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Market and Opportunities Assessment for Mobilizing Private Sector Participation and Investment to Support Energy Sector Transition in South Asia

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Market and Opportunities Assessment for Mobilizing Private Sector Participation and Investment to Support Energy Sector Transition in South Asia

Final Report

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ACRONYMS & ABBREVIATIONS

ADB	Asian Development Bank
AIIB	Asian Infrastructure Investment Bank
AEPC	Alternative Energy Promotion Center
AES	Advanced Energy System
APPC	Average Pooled Power Cost
AREP	Alternative Renewable Energy Policy
ARISE	Accelerating Renewable Energy Integration and Sustainable Energy program
BAU	Business as Usual
BCD	Basic Customs Duty
BCCTF	Bangladesh Climate Change Trust Fund
BCCRF	Bangladesh Climate Change Resilient Fund
BESS	Battery Energy Storage System
BFI	Banking and Financial Institutions
BHEL	Bharat Heavy Electricals Limited
BPC	Bhutan Power Corporation
BPDB	Bangladesh Power Development Board
BWDB	Bangladesh Water Development Board
BOOT	Build-Own-Operate-Transfer
BOI	Board of Investment (Sri Lanka)
BSTI	Bangladesh Standards and Testing Institution
CAPEX	Capital Expenditure
CET	Clean Energy Technology
CEB	Ceylon Electricity Board
CIF	Climate Investment Fund
CKD	Complete Knocked Down (Vehicles)
CTF	Clean Technology Fund
C&I	Commercial and Industrial
DFI	Development Finance Institutes
DGPC	Druk Green Power Corporation
DRE	Department of Renewable Energy (Bhutan)
DHI	Druk Holding Investments
DHPS	Department of Hydropower and Power Systems (Bhutan)
EIB	European Investment Bank
EPC	Engineering Procurement Construction
EV(s)	Electric Vehicles
FAME	Faster Adoption and Manufacturing of Electric (and Hybrid) Vehicles

FiT	Feed-in-Tariff
GCF	Green Climate Fund
GEF	Global Environment Facility
GDP	Gross Domestic Product
GHG	Green House Gases
GW	Gigawatt
HPP	Hydropower Projects
IDA	International Development Association
IDCOL	Infrastructure Development Company Limited
IFC	International Finance Corporation
INDC	Intended National Determined Contribution
IPFF	Investment Promotion and Financing Facility
IREDA	Indian Renewable Energy Development Agency
IRENA	International Renewable Energy Agency
JFJCM	Japan Fund for Joint Crediting Mechanism
JICA	Japan International Cooperation Agency
KfW	Kreditanstalt für Wiederaufbau
KUSUM	Kisan Urja Suraksha evam Uthaan Mahabhiyan (PM-KUSUM scheme)
KW	Kilowatt
MDI	Multilateral Development Institutes
Mn	Million
MNRE	Ministry of New and Renewable Energy
MW	Megawatt
NDC	Nationally Determined Contributions
NEA	Nepal Electricity Authority
NEMMP	National Electric Mobility and Mission Plan
NHPC	National Hydropower Corporation
NPACC	National Program on Advance Chemistry Cell
NREP	New and Renewable Energy Nepal
NREL	National Renewable Energy Laboratory
NTPC	National Thermal Power Corporation
OEM	Original Equipment Manufacturers
OPEX	Operational Expenditure
PFC	Power Finance Corporation
PLI	Production Linked Incentive
POISED	Preparing for Outer Islands Sustainable Energy Development
PPA	Power Purchase Agreement
PPP	Public Private Partnership
PV	Photovoltaic

RE	Renewable Energy
REC	Rural Electrification Corporation
RECs	Renewable Energy Certificates
REDF	Renewable Energy Development Fund (Bhutan)
REFF	Renewable Energy Financing Facility
REMCL	Railway Engineering and Management Company Limited
RESCO	Renewable Energy Services Company
RET	Renewable Energy Technology
RGoB	Royal Government of Bhutan
RTS	Rooftop Solar
RPO	Renewable Purchase Obligation
SAR	South Asian Region
SAREH	South Asia Regional Energy Hub
SAREP	South Asia Regional Energy Partnership
SBI	State Bank of India
SECI	Solar Energy Corporation of India
SJVN	Sutlej Jal Vidyut Nigam
SKD	Semi Knocked Down
SLSEA	Sri Lanka Sustainable Energy Authority
SREDA	Sustainable Renewable Energy Development Authority (Bangladesh)
SREP	Scaling up Renewable Energy Plan
SURE	Scaling Up Renewable Energy program in South Asia region
STELCO	State Electric Company Limited (Maldives)
TA(s)	Technical Assistance(s)
UDAY	Ujwal Discom Assurance Yojana
UNDP	United Nations Development Program
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USDFC	United States International Development Finance Corporation
USEA	United States Energy Association
WB	World Bank
WtE	Waste-to-Energy

Executive summary

The South Asian region (SAR) nations, namely Bangladesh, Bhutan, India, Maldives, Nepal, and Sri Lanka have more than 20% of the world's population and are among the economically fastest growing regions in the world. The region is also highly vulnerable to the risks posed by climate change. These nations show a wide variation in the energy mix primarily due to their location and the geographical features they are endowed with. All the SAR nations have committed to Nationally Determined Contributions (NDCs) to reduce the GHG emissions and they all envision decarbonizing their energy mix over a period of time as one of the potential solutions to achieve the NDCs. Achieving this clean energy transition would require mobilisation of finance on a much larger scale than what is being currently done, from both the public sector and the private sector stakeholders. These will require creating a conducive environment for enabling private sector participation, and enhanced role of international and development finance institutions to catalyse the required investments.

This study was commissioned by the USAID with an intent to leverage its and USDFC's resources including grants, technical assistance, de-risking tools such as guarantees and convening power - to help raise awareness of investment opportunities, financial instruments (debt, mezzanine finance, equity, green bonds, etc.) and non-financial instruments (feasibility studies, technical assistance, etc.). The outcome from this study is envisaged to further the strategic clean energy partnership and give an impetus to the climate action and finance mobilisation dialogue in the Indo Pacific region especially the SAR countries. The study methodology consisted of combination of secondary research and primary research across wider spectrum of stakeholders including development finance institutions and financial institutions. It also included public sector and private sector renewable energy project developers, promoters, government owned utilities, industry associations, and enterprises with new or emerging business models in the SAR region.

The SAR countries exhibit different levels of market maturity for supporting private sector participation in developing various renewable energy and advanced energy technologies. Bhutan's energy sector is mostly hydropower dominated and state controlled. Bangladesh's energy sector lacks specific policy and incentives to promote renewable technologies over the fossil fuel-based technologies. India has the most vibrant, robust, and advanced market in the region with increasing interest of private sector participants in the clean energy transition. Energy sector transition in Maldives is mainly driven by the support from Development Finance Institutions. Nepal's energy sector is hydropower dominated with increasing interest from the private sector to participate in clean energy transition. Macroeconomic instability is the key obstacle to scaling up Sri Lanka's clean energy ambitions. The key risks and barriers to enabling private sector participation in the SAR nations varies from country to country, however, there are a few key risks and barriers that are common to most of the SAR nations. These are:

- Macroeconomic risks resulting in high inflation, currency volatility, and reduced borrowing capacity.

- Insufficient domestic pool of capital (e.g., financial institutions with adequate capacity, financial markets with adequate depth, etc.) to fund utility scale projects (other than in India).

- High costs of financing due to various perceived risks such as counterparty default risk, policy and regulatory uncertainty, technological risks etc.,

- Non-availability of hedging instruments for covering the foreign exchange risk or high costs of hedging making renewable energy projects financed through international finance unviable, and

- Insufficient avenues to monetise operational assets and recycle the capital.

To overcome some of the identified risks and barriers to unlocking private sector capital for clean energy transition in the SAR countries, six innovative financing instruments are suggested in the study.

Sr. no.	Key issue/ barrier	Innovative financing instrument	Modality of solution	Applicability
1	High cost of financing for disaggregated and advanced energy systems	Aggregation platforms and marketplace	Aggregation platform packages various projects into a portfolio risk, effectively reducing cost of capital through portfolio risk diversification. A marketplace enables seamless flow of information and helps pool demand bringing economies of scale and competitive nature of market, making advanced energy system technologies (BESS, EV) affordable.	Bangladesh, Bhutan, and India.
2	High cost of leading low carbon technologies & lack of avenues to finance them.	Carbon crediting mechanism fund	Opportunity to leverage carbon credit mechanism (through measurement, reporting, and verification) to unlock private sector capital from developed nations to finance clean energy transition. The returns for private sector are in carbon credits to offset their GHG emissions and achieve the goal of Net Zero.	Maldives, Bhutan, and other SAR countries (opportunity specific).
3	Inadequacy of non-traditional financing instruments/ vehicles	Asset backed securities	Non-regulated platform to package various assets (on-grid, off-grid, government PPA, private PPA, small size, large size etc.) in portfolio (bringing down the overall risk) and enabling to raise funds through various modes (debt, equity, grants) for e.g., crowdfunding platforms.	Bangladesh, India, and Sri Lanka.
4	Inadequate avenues to monetise	Infrastructure investment	Regulated financial instrument to monetise operational assets by means of issuance of tradable securities (broadening the	India (already being used across

Sr. no.	Key issue/ barrier	Innovative financing instrument	Modality of solution	Applicability
	operational assets and recycle capital	trusts/ YieldCos	investor base) and a tool to recycle capital to pass on the benefit of lower cost of capital to the next batch of RE projects.	multiple sectors); Nepal, Bhutan, and Sri Lanka (where regulations must emerge first.)
5	Non availability/ high cost of hedging currency risk	Currency risk hedging facility	Facility that can provide part protection against the foreign exchange devaluation risk limiting the probable loss due to currency devaluation.	All the SAR countries.
6	Non availability of counterparty risk protection	First loss protection guarantee/ insurance	Insurance/ guarantee that can provide part protection against the counterparty default risk limiting the probable loss of revenue due to default by the counterparty.	All the SAR countries.

Additionally, the study recommends country-specific non-financing interventions in the reforms, technical assistance and capacity building areas, recommendations on country-specific application of USDFC's existing instruments and a list of nine potential investment opportunities for USDFC in the short term.

Introduction

Recently, India and the United States launched the 'India-US Climate and Clean Energy Agenda 2030 Partnership'. Through this partnership, India and the United States are firmly committed to working together in achieving their ambitious climate and clean energy targets. The United States has set an economy-wide target of reducing its net greenhouse gas emissions by 50% - 52% below 2005 levels in 2030, while India has set a target of installing 500 GW of non-fossil fuel capacity by 2030. The aim is to strengthen the bilateral collaboration across climate and clean energy. This strategic partnership will proceed along two tracks:

(i) the strategic clean energy partnership, and

(ii) the climate action and finance mobilisation dialogue.

The United States through the United States Agency for International Development (USAID) and the United States International Development Finance Corporation (DFC) has been instrumental in various development finance initiatives across the world including South Asia. USAID and DFC intend to leverage their resources including grants, technical assistance, de-risking tools such as guarantees and convening power – to help raise awareness of investment opportunities, financial instruments (debt, mezzanine finance, equity, green bonds etc.) and non-financial instruments (feasibility studies, technical assistance etc.). This is to further the strategic clean energy partnership and give an impetus to the climate action and finance mobilisation dialogue in Indo Pacific region especially the South Asian Region (SAR) countries namely Bangladesh, Bhutan, India, Maldives, Nepal, and Sri Lanka.

Under this context, the United States Energy Association (USEA) has commissioned a study to identify critical financing gaps and recommend financing and non-financing interventions to address the gaps to support the renewable energy and climate change commitments of the South Asian countries (Bangladesh, Bhutan, Maldives, Nepal, and Sri Lanka). PricewaterhouseCoopers Private Limited was selected to conduct this study through a competitive process, under Sub-agreement No. USEA/ USAID/ 2021-763-94-01 dated 19 January 2022.

Objectives and scope of the study

The objective of this study is to present gaps and opportunities both that are country specific and common across the region through in-depth secondary research of existing data, extensive primary research tailored to a wide range of stakeholders, and strategic analysis of opportunities and interventions for addressal of the identified gaps.

The scope of the study covers the following:

1. Broad landscape assessment of the clean energy sector to evaluate investment trends and outlook, identify risks and uncertainties, and map various business and operating models with the objective of identifying critical financing gaps across the clean energy value chain.

2. Identifying 5-7 financing instruments and solutions which can address some of the identified financing gaps along with opportunities for USAID and DFC to enable the identified financing instruments.

3. Identifying pipeline of potential investment opportunities for DFC in the short term.

4. Non-financing interventions to address financing bottlenecks and attract greater private sector participation in financing clean energy projects in SAR countries.

Further, it was discussed and agreed that evaluation of options related to power sector policy, regulatory and market reforms, though these have substantial impact on financing clean energy development, is not a focus of this study.

Methodology adopted

As per the terms of reference (ToR), the methodology adopted for this study included primary research by means of interactions among the identified stakeholders and secondary research to gather relevant information from the public domain. The schematic below depicts our overall approach and methodology.

