers of government involved in executing national development plans • Other intervention find a need for capacity building at the three levels of govt for effective deployment of RE	ZE Gen can work with GoN to design capacity building programs for lower levels of government
Exclusion of local governments from decision making	• Local governments have expressed concerns about being excluded from the decision-making process for RE projects despite constitutionally having a decision-making mandate	There is potential of encountering bureaucratic delays in deploying interventions
Frequent policy changes	• RE subsidy policy was revised four times between 2000 and 2016, with subsidies for SHS (solar home system) generally decreasing in each revision; could potentially point to relatively high maturity of SHS in Nepal	ZE Gen's interventions cannot solely rely on GoN–subsidies to make business models viable
Abrupt changes to policy & no implementation	• Solar developers suffer as customers refuse to pay for systems after the NEA's sudden net metering policy cancellation • Utilities discourage net metering as they cannot handle excess power using current grid infrastructure & face reduction in revenue sources	Net metering cannot be relied on as part of grid-connected RTS intervention
High cost of battery storage	• Battery storage incurs taxes up to 43% and represents 26% of the total capital costs for solar mini-grid projects, making capital expensive	ZE Gen can work with FIs to advocate for pay-as-you-go models and low-interest loans to make investments affordable

NEA is the sole utility provider of electricity in Nepal; it's policy changes are frequent & material for power providers

Government body	Primary role	Relevance for ZE Gen
Ministry of Energy, Water Resources and Irrigation (MoEWRI)	• Created in 2009 to manage Nepal's energy sector and develop energy resources to accelerate development including activities such as policy design, planning, regulation, and research	• Community-level irrigation installation schemes would require interfacing with MoEWRI
Ministry of Science, Technology and Environment (MoSTE)	• It's the agency responsible for formulating environmental policies/regulations and protection of the environment. It is the focal point to the United Nations Framework Convention on Climate Change (UNFCCC) • The Department of Environment, established in 2012, under MoSTE, is responsible for implementing and monitoring environmental pollution activities	• Limited relevance for ZE Gen • Defines the quality & emissions standards for FFG use in Nepal
Nepal's Energy Regulatory Commission (ERC)	• Self-governing regulatory commission formed under Electricity Regulation Act 2017 to regulate the generation, transmission, distribution, and trade of electricity.	• Potential partner to increase access to BESS via policy-level interventions
Nepal Electricity Authority (NEA)	• State-owned utility responsible for planning, construction, and operation of electricity supply • Acts as the sole buyer of electricity from all IPPs, and the agent for all power purchase agreements for energy exchanges with India	• National-level interventions would have to go through NEA • Body chiefly responsible for net metering regulations & implementation
Alternative Energy Promotion Center (AEPC)	• Nodal agency for the promotion and dissemination of all renewable energy in the country, as well as all major off-grid electrification programs • AEPC is a semi-autonomous institution under MoEWRI	• Main implementation partner for DFI-backed subsidy & RE programs • Likely partner for national interventions or for co-funding DFI-programs

AEPC has several initiatives with international partners to increase RE uptake; potential partner for a ZE Gen national-level intervention

Roles & responsibilities

- Develops policies and plans and implements programs for RE and energy efficiency
- Integrates energy efficiency in a mainstream national energy context

- Coordinates with the government, development partners, NGOs, and the private sector
- Provides financial assistance and subsidies to support RE deployment

- Works to protect the environment and reduce carbon emissions
- Monitors, evaluates, and ensures quality control of RE installations & programs

Key AEPC programs

Program	RERL	MGEAP	RERA	NREP	DKTI	POSTED	REEEP-GREEN
Partner bodies	Joint project of GoN and UNDP	Project supported by GoN (as subsidy) & World Bank (as loan & grant)	Joint technical support program of GoN and BMZ, implemented by AEPC and GIZ	Joint project of GoN and British Embassy	Joint project of GoN and KFW development bank	Project commissioned by BMZ, implemented by AEPC and GIZ	Supported by GIZ on behalf of BMZ and the EU
Objectives/ Achievements	Boost development of RE initiatives and connect RE with enterprise development	Boost electricity access from RE mini-grids by providing financial support to ESCOs	To support provincial and local governments in implementing decentralized RE	Significantly increase private sector investment in the RE market	Investments in on-grid (RTS) and off-grid (SPIPs, SMGs)	Improve conditions for the dissemination of solar technologies—mini-grids, irrigation pumps, and rooftops	Create regulatory, institutional, and private-sector conditions for disseminating RE
Support (USD)	2.52 Mn	7.61 Mn	5.2 Mn	11.44 Mn (SECF) & 0.65 Mn (TA)	9.9 Mn (interest subsidy of 50% for 5 years for RTS & 60-80% for off-grid)	4.26 Mn	10.45 Mn (4.26 Mn from the EU)

Nepal subsidizes solar projects however the extent of subsidies is limited as subsidy programs are underfunded

Target Segment	Incentive (range in USD)	ZE Gen relevance
Household (SHS of 10 - 20 Wp)	USD 34.62- USD 38.46	• Limited relevance as broad target is C&I installations
C&I, Small Business (SHS of 50 Wp and above)	USD 61.54 - USD 76.92	• Limited relevance for ZE Gen as target intervention is RTS
Solar mini-grids for C&I & households (based on project and energy consumption) (up to 1,000 kWp)	Up to 60% (not exceeding USD 3,807)	• Limited relevance for ZE Gen as targets are grid-connected solar installations
Solar mini-grids for public institutions (up to 1,000 kWp)	Up to 65% (not exceeding USD 3,846)	• Limited relevance for ZE Gen as targets are grid-connected solar installations
SPIP (drinking water)	Up to 60% (not exceeding USD 11,538)	• SPIP demand is increasing, but allocations are limited due to budgetary constraints
SPIP (irrigation)	Up to 60% (not exceeding USD 15,384)	• SPIP demand is increasing, but allocations are limited due to budgetary constraints
RTS installations for C&I (above 500 kW)	50% subsidy on loan interest	• Good opportunity to partner with banks or financial institutions to facilitate these subsidized loans
Net meteting	USD 0.044 per kWh (~30 – 50% of electricity costs)	• Important financing mechanism for grid-connected RTS installations, however, NEA has a history of non-implementation & halting net metering programs

Source: Renewable Energy Subsidy Policy, 2016

What are the key segments for substitution?

C&I and agriculture segment have high impact potential driven by GHG emission reduction potential & high co-benefits

ZE Gen relevance: C&I (GHG reduction potential & high WTP) & agriculture (high co-benefits) are targeted segments

C&I (targeted)

Impact potential:
- ~1000 MW of back-up gensets

WTP:
- High WTP: Comparatively best access to financing & RE subsidies

Likelihood to transition:
- Among the early adopters of RTS (~30% RTS capacity)
- Switch to RE can rationalize electricity costs & supply issues

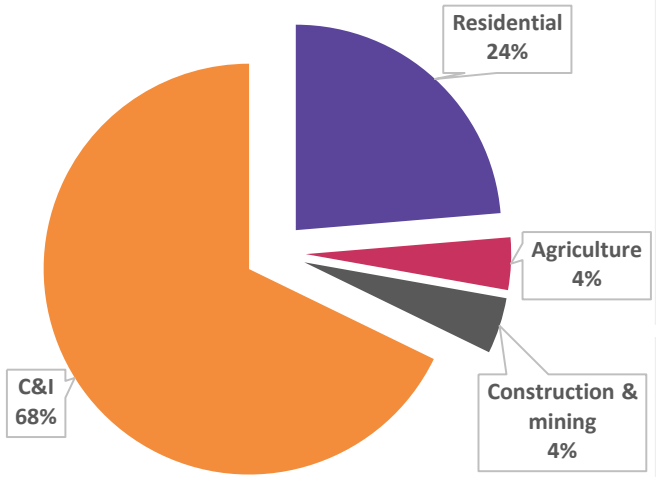
Segments not considered

Construction & mining: Limited success of RE solutions in harsher environments (mining) & construction sector in Nepal has a track record of delays & poor payments