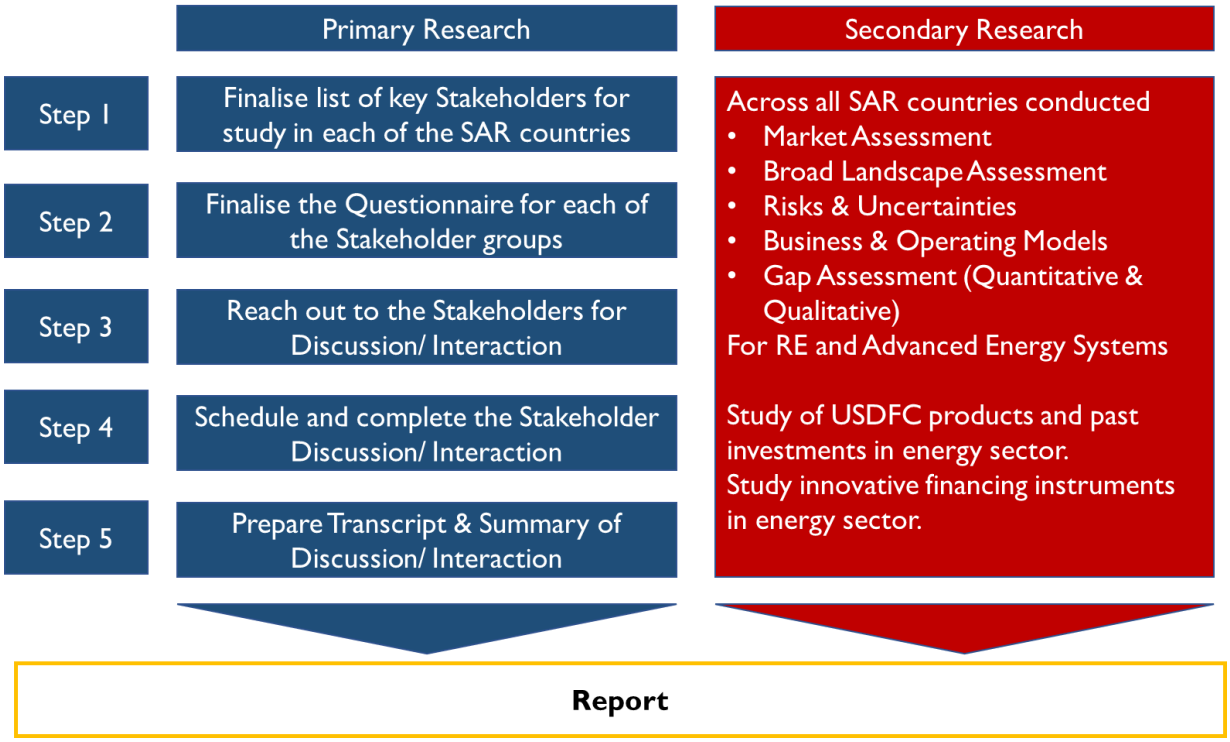


Figure 1: Methodology followed in conducting study

Primary interactions with key stakeholders were one of the key focus areas of the markets and opportunities assessment study. A substantial emphasis was provided to finalise the list of

stakeholders, interview questionnaires, and approach to reach out in consultation with USEA and USAID South Asia Regional Energy Partnership (SAREP) team. The list of the stakeholders who supported in conducting this study by sharing their experience and providing their valuable perspectives and suggestions, is provided below.

Table 1: Details of interactions/ consultations held with the identified stakeholders

S. no.	Date	Country	Stakeholder
1	16/03/2022	South Asia	ADB (Private Sector Operations Department)
2	17/03/2022	South Asia	World Bank
3	22/03/2022	Bhutan	Druk Green Power Corporation (DGPC)
4	24/03/2022	Bangladesh	Orion Group
5	24/03/2022	Nepal	Renewable Energy Confederation of Nepal (RECON)
6	29/03/2022	Bangladesh	Xolaren Bangladesh
7	31/03/2022	Bangladesh	Eastern Bank Limited (EBL)
8	02/04/2022	Bhutan	Department of Hydropower Systems, Government of Bhutan
9	02/04/2022	Bhutan	Department of Renewable Energy (DRE), Government of Bhutan
10	04/04/2022	Bangladesh	SolarTie Limited
11	05/04/2022	Bangladesh	Power Utility Bangladesh Limited
12	06/04/2022	Nepal	Nepal Infrastructure Bank Limited (NIFRA)
13	10/04/2022	Maldives	State Electric Company Limited (STELCO)
14	11/04/2022	Sri Lanka & Maldives	ADB
15	14/04/2022	India	AGP Sustainable Real Assets Holdings Pte. Ltd
16	13/04/2022	India	Oakridge Energy
17	19/04/2022	Bangladesh	Bangladesh Infrastructure Finance Fund Limited (BIFFL)
18	20/04/2022	Bangladesh	Bangladesh Solar and Renewable Energy Association (BSREA)
19	25/04/2022	India	Convergence Energy Systems Ltd. (CESL)
20	25/04/2022	Nepal	Sushmit Energy Private Limited
21	04/05/2022	India	Vikram Solar

A brief profile of the above listed stakeholders is provided at **Annexure-I**.

Report structure

The report comprises six chapters based on the scope of the study and the objective set at the outset of the study.

Chapter 1: Introduction provides the context of this study, the objective and the scope of work and the methodology followed to achieve the intended objective as delineated in the scope of work or ToR.

Chapter 2: Background and context introduces the reader to the potential and status of clean energy development in the SAR countries along with their NDC commitments. A broad overview of the current financing landscape is also provided before going into a detailed landscape assessment in the next chapter.

Chapter 3: Market assessment summarizes the key findings from the broad landscape assessment – investment trends and outlook, risks and uncertainties, and business and operating models prevailing in the renewable energy and advanced energy system sub-sectors for each of the SAR countries.

Chapter 4: Gap assessment summarizes the quantitative financing gaps in scaling RE and advanced energy systems in the SAR countries (along with the broad methodology followed to assess the gaps) and qualitative gaps (i.e., challenges and barriers to financing) assessed through the primary and secondary research during the study.

Chapter 5: Financing interventions cover our suggestions on a few innovative financing instruments that are required to address some of the identified financing gaps (i.e., risks and challenges) and potential short term investment opportunities for USAID and DFC.

Chapter 6: Non-financing interventions cover areas where USAID can engage at the policy and institutional level to facilitate mobilisation of financing for clean energy development.

Background and context

Background

The SAR nations, namely Bangladesh, Bhutan, India, Maldives, Nepal, and Sri Lanka, show a wide variation in the energy mix. This is mainly due to their location and the geographical features they are endowed with. For example, Nepal and Bhutan are in the Himalayas and have huge hydropower potential. On the other hand, India has the fourth largest coal reserves in the world, and Bangladesh holds 7.25 trillion cubic feet (Tcf) of proven natural gas reserves as of 2017. Further, Sri Lanka has plenty of sunshine year around along with scope for harnessing wind power.

The table below shows the available resources or potential of solar, hydro and wind in the SAR countries (India P. , 2020) (NHPC, Hydro Scenario, 2022)

Table 2: RE potential/resource in SAR countries

Country	Solar power resource (kWh/day/m²) *	Hydro power potential (MW)**	Wind power potential (MW)***
Bangladesh	4.50 kWh/day/m^2	60	-
Bhutan	4.75 kWh/day/m^2	42,000	760
India	5.00 kWh/day/m^2	250,000#	302,000
Maldives	5.00 kWh/day/m^2	-	20
Nepal	4.66 kWh/day/m^2	42,000	3,000
Sri Lanka	5.00 kWh/day/m^2	2,000	24,000

** Source: https://datacatalog.worldbank.org/search/dataset/0042044*
*** Including pumped hydro, and small/ mini/ micro schemes, source: https://www.saarcenergy.org/wp-content/uploads/2021/02/Draft-Report-Challenges-in-CET-Financing_reviewed_07.12.2020.pdf,*
 # http://www.nhpcindia.com/Default.aspx?id=130&lg=eng& (last accessed on 16th February 2022)
**** Source: https://www.saarcenergy.org/wp-content/uploads/2021/02/Draft-Report-Challenges-in-CET-Financing_reviewed_07.12.2020.pdf, NIWE, https://niwe.res.in/department (India)*
 # As reported on NHPC website. (NHPC, Hydro Scenario, 2022)

As against this resource and potential, the actual energy mix or installed capacity of RE and non-RE sources in each of these countries is as follows:

Table 3: Actual energy mix (installed capacity) in SAR countries

Name of the SAR country	Year	Total installed capacity (MW)	Non-renewable capacity (MW)	Renewable installed capacity (MW)				RE capacity as % of total installed capacity
				Hydro	Solar	Wind	Other RE*	
Bangladesh	2022	25,514	24,727	230	553	2.9	1	3.08%
Bhutan	2021	2,350	18	2,326	0.3	1	4.3	99.22%

Name of the SAR country	Year	Total installed capacity (MW)	Non-renewable capacity (MW)	Renewable installed capacity (MW)				RE capacity as % of total installed capacity
				Hydro	Solar	Wind	Other RE*	
India**	2022	399,467	235,219	47,930	53,994	40,500	15,449	39.52%
Maldives	2021	297	276		19	1	1.5	7.24%
Nepal	2021	2,143	78	2004	60	-	1	93.51%
Sri Lanka	2022	4,645	2,168	1,815	425	179	58	53.32%

Notes: * Other RE may include (depending on the country) bioenergy, biogas, waste to energy, decentralized off-grid generation, cogeneration plants etc.
** India has installed nuclear capacity of 6,780 MW which is not covered in the Non-RE and RE composition in the table.
Source: Websites of Sustainable Renewable Energy Development Authority (SREDA), Central Electricity Authority (India), MNRE, ADB and IRENA publications (last accessed on 16th February 2022)

Thus, it is observed that there is a substantial scope for the SAR countries to accelerate clean energy deployment. For example, countries like Bangladesh and Maldives continue to be heavily dependent on non-RE sources. These RE sources represent just around 5-6% of the installed capacity mix, indicating that it is important to understand the barriers and gaps and propose suitable interventions. Similarly, while the RE capacity as percentage of total installed capacity in Bhutan and Nepal are over 95% (due to large hydropower installed capacity), it is to be noted that this is only less than 10% of these countries' hydropower potential.

A few other key observations on the energy sector scenario in SAR which underscores the requirement for rapid mobilisation of finance for clean energy deployment are provided below:

- The region has more than 20% of the world's population and is one of the fastest growing regions economically (with a pre-COVID average growth rate of around 6% per annum); this steady economic growth is likely to lead to increased energy consumption.

- The average per-capita electricity consumption in the region is around 1,000 kWh/ capita compared to global average of >3,300 kWh/ capita indicating substantial latent demand.

- Fossil CO_2 emissions in the SAR countries is at 1.63 Mn tones CO_2 per year which, though lower than the global average, has been showing an increasing trend (about 4% CAGR increase between 2010-19). The power sector accounts for around 44% of the total fossil CO_2 emissions.

- Most of the countries in the region are highly vulnerable to climate risk which necessitates focus on developing sustainable and resilient infrastructure.

Therefore, it is observed that there exists varied scope for decarbonization of energy mix including deployment of Advanced Energy Systems (AES) (such as energy storage and electric vehicles) across the SAR nations. While the clean energy potential/ resource availability varies across the countries, it is imperative for the region to focus on decarbonization of power sector and development of sustainable and affordable energy infrastructure.

Commitments of SAR countries to sustainable energy development

Most of the SAR countries have nationally determined contribution (NDC) targets and RE commitments to achieve sustainable power development as provided in the table below:

Table 4: RE commitments and NDC targets of SAR countries

Country	RE commitments	NDC targets
Bangladesh (Bangladesh U. , 2021)	7.9 GW of renewables by 2041	Reduce GHG emissions unconditionally by 6.73% from business as usual (BAU) levels by 2030 or 27.56 Mt CO_2e by 2030 in the power, transport, and industry sectors and conditionally – 89.47 Mt CO2e (21.85%) below BAU in 2030
Nepal (Nepal, 2020)	15% of total energy demand to be met from clean energy sources by 2030	Around 23% reduction in emissions.
India (MoEF&CC, 2016)	To achieve 500 GW of non-fossil capacity by 2030 (revised from 450 GW)	• Achieving net-zero carbon emissions by 2070, by carbon sequestration and to reduce carbon intensity by 45% at the end of the decade by 2030. • To achieve about 50% cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030 and achieving non-fossil fuel-based power generation of 500 GW by 2030. • To reduce GHG emissions by 1 Bn Mt by 2030, thereby pledge to reduce carbon intensity of the nation's economy by 45% at the end of the decade and net-zero carbon emission by 2070.
Sri Lanka (Ministry of Environment G. , 2021)	To achieve 70% generation from RE by 2030	Increase 32% forest cover by 2030 and reduce GHG emissions by 14.5% for the period of 2021-2030 from power (electricity generation), transport, industry, waste, forestry, and agriculture. 4.0% (unconditional) and 10.5% (conditional) of GHG emissions reduction with respective to BAU scenario for the period 2021-2030.
Bhutan (Bhutan, 2021)	To achieve 20 MW of RE (excl. hydro) power by 2025	Bhutan's target is to maintain the status as a carbon neutral country where total GHG emissions do not exceed total removals by sinks including forests.

Country	RE commitments	NDC targets
Maldives (Ministry of Environment G. , 2020)	RE share to be 15% of total capacity by 2030	Reduce unconditionally 10% of its greenhouse gases (below BAU) for the year 2030 which could be conditionally increased to 26%.

Source: https://www4.unfccc.int (last accessed on 25 May 2022).

Contextual overview of current financing landscape

Achieving these ambitious NDC targets by scaling up RE and advanced energy systems would require vast sums of financing. In these times of global uncertainty, geopolitical tensions, and high demand on scarce public resources, the sums required far exceed the capacity of SAR country governments. Therefore, it is imperative to create partnerships that bring together all the potential resources available for development, including mobilization of private sector investments. These necessitates addressing the various challenges, gaps, and barriers in unlocking private sector participation in the region which have been discussed in subsequent chapters of the report.

Various development finance institutions (DFI) such as the World Bank, ADB, KfW, GiZ, etc., are active in the SAR countries and have come up with several interventions to help the governments address some of the challenges in unlocking private sector participation in RE and advanced energy systems sub-sectors. Such interventions by the governments and DFIs can be broadly classified into:

- 'Demand side interventions' to improve the demand side of financing RE projects; and
- 'Supply side interventions' to improve the supply side of the financing RE projects.

The key instruments deployed to mobilise private sector investment by the DFIs include concessional and non-concessional debt, equity, guarantees and other de-risking instruments, including insurance, local currency facilities, swaps, and derivatives. DFIs with a private sector mandate, including the private sector arms of multilateral development banks, tend to offer a wider range of financing instruments.

There are other thematic funding institutions which specialize in climate/ RE related funding such as the climate investment fund (CIFs) and the green climate fund (GCF) which also deploy a variety of financial instruments, including grants, loans, equity and guarantees. DFIs and climate funds also provide advisory services and technical assistance support, generally as grants.

The key stakeholders along with an overview of financing and non-financing interventions currently deployed by these stakeholders in the RE and advanced energy systems sectors of SAR are depicted in the figure below:

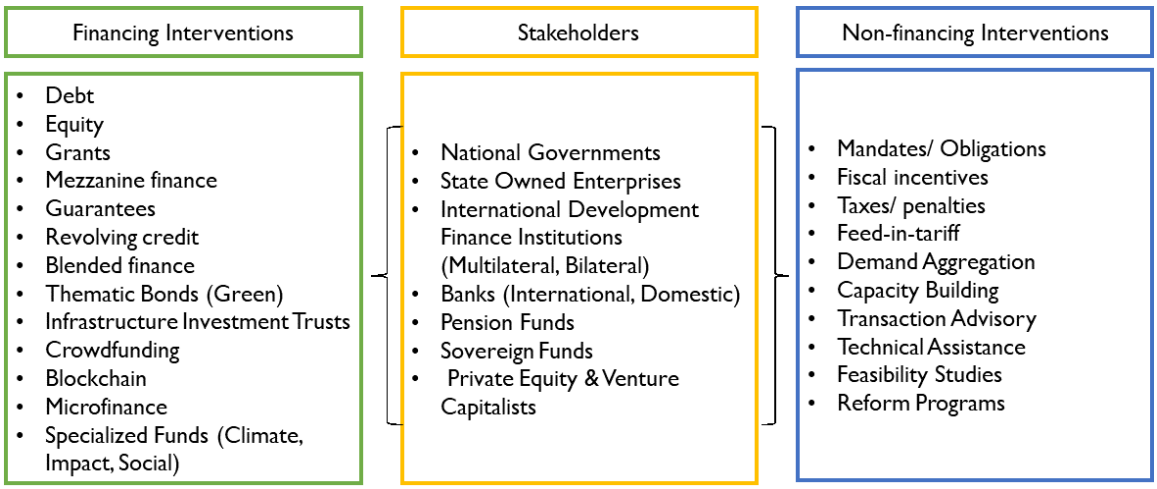


Figure 2: Stakeholders, financing, and non-financing Interventions in RE and AES of SAR countries (Source: PwC research)

These stakeholders and interventions have achieved varied success in addressing the challenges and barriers faced by the private sector, such as addressing risks associated with political instability, currency fluctuations, technological challenges, counter party default risk, prohibitive costs, low paying ability of the end consumers etc. However, a few of the interventions from DFIs have been tremendously successful in terms of unlocking private sector capital in clean energy space in SAR countries. A few of the recent landmark ones from SAR are indicated in the box below.

1. The World Bank in partnership with the State Bank of India has created a credit line of USD 625 Mn to offer concessional credit to developers establishing rooftop solar projects under the Indian government's rooftop solar programme.

   The Sustainable Partnership for Rooftop Solar Acceleration in Bharat (SUPRABHA) is a USD 13 Mn program, under this credit line, implemented in partnership with the World Bank, State Bank of India and MNRE. The program offers technical assistance to 17 partner states in India towards establishing and enabling ecosystem for accelerated deployment of grid connected rooftop solar. The initial funding from the World Bank, through SBI, resulted in a domino effect – it was not long until players from private equity, commercial banks, and pension funds started investing in the sector.

2. The Asian Infrastructure Investment Bank (AIIB) and the Government of Bangladesh have signed a USD 200 Mn on-lending facility to Infrastructure Development Co. Ltd (IDCOL) to finance infrastructure projects in Bangladesh. IDCOL is a government-owned nonbanking financial institution established for infrastructure financing in Bangladesh. AIIB's investment will provide IDCOL with financing that it will further on-lend to private companies to support infrastructure projects. The project will support Bangladesh's goal to bridge its infrastructure deficit and achieve sustainable growth by making long term financing available for infrastructure subprojects in power generation, renewable and low-carbon electricity, and others.

3. ADB has financed the Preparing Outer Islands for Sustainable Energy Development (POISED) project in Maldives. The project envisions installing energy management and control systems; energy storage; and improvements in distribution networks, to significantly reduce the need for diesel to generate electricity. The project is supported by USD 55 Mn in grants from ADB (including USD12

Mn from the Strategic Climate Fund, and USD 5 Mn from the Japan Fund for the Joint Crediting Mechanism), and USD 50 Mn loan from the European Investment Bank (EIB). It is expected that this initiative, one of the largest and first-of-its-kind energy sector interventions in the Maldives, will lead to private sector interest in the country's clean energy sectors.

Market assessment

In this chapter, we have provided a broad landscape assessment of the clean energy sector, evaluated investment trends and outlook, assessed business and operating models in practice, and identified key financing risks and uncertainties (separately for each of the SAR countries) for the sub-sectors identified below:

- Renewable energy (large grid connected and decentralized energy systems, single generation source, and renewable hybrid with and without energy storage).
- Advanced energy systems (electric vehicles, energy storage, etc.)

Bangladesh

Broad landscape assessment

Renewable energy:

Considering RE playing a minor role in today's energy mix (3.08% of total installed capacity), the Government of Bangladesh has set a target to scale RE by achieving up to 40% of RE generation estimated to be around 40 GW of RE by 2041. Out of this around 40% (i.e., 16 GW) is projected to be achieved from solar PV sources. Considering the scarcity of land in Bangladesh, it is envisaged that rooftop solar based PV installations will contribute majorly to achieving this target. With an estimated 1,500 km^2 of pond area available in Bangladesh, tapping floating solar has immense potential in scaling up RE deployment. The status of RE installed capacity in Bangladesh as on 2021 as reported by SREDA is presented below:

Table 5: RE installed capacity in Bangladesh as of 2021 (SREDA)

Renewable technology	Installed capacity in MW		
	Off-grid	On-grid	Total
Solar	350.18	203.49	553.68
Wind	-	2.9	2.9
Hydro	-	230	230
Biomass	0.69	-	0.69
Biogas	0.4	-	0.4
Total	**351.27**	**436.39**	**787.67**

Source: National Renewable Energy Database, Bangladesh (SREDA)

Grid connected solar PV energy: The average daily solar radiation in Bangladesh varies from 4 kWh/m^2 to 6.5 kWh/m^2. In the near-term, Bangladesh has the capacity to deploy up to 156 GW of utility-scale solar (Tachev, Energy tracker.Asia, 2022). With the draft National Solar Energy Roadmap being formulated by the Government, it is expected that, in the coming years a lot of potential project proposals from the international and national developers would evince their interest to invest in Bangladesh's solar sector (see gap assessment section for details).

So far, the implemented utility scale grid tied solar PV projects are relatively small (in size) and Bangladesh is yet to fully grasp the real challenges of implementing large-scale projects. The economics

of the manufacturing value chain for solar PV cannot compete with the imports therefore, there has not been any solar PV cell manufacturing facilities planned in Bangladesh.

Grid connected wind energy: According to the National Renewable Energy Laboratory (NREL), Bangladesh has over 20,000 km^2 of land where the wind speeds vary between 5.75 m/s to 7.75 m/s. This translates to a potential of over 30 GW. Against this, only 2.9 MW of wind energy capacity is installed and in operation at Bangladesh [900 kW wind plant at the Muhuri Dam and two 1,000 kW wind plants] (SREDA, SREDA | National Database of Renewable Energy, 2022). Thus, there is substantial wind energy potential yet to be tapped in Bangladesh.

Bangladesh does not have any wind energy plant and equipment manufacturers. All the needs are met through import of equipment. (Abdul Hasib Siddique, 2021)

Grid connected hydropower: Though Bangladesh is a riverine country, due to the flat terrain and frequent flooding concerns, the potential for hydropower development is limited (Prof. Dr. Md Abdul Wazed, 2008). Currently, the 230 MW Kaptai hydropower plant and a 10 kW micro-hydropower plant in Bamerchara are the only operational hydropower plants. The overall additional potential for hydropower development in Bangladesh is around 60 MW, with the Ranga Pani Gung region in Sylhet division having a potential of 616 kW of mini hydro capacity.

Off-grid and decentralized energy generation sources: The Government of Bangladesh had undertaken an initiative in 2016 to generate 500 MW of electricity from its decentralized off-grid solar systems. Under this initiative, with the help of the World Bank, Bangladesh successfully implemented the largest off-grid decentralized programme in the world - the Bangladesh Solar Home Systems Program. Around 5.5 Mn solar home systems have been installed till 2021 (Syed Munir Khasru, 2021).

Further, Bangladesh has around 1.34 Mn diesel-based irrigation pump sets and has installed around 1,446 solar based irrigation pumping systems (M. A. Hossain, 2015). Thus, converting the remaining diesel-based pumps to solar based irrigation pumping systems is the next frontier in scaling off-grid solar in Bangladesh. Under the solar rural electrification programme by IDCOL, around 102,191 solar streetlights, 152 solar based pumping systems for drinking water, and around 1,933 solar telecom towers and 11 mini grids were installed (Abdul Hasib Siddique, 2021).

The national solar energy action plan has set a target to achieve 2.8 GW of off-grid and decentralized energy generation by 2041 comprising 2.5 GW from solar irrigation pumps, 285 MW from individual-household solar home systems and around 16 MW from mini and micro grids and other off-grid installations. (Tachev, pv-magazine.com , 2020)

Advanced energy systems:

Battery energy storage systems (BESS): The BESS technology is still at a nascent stage in Bangladesh. Currently, the lead acid battery-based storage systems dominate in Bangladesh. There is no policy to support and promote the BESS manufacturing ecosystem in Bangladesh ((BSREA), 2022).

BASE Technologies Ltd, Dongjin Group, SARBS Communications Ltd, Okaya Power Pvt Ltd, and Karacus Energy Pvt Ltd are the key players in BESS (Lithium-ion battery) space in Bangladesh. The market is mostly dominated by imported batteries from countries such as China due to competitive cost advantage.

Electric vehicles (EVs): Bangladesh does not have a comprehensive EV policy to promote development of EV ecosystem in the country. This has resulted in private sector driving the growth of EVs in Bangladesh. Bangladesh currently has battery-run three-wheelers which are popularly known as Easy Bikes and Tom Toms. This mode of transport is one of the most widely used means of transportation for the masses in both urban and rural areas. It is estimated that approximately 1.5 Mn - 2.0 Mn electric vehicles currently running in Bangladesh are majorly electric three-wheelers and two-wheelers (Forum, 2020).

Investment trends and outlook

Renewable energy: Bangladesh has installed over 554 MW of solar projects consisting of solar rooftop and ground mounted utility scale. Previously, the renewable energy market was dominated with solar home systems (SHS) and off-grid power pack systems. This was based on the IDCOL SHS programme which was one of the most successful programmes implemented in Bangladesh (Bertsch, 2015).

The World Bank has also provided substantial support to scale up various clean energy initiatives which includes solar irrigation, solar mini-grids, roof-top solar, solar farms, and other projects through two consecutive rural electrification and renewable energy development (RERED) projects worth USD 726 Mn (Tachev, The Renewable Energy Potential of Bangladesh, 2021).

Domestic lenders also participate in financing RE projects in Bangladesh. However, they show greater propensity to finance fossil fuel-based power projects due to lack of incentives to RE and comfort in financing projects with capacity charge payments. The graph below provides past trend of investments in clean energy sector of Bangladesh.

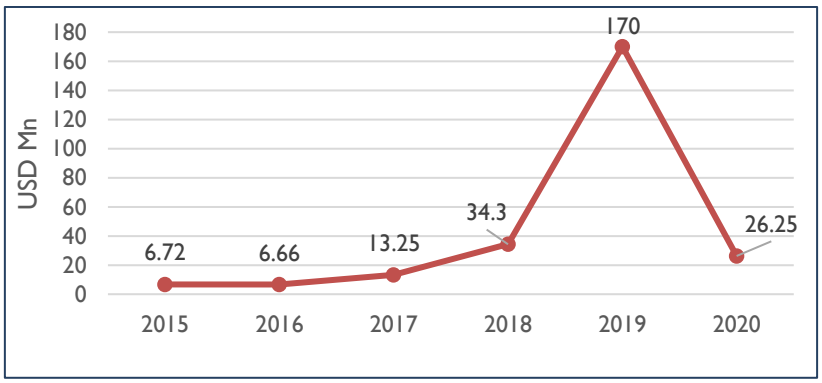


Figure 3: Trend of clean energy investments in Bangladesh
(Source: Climatescope by BloombergNEF, https://global-climatescope.org/tools/geography-comparison/)

Private sector in Bangladesh now accounts for almost 43% of the total installed generation capacity. The private sector has invested more than USD 15 Bn over the last decade by setting up power plants. (Haque, 2020) However, majority of this installed capacity is fossil fuel based conventional power plants.

Currently Bangladesh is in the process of scaling up RE assets and solar PV is likely to play key role in achieving that.

- Under the World Bank CIF-SREP program (scaling up renewable program), Bangladesh has been able to avail financing of around USD 75 Mn for utility scale solar and wind projects (IDA, 2019).

- The Bangladesh climate change resilience fund (BCCRF) and the Bangladesh climate change trust fund (BCCTF) have a commitment of USD 188.2 Mn and USD 400 Mn towards clean energy projects which are being deployed in various renewable projects at present.

- In May 2022, the Asian Infrastructure Investment Bank (AIIB) and the Government of Bangladesh signed a USD 200 Mn on-lending facility to IDCOL to finance infrastructure subprojects in power generation, renewable and low carbon electricity, information and communication technology, cross regional transportation, and others (AIIB, AIIB Signs USD200M On-lending Facility to Support Sustainable Infrastructure Development in Bangladesh, 2022).

- In May 2022, the state minister for power, energy and mineral resources of Bangladesh announced that around 29 different companies have shown interest in investing various segments of RE in Bangladesh. Further agreements to set up 10 RE plants by the private sector are already signed and the Government has estimated a target to invest USD 21 Bn to promote the RE, enhance energy efficiency and transport sector under the Mujib climate prosperity plan (Bangladesh T. F., 2022).

Details of key financing commitments from various stakeholders for scaling RE in Bangladesh are provided in the table below.

Table 6: Key financing commitments for scaling RE in Bangladesh

S. no.	Name of the financial institution (FIs) / funding schemes	Amount (Mn USD)
1.	Bangladesh Climate Change Trust Fund (BCCTF)	400
2.	Bangladesh Climate Change Resilience Fund (BCCRF)	188.2
3.	Global Environment Facility (GEF)	143.59
4.	Scaling up of Renewable Energy Program in Low Income Countries (SREP), under the World Bank (WB)	110
5.	Climate Infrastructure Mainstreaming Through Bangladesh Funds	40
6.	Scaling up Renewable Energy Program (SURE) in Bangladesh from World Bank (WB)	89.17
7.	Renewable Energy Financing Facility (REFF) from World Bank (WB) (108.23 + 3.64)	111.87
8.	CIF-SREP Investment Plan (Scaling up Renewable Energy Plan) for Bangladesh approved in 2015, was approved USD 75 Mn funding for the following renewable energy implementation, in cooperation with the World Bank, the International Finance Corporation (IFC), and the Asian Development Bank (ADB) as: 1. USD 29.25 Mn for utility scale grid connected renewable projects and a Waste-to-Energy pilot project approved by World Bank. 2. IFC Commitment for Utility scale grid connected solar and wind projects and rooftop solar projects for USD 15 Mn. 3. An amount of USD 29.95 Mn approved by the Asian Development Bank (ADB) for funding of off-grid decentralized projects, solar irrigation, and mini-grid projects.	75
	Total financial commitments	**1,157.83**

Advanced energy systems: In June 2021, the automobile industry development policy 2021 was published by the ministry of industries (News, 2021). The policy provides fiscal incentives for building assembly plants as well as tax reduction for importing semi knocked down (SKD) and completely knocked down (CKD) parts to facilitate the local assembly of vehicles. Further, the Government of Bangladesh has targeted to achieve at least 15% of all registered vehicles as EVs by 2030. These developments have provided an impetus to the EV sector in Bangladesh with Omega Seiki Mobility (~ USD 13 Mn, plant near Dhaka), and Bangladesh Auto Industries Ltd (~ USD 38.15 Mn, plant at Bangabandhu Sheikh Mujib Shilpa Nagar, Chattogram), announcing plans for investments in manufacturing facilities in 2021.