Data centers: Promising segment of the future (colder climate & clean electricity); limited capacity right now (6 total in Nepal)

Sources: Expert interview; DataCentreMap; WECS

Total commercial energy consumption (in TJ)



Residential (not targeted)

Impact potential:
- Low capacity of back-up gensets (largely from pre-2016 era)
- Negligible consumption of diesel

WTP:
- Have some access to financing & subsidies

Likelihood to transition:
- Unlikely to transition as they now face limited power cuts
- Old gensets used for odd power cut cases

Agriculture (targeted)

Impact potential:
- ~8% of all diesel consumed
- Employs 65% of all Nepalese

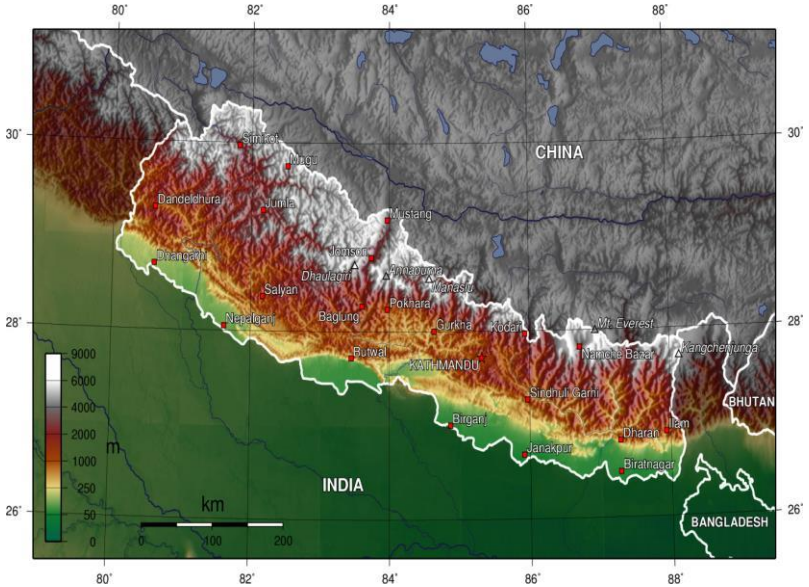
WTP:
- Limited access to financing but high access to subsidies

Likelihood to transition:
- Likely to transition driven by GoN subsidies (60-90% cost subsidized)
- SPIPs are a commercially viable technology

Tarai is ideal region for intervention as it's a hub for agriculture & industry; proximity to Kathmandu & India eases implementation challenges

ZE Gen relevance: ZE Gen's immediate interventions should the Tarai region due to easier access to enterprises, logistics & financing

Topographical map of Nepal; light green regions are Tarai region

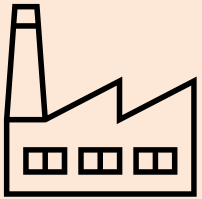


1	**Target the light green regions:** The light green regions are the Tarai region of Nepal; home to about 45% of the total population
2	**Agriculture-focus areas:** Tarai has 34% of the total cultivable land in Nepal; and houses ~50% of all Nepalese farmers. SPIP-interventions should focus on the Tarai region
3	**Hub of industry:** Manufacturing is concentrated in the Biratnagar, Birganj & Kathmandu Valley; RE enterprises like Gham Power have majority of their customers in Kathmandu & south of Kathmandu
4	**Ease of access to RE enterprises & financing:** Proximity to Kathmandu eases access to RE enterprises which reduces incidences of issues related to installation & servicing
5	**Ease of logistics:** Proximity to the Indian border & flatter land eases logistical issues in the Tarai region

Sources: Brittanica; FAO

C&I segment represents ~1 GW of installed FFGs that can be replaced initially with a solar system; eventually BESS can further reduce dependency on FFGs

C&I



What do they use DG for?

- Lighting systems
- HVAC system
- Appliances
- Processing equipment

How do they use gensets?

Type of power	Back-up source
Location	On-grid
Genset capacity	100 – 750 kW
Business model	CAPEX
Average runtime	1 – 3 hr/day
CO2 emissions	560 kg/day
NOx emissions	35 kg/day
SO2 emissions	7 kg/day

What problems do they face?

- **Power intermittence:** Parts of Nepal (outside Kathmandu) still face 10-15% load shedding; the burden of load shedding falls on industrial customers
- **High electricity tariffs:** Tariffs for C&I customers are higher (20 – 50%) to cross-subsidize residential & other users
- **Poor quality of supply:** C&I users have issues with voltage fluctuations and other quality issues with grid power

What is the market size?

- **Capacity that can be targeted:** 600 – 1000 MW
- **Immediate target:** 1. Users with 500+ kW installations to utilize subsidy programs; 2. Users with high day-time load

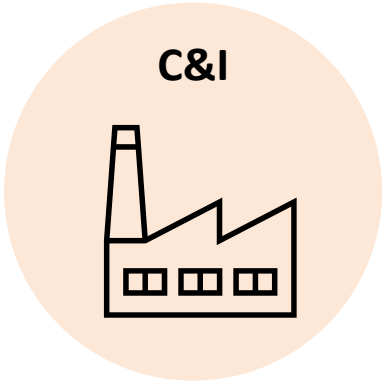
What are the relevant policies?

- **Interest subsidies:** Interest subsidy programs (DKTI) are a possible subsidy source
- **VGF via SECF:** Viability gap funding from SECF is another potential source of funding for C&I customers
- **Net metering:** Net metering has the potential to offset ~30% of generation costs; implementation & realization of policy is limited

ZE Gen's target intervention should be funding enterprises or Fis with lower-cost financing to provide RE access through RESCO model to C&I users

What is the solution pathway?

- **Short-run:** Installation of an RTS system. RTS will be a hybrid system that will work in conjunction with FFGs. Limited BESS-installed with this system
- **Long-run:** Installation of a BESS-system to supplement the RTS. FFGs can be phased out at this point



How will they finance the switch?

- **RESCO model:** The most common RE installation model is the RESCO model for C&I customers; financing would be needed for the solution providers
- **CapEx model:** Preferred model for mature firms in Nepal; most often self-financed or debt-financed with 15% promoter equity

Why will they switch?

- **Cost savings:** Solar power from a RTS installation can cost 10-15% lower than grid power
- **De-risking operations:** Captive power reduces reliance on grid power ensuring operational continuity

What are the challenges?

- **Operational burden:** Operational burden of managing an RE system is a deterrent for C&I customers
- **Misaligned investment preferences:** Nepalese business leaders prefer revenue enhancement projects
- **Proof-of-concept:** Limited awareness of BESS technologies could be a hindrance down-the-line

What is the total impact potential?

1,031,000 MT CO2e

350,000,000 liters fossil fuels annually

USD 421,000,000 in savings

Diesel-powered represent nearly 7 Mn liters of annual consumption that can be replaced with SPIPs with active subsidy push from GoN

Solar pumps

What do they use FFGs for?

- Irrigation
- Accessing drinking water
- Water pumps

How do they use gensets?

Type of power	Primary source
Location	Off-grid
Genset capacity	<15 kW
Business model	CAPEX/PAYG/rental
Average runtime	3 hr/day
CO2 emissions	27.5 kg/day
NOx emissions	5 kg/day
SO2 emissions	1 kg/day

What problems do they face?

- **Power intermittence:** Limited or poor access to power which limits ability to use irrigation technology
- **Limited access to diesel:** Access to diesel can be difficult & expensive in the remote parts of the country
- **Poor farm productivity:** Farmers without pumping equipment limited to subsistence farming; access to irrigation is a pathway to commercial farming & higher incomes

What is the market size?