It is expected that local and foreign Original Equipment Manufacturers (OEMs) will not go for 'full manufacturing' of EVs as the viability of the same is based on local demand for EVs, cost of EVs, and availability of supporting ecosystem for manufacturing. Therefore, in the near future most automobile investments are projected towards assembly plants for SKD and basic CKD assembly of vehicles.

Business and operating models

Renewable energy: The utility scale RE projects in Bangladesh are mainly owned and sponsored by the government. However, the solar rooftop segment for commercial & industrial segment (C&I) (comprising garment industries, textiles, food industries, pharmaceutical industry, etc.) is seeing traction off late. The business model is mostly 'ownership business model' where the C&I consumer owns the rooftop solar system, and the developer only provides the service of engineering procurement and commissioning along with O&M services for a set period. The 'service business model' such as energy performance contracting, and Renewable Energy Services Company (RESCO) are not the prominent business models in Bangladesh.

Advanced energy systems: The primary business model in EV is importing SKD or CKD and assembling them before selling to the customers. In case of BESS, there are very few manufacturers of lead acid battery in Bangladesh. In case of lithium-ion batteries, the market is dominated by Chinese players importing the batteries, while there are few players who assemble the lithium-ion batteries and sell in the local market. There are no specific business models observed in manufacturing and services for advanced energy systems.

Risks and uncertainties

Based on our assessment of the current landscape, investment trends and outlooks, business, and operating models in practice, and deriving substantial inputs from the primary interactions, we have identified the following risks and uncertainties.

Uncertainty in timely receipt of approvals, clearances, and licenses

Most of the power sector projects in Bangladesh face issues such as slow pace of getting approvals and licenses leading to uncertainty in project initiation. The approvals required for power sector projects in Bangladesh include:

1. Approvals/ clearances on environmental social impact assessment and mitigation plans are key requirements to avail financing from the DFIs. There are substantial delays in obtaining environmental clearance certificates from the Department of Environment. This is a key challenge for financial closure where DFIs are involved. Recently, a solar project in Kushtia,

which was supposed to be co-financed by Eastern Bank Limited (EBL) and a DFI, failed to achieve financial closure as the DFI was unable to proceed due to substantial delay in receiving environmental clearances and absence of a comprehensive technical feasibility.

2. Legal approvals are required in land acquisition processes for setting up renewable energy projects. This is often challenging as land is a scare resource in this country, and with a very high population density, land ownership is often distributed among several hundred individuals. Besides, the country is prone to flooding and erosion, so the identification of suitable land is also often a challenge.

3. Technical clearances required for equipment to be used in RE projects (such as solar modules, inverters, batteries, solar pumps, etc.) is another challenge. Such clearances are governed by guidelines which mandates that all these equipment must be approved from designated labs and testing centres approved by the government like the Bangladesh Standards and Testing Institution (BSTI). The process of testing, verification, and approval requires substantial time.

Inadequate policy interventions and planning

Lack of adequate policies and planning across multiple dimensions is evident. For example, there are no standard bid documents and PPAs for grid scale RE projects. Similarly, fiscal incentives and other innovative structuring arrangements to increase project viability are absent. Further, the government is yet to come up with policies and regulations to promote the development of advanced energy systems such as BESS, hydrogen, etc.

At a project level, evacuation of power is often a challenge due to absence of adequate transmission infrastructure as investment decision to augment transmission infrastructure are often delayed by the transmission utility or the government departments.

Furthermore, Bangladesh's troubled political past and comparative uncertainty, along with a BB- credit rating (Standards & Poor), adds to the risk perceived by foreign developers.

Financing risks

Most of the financing risks and challenges that are seen in Bangladesh for the clean energy sectors emanate from the points discussed above. There is an inadequacy of workable financing models and innovative project structures that can help finance RE and advanced energy systems in a commercially viable and sustainable manner.

The financing options for local investors are very limited and ranges from concessional debt from DFIs, debt from commercial banks and a few instances of credit enhancement mechanisms (e.g., Orion Group financing of Khulna solar power plant through stand-by letter of credit from Cargill Financial Services Inc.). The domestic bond market lacks depth. Financial institutions are unwilling to invest in new and emerging technologies due to perceived risks of investing in new technologies.

Currently IDCOL is the only dedicated RE financing institution in Bangladesh. However, as per private sector stakeholders seeking financing from IDCOL, the terms and conditions of their debt financing are stringent and the process of obtaining loan is quite cumbersome.

Clean energy development in Bangladesh has been very slow due to a subsidy driven (towards fossil fuel-based sources) power market, scarcity of land and other land acquisition related issues, non-availability of adequate technical capacity and resources, and absence of favourable government policies and regulations to promote RE. However, in the last few years, there have been several visible efforts to drive the clean energy transition agenda by the government. This is important as the country is highly vulnerable to climate change and related natural disasters.

There are several domestic players in Bangladesh with the capacity and intent to invest in clean energy subsectors. The country has also seen substantial interest from DFIs and foreign investors in the past in other infrastructure sectors (including fossil fuel generation). Thus, it is envisaged that, driven by concerned government effort and DFI support, Bangladesh will strive to achieve its NDC and other RE capacity addition targets over the next few decades. However, the risks, challenges and financing gaps will need to be addressed adequately to mobilise private sector investments for Bangladesh's energy transition.

Bhutan

Broad landscape assessment

Renewable energy:

The RE landscape in Bhutan is dominated by hydropower which caters the domestic electricity demand and electricity exports to India, that contribute to around 20% of the gross domestic product (GDP) of Bhutan. The Bhutan sustainable hydropower development policy, first developed in 2008, and re-introduced in 2021, by the Royal Government of Bhutan (RGoB), aims to mobilise funds and attract investment for accelerated hydropower development.

There are two major state-owned utility companies in Bhutan developing the hydroelectric energy projects namely (a) Druk Green Power Corporation Limited (DGPC), and (b) Bhutan power corporation (BPC).

- DGPC and its subsidiaries owns and operates almost all the large, commissioned hydropower plants in Bhutan. 15% of the total power generated by these hydropower projects is provided as royalty to the RGoB, which allocates a part of the same in accordance with domestic tariff policy, 2016 to subsidise domestic tariffs. Rest of the power is exported by DGPC to India.

- BPC, the transmission & distribution utility of Bhutan, owns and operates hydropower plants with capacity below 5 MW, including micro/ mini-hydro and diesel power plants.

- The department of renewable energy (DRE) is responsible for planning, coordinating, and exploring the potential for development of various RE technologies apart from the hydropower in Bhutan.

Grid connected hydropower: Bhutan's current commissioned hydropower capacity is 2,326 MW. The major hydropower projects installed in Bhutan (as of 2021) along with their capacities and source of funding are highlighted in the table below:

Table 7: List of major hydropower projects installed in Bhutan

S.No.	Name of the hydropower project	Capacity (In MW)	Source of funding
1.	Basocchu HPP	64	Government of Austria funding in association with DGPC.
2.	Chhukha HPP	336	Government of India funding under bilateral agreement with RGoB, owned and operated by DGPC.
3.	Kuricchu HPP	60	Government of India funding under bilateral agreement with RGoB, owned and operated by DGPC.
4.	Dagachhu HPP	126	The Asian Development Bank (ADB), Austria's Raiffeisen Bank and the National Pension and Provident Fund of Bhutan (NPPF) - executed by DGPC in PPP/ JV mode with Tata Power, India.
5.	Tala HPP	1,020	Government of India funding under bilateral agreement with RGoB, maintained by DGPC.
6.	Mangdechhu HPP	720	Government of India funding under bilateral agreement with RGoB, currently owned and operated by Mangdecchu Hydroelectric Project Authority and to be transferred to DGPC soon.

Source: DGPC, (Drukgreen, 2021), (thyE.bt, 2020)

The 126 MW Dagachhu HPP is the first and only public-private partnership (PPP) project in Bhutan's energy sector executed jointly with Tata Power (India) as the private partner along with DGPC. The project has been registered as the first cross-border project activity under the clean development mechanism (CDM) of the United Nations framework convention on climate change (UNFCCC). The 118 MW Nikachhu HPP, currently under construction, is financed by ADB along with the State Bank of India and Exim Bank of India.

There are several other projects under construction based on bilateral support from India. As per the renewable energy master plan, the RGoB has planned to add 10,000 MW of hydroelectric energy projects by 2025. This includes nine proposed projects ranging in size from 400 MW to 4,000 MW.

Grid connected systems from other RE: No utility scale grid connected solar power plant has been installed yet in Bhutan. Efforts are on for installation of utility scale solar power plants at Sephu in district Wangdue (17.38 MW) and a waste to energy power plant at Thimphu (capacity 10 TPD). (DRE, 2022)

The lack of development of other RE technologies as compared to development of hydropower can be attributed to the fact that other RE technologies are not cost competitive with respect to hydropower. In case of wind energy, high capital cost, mountainous terrain, and difficulty in

transportation due to narrow roads are the key challenges. The energy availability of biomass and biogas feed and low performance at high altitudes pose challenge in the uptake of these technologies.

However, currently, Bhutan is looking to explore alternative clean energy sources other than hydropower as, during the winter months, hydropower generation is comparatively less in the monsoon season, requiring Bhutan to import power from India. This issue can be addressed if alternative renewable energy technologies like solar energy can be commercially integrated with the existing hydropower system.

Advanced energy systems:

Battery energy storage systems (BESS): Although Bhutan is planning to increase penetration of both ground mounted solar PV and RTS, as discussed above, there are no plans as of now for introduction of utility scale BESS. However, some pilot projects are being proposed to be explored in the near future. The RGoB plans to conduct detailed feasibility studies for such technologies to be used in future for other applications in the energy sector. (DGPC, 2022)

Electric vehicles (EVs): The RGoB, under the Bhutan sustainable low-emission urban transport systems project (BSLEUTS), is rolling out a program to electrify the taxi fleet of the capital, Thimphu. The plan was launched in early 2018 with 26 electric taxis. The city has 535 taxis, 500 of which are envisioned to become electric over the course of three years (IRENA, Renewable Readiness Assessment for Royal Kingdom of Bhutan, 2019). BPC has been installing charging stations at various Dzongkhags (Primary Subdivisions) namely Thimphu, Paro, Haa, Wangdue Phodrang, Punakha, and in the city of Phuentsholing.

Investment trends and outlook

Renewable energy: The Alternative Renewable Energy Policy 2013 (AREP) envisions a combined target for RE (except hydropower) of 20 MW by 2025 (IRENA, Renewable Readiness Assessment for Royal Kingdom of Bhutan, 2019). The AREP also includes provisions for a Renewable Energy Development Fund (REDF), which would aim to provide financial assistance to create a favourable investment climate for renewable energy projects. The REDF is envisioned to be the central financing instrument for the development of renewable energy projects in Bhutan, and it is supposed to be funded through contributions from hydropower plant revenues and royalties.

The AREP is currently under revision and the revised policy is envisaged to mandate minimum offtake obligations from other RE sources, such as solar, which will boost alternative renewable energy development. Further, Bhutan Electricity Authority (BEA), the sector regulator, is also working on various policies such as net metering and others to boost solar rooftop deployment in the country. The investments in this sector will be driven by these policy decisions.

Details of key financial commitments by various DFIs, multilateral agencies, and governments to scale up RE sector in Bhutan are provided in table below.

Table 8: Key financial commitments for RE scale up of Bhutan

S. no.	Key financial commitments by various DFIs or multilaterals/ government sources	Amount (Mn USD)
I	Green power development project II	120.0

S. no.	Key financial commitments by various DFIs or multilaterals/ government sources	Amount (Mn USD)
2	Acceleration of hydropower trading development	1.0
3	Promoting clean energy development	5.6
4	Green power development project for off-grid and on-grid rural electrifications and solar electrifications, small hydropower systems	106.3
5	Rural renewable energy development project for off-grid and on-grid rural electrification, solar electrification, wind power projects and biogas plants	21.6
	Total	**254.5**

Advanced energy systems: There have been no considerable investments in the new and advance technologies sector like EVs and BESS. Recently, the RGoB procured EV taxi fleets (Forum, 2020). A few PPP model-based investment schemes are in the planning stage for the development of EV charging stations, in collaboration with the Ministry of Transport, RGoB.

Though recent amendments in the Sustainable Hydropower Development Policy, 2021 stressed upon new and advanced technology systems for storage aggregation such as hydrogen fuel, green ammonia, and other emerging technologies, a detailed roadmap is yet to be prepared for the promotion of such technologies. (RGoB, 2021)

Business and operating models

Renewable energy: The power sector in Bhutan is dominated by the large-scale hydropower sector which is primarily publicly owned. Further, the SHDP 2021 states that the hydropower resources shall be developed (RGoB, 2021) with full ownership of RGoB through the following implementation and financing modes:

a) RGoB initiatives: The RGoB may undertake the development of hydropower projects on its own. Under this route the financing may be from DFIs or from financial institutions or from own sources of financing.

b) Inter-governmental (IG): Under this mode, the hydropower projects may be owned partly or in collaboration with development partner countries (e.g., India) where the financing is provided from the developing partner country(ies).

c) Sub-regional and regional arrangement: The RGoB may undertake projects as part of the regional or trilateral partnership framework. Under this mode, the RGoB may pursue financing by partner countries in sub-regional/ trilateral cooperation or from DFIs.

Currently, the commissioned or under-construction projects are based on RGoB initiatives or IG route (apart from Dagachhu which, as mentioned before, is a PPP project). Financing is through a mix of government grants, loans, and concessional finance from DFIs and other financing institutions. Small-scale hydropower projects and decentralized micro or mini grid projects have often been funded from partner governments and DFIs for e.g., the proposed utility scale grid connected 17.38 MW solar PV project is proposed to be funded by ADB.

Advanced energy systems:

Battery energy storage services (BESS): Currently, there are no specific business models observed in case of BESS technology in Bhutan.

Electric vehicles (EVs): The primary business model by the OEMs viz. Nissan, Tata Motors, Mahindra & Mahindra Ltd, Toyota, etc. is importing SKD or CKD and assembling them before selling to the customers. No OEMs has shown interest to invest in the EV value chain in Bhutan.