- **Replacement market:** ~40,000 diesel or hand-based irrigation systems in Tarai (main agriculture state); prime for replacement
- **New irrigation market:** ~2,000,000 farming households in Tarai, Nepal

What are the relevant policies?

- **Subsidy programs:** RERL, DKTI & SECF among various subsidy programs that are run for SPIPs providing ~60% subsidies
- **Community pumps:** Potentially higher subsides under same programs for community pumps

Sources: Expert interview; PPAC; IJRR

Providing access to SPIPs enhances farm productivity & has potential co-benefits in the form of women land ownerships transfers

What is the solution pathway?

- **Individual pumps:** 1 kW irrigation pumps that serve 1 household; costs ~ USD 2,200
- **Community pumps:** 15 kW irrigation systems that can serve 48 household; Costs ~ USD 15,000 (including costs of borewell); usually installed at the community level with a registered user group

Solar pumps

How will they finance the switch?

- **PAYGO:** Promising model to switch with grant & subsidies reducing the cost; monthly payments (~USD 50) is less than monthly cost of diesel
- **CapEx model:** Possible switch model if product is heavily subsidized by the government (~90%); own funds or microfinancing needed to fund equity amount

Why will they switch?

- **Heavily-incentivized product:** GoN is heavily committed to SPIPs through policies & subsidies as it matches their fiscal goal of reducing oil imports
- **Limited access to electricity:** SPIPs reduce the reliance grid electricity to provide access irrigation & drinking water
- **Increased farm output:** SPIPs installations increase sown area, & move farmer's away from subsistence farming

What are the challenges?

- **High upfront cost:** Despite heavy subsidies, the equity portion of pumps is difficult to finance (cost is ~1/3rd annual income)
- **Poor after-sales service:** AEPC mandates private players to give O&M for 2-years however; limited oversight on whether services are received
- **Low CUF:** SIPs become cost competitive with diesel at CUF of 30+%

What is the total impact potential?

20,000 MT CO2e

7,500,000 liters fossil fuels annually

USD 8,000,000 in savings

SPIP installations in Nepal allowed farmers to improve productivity & enhancing their income by nearly 3x

Project details

- **Pilot Project:** 12 SPIPs installed by LI-BIRD with support from CCAFS & CDKN
- **Target Beneficiaries**: 185 households across Mahottari, Nawalparasi, Dang, and Bardiya
- **Total Cost:** USD 8,000; 75% funded by the project, 25% by beneficiaries
- **Capacity**: Lifts 100,000 liters per day, operating up to 6 hours with good sunlight
- **Objective**: Building resilience of farmers against climate change impacts

Nepal's irrigation challenges

- **Climate Vulnerability**: Erratic rainfall, heat stress, prolonged drought, reduced water availability and flood (in rainy season)
- **Water Scarcity**: Increased dry days lead to water shortages & fallow land.
- **Irrigation Needs**: Year-round for crop productivity
- **Diesel Pumps**: Farmers rely on costly diesel pumps due to unreliable electricity
- **Sustainability Challenge**: High operational costs of diesel pumps

Benefits of the transition

Cost savings: Reduced irrigation costs from NPR 400 per hour (diesel-based pumps) to NPR 50 per hour

Diversified cropping patterns: Transitioned from traditional crops to high-value vegetables

Improved productivity: Increased crop production & reduced fallow land due to consistent water availability

Increased income: Earned USD 37 in the first year USD 133 in the second year from vegetable sales

Ease of use: Users found SPIPs to be easier to use & less labor intensive as compared to diesel pumps

Increased cropping intensity: Up by 200% compared to before

Source: LI-BIRD

What is RE ecosystem?

Solar PV is ideal target for funding; BESS potential can be unlocked by engaging policy-makers to rationalize taxes on batteries

Technology	Market maturity of technology	Challenges	ZE Gen Relevance
Solar (RTS & ground-mounted)	• Maturity: RTS is a mature & commercially viable solution • Capacity: 115 MW (~25 MW RTS for C&I) • Potential: 28 GW (1.5 GW GoN target)	• RTS constrained by space • Limitations due to extreme weather conditions in the hilly regions of Nepal	• Funding solar enterprises that deploy solar through RESCO model for C&I enterprises
MHP	• Maturity: Commercially viable solution • Capacity: 3,000 projects	• MHP does not address the issues of hydro-seasonality • Possible adverse effects on the local flora & fauna	• Limited relevance for C&I customers
BESS	• Maturity: Not commercially viable yet • Capacity: Limited capacity; no large (1+ MWh projects)	• Consumers are aware of batteries but limited awareness of larger-scale BESS • Almost ~43% (duties, customs & VAT) severely limits	• RE players are engaging the government to rationalize the taxes on BESS; ZE Gen can reinforce these efforts
Wind (Small-medium)	• Maturity: Gaining maturity; commercial viability uncertain given low penetration • Capacity: 0.2 MW (0..01 % of RE capacity)	• Large-scale wind projects have not been successful in Nepal due to rugged geography & poor maintenance	• Small-medium wind is seen as a supplemental technology to solar; should not be a funding priority & limited relevance for target segments

ZE Gen's long-term strategy could involve developing a BESS ecosystem in Nepal; particularly funding growth firms & training engineers

Challenges	Why is this a problem?	What can ZE Gen do?
Import dependency for RE components	• Nepal imported USD 7 Mn worth panels last year; nearly 80 – 90% of solar-related components are imported; solar panels are **imported duty free** with **VAT of 13%** • Domestic components are more expensive than imported components • Nearest port to Nepal is Kolkata (India) leading to **procurement time of 1.5 months** from China; requires efficient planning to procure components	• Aggregating demand of RE components at a solution provider level can reduce shipping costs by increasing volumes
Limited BESS ecosystem	• Nepal has limited BESS deployment, no policies or subsidy support for batteries & no battery recycling ecosystem • Penetration of BESS is critical to eventually reducing dependence on fossil fuel gensets; however, an ecosystem would need to be developed	• Piloting a 1+ MWh BESS project in Nepal would be critical in demonstrating viability
Skilled labor availability	• Availability of skilled labor not an issue for RE firms who train their labor & provide contract-based O&M to C&I end-users • Likely to be an issue once BESS technologies are common as **limited exposure of engineers & servicemen**; BESS would require **prompt servicing** once viable	• Training & capacity building for servicemen in target regions to reduce service & installation timelines
Logistical challenges	• Solution deployers face issues installing RE solutions in Nepal's hilly & mountainous regions where it is **difficult to work for nearly ~6 months due to (rains & snow)**	• Limited relevance as immediate target segments are not in the hilly or mountainous regions regions

Sources: Expert interview; Nepal Customs.

Directly funding experienced developers like Gham Power is a key initial step in ZE Gen's intervention in Nepal

Gham Power

Target segments
C&I RTS, solar mini-grids, SPIPs

Solar installed
5.82+ MW

Projects completed
4,000+ with 13.5 kL of diesel displaced

Key activities

- **RTS focus:** Seeing high demand from C&I customers with steel, pharma, plastics & shoe manufacturing being key sub-segments
- **Cost savings value proposition:** C&I attracted to RTS due to proposition of saving ~20% of power costs
- **MFI-led SPIP installations:** Worked with microfinance to install SPIPs; installations driven by heavy subsidies from GoN

Key challenges

- **Limited green financing for RE:** Customers have limited access to green financing, difficulty in fund-raising via equity (diluted equity), and hesitancy in taking on loans for products they do not fully understand
- **SPIPs tough market to compete in:** Have started to reduce work in SPIPs due to reliance on subsidies for farmers to install product

What's next for Gham Power?