Risks and uncertainties

Financing risks and uncertainties

1. Unforeseen geological challenges are a major risk for hydropower project development in Bhutan despite significant studies and surveys being undertaken during the project feasibility studies. This leads to significant cost overrun and time overrun of the projects which impacts the financial viability of the projects. Hydropower projects have long gestation period which causes delay resulting in additional financial burden for the project developer. There is lack of flexibility in the loan agreements in terms of debt repayment while considering the technical challenges.

2. Financing alternate RE projects through domestic sources (for example ground mounted solar, RTS, etc.), is challenging as they are often compared to the tariffs of hydropower projects. In addition, the general public's understanding, and acceptance of Bhutan's need to diversify energy sources is very minimal. Hence, there will be substantial reliance on DFIs for meeting the funding requirements of alternate renewable energy projects.

Other techno-commercial risks and uncertainties:

1. Given that the domestic demand in Bhutan is limited, Bhutan needs to rely on exports for optimum value realization of its energy resources. The export market for future projects in South Asia will be driven by regional geopolitics, demand-supply, and cost competitiveness considerations. Thus, many of the projects are implemented at a significant risk for Bhutan and hence, Bhutan is exploring its power market to overcome such uncertainties and to grow significantly. This is the reason why Bhutan is currently exploring increasing usage of electricity across transport and industry sectors through emerging technologies other than hydro, such as hydrogen, pumped storage hydro, solar PV, et al.

2. Unforeseen geological challenges are a major risk for hydropower project development in Bhutan despite significant studies and surveys being undertaken during the project feasibility studies. This leads to significant cost and time over-run of the projects which impacts the financial viability.

3. The availability of technical expertise and skilled manpower to support new technologies such as EV ecosystem, BESS, and other RE technologies is inadequate. Further, there are currently no commercially proven business models in EV ecosystem and BESS ecosystem. This is likely to constrain development of these new and emerging technologies in Bhutan.

Bhutan has been traditionally dependent on clean and green hydropower generation to meet its energy needs and generate revenues for the government exchequer by exporting power to India. Traditionally, most of the hydropower projects have been funded by support from the Government of India, DFIs or from public resources.

Recent events resulting from climate vulnerability and other factors (like Bhutan's continuing efforts to achieve the highest standards of sustainability) have resulted in the country exploring options for other generation sources (e.g., solar) and advanced energy systems (e.g., EVs, hydrogen). This, and the other planned hydropower projects which can meet regional needs, requires mobilisation of finance beyond what Bhutan's domestic resources can provide.

Therefore, it is envisaged that apart from DFI support, Bhutan will also require to explore innovative financing options and private financing as it looks to diversify its energy resources.

India

Broad landscape assessment

Renewable energy:

India ranks 5th in the world for highest installed RE capacity. India has set a target of achieving 500 GW of RE installed capacity by 2030.

Grid connected solar energy: India's solar power growth has been driven by an increased surge in local investments from commercial banks, public sector banks, non-banking financial institutions, and an increased awareness about solar power benefits across public utilities and among the consumers. In the period between 2016-2021, India has installed over 7 GW of solar power annually on an average. India, with around 54 GW of installed capacity of solar assets as of March 2022, is currently the 5th largest solar power producing nation in the world. The following figure highlights the capacity addition over the years in India for the past 7 years from 2016 to 2022 (up to March 2022).

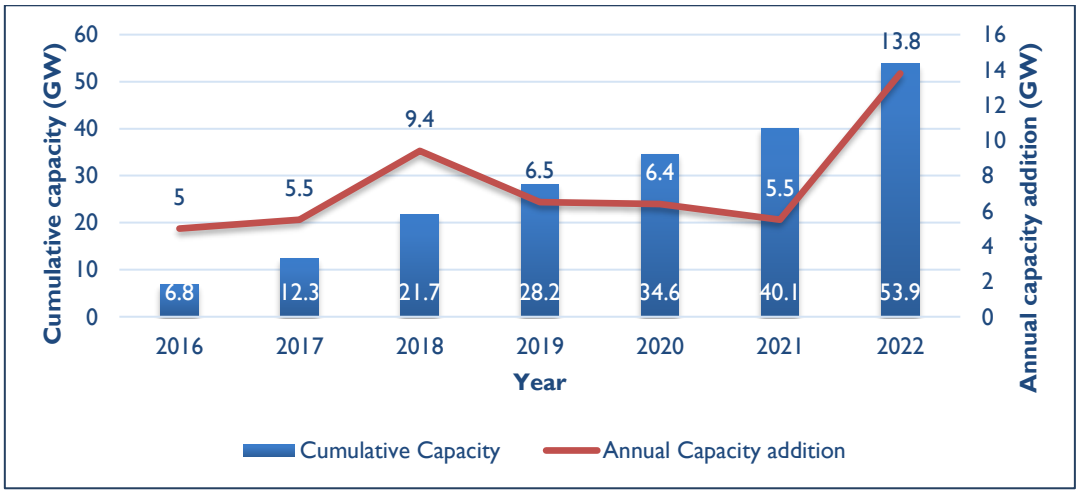


Figure 4 Cumulative vs annual solar capacity addition in India from 2016-2022 (March)

Source: (MNRE M. o., 2022)

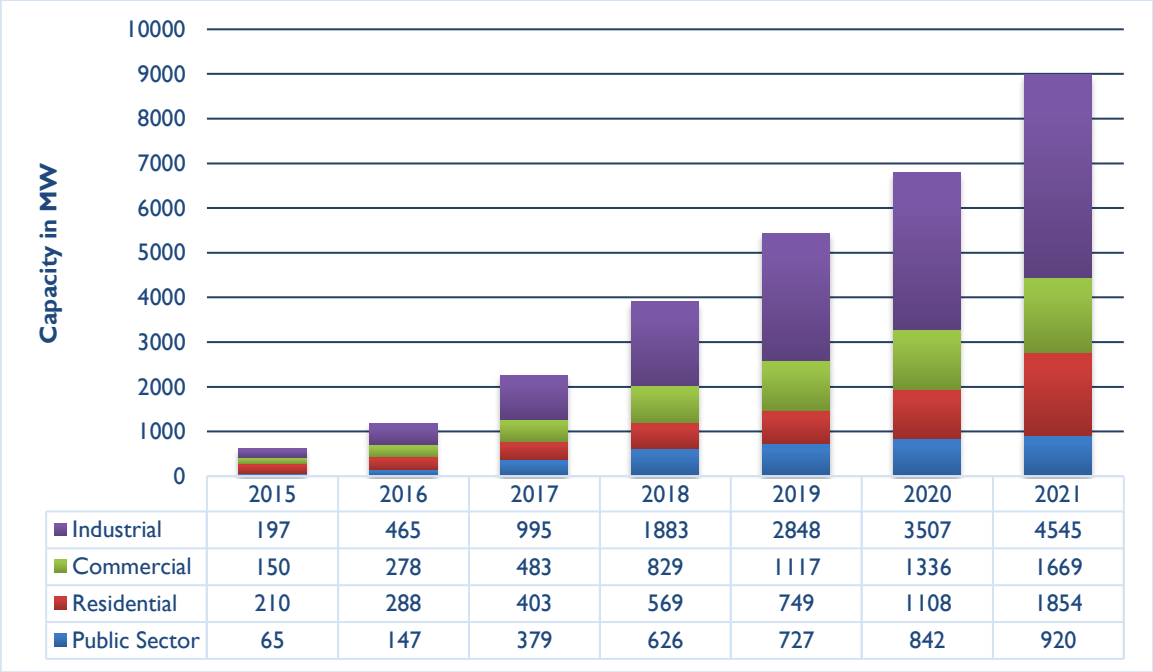
India's rapid solar capacity expansion owes to several policies and initiatives from the Government of India, like the Jawaharlal Nehru National Solar Mission (JNNSM), which initially set a target of 20 GW of solar power by 2022 (Gupta A. R., 2020), later extended to 100 GW. The growth in India's solar capacity is attributed mainly to two factors, which are:

a) option of affordable financing available in the domestic market, from varied sources. (Vibhuti Garg , 2022) and

b) newer policies introduced by the government supporting the ecosystem such as production linked incentive scheme (PLI) for solar PV manufacturing, the Ujwal Discom Assurance Yojana (UDAY) policy improving the financial health of the distribution utilities and reducing the off-taker risks, solar park scheme for setting up of 50 solar parks and targeting 40 GW of solar assets, viability gap funding scheme for 5 GW of solar PV projects through SECI for inter-state transmission network and MNRE Phase II Solar rooftop programme for 40 GW of rooftop solar through distribution utilities. (MNRE, mnre.gov, 2022)

In 2021, India added 1.7 GW of grid connected solar rooftop capacity, the highest ever in a year (PTI, India adds record 1,700 megawatt rooftop solar capacity in 2021: Mercom, 2022). This was largely attributed to the pent-up demand from 2020 which experienced decline in addition due to COVID-19 pandemic. The factors impacting the uptake of grid connected solar rooftop segment in India are mainly the net metering policies, cost of rooftop systems, the taxes and duties imposed on the rooftop system components and the perceived benefits derived by various consumer segments from the tariff applicable to them and levelized cost of the electricity from the rooftop system.

The graph below shows the rooftop solar market size and growth over the last few years.



	2015	2016	2017	2018	2019	2020	2021
Industrial	197	465	995	1883	2848	3507	4545
Commercial	150	278	483	829	1117	1336	1669
Residential	210	288	403	569	749	1108	1854
Public Sector	65	147	379	626	727	842	920

Figure 5: Cumulative grid connected rooftop solar capacity in India in past few years
(Source: India RE Navigator, https://india-re-navigator.com/rooftop)

The country's installed manufacturing capacity of solar PV cells is about 4 GW consisting of 18 companies and that of modules is about 16 GW consisting of nearly 175 companies (JMKResearch). The graph shows existing manufacturing capacity in India as of March 2021.

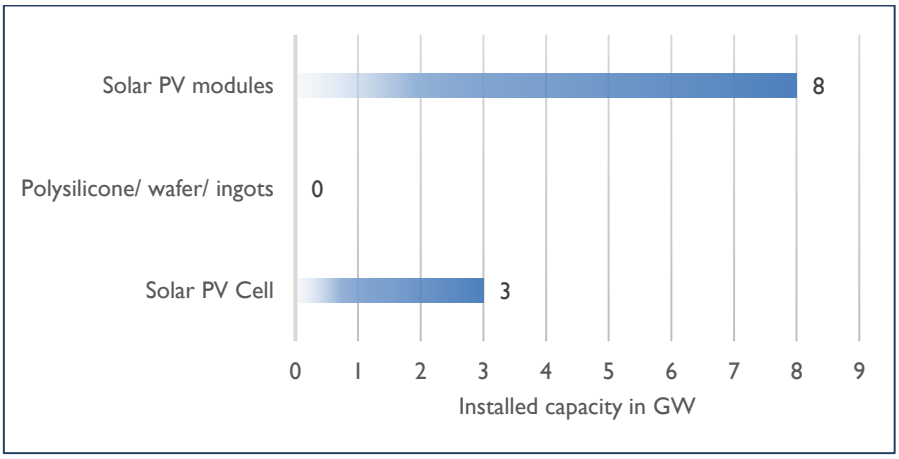


Figure 6: Solar PV manufacturing capacity in India (as of March 2021)
(Source: Crisil Research)

Manufacturing capacity for upstream stages of polysilicon, ingot and wafer is absent in the current Indian landscape, on account of primarily, high production costs. Further, the current 8 GW solar PV modules capacity is underutilised at around 20% due to higher cost of domestic modules compared to Chinese solar PV modules which are 15%-25% (4 cents/ watt – 6 cents/ watt) cheaper because of the subsidies and economies of scale. As a result, around 80% of India's current solar PV module demand is catered by the Chinese module manufacturers. Hence, the Government of India in a renewed effort to reduce import dependence and scale up domestic PV manufacturing capabilities, has introduced basic customs duty (BCD) on imports. Effective from April 2022, the BCD on solar modules will be 40%, and on solar cells, it will be 25%.

Grid connected wind energy: India has set a target of 100 GW of installed wind power capacity by 2030. The current installed capacity of wind energy power in India is around 40.5 GW (as of March 2022) (MNRE, mnre.gov, 2022), and in 2021, India added 1.11 GW of grid connected wind power (PTI, India adds 13.5 GW of renewable capacity in FY22, 12% higher than last yr, 2022). While wind energy sector has been developing in India since the last four decades and experienced a steady growth till 2015, from 2016-17 onwards, the momentum was lost primarily due to abolition of feed-in-tariff regime and with solar energy becoming more cost competitive. As a result, new installations have declined by 50% in the last two years.

Though the government has put more than 17 GW of capacity up for auction since 2017, nearly one-third of these was either unsubscribed or cancelled or abandoned after being awarded (GWEC, 2022). The wind power sector in India has been exploring the possibility of repowering older wind farms, a move that can accelerate capacity addition of wind power in India.

Wind energy manufacturing supply chain faced massive disruption in the wake of COVID-19 pandemic and most of the wind turbine manufacturers in India reduced their production capacity thereby reducing the pace of installations and delaying the project timelines. The margins of wind turbine manufacturers and suppliers are shrinking because of aggressive auction prices. Further, the market is demanding turbines suitable for low to medium wind speed sites. This has resulted in several turbine

vendors struggling to align themselves with the changing market realities and has slowed down the pace of wind energy installations in India.

Grid connected hydropower: In India, hydropower plants are classified into 4 categories:

a) micro hydro in the range of 100 kW or below,

b) mini hydro in the range of 101 kW to 2 MW capacity,

c) small hydro in the range of 2 MW to 25 MW and,

d) large hydro power plants with above 25 MW capacity.

India has installed around 47,930 MW of hydropower plants (both large & small combined), while the economically exploitable and viable hydro potential is assessed to be about 240,000 MW (including pumped hydro and micro/ mini/ small hydro) (NHPC, NHPC India , 2021). Regional assessment of hydropower development shows that almost 75% of the total potential for large hydropower development in India is concentrated in the north-eastern and northern regions. However, only 34% of the total potential in the northern and 2% of the potential in the north-eastern region has been developed till now. The National Hydroelectric Power Corporation (NHPC), Northeast Electric Power Company (NEEPCO), Sutlej Jal Vidyut Nigam (SJVNL), Tehri hydro Development Corporation (THDC) are some of the top public sector companies producing hydropower in India. Some of the large private hydropower players include JSW Energy, JP Power Ventures (Jaypee Group), Tata Power, etc. The Ministry of Power (Government of India) recently announced a 70 GW of hydropower capacity installation target by 2030, which would be brought under the clean energy targets set by the country by 2030 (energy.economictimes, 2022), thus, giving it a good enough push to increase the power capacity of renewable energy above 45% by 2030 and net-zero by 2070, as part of the NDC commitments made by India in COP 26 Glasgow summit. (livemint.com e. b., 2021)

Biomass energy: India produces about 450-500 Mn tons of biomass per year. India has achieved the target of 10 GW of biomass power before 2022. The biomass used for power generation includes bagasse, rice husk, straw, cotton stalk, de-oiled cakes, sawdust etc. Karnataka, Andhra Pradesh, and Maharashtra are some of the states leading in establishing biomass-based power plants. The defragmented nature of agriculture lands does not allow for high mechanisation reducing efficiency and increasing procurement costs. (Gupta A. , 2021) The transportation costs constitute a significant portion of the fuel cost making biomass energy costly in comparison to solar and wind energy. Further, the Government of India does not have any plans to scale up the biomass power and cogeneration in a significant way. (Aggarwal, 2021)

Off-grid and decentralized energy generation sources: The key drivers for off-grid and decentralized energy generation solutions are rate of electrification, reliability and quality of electric supply, ability to pay by the end consumers, and government schemes. In India, the off-grid solar market has not been growing as much as it was envisaged to, compared to the grid connected solar systems, since off-grid solar systems need comparatively high capital investments along with availability of net metering regulations (which was slow to pick up in multiple states).

As of 2022 (March), around 1,557 MWp of solar off-grid power plants have been installed, 350,807 numbers of solar pumps, 0.93 Mn of solar street lighting (SSL) applications, 8.45 Mn of solar home

lighting systems and nearly 7 Mn of solar lamps/lanterns (SLS) have been installed or distributed across various states, villages, rural clusters across India over the past 12 years (MNRE, mnre.gov, 2022).

The Ministry of New and Renewable Energy (MNRE) issued framework for promotion of decentralized renewable energy (DRE) livelihood applications on 14th February 2022. The framework aims to facilitate development of an enabling ecosystem for widespread adoption of DRE (MNRE, Framework for Promotion of Decentralised Renewable Energy Livelihood applications, 2022). Solar and biomass dryers, solar or biomass power cold storage/ chillers, solar charkhas, and other such applications are some of the popular DRE applications in India. End user financing is a key barrier for penetration of DRE appliances (Ananya Saini, 2021).

Advanced energy systems:

Battery energy storage systems (BESS): India currently has around 20 MW of installed BESS capacity, with 1.7 GW of battery capacity in the pipeline. India has set a target of 38 GW of 4-hour battery storage for cost and efficient reliable integration of renewables by 2030. In 2020 the Government of India launched National Program on Advance Chemistry Cells (NPACC) with the aim to promote economic growth and local manufacturing in the battery storage sector. As part of the NPACC, the ministry of heavy industry and public enterprises notified a production-linked incentives scheme in June 2021 (ACC PLI), for both domestic and overseas investors seeking to incorporate giga-scale ACC manufacturing facilities in India. The ACC PLI scheme has a total incentive pay-out of around USD 2.47 Bn over a 5-year period (Arora, 2021). In 2021, SECI invited bids for 2,000 MWh of standalone energy storage systems. The projects were to be set up on build-own-operate (BOO) basis for 25-year period. NTPC Ltd invited expression of interest from Indian and global companies to set up 1,000 MWh of grid connected BESS on premises of its thermal power projects across India.

Electric vehicles (EVs): As on December 2021 India had 0.8 Mn registered EVs which are plying on Indian roads (Bhatnagar, 2021). Around 380 EV manufacturers operate in India (e-Amrit, 2022). The Government of India has set an ambitious target of achieving 30% of all vehicle sales to be EVs (livemint.com, 2021)(livemint.com, 2021). To promote manufacturing and adoption of EVs the Government of India launched the faster adoption and manufacturing of (hybrid &) electric vehicles scheme (FAME) in India. Presently phase-II of the FAME scheme is being implemented for a period of 5 years from 2019 onwards with a budgetary support of around USD 1.3 Bn. The scheme has three components namely (a) demand incentives, (b) charging infrastructure and (c) industries (Industries, 2019).

The EVs in India are exempt from payment of fees for issue or renewal of registration certificates and enjoy lowest tax rates of 5%. In September 2021, the government approved incentives under the PLI scheme for automobiles and auto components where battery based EVs OEMs are eligible for the incentives. Elest, Hop Electric Manufacturing, Ola Electric Technologies, and Powerhaul Vehicle received approvals for their applications under this scheme. These concerted efforts have helped scale up the EV market in India with considerable traction in uptake of EVs in the recent times.

Hydrogen technology: Hydrogen technology is in nascent phase in India. The Government of India on 17th February 2022 formulated the green hydrogen policy. The policy provides incentives such as waiver of inter-state transmission charges to RE plants commissioned up to 2025 to produce green hydrogen and green ammonia for a period of 25 years. (Power, 2022)

Investment trends and outlook

Renewable energy: India has been consistently ranked among the top 10 countries among emerging markets in clean energy investments and is ranked 3rd among the countries in terms of 'renewable energy country attractiveness index', just after USA and China. (E&Y, 2021)

During the 2014-2019 period, renewable energy programs and projects in India attracted investments of USD 64.4 Bn, as per REN21 renewables 2020 global status report. Nevertheless, in 2021, new renewable opportunities have started to emerge after the COVID-19 pandemic induced slowdown in 2020, developments have started gaining pace. Indian companies now have started to explore various overseas markets to raise funds. In August 2021, ReNew Power became the first Indian renewable energy company to be listed on Nasdaq (Bloomberg New Energy Finance Report, 2021). The graph below provides past trend of investments in clean energy sector of India.

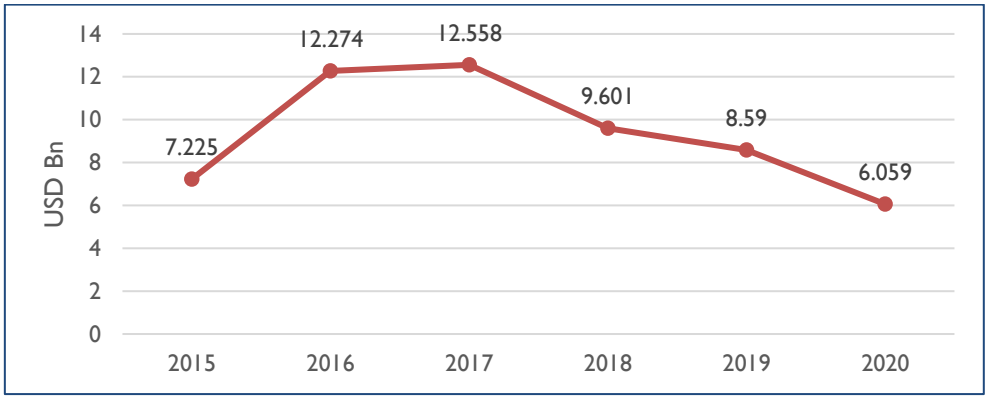


Figure 7: Trend of clean energy investments in India
(Source: Climatescope by BloombergNEF, https://global-climatescope.org/tools/geography-comparison/)

The financial commitments of various stakeholders for scaling RE sector in India are provided in table below:

Table 9: Key financial commitments for achieving India's RE scale up target of 2030

S. no.	Key financial institution (FIs) / funding schemes	Financial commitment (in Mn USD)
1	Indian renewable energy development agency (IREDA)	435.42
2	Power finance corporation (PFC)	299.55
3	Rural electrification corporation (REC)	304.64
4	World Bank-SBI credit line for solar rooftop development	660
5	Asian development bank (ADB) loan commitment to PNB for rooftop solar projects	500
6	New development bank (NDB) loan financing to Canara Bank for renewable energy projects	200
7	KfW (Kreditanstalt für Wiederaufbau) Germany, credit line for solar rooftop project construction	1,193
8	Battery production development central financial assistance for ACC based Battery production (INR 19,500 Cr from Ministry of Finance)	2,565.78
9	FAME commitment for EV manufacturing enhancement from Ministry of Finance	1.54

S. no.	Key financial institution (FIs) / funding schemes	Financial commitment (in Mn USD)
10	Central financial assistance (CFA) commitments for PM Kusum Scheme applications (INR 344.22 Bn)	4,529.21
	Total financial commitments	**10,689.14**

Further, it is projected that the investments in the clean energy sector would cross above USD 15 Bn in 2022. Some of the key clean energy commitments made recently by Indian corporates in both public and private sector are mentioned below:

Table 10: Key clean energy commitments by large Indian corporates and public sector institutions

S. no.	Name of the company	Investments/capacities committed in RE sector
1.	Reliance Industries Ltd	USD 10 Bn for RE ecosystem creation by 2024 and 100 GW of solar energy building and development by 2030.
2.	JSW Energy	USD 10 Bn investments/20 GW of RE capacity to be developed by 2030.
3.	NTPC	60 GW of RE capacity to be developed by 2032.
4.	Adani Green Energy	USD 20 Bn investments in the RE space over the next decade and 2GW/year for Solar PV production capacity by 2030.
5.	ReNew Power	ReNew Power aims to triple its capacity to 18.5 GW by 2025 by investing USD 9 Bn in wind and solar projects.
6.	Greenko power	USD 961 Mn of investment as Equity in RE space over the next decade.
7.	SJVN	SJVN has signed MoU with REMCL and BHEL for building RE projects of 25,000 MW by 2025 and 50,000 MW by 2040.
8.	ACME Solar	USD 1,040 Mn of investments in solar energy project in the form of asset acquisition of existing assets and energy bonds.
9.	REC Limited	A Green energy Bond of USD 500 Mn has been committed by REC towards RE development.
10	TATA Power	Target of developing 25 GW of Green energy capacity by 2030.

Source: (Garg, 2021), (Santanu Jaiswal, 2022), (Times, ET burea , 2022), (Times, economictimes , 2021)

In addition to the above, the lending portfolios of Indian financial institutions viz. State Bank of India (SBI), Power Finance Corporation (PFC), etc. now includes more RE assets than fossil fuel assets, a trend which has picked up significantly in the past 1-2 years (Garg, 2021).

The table below illustrates the topmost investors who have invested in the Indian solar sector:

Table 11: List of different financing institutions/investors working across the RE sector in India

S. No.	Category of the investor	Name of the investor/agency/banks/FI's	Type of financing (equity/ debt/ grants)
1.	Private equity player	Actis Goldman Sachs Brookfield Morgan Stanley KKR	Equity
2.	Sovereign wealth funds	Abu Dhabi Investment Authority (ADIA) Masdar Clean Energy Temasek Holdings GIC PL (Singapore)	Equity
3.	Global Utilities	EDF (Electricite De France) Sembcorp Enel S.p.A (Italy) Fortum Oyj (Finland)	Equity
4.	Government/PSUs	NTPC NHPC SJVN NLC	Equity
5.	Indian conglomerate/corporate	Adani Green Energy TATA Power Hero Future Energies JSW Energy	Equity
6.	International banks	BARCLAYS DBS (Deutsche Bank) Standard Chartered	Debt
7.	Government banks	State Bank of India (SBI) Union Bank of India (UBI) Bank of India (BOI)	Debt
8.	Indian private banks	Axis Bank Yes Bank HDFC Bank IndusInd Bank	Debt
9.	NBFC	PFC IREDA IIFCL TATA Capital L&T Financial Services	Debt
10.	Development finance institutes (DFIs)	Asian Development Bank (ADB) World Bank (WB) AIIB KfW USDFC	Debt/Grant

A few other key investments trends and outlooks are summarized below:

- As mentioned under the landscape assessment, the government has started supporting the domestic Solar PV manufacturers through various fiscal and policy measures to improve the competitiveness relative to the Chinese manufacturers.

- Under the 'Atmanirbhar Bharat' commitment to catalyse India's manufacturing capabilities, as part of the PLI scheme, the government has committed INR 45 Bn for high-efficiency solar PV modules which will be implemented by MNRE. Under this PLI Scheme, 10 GW capacity of integrated solar PV manufacturing plants (from manufacturing of wafer-ingot to high-efficiency modules) will be set up by Q4 of 2022-23 with a direct investment of around USD 1.8 Bn.

- Research by Crisil (Crisil, Solar module making capacity set to soar 400%, 2022) estimates investments of around Rs. 500 Bn by 2025 across the value chain of Solar PV cell and module capacity with 30 GW to 35 GW of fresh module capacity being commissioned in India.

- During the feed in tariff regime for wind energy, there were more than 13 active wind energy OEMs most of which were domestic players. After the introduction of auction mechanism (from 2016-17 onwards) which led to sharp decrease in wind energy prices, and reduction in profit margins of OEMs, the number of operating OEMs reduced to only around 7-8 (Swarnim Srivastava, 2020). In future, the OEM base is projected to consolidate further. However, solar-wind hybrid supply for reliable round the clock power, development of ultra-mega renewable energy parks in some of the states, offshore wind power (which is envisaged to become cost competitive) are some of the triggers that can boost the wind energy sector in the near future.

- In March 2019, the Government of India accorded RE status to large hydropower plants enabling newly commissioned large hydropower plants to enable them to receive concessions and green financing.

- The component-B of the PM KUSUM scheme has been implemented for the development of solar decentralized applications in the farming and agriculture sector. Under this component B, 1.75 Mn stand-alone solar water pumps are targeted to be replaced by the existing diesel pumps with financial assistance of USD 4.42 Bn to be implemented by 2022.

- The Government of India, along with United Nations Development Program (UNDP) and global environment facility (GEF) has launched a scheme for 'scale up of access to clean energy for rural productive uses' in three states: Assam, Madhya Pradesh, and Odisha with funding support of USD 23 Mn. The project aims to demonstrate and develop the market for off-grid renewable energy systems that have rural livelihood applications (UNDP, 2018).

Advanced energy systems:

Battery energy storage systems (BESS): According to NITI Aayog Study, under the accelerated scenario the annual battery market in India could surpass USD 15 Bn by 2030, comprising of almost USD 12 Bn from cells and remaining USD 3 Bn from battery pack assembly and integration. This case assumes two giga factories (of nameplate capacity 10 GWh of annual production) in 2022, 5 giga factories in 2025 to 26 giga factories by 2030. Under the more conservative case, it is expected that the annual battery storage market would be around USD 6 Bn annually assuming 3 giga factories in

2025 and 10 giga factories in 2030. The report concludes the above cases are possible with the successful local battery manufacturing industry and a supportive local supply chain. (Aayog N. , 2022)

According to the India Energy Storage Alliance (IESA), around 85 MWh of BESS are in construction or commissioned in India. As per NITI Aayog, India's BESS market is expected to reach more than 1,000 GWh by 2030. For this, India will need BESS manufacturing investments of around USD 16.5 Bn over the next five to six years (Sinha, 2022).