- **C&I is the promising segment:** Seeing heavy demand for C&I installation; primarily install using RESCO model
- **Funding for growth:** Looking for ~USD 6.5 Mn in financing to install 25 MW of solar across segments; looking for a mix of debt & equity financing
- **Shaping national BESS policy:** Working with ERC & SEMAN to promote policy-focus of BESS technologies in Nepal

ZE Gen relevance

Working capital financing: Directly financing an enterprise like Gham Power to install C&I RTS would be a straightforward funding opportunity

Re-double efforts to affect BESS policy: Support the efforts of enterprises like Gham Power to instill a national battery policy & rationalize taxes on batteries

Aggregating demand at the enterprise-level: Given the import dependence, aggregating demand at the enterprise-level can reduce logistics costs

Sources: Expert interview; Gham Power

Nepal's first off-grid solar micro-grid built in partnership between GoN, Saral Urja Nepal, and the Dubung community, offers a blue-print for PPP

Project Overview

Project technical specifications: Mini grid with 18 kW of Solar modules, integrated with 25.5 kW inverter and battery bank.
Coverage Area: Three hamlets within 3 km radius covering 150 households and a population of around 900
Metering: Each end-user has a pre-paid meter that manages load and restricts daily electricity supply based on their chosen package
Ownership: The Community actively participates in the management of the solar micro-grid and holds shares in Baidi Micro-Grid Private Limited, the special purpose vehicle (SPV) that owns and operates the micro-grid

- Saral Urja Nepal holds 60% equity in the SPV and responsible for technical backstopping
- The community, represented by an electricity user's group cooperative, holds 40% equity in the SPV and contributes labor and participation in O&M

Total project cost: USD 0.086 million
Grant and subsidy: USD 0.070 million funded by UNESCAP through AEPC
Equity: USD 0.015 million through SPV: Community (40%) & Saral Urja Nepal (60%)

ZE Gen Relevance

Scalability & Partnership: The project's defined area serves as a blueprint for ZE Gen to scale in similar rural regions. Additionally, the successful collaboration between GoM, private sector, and community highlights an effective PPP model

Community Engagement: ZE Gen can offer capacity-building programs for O&M and establishing partnerships with community members to empower them in managing the solar micro-grid effectively

Technical Support Framework: ZE Gen can explore opportunities for technical backstopping by offering expert guidance, troubleshooting support, and partnering with local vendors to supply tools and software for effective project execution.

Which enterprises can support ZE Gen's work in Nepal? (1/5)

Enterprise	Technologies	Experience delivering solutions C&I segment	Experience delivering solutions for solar pumps	Maturity
Gham Power	Solar, BESS	✓	✓	Moderate
WIND POWER NEPAL	Solar, wind, BESS	✓	✓	Growth
Danphe	Solar, wind, BESS	✓		Growth
Everest Solar Energy (P) Ltd.	Solar, BESS	✓	✓	Moderate

Which enterprises can support ZE Gen's work in Nepal? (2/5)

Enterprise	Technologies	Experience delivering solutions C&I segment	Experience delivering solutions for solar pumps	Maturity
OHM ENERGY NEPAL PVT. LTD.	Solar, BESS	✓	✓	Growth
KARACUS	BESS			Growth
energyNP	Solar, Wind, BESS, Hydro			Moderate
bfl	Hydro			Mature

Which enterprises can support ZE Gen's work in Nepal? (3/5)

Enterprise	Technologies	Experience delivering solutions C&I segment	Experience delivering solutions for solar pumps	Maturity
Peak Power Pvt. Ltd.	Solar, BESS	✓	✓	Moderate
PASHUPATI RENEWABLES	Solar, Hydro			Moderate
Lotus Energy Nepal	Solar, BESS, Wind	✓	✓	Mature
Panchakanya GROUP	Solar, Hydro			Mature

Which enterprises can support ZE Gen's work in Nepal? (4/5)

Enterprise	Technologies	Experience delivering solutions C&I segment	Experience delivering solutions for solar pumps	Maturity
SMART SOLAR NEPAL CORPORATION	Solar, BESS	✓		Mature
Sunbridge Nepal Solar	Solar, Wind, Hydro, BESS	✓	✓	Growth
सरल उर्जा Simple Energy	Solar	✓	✓	Moderate
सनशाइन एनर्जी प्राइभेट लिमिटेड Sunshine Energy Pvt. Ltd.	Solar, BESS	✓	✓	Moderate

Which enterprises can support ZE Gen's work in Nepal? (4/5)

Enterprise	Technologies	Experience delivering solutions C&I segment	Experience delivering solutions for solar pumps	Maturity
Quality, Reliability, Excellence OSWAL PUMPS	Solar		✓	Mature
Arambha	Solar	✓		Moderate

SEMAN & RECON could be potential partners for ZE Gen to affect policy changes pertaining to BESS

Organization	Key activities	ZE Gen relevanve
Renewable Energy Confederation Nepal ★ RECoN ★	• **Promotion of renewable energy:** RECON (Renewable Energy Confederation of Nepal) promotes alternative energy systems in Nepal, focusing on technology transfer, policy advocacy, and capacity building • **Project implementation**: Engages in initiatives like the Green Homes Project and GIE Nepal Project to integrate renewable energy solutions in various sectors • **Stakeholder engagement:** Facilitates collaboration among government, private sector, and communities for sustainable energy development.	• RECON could be a potential partner for capacity building & policy advocacy • RECON has significant contacts with NGOs; potential contact for rural interventions
SEMAN	• **Representation of solar PV industry:** SEMAN (Solar Electric Manufacturers Association Nepal)represents the solar electric manufacturing and trading companies in Nepal, promoting the growth and development of the solar PV sector • **Training and capacity building:** Conducts technical training and workshops for solar electric technicians and stakeholders to enhance the quality of solar installations • **Policy advocacy and research:** Engages in policy advocacy and research activities to strengthen the solar energy sector and address capacity gaps	• SEMAN could be a potential partner for BESS policy advocacy & training
CNI	• **Policy advocacy and industrial growth:** CNI (Confederation of Nepalese Industries)advocates for policies that enhance industrial growth and promote economic development in Nepal • **Business support and investment promotion:** Engages with stakeholders to create a favorable business environment and attract investments • **Entrepreneurship and innovation:** Supports entrepreneurship and innovation through research, networking, and capacity-building initiatives	• CNI could be a potential partner for accessing promising RE enterprises

Sources: Expert interview; RECON; CNI; SEMAN

What is the cost of the transition & how can it be financed?

DGs are 2.5x less expensive than the short-term solution of solar; in the long-term reducing taxes on BESS critical to promote wide-scale use

ZE Gen relevance: In the short-run, RTS can reduce DG dependence, but rationalizing BESS taxes is critical to eliminate DG use

Technology	Initial outlay (USD)	OPEX (USD)	LCOE (USD/kWh)
DG	13,035	30,934	0.32
RTS	33,750	Minimal/incidental	0.04
BESS	63,900	Minimal/incidental	0.29
RTS + BESS	97,650	Minimal/incidental	0.15

Assumptions for figures & calculations:
- DG size 100 kW with 1,500 hours of annual use; diesel cost USD 1.09 per liter
- RTS capacity 100 kW
- BESS 300 kWh