In case of BESS for off-grid systems, the ministry of new and renewable energy (MNRE) has a target to install 10,000 micro-grid/500 MW of micro and mini-grid systems, which will offer an additional opportunity to the tune of INR 33 Bn (USD 0.51 Bn) for battery manufacturers. The overall battery energy storage market for off-grid renewables in India is currently worth at INR 130 billion (USD 2 billion) in 2022 (India M. , 2021).

Electric vehicles (EVs): With government policy supporting the supply side (PLI scheme, EV charging stations) and demand side (FAME phase-II and other fiscal incentives) the EV sector has attracted investments from domestic and international OEMs. Some of the recent announced investments are tabulated below:

Table 12: Recent announcements by auto OEMs in EV value chain in India

OEM	Investment commitment (in Mn USD)	Month & year
Switch Mobility (Ashok Leyland)	130 Mn	May 2022
Suzuki	1,350 Mn	March 2022
Hyundai India	515 Mn	December 2021
Tata Motors	2,000 Mn	October 2021
Causis E-mobility	360 Mn	October 2021

Source: (e-Amrit, 2022)

As per NITI Aayog's report titled 'India's Electric Mobility Transformation', EV sales penetration in India by 2030 would be at 70% for commercial cars, 30% for private cars, 40% for buses, and 80% for two-wheelers and three-wheelers. Government plans to install EV chargers in several cities and highway corridors and expand private sector participation in the infrastructure rollout. It is projected that India's EV charger market would be worth USD 5.2 Bn by 2030 with around 7 Mn – 8 Mn EVs plying on Indian roads (Macquarie, 2021). As per research by RBSA Advisors, by 2030 the Indian EV market is estimated to grow by 90% to touch USD 150 Bn.

Hydrogen technology: The Government of India plans to spend USD 200 Mn over the next 5 to 7 years to promote use of hydrogen, and position India as global hub for green hydrogen production and exports. The potential of hydrogen as transport fuel is currently being explored through various initiatives including 18% hydrogen enriched compressed natural gas (HCNG) as an automotive fuel and promoting projects for hydrogen powered vehicles such as six fuel cell buses by Tata Motors and roll out of HCNG buses in the city of Delhi (Macquarie, 2021). The figure below provides investment trends observed in last one year.

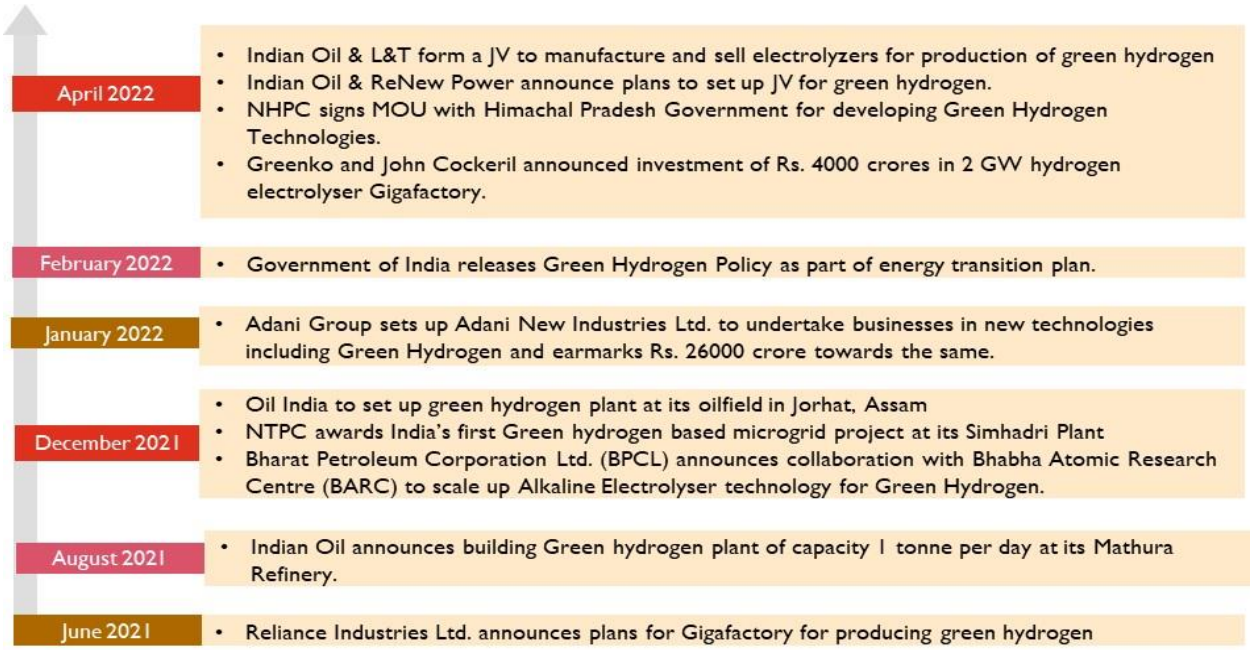


Figure 8: Investment trends in India's Hydrogen technology sector

Business and operating models

Renewable energy:

Grid connected solar & wind energy: In case of utility scale solar and wind energy projects, following are the prevalent business and operating models in India:

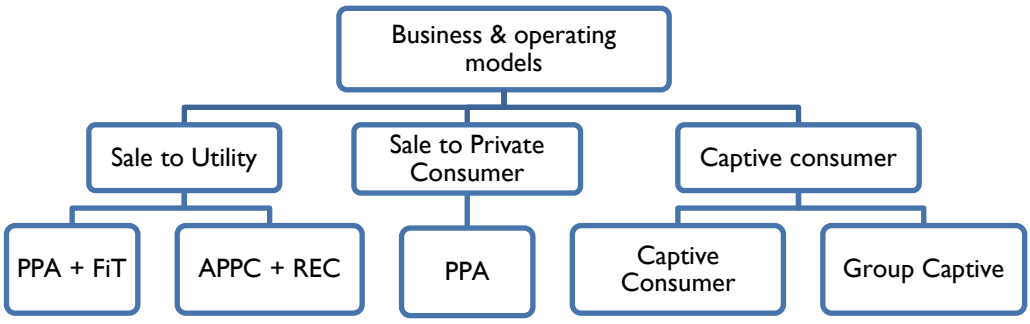


Figure 9: Business and operating models of utility scale solar and wind producers in India

Table 13: Terminology used in business models of utility scale solar and wind producers in India

Terminology	Explanation
PPA + FiT	PPA is signed with distribution company for 25 years where tariff is either determined through competitive bidding or feed-in tariff determined by regulator or the government.
APPC + REC	Developer sells power to the distribution company at average pooled power cost (APPC) which is fixed by each state and is usually lower than (PPA + FiT). The developer additionally receives renewable energy certificates (RECs) that can be sold to entities with renewable purchase obligations (RPOs).
PPA	Developer signs PPA with private consumer for medium (5 years) to long term (25 years). The price is based on negotiations. Private consumer needs to apply for open access of power. The developer can monetise the RECs if private consumer does not have RPOs.

Terminology	Explanation
Captive consumer	Energy intensive industry sets up solar/ wind plant for its consumption and fulfilment of RPOs.
Group captive	A group of industries pool resources to set up group captive solar/ wind plant for their consumption and fulfilment of RPOs (if any). The group captive industries sign ownership/ share sale agreement.

In case of grid connected solar rooftop systems, the prevalent business models in India (Anurag Mishra, 2018) are as follows:

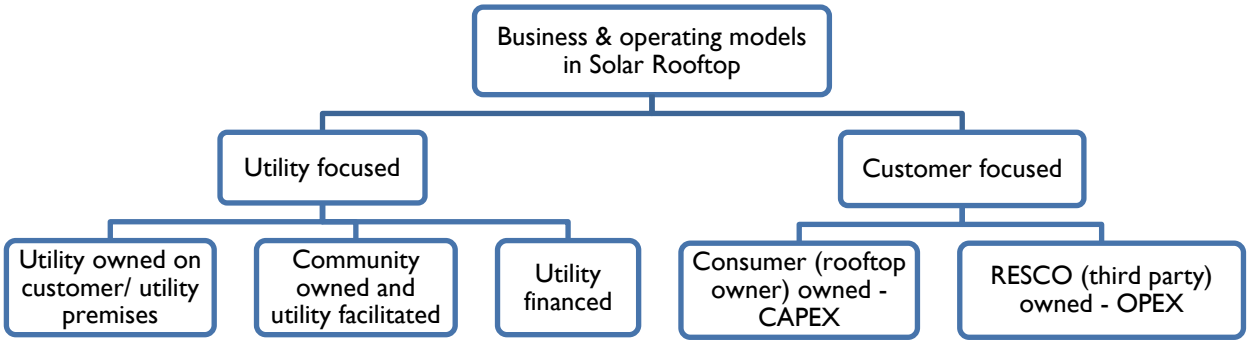


Figure 10: Business and operating models in solar rooftop sector in India

Table 14: Details of business and operating models in solar rooftop sector in India

Business & operating model	Explanation
Utility owned on customer/ utility premises	The utility invests capital to set up rooftop solar projects on customer premises. The consumers agree to buy the electricity generated, and lease their rooftops, to site the system to the utility for the useful life of the project (which is usually 25 years). As the utility can aggregate and procure large capacity up front, significant reduction in costs is available due to economies of scale. If the utility has potential to raise low-cost debt, avail tax depreciation on assets, costs can be further reduced leading to lower cost of solar supply and/ or higher margins. As the overall capital expenditure incurred by utility is lower than market rates, the cost of generation (vis a vis the CAPEX or OPEX (RESCO-based) models are reduced and can be passed on to the consumer.
Community owned and utility facilitated	The utility acts as the developer and directly enters into an EPC agreement with the consumers for the design, supply, engineering, installation, and commissioning of systems. Utility in turn can (if desired) enter into a back-to-back EPC agreement with a project developer. Utility can identify developer(s) through a competitive bidding process for developing the aggregated capacity.
Utility financed	The utility invests capital to set up rooftop solar projects on customer premises. Consumers agree to buy the electricity generated, and lease their rooftops, to site the system, to the utility for the useful life of the project (which is usually 25 years).
Consumer (rooftop owner) owned – CAPEX	The utility acts as the intermediary between the consumer and the financial institution, the cost of financing is lower due to economies of scale, lower cost of financing due to preferential rates available to the consumer, lower risk profile and lower transaction costs. Under this model, the utility collects, preferably through the electricity bill, equated monthly instalments (EMIs) on the loans taken by consumers for rooftop solar systems. EMIs are passed on to the financial institution by utility for a small service fee.
RESCO (third party) owned - OPEX	The utility identifies interested consumers in setting up rooftop solar systems and aggregates the demand but services them through power purchased through interested RESCOs. The utility signs a PPA with RESCO (that sets up, own, and

Business & operating model	Explanation
	operate the system on consumer premises) and a power sale agreement between the utility and consumer.

Hydropower energy: In Indian hydropower sector, the capex model (mostly adopted by state owned enterprises) and PPP models are the two common business models implemented for financing of hydropower plants. The operating model in vogue is mostly the developer/ owner who operates the hydropower plant. However, few exceptions exists where the owner leases the hydropower plant to separate entity (for e.g., hydropower assets in the state of Maharashtra are owned by the government of the state but operated by state owned generation utility).

Off-grid & decentralized energy generation: The business and operating models prevalent in India's off-grid and decentralized energy generation sector (Amy Davidsen, 2014) are as follows:

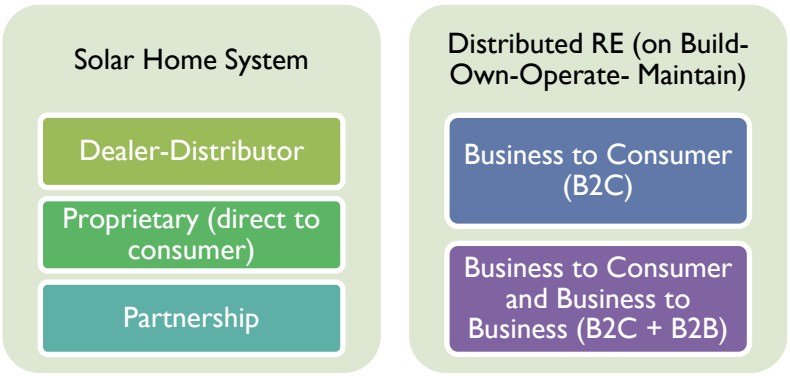


Figure 11: Business and operating models prevailing in India's off-grid and decentralised energy generation

While the models under distributed RE are self-explanatory, the solar home system models are explained below:

Dealer-distributor model: In this model, a company sells its products through the traditional channels of local general, specialty shops, and individual dealers.

Proprietary (direct to consumer): Companies with a proprietary distribution strategy have in-house storage facilities and reach the consumer often through a dedicated sales force or commissioned agents.

Partnership: Manufacturers often partner with non-traditional distributors such as NGOs of DFIs or governments, to tap into existing rural networks and many potential customers. Close to 80% of enterprises rely on traditional dealership networks like local specialty shops to sell their products. Assemblers and distributors also provide after-sales support and maintenance services. (Sachs, 2019)

Advanced energy systems:

Battery energy storage systems (BESS): Globally for utility scale BESS, three business models are prevalent namely

i. BESS as generation coupled asset and behind-the-meter (BTM) based business model,

ii. BESS as grid asset, and

iii. BESS as merchant asset.

BESS as generation coupled and behind-the-meter based business models are gaining importance as it provides both grid and customer services, acting both as a load (while charging) and a generation asset (while discharging). However, currently there are no business and operating models in the utility scale BESS sector in India, apart from a few pilot projects which are exploring these business models in India.

Electric vehicles (EVs): The EV space in India has seen fast emerging business models in three areas namely mobility, infrastructure, and energy. (Aayog N. , 2022)

Mobility & services	Infrastructure	Energy
•Micro mobility •Ride hailing •Car sharing •Car subscription •E-roaming •Carpooling/ ride sharing •Digital payment services.	•Charging infrastructure manufacturers •Charging point operators •Battery recycling •Battery subscription •Pay as you go •Battery as a service	•Storing excess energy •Equipment provider (solar) •Smart solution providers •Virtual power plant

Figure 12: Prevalent business and operating models in Indian EV sector

Many of the above listed business models are being tested for their viability.

Hydrogen technology: Currently efforts are on for testing the viability of the technology in India on pilot basis. There are no business and operating models in vogue.

Risks and uncertainties

Risks and uncertainties due to complex approvals and license processes

RE project developers in India frequently face legal issues in acquisition of land for the project, frequent delays in getting statutory clearances for commissioning and operationalising RE projects, and resistance from local communities to utility scale solar and wind projects. Farmers in the state of Rajasthan in August 2021 protested acquisition of land for setting up 1,500 MW ultra-mega solar plant (Law, 2021).