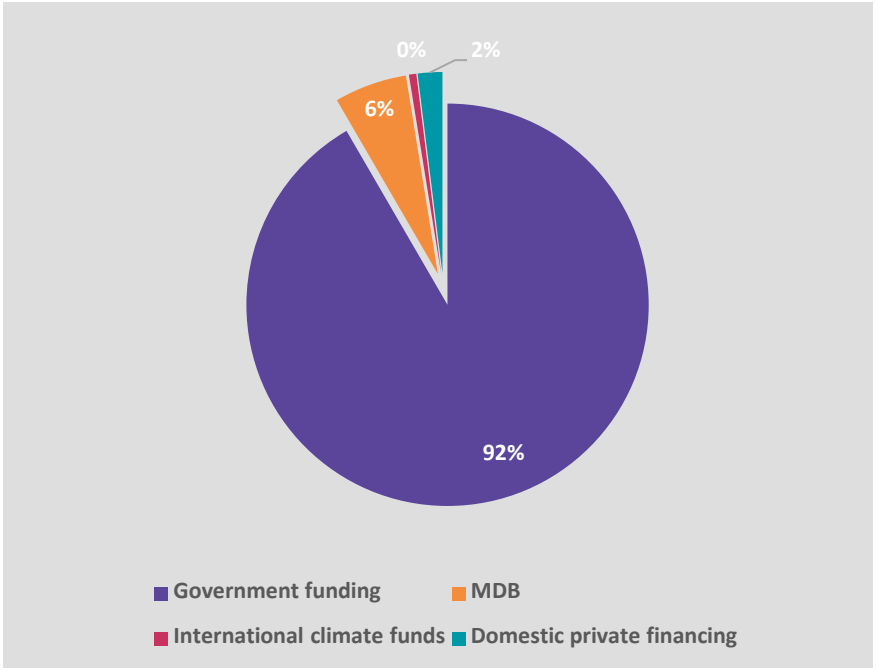
Sources: Expert interview; Auroville Consulting; Urja Khabar

1. **High initial outlay:** High import dependence on RE components like panels leads to escalated costs & installation timelines. Initial outlay is the main barrier for adoption.
2. **RTS can be an effective, short-run solution:** Grid-connected RTS can be an effective solution to partially reduce dependence on DGs as its LCOE is significantly lower than DGs & grid power (USD 0.08 per kWh) while reducing grid dependency
3. **Challenges with BESS:** BESS installations are complicated by the fact that there are limited large-scale installations partly due to high taxes & duties (~40%) on BESS imports. BESS is barely cost competitive with DGs
4. **Subsidies:** Interest subsides & generation-based incentives from AEPC programs can lower costs; however, subsidies are limited due to underfunding of programs
5. **Lower effective costs via aggregation:** Aggregation solar installations at solution provider level can further reduce cost of installation as logistical costs can be reduced from nearest port in Kolkata to installation sites in Nepal

GoN successful in mobilizing climate funds through international donors; however, Nepal will fall short of 2030 funding needs

ZE Gen relevance: Financing solar-based RE interventions & building local capacity to finance are ideal targets for ZE Gen-led interventions

Sources of estimated annual USD 5 Bn of climate finance in Nepal



1. **Government funding increasing:** Nepal's climate budget has grown at ~5% over the past 5 years; in the same period climate change projects have grown by 2x to 243
2. **MDB & donor contributions lead the way:** ~20% of the government funding came from MDB & donor funding; ~5% of all the government funds were grants & ~18% were concessional loans from international donors
3. **Limited private sector financing:** There is low visibility on the exact amount of private sector flows into Nepal's green finance; however, majority of financing by banks is local currency debt targeting hydropower projects
4. **50% shortfall in climate finance needs:** Nepal requires USD 46 Bn by 2030 (~USD 21 Bn for mitigation); based on pledges from IDPs & projected contributions of GoN & private sector; there is likely to still a shortfall of USD 26 Bn by 2030
5. **Under-funded solar opportunity:** IFC estimate's that there is USD 1.3 Bn opportunity for solar in Nepal between 2018 – 2030; solar essentially competes with hydro (USD 22 Bn) with hydro being the preferred recipient of domestic financing

Sources: Oxford Policy Management; WB; Climate Adaption Finance Study; ADPC

ZE Gen will face several challenges as a private investor in Nepal; managing FOREX risk will be the key challenge to address

Financing challenges	Why is this a challenge?	ZE Gen Relevance
Institutions & governance	• Delays in the decision-making process in most of the phases of project development & implementation • Sudden changes in provisions & regulations by the government; NEA altered policy from fixed rate regime to auction-based for solar projects	Any intervention that involves interfacing with government should factor in the possibility of sudden regulation changes
High cost of capital	• Funders face limited to no GoN-backed guarantees in case of default • GoN is perceived as untrustworthy as a project proponent; it does not have a sovereign credit rating as of now • RE solution models are new or largely untested; which result in an effective high cost of capital	Avoid interventions that require GoN interfacing; off-treasury modalities for support will be key if interventions interface with GoN agencies
FOREX risk	• Nepal does not offer suitable solutions to managing FX exposure like hedging • Repatriation of currency can be a challenge in Nepal as it is cumbersome to convert the currency & obtain approvals from relevant bodies	Repatriation of currency will be a challenge for ZE Gen; initial interventions can be those that would not need repatriation like capacity building projects or grants
Market-related	• Private enterprises (C&I that will be targeted for intervention) prefer investments that target business scale-up like capacity or revenue increase projects; there is limited interest in climate-based interventions that tend to focus on cost-savings	Demonstrating the business value of solar + BESS will key to change consumer behavior; piloting 1+ MWh solar project can be a possible intervention
Capacity & knowledge challenges	• Banks & FIs have limited capacity to appraise green projects; this will be a significant problem with BESS projects in the future • Banking personnel lack the capacity to effectively evaluate the risks & opportunities of RE projects	Grant funding for training & capacity building that enhances the ability of banks to evaluate solar + BESS projects

Sources: Expert interview; Capitalising Green Finance for Nepal.

NMB Bank is witnessing increased interest in C&I RTS; access to concessional finance can lower the rates offered to end-users

Target segments
C&I sector, hotels (in Kathmandu specifically), large-scale hydro

Total loan book size
USD 1.5 Bn (10th largest bank in Nepal)

Coverage
340 branches (5th most in Nepal)

Key activities

- Dedicated sustainable banking division that covers RE, hydro & agriculture
- **Wide sectoral & product coverage:** Off-grid mini-hydro, RTS (provide CAPEX & RESCO financing), utility-scale solar, working capital financing & project financing are key products across sectors
- **Primary focus:** Large-scale hydro (80 – 90% of loans); expect RTS, utility-scale solar & biomass to grow in next 5 years

Key learnings

- **Rise in interest from C&I for RTS:** NMB financed 5 MW in previous fiscal year
- **Low defaults:** <1% defaults in RTS; higher defaults in off-grid & working capital financing interventions
- **Sectors of limited interest:** RTS from residential sector (negligible power cuts) & BESS installations (expensive compared to grid)

Loan operationalization

- NMB prefers recourse-based financing either guarantees from promoters or FLGs from lenders
- Regulations requires **min. 20% equity** & **Nepalese registration of firm** for financing
- **Commercial rates:** Base rate (~8%) + 2.5%
- **Concessional lending:** Have financed projects @ 7% with DFI support; claim highest borrowing from DFIs in Nepal
- One of few banks to offer financing for RESCO model (riskier for banks)

ZE Gen relevance

Provide concessional capital: NMB have provided loans at concessional rates (5 – 7%) when they have access to DFI or concessional funds

Increase RE financing by providing FLGs: First-loss guarantees (20 – 50% of loan) from CT can increase the solar loan portfolio of NMB

Provide enterprise financing for RESCO model: CT can fund NMB to provide funding for RESCO-model based RTS installations & potential risk mitigation

Sources: Expert interview; NMB Bank; NEPSE trading; List of banks in Nepal

Building the capacity of local commercial banks & then co-financing them would the key financial intervention in Nepal

	Commercial lending	Cooperatives	VC/PE
Landscape	• 20 commercial banks; control ~89% of total assets among all BFIs • Nepal Bank Limited (NBL), Rastriya Banijya Bank Limited (RBBL), and Agriculture Development Bank Limited (ADBL) are state-owned; control 15% of total assets	• ~31,000 cooperatives that have a total of 7.38 Mn members; have extend about USD 3.18 Bn in credit • Mandated to integrate technology & capital among farmers, marginalized communities by the Cooperatives Act • Regulated by the Department of Cooperatives	• ~15 funds in Nepal have the SIF license; i.e. license which provides regulatory framework to operate as a VC/PE fund • Over the last 5 years, the industry raised ~ USD 350 Mn; however, only 11% was seed stage capital • VC/PE industry is relatively new in Nepal with limited fundraising & limited exits
Details	• **Limited green financing:** NMB Bank is one of the few banks with a dedicated sustainable banking program; Nepal Investment Mega Bank has recently become an accredited entity to access funds from GCF • **Limited knowledge of non-hydro projects:** Banks in Nepal have a history of financing hydro projects; however, RTS is new territory for them	• **Last mile financing:** Cooperatives can be a part of last mile financing given their penetration in rural areas & among farmers • **Misuse of funds:** A working committee is reviewing misuse of funds by cooperatives; ideal to lend to not directly fund cooperatives	• **Slowed ability to raise funds:** Limited awareness among enterprises & investors compounded by limited funding instruments hampers the abilities of funds to increase size • **DFI-backed funding:** Dolma Impact Fund & Business Oxygen Fund have access to DFI-capital like IFC & BII; managing over USD 100 Mn each
ZE Gen relevance	**Co-financing commercial lenders:** Capacity building & co-financing commercial lenders for concessional on-lending to moderate-mature RE enterprises	**Cooperatives included in business models:** SPIPs targeted enterprises can involve cooperatives as part of their business models; critical to employ risk-sharing & M&E mechanisms to mitigate potential misuse of funds	**Funding DFI-backed funds:** ZE Gen fund the impact funds like Dolma Impact that have existing DFI-funding & global expertise to fund early-stage investments in Nepal

Sources: Expert interview; Team Ventures; Statista

Microfinancing has a key role to play in providing access to finance to SPIPs end-users

Why is microfinancing needed?

How is GoN addressing last-mile financing issues?

- Government wants to have 1 bank branch per local government unit; however, access challenges remain
- GoN has mandated commercial banks & development banks to extend @ 4 – 5% transactions to MFIs under Deprived Sector Credit Program

What challenges remain?

- Last-mile financing is a challenge in Nepal due to the terrain, scattered population & challenges with market access to banks (in certain areas users must walk 1-2 miles to access)

What is the MFI landscape?

- As of 2023, there are 57 MFIs operating in Nepal that have USD 1.6 Bn in total borrowings
- MFIs typically lend at 10 – 12 % in Nepal
- MFIs serve 2.5 Mn people (~10% of Nepalese population)

Potential financing mechanism

Commercial bank

- Provides loan to MFI @ base rate (~8%) with 5 yr tenor
- Chief risk is from MFI default

MFI

- Recommended to finance to end-users at 1-2% above base rate with <5 yr tenor
- Responsible for collections
- Chief risk is from end-user defaulting

End-user

- End-user can be a farm cooperative that takes on the liability or an individual farmer
- Pays back to the MFI on an EMI-basis

ZE Gen relevance

Microfinancing key for rural-targeted intervention: Any rural-oriented intervention/enterprise should address challenges regarding last-mile finance; one pathway can be collaboration with an MFI

Financing commercial banks: Fund a partner commercial bank to deploy funds to MFIs for the purpose of SIPs installations

Capacity building of MFIs: MFIs struggle with low-levels of human capital; grant funding can be used to build capacity of MFIs to improve functions

Deliver co-benefits of financing: Women & marginalized groups excluded from financing regardless of their ability to repay; ZE Gen can provide incentives to lend to these groups

Sources: Nelito; Nimb Ace Capital; Himalayan Times; Nepal Rastra Bank Financial Stability Report

ZE Gen should look to fund SPIP projects that rely on PAYG models; demonstrations are key to converting awareness into demand

Model	Grant	Grant + loan	Grant + PAYG
Upfront cost (USD)	1,400 (1,050 if female farmer)	700 (500 if female farmer)	0
Monthly payments (USD)	0	21 (16 if female farmer)	42 (32 if female farmer)
Key features	**Subsidy/grant:** 60 – 70% of cost **Farmer's upfront cost:** 40% (further opportunity for grants) ICIMOD's pilot offered extra 10% to female farmers (contingent on transfer of land ownership)	**Subsidy/grant:** 60 – 70% of cost **Farmer's equity:** 15 – 20% (further opportunity for grants) **Loans:** 15 – 20% (@5% for 3 years) **Collateral:** SPIPs **Last mile financing:** SIPs installer or farm co-operative (@18% pa)	**Subsidy/grant:** 60 – 70% of cost **Collateral:** SPIPs **Last mile financing:** SPIPs installer/farm co-ops/MFIs used to collect monthly payments
Key benefits	Low transactional costs Immediate impact potential	Customized solution to the economic condition of targeted farmers Incentives farmers to continually use SPIPs	Functionally like prominent existing model of DG-use i.e., where farmers rent pumps for season
Key challenges	Active funding needs from donors & government	Loan risk if SPIPs are not performing as expected Requires a robust last-mile financing mechanism	Loan risk if SPIPs not performing as expected Robust last mile financing needed

ZE Gen relevance

PAYG/loan models key for deploying SPIPs: ICIMOD's case study found that 80% of applications preferred these models; funding enterprises with proven PAYGO could unlock pump potential

Water entrepreneurship model: A rural commercial enterprise owning a SPIP & renting it out for monthly/seasonal use to farmers was another successful model that emerged from the study

SPIP demonstrations were key to generating demand: 95% of pumps were demanded by applicants that witnessed demonstrations of the product

Tailoring the program for women led to increased demand from women: Nepal has significant seasonal migration of male workforce; tailoring the program to women led to rise in land ownership & applications

Sources: IWMI

Nepal has several DFI-funded energy transition programs that can be potential collaborators for ZE Gen for co-funding

DFI Program	Financiers	Funding	Objectives
Green and Resilience Financing Facility Investment Program	ADB	USD 30 million	To bridge financing, capacity, and technical gaps in Nepal's National Adaptation Plan and Second NDC
The Renewable Energy for Rural Livelihood (RERL)	UNDP, GEF	USD 35.31 million	Increase electricity access in rural Nepal by installing 4.3MW MHP and 0.5MW SMG
SASEC Power transmission and Distribution System Strengthening Project	ADB	USD 16 million	Scaling up on-grid and off-grid RE supply, facilitating cross-border power exchange, increasing rural access to RE, and building capacity in the power sector
Promoting Renewable Energy (RE) and Energy Efficiency (EE)	GIZ, EU	USD 10.4 million (including USD 4.3 million from EU)	To establish regulatory, institutional, and private sector conditions to promote renewable energy dissemination and enhance energy efficiency
Promotion of Solar Technologies for Economic Development (POSTED)	BMZ, GIZ	4.26 million	Improve conditions for the dissemination of solar technologies—mini-grids, irrigation pumps, and rooftops – in select provinces of Nepal
Promotion of Solar Energy in Rural and Semi-urban Regions of Nepal (DKTI)	KfW Development Bank	9.9 million	Improve Investments in on-grid (RTS) and off-grid (SPIPs, SMGs)

ZE Gen relevance

ZE Gen can explore collaborating with AEPC to leverage **O&M capacity-building opportunities in the RERL and SASEC programs**

50% interest subsidy for C&I, and 60% and 80% subsidies for medium and large SPIPs in DKTI are potential financing mechanisms for end-users of planned intervention

ZE Gen can collaborate with mandated actors at sub national levels to **offer basic training programs to private companies for quality installation of solar PV solutions** under **POSTED program**

GoN & British Embassy-supported SECF is a potential subsidy mechanism for ZE Gen target segments & relevant enterprises

What is the SECF?

Central Renewable Energy Fund (CREF), a financial mechanism of AEPC established a Viability Gap Funding based Sustainable Energy Challenge Fund (SECF) with funding support from UK-Aid.

Objective of SECF: SECF is designed to attract private sector investments into the RE sector either in the form of equity and credit

What does the SECF do?

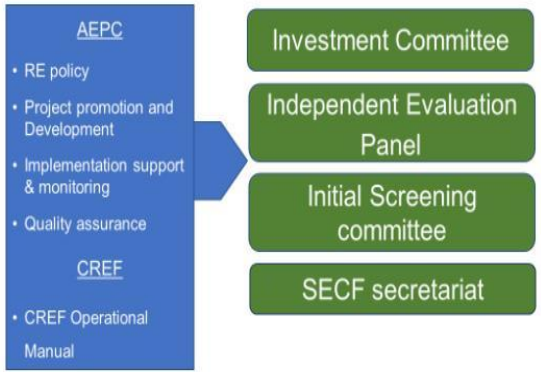
SECF provides financial & technical assistance to private sector led, or public-private partnership (PPP) DRE projects with a proven viability gap, to ensure their financial viability and sustainable operation. Investment de-risking mechanisms:

- Partial absorption of initial investment risks through incentives to the DRE projects through cost sharing
- Facilitation of commercial or low interest credit & grants

Who is eligible for support?

- Renewable energy companies
- Banking & financial institutions
- Cooperatives
- C&I entities
- Companies that have two years of experience working in RE sector

Who governs the SECF & how?



How is funding distributed?

SECF approval process is a 2-stage process that takes ~10 weeks from submission to selection

Final funding decisions from SECF support depends on **Independent Evaluation Panel recommendation** & **approval from Investment Committee**

Who are the partner organizations?

Sources: Expert interview; SECF; SECF Information Package

SECF's viability gap support via interest subsidy or generation-based incentives are key subsidy mechanisms available for C&I users

Select SECF funding windows	Type & ceiling of support	ZE Gen relevance
For projects to be implemented in the form of Aggregated Demand for increasing access to clean energy services to the households, MSMEs and public institutions	**Financial support for market development and promotion based on result:** maximum of 50% of these costs or < USD 750 K or financial support requested - whichever is less	Possible subsidy support mechanism for enterprises or projects that use renewable energy for irrigation
Viability Gap Support: For captive grid tied project, where minimum of 51% of the annual energy produced is used for self-consumption	**Interest buy-down:** Maximum of 50% of the total interest on approved loan for maximum of 5 years or rate proposed by the applicant	Possible subsidy mechanism for replacement grid-connected solar PV projects
Viability Gap Support: For captive grid tied project (Max 1MW) where minimum of 51% of the annual energy produced is used for self-consumption	**Generation based incentives:** Based on the produced energy units of every 4 months - maximum of USD 0.01 per unit for up to 5 yrs or tariff top-up proposed by the applicant	Possible subsidy mechanism for replacement grid-connected solar PV projects
Loan loss guarantees on RE loans	**Loan loss guarantee:** Maximum of 20% of the total RE portfolio of all loans recommended by SECF	Available for all SECF funding windows; possible subsidy mechanism for banks & enterprises using SECF credit facilities

ZE Gen opportunities

Accessing SECF funding windows: Target enterprises & end-users that can access SECF funding windows to subsidize RE installations

OR

Potential funding partnership: Exploring co-funding the SECF could be a potential intervention mechanism for ZE Gen; the benefits are immediate impact with the downside of interfacing with the GoN

What are the recommendations?

ZE Gen's initial efforts should target viability demonstration of BESS while simultaneously developing the ecosystem

What can be done?	Why is it needed?	What is the envisioned impact?	Where does ZE Gen come in?
Rationalization of BESS-related taxes	• Battery imports have associated duties and taxes of nearly ~40% which severely impacts the commercial viability of battery-systems • SEMAN, ERC and similar industry groups are advocating GoN to reduce taxes & release BESS focused policies	• Policy focus on BESS technologies from GoN; reduced taxes	• Engage with RE enterprises to steer government policies on BESS and rationalize the taxes
Demonstration of viability and benefits of large-scale BESS	• BESS technologies have limited large-scale installation; installing a 1+ MWh BESS system will create awareness of the technology among end-users & demonstrate benefits • Large-scale BESS demonstration will also serve as a capacity building exercise	• Increased awareness of BESS & push on GoN to rationalize tax regime	• Fund a local or international RE enterprise to install a 1+ MWh solution in an industrial zone; funding can be a mix of grant & concessional loans
Capacity building & training of engineers for BESS deployment	• Local servicemen & engineers have limited expertise with BESS-installations • BESS-installations require faster servicing than RTS installations	• Ecosystem building for BESS technologies which can handle anticipated future demand	• Utilize grant funding to train engineers & servicemen through training programs of organizations like SEMAN

ZE Gen can fund SPIP enterprises to demonstrate technology in target regions & provide working capital financing to unlock PAYG models

What can be done?	Why is it needed?	What is the envisioned impact?	Where does ZE Gen come in?
Demonstrate the value of SPIPs to end-users	• SPIP demand rises with demonstrations & proof-of-concept of the technology • Awareness of the technology is high among end-users; however, limited knowledge of the actual working of the technology & benefits	• Increased awareness of SIPs through demonstrations	• Fund SPIP enterprises with grant funding to pilot community SPIP installations in Tarai region
Increasing prevalence of PAYG model	• PAYG models are among the most effective models for SPIPs in Nepal; key blocker for installing SPIPs is access to working capital for solution deployers	• Increased penetrations of SPIPs in target regions through PAYG model	• Fund SPIP enterprises with concessional debt to install SPIPs in a PAYG model
Funding or co-funding government subsidies for SPIPs	• Government subsidies have consistently fallen short of meeting the demand for SPIPs • End-users require ~60-80% subsidies to install SPIPs	• Increased %age of SPIP demand met	• Explore a funding programs for SPIPs with AEPC • Co-fund DFI funding programs for SPIPs in Nepal

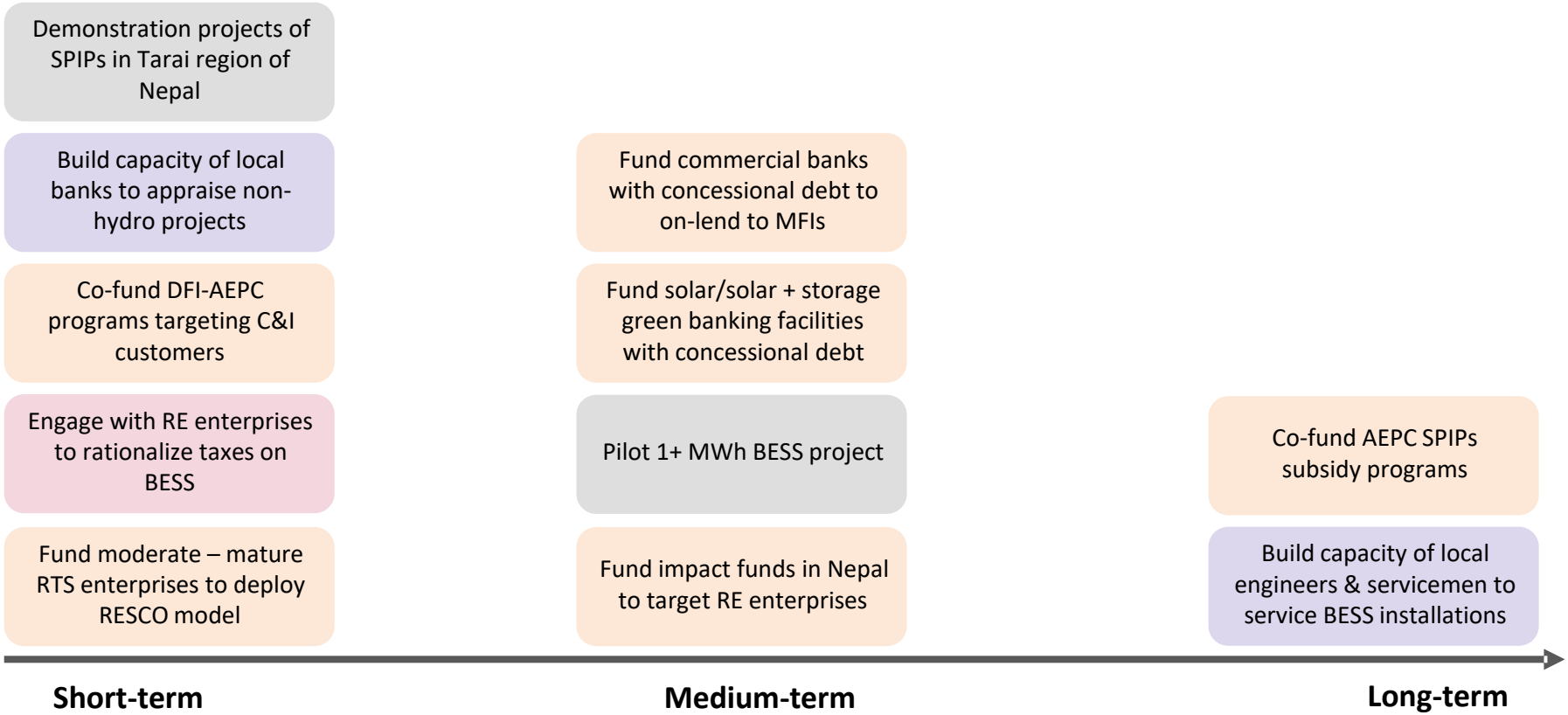
ZE Gen fund the green financing facilities of local commercial banks after building capacity to appraise solar projects

What can be done?	Why is it needed?	What is the envisioned impact?	Where does ZE Gen come in?
Capacity building for local banking institutions	• Local banks have limited capacity & knowledge to appraise solar projects & appropriately gauge risks & opportunities • RTS projected to be a growth segment for banks so limited capacity could be an issue down-the-line	• Increased capacity of local banks to finance solar projects	• Utilize grant funding to train key staff at commercial banks to build capacity to finance solar + storage projects
Financing green banking programs	• Banks like NMB have sustainable banking programs that have historically targeted hydro power but are not increasingly focused on RTS for C&I • Banks can extend loans at below market rates when they have access to DFI/foreign below market funds	• Increased local financing for RTS projects; higher uptake of technology among C&I segment	• Provide concessional debt to local banks that have RTS pipelines • Provide credit risk mitigation in the form of FLGs that will increase the capacity of the banks to extend debt
Financing MFIs through commercial banks	• MFIs have limited access to capital to extend to rural communities despite mandates from GoN • Access to capital is one of the chief barriers that prevents higher penetration o SPIPs; GoN subsidies programs cannot effectively meet the demand	• Increase uptake of SPIPs in target regions	• Provide concessional debt to commercial banks to on-lend to MFIs for solar-pump installations

ZE Gen immediate funding should target established enterprises with working capital funding

What can be done?	Why is it needed?	What is the envisioned impact?	Where does ZE Gen come in?
Fund RTS enterprises with working capital funding	• Enterprises in Nepal like Gham Power require debt-funding to grow their enterprises & provide RTS systems on a RESCO model • Directly funding enterprises will help aggregate demand and lower overall installation costs	• Increased capacity of enterprises to services C&I customers	• ZE Gen can directly fund solar enterprises with debt funding to fund working capital needs
Explore co-funding DFI programs like SECF	• SECF's viability gap fund & DKTI C&I program are a few of the subsidy programs in Nepal for installing C&I RTS solutions	• Increased uptake of RE solutions in the C&I segment	• ZE Gen can co-fund the programs like SECF or DKTI • ZE Gen can explore expanding the scope of support of these programs to target certain industries or regions with VGF
Fund DFI-backed VC/PE funds	• Nepal has a limited PE/VC industry with limited access to funds, awareness & exit opportunities • Enterprises in the RE space are competing with a small quantum of funds with other industries	• Increased access to early-stage finance for Nepalese RE enterprises	• ZE Gen can provide funding to established large funds like Dolma Impact to provide early-stage capital to Nepalese RE enterprises

ZE Gen can target immediate impact by funding enterprises with working capital funds to deploy RTS; long-term strategy hinges on successful demonstration of BESS & rationalization of related taxes



Appendix

Glossary

Abbreviation	Full form
ADB	Asian Development Bank
AMC	Annual maintenance contract
BESS	Battery energy storage solution
BII	British Investment International
BMZ	Federal Ministry of Economic Cooperation and Development (Germany)
C&I	Commercial & industrial
CCAFS	Climate Change, Agriculture and Food Security
CDKN	Climate and Development Knowledge Network
CNI	Confederation of Nepalese Industries
CREF	Central Renewable Energy Fund
DFI	Development finance institutions
DG	Diesel generator
DKTI	Promotion of Solar Energy in Rural and Semi-urban Regions of Nepal
DRE	Decentralized renewable energy
ERC	Energy Regulatory Commission (ERC)
ESCO	Energy Service Company
EU	European Union
FDI	Foreign direct investments
FFG	Fossil fuel gensets
FFG	Fossil fuel gensets
FX	Foreign exchange
GEF	Global Environment Facility
GHG	Greenhouse gases
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GoN	Government of Nepal
IFC	International Finance Corporation
IPP	Independent power producer

Abbreviation	Full form
IPP	Independent power producer
LCOE	Levelized cost of electricity
LI-BIRD	Local Initiatives for Biodiversity, Research and Development
MCCEE	Ministry of Climate Change, Environment and Energy
MDB	Multilateral Development Bank
MFI	Microfinance institutions
MGEAP	Mini Grid Energy Access Project
MoEWRI	Ministry of Energy, Water Resources and Irrigation (MoEWRI)
MoSTE	Ministry of Science, Technology and Environment (MoSTE)
MW	Megawatt
NDC	Nationally Determined Contribution
NEA	Nepal Electricity Authority
NREF	National Renewable Energy Framework
NREP	Nepal Renewable Energy Programme
O&M	Operations and Maintenance
PAYG	Pay-as-you-go
POSTED	The Promotion of Solar Technologies for Economic Development
PPP	Public-Private-Partnership
PROR	Peaking run-on-the-river
PV	Photovoltaic
RE	Renewable energy
REEEP-GREEN	Renewable Energy and Energy Efficiency Programme-Green Recovery and Empowerment with Energy in Nepal
RECON	Renewable Energy Confederation Nepal
RERA	Renewable Energy for Rural Area
RERL	Renewable Energy for Rural Livelihoods
RESCO	Renewable energy service company

Glossary

ROR	Run-on-the-river
RTS	Roof-top-solar
SASEC	South Asia Subregional Economic Cooperation
SEMAN	Solar Electric Manufacturers Association Nepal
SME	Small and Medium Enterprises
SMG	Solar Mini Grid
SPIP	Solar-powered irrigation pump
SUN	Saral Urja Nepal
ToD	Time of day
UNDP	United Nations Development Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNFCC	United Nations Framework Convention on Climate Change
WB	The World Bank
WTP	Willingness-to-pay