The process of environmental and social clearances, after assessment of impacts and coming up with a mitigation plan, is also often complex and the complexity is dependent on the project location. There have been several instances of hydropower projects getting significantly delayed due to such issues. Resistance to wind farms due to environmental and social issues have also been observed. For example, in August 2021 villagers from a small village in Kutch protested setting up of 11 windmills in protected forests around their village (Service, 2021).

Commercial risks and challenges

Poor financial health of the off takers/ distribution companies in India is a key deterrent for investors. In December 2021, the Ministry of Power urged banks to exercise caution while giving loans to state owned distribution utilities to avoid putting the financial system at risk. Further, non-enforcement of sanctity of PPAs by distribution companies and regulators and payment delays is a key risk.

In March 2021, Crisil (a rating agency in India) highlighted that wind power project developers in the four states namely Madhya Pradesh, Maharashtra, Rajasthan, and Andhra Pradesh with cumulative installed capacity of 9.5 GW are facing payment delays of around nine months due to persistent weak financial health of the distribution companies. The delays could put underlying debt of INR 300 Bn under stress (Crisil, For wind projects, payment risk resurfaces via discoms, 2021).

A few other commercial risks and uncertainties include:

- Given the nascent stage of the EV industry and its associated risks, start-ups cannot easily access debt capital and must largely depend on private equity and venture capital. In 2021, EV technology start-ups in India raised equity capital to the tune of USD 444 Mn across more than 25 deals.

- Fluctuation in prices of solar PV cell/ modules and frequent changes in import duties is key risk faced by Solar PV developers.

- High costs and import dependence of key elements (Nickel, Cadmium, Lithium, and other battery elements) is key risk perceived by RE developers and AES developers.

- Reduced paying capacity of end consumers is the key risk for development of off-grid decentralized systems in India.

- Lack of proven business models by developers in BESS.

Other risks and uncertainties

- One of the critical challenges facing rooftop solar adoption is the uncertainty around net metering provision. There is lack of uniformity of net-metering process among the states in India, causing uncertainty over the pace of execution for such projects. (Vibhuti Garg D. G., 2021) Further, shortage of skilled manpower required for operations and maintenance of the off-grid systems impact the project life of off-grid systems.

- Similarly, regulatory clarity is lacking for hydrogen energy development in India. The Indian government has a policy in place for R&D and demonstration of hydrogen technology, but the policy lacks clear and long-term vision and does not justify the end-use applications of hydrogen energy in India. Further, safety challenges in hydrogen storage, transportation and handling prevail. Since the technology is not yet proven in the Indian subcontinent the risk perception is high.

- Climate disasters like floods, landslides, and glacier disasters in the Himalayan regions are key risks for hydropower development. In February 2021, a glacial lake burst led to rise in water levels in Rishiganga river in Uttarakhand state. This damaged NTPC's 520 MW Tapovan

Vishnugad hydropower project which was under construction and washed away Rishiganga small hydropower project of capacity 13.2 MW (Nair, 2021).

- Uncertainty about the pace of growth of charging infrastructure, battery technology, and quality issues (recent EV fires) are some leading risks and uncertainties faced by the EV sector stakeholders in India.

Renewables and advanced energy systems are poised to play a key role in India's energy sector, with installed capacity expected to increase multi-fold by 2030. However, the success of this transition will require the penetration of hybrid commercial structures along with viable storage systems to ensure peak power requirement and grid stability. Another major leap that India and other global economies are pursuing is green hydrogen, which is expected to replace the conventional pollutant fuel in the fertilizer, ammonia, steel, marine, refinery, and heavy vehicle industries.

This transition from grey to green energy, backed by envisaged favourable policies, will provide a strong impetus to domestic investors and manufacturers to make RE a sustainable and competitive industry. Further, the viability of storage and green hydrogen will play a key role in the success and mass-scale adoption of RE and in boosting investments across the various clean energy sub-sectors.

While India has a strong domestic capital market and vibrant private sector (many of whom have already drawn up their investment plans to leverage this energy transition), it will be important for the government (both at the centre and states) to continue to provide the right policy impetus and adequately address the various risks and challenges which are often deterrent to foreign investors.

Maldives

Broad landscape assessment

Renewable energy:

The total installed capacity of RE in Maldives is about 21.5 MW as of December 2020. The FENAKA corporation limited, state electric company limited (STELCO) and the Male water and sewerage company private limited (MWSC) are the main electricity utilities in Male.

Grid connected solar energy: In January 2015, the Preparing Outer Islands for Sustainable Energy Development (POISED) project was initiated to help Maldives move towards self-sufficient, cost-efficient, clean energy by transforming the existing mini grids, including physical investments in the form of solar PV battery diesel hybrid systems. The objective was to decrease their excessive dependence on fossil fuels for power generation, reduce high electricity prices, and improve livelihoods. In 2020-2021, POISED added 1,794 businesses with improved access to electricity, with cumulative 2,104 businesses using solar PV battery diesel hybrid systems. Additionally, inhabitants with improved energy access also shot up from 39,939 in 2020 to 117,692 in 2021 (CIF, 2021). The total solar installed capacity in Maldives is around 19.15 MWp with the POISED project contributing to around 16.5 MWp of installed capacity.

Grid connected wind energy: The urban small vertical axis rooftop wind turbines have the potential to operate in all inhabited islands in Maldives under the net metering arrangement. Wind resources are not equally distributed across the country. The wind energy resource maps indicates that the northern half of the country is relatively richer in wind resource than the southern part. The estimated wind potential in Maldives is 80 MW. The total installed wind energy capacity has been around 1 MW comprising of small pilot scale projects in some of the outer islands of the country.

Biomass energy: Biomass resources, mostly coconut shells and coconut oil, are available in abundance in Maldives, but they are distributed in much dispersed small quantities across the country. The amounts of biomass are too small for local solutions, and their collection would be too complex and carbon intensive to bring them to a place with large energy demand. Marine biomass may become an interesting resource in the long term when technologies for converting them into energy are cost-effective. No assessment is present on the potential of marine biomass.

Advanced energy systems:

Battery energy storage systems (BESS): The solar PV project is being successfully implemented in hybrid systems (combined with BESS) in several inhabited islands through the POISED project. In a country like Maldives, renewable energy penetration is inherently limited by the grid capacity. Increasing renewable energy installation requires the grid to absorb intermittent surges caused due to unpredictable supply of renewable sources and it can create significant challenges in regulating voltage and frequency for isolated small island grids. Thus, such issues can be addressed by using advance battery storage technologies which uses energy management system. Thus, BESS is widely being used along with solar PV in Maldives to generate electricity in the islands and at present, near to 20 MW of such systems have been established so far, another 36 MW is in the pipeline.

Electric vehicles (EVs): Despite several assessments and strategies designed by the Government of Maldives about low carbon development, no concerted efforts have been made in the formulation of a plan or policy for EV implementation. Most of the strategies have focused on transport demand management, improvement in transport infrastructure, promoting biofuels, implementing efficient motor vehicles, and encouraging better traffic behaviour. There has been little mention of electric or hybrid vehicles. There has been negligible adoption of EVs. ILAA Maldives Pvt Ltd, a company in Maldives, has been manufacturing electric vehicles indigenously. (Forum, 2020)

Investment trends and outlook

Renewable energy: The detailed status of installations of hybrid systems in Maldives under the POISED programme (ADB, A Brighter Future for Maldives powered by Renewables , 2020) is as follows:

Table 15: Status of progress of POISED program (November 2020)

Phase	Details	Status
Phase 1	2.3 MWp installed in 5 islands	Completed
Phase 2	• 2.3 MWp installed in 14 islands • The European Investment Bank (EIB) support planned for 3.5 MWp in 13 islands	Ongoing
Phase 3	• 3 MWp installed in 27 islands	Ongoing

Phase	Details	Status
	• The EIB support planned for 2.9 MWp in 25 islands	
Phase 4	The EIB support planned for 11.2 MWp in 45 islands	Ongoing

Under the POISED scheme, ADB has funded around USD 38 Mn towards grants, USD 5 Mn as grants under the Japan Fund for Joint Crediting Mechanism (JFJCM), co-financing of USD 50 Mn of debt by European Investment Bank (EIB), and co-financing of USD 12 Mn of debt from Bettervest Investment funding.

In 2020, the AIIB approved USD 20 Mn Sovereign debt for financing 36 MWp solar power project along with 50 MWh of battery energy storage solution in selected islands in the Maldives. The project also involves grid modernisation for the integration of variable renewable energy with the grid, which will be financed under the proposed AIIB loan (AIIB, Maldives: Solar Power Development and Energy Storage Solution, 2020).

The Government of Maldives is also exploring installation of floating solar PV with ADB assistance and World Bank assistance under the Accelerating Renewable Energy Integration and Sustainable Energy (ARISE) programme. The approximate investments needed in new RE infrastructure, including the costs of distribution grid upgrade and storage, are USD 120 Mn in the base case scenario (which assumes RE contribution of 13%), and USD 260 Mn in the paradigm shift scenario (which assumes RE contribution of 38%). (Bank, Roadmap for the Energy Sector 2020-2030- A Brighter future for Maldives powered by Renewables, 2020).

The list of financing commitments from various stakeholders for scaling Maldives RE sector is provided below:

Table 2216: Key financial commitments for achieving Maldives' RE scale up target of 2030

S. no.	Key financial commitments	Amount (in Mn USD)
1.	Accelerating sustainable private investments in renewable energy – CIF & WB	18.0
2.	POISED- ADB, JFJCM, EIB & CIF	105.0
3.	Greater Male waste-to-energy project- ADB & AIIB	151.0
4.	Small-scale waste-to-energy- ADFD & IRENA	12.5
5.	Waste-energy Addu City- ADFD & IRENA	14.0
6.	Accelerating renewable energy integration for sustainable energy (ARISE)- WB, CTF, Canada Facility, and AIIB	86.0
	Total	**386.5**

ADB- Asian development bank, AIIB- Asian infrastructure investment bank, CIF- Climate investment fund, JFJCM- Japan fund for joint crediting mechanism, EIB- European investment bank, CTF- Climate technology fund, ADFD-Abu Dhabi fund for development, IRENA- international renewable energy agency, WB-World bank.

Business and operating models

Renewable energy: The operating model for RE projects in Maldives is:

a. direct ownership by consumers (mainly government bodies or utilities like STELCO or FENAKA) via net-metering arrangements, and

b. PPP (still emerging).

Advanced energy systems: No information regarding business and operating models exists in the public domain for advanced energy systems.

Risks and uncertainties

Macro-economic and financing risks and uncertainties

Maldives' economy is import dependent and is exposed to global uncertainties like fuel shocks, pandemic etc. Further, the country's public debt is very high (government debt to GDP ratio reached 115.6% in 2020) (Ratings, 2021), which severely restricts the borrowing capacity available for financing clean energy transition in Maldives. To add to this, high cost of financing in local currency and currency risk for financing in foreign currency are the key perceived risks by foreign investors.

Climate vulnerability

Maldives is one of the most vulnerable countries to the impact of climate change. The country lacks sufficient capacities and resources to respond locally, on time, and effectively to weather-related disasters. Annually over 90% of the islands report flooding, over 97% report shoreline erosion and 64% of islands report severe erosion (Behsudi, 2021). This poses risks to electricity infrastructure and investments and deters investment interest.

Other risks and challenges

A few other risks and challenges which act as deterrent towards investment and financing are:

1. Technology options for RE are severely limited in Maldives due to non-availability of land.
2. There is lack of local technical expertise in renewable and in advance energy sectors like BESS, EV related ecosystem (charging infrastructure, operation & maintenance etc.).
3. Inadequate policies, plans and regulations for AES like EV.

With DFI support, Maldives have taken several steps to transition towards clean energy. However, going from a fossil-fuel-based energy sector to a brighter future powered by renewables is a capital-intensive commitment, especially for a small island nation like Maldives. Private sector participation is crucial for achieving this transition. However, attracting private sector participation in Maldives' energy sector will be a complex challenge.

The country faces many difficulties in structuring and financing its envisaged clean energy projects. The main limiting factor is the reduced public sector financing capacity. This makes Maldives highly dependent on grants and soft loans from DFIs to boost private sector investments. An enabling environment to boost public sector financing capacity is needed. The Government of Maldives should provide such enabling environment by establishing adequate policies, building consensus, and developing institutional capacity.

Nepal

Broad landscape assessment

Renewable energy:

Nepal's RE sector is dominated by hydropower. Most of the hydropower projects are run-of-river (RoR) with little or no capacity to store water in a reservoir. The government has, however, realized that there is tremendous potential for the development of large-scale hydroelectric projects with sizeable reservoirs that can be used to store water to reduce seasonal variations in the availability of generation capacity. The wind and solar projects are not cost-competitive vis-à-vis hydropower.

Hydropower systems: Nepal's installed hydropower capacity stands at around 2,004 MW as of June 2022 (DOED, doed.gov.np, 2022), out of estimated economically exploitable hydropower potential of 42,000 MW (Bank, Nepal Energy Sector Assessment, Strategy and Roadmap, 2017). In terms of the recent progress in hydropower development, survey licenses for 302 projects with a total capacity of 15,885 MW have been already issued, out of which 172 projects have secured generation licenses and construction is ongoing for total capacity of 4,642 MW. Power purchase agreements have been completed for 244 projects with total capacity of 4,138 MW. (Herath Gunatilake, Hydropower Development and Economic Growth in Nepal, 2020)

Earlier all hydropower projects were owned by the NEA. However, in recent years, a considerable number of private developers are also engaged in developing small hydropower projects. NEA has also been investing in several medium and large-scale hydropower projects through Special Purpose Vehicle (SPV). In the projects under NEA's subsidiary companies and many of the private projects, approximately 30% of the shares in the project company are floated to the public, including project-affected people and employees of the developer. (Pogue, 2020)

Decentralized energy generation systems: Decentralized renewable energy supply systems, such as biogas, biomass, solar PV, micro-hydro, and improved cooking stoves, has been providing feasible and sustainable supply options in Nepal. Almost 30% of electricity supplied in the rural areas has been through the off-grid route. The Energy Sector Assistance program (ESAP) has been instrumental in supporting the Alternate Energy Promotion Centre (AEPC) to promote micro-hydro schemes of up

to 100 kW (Punam Karki, 2019). Besides loan financing available through commercial banks, there is provision of financial subsidy for these projects.

Advanced energy systems:

Electric vehicles (EVs): Nepal has special EV tariffs and time of usage tariff in place that can encourage EV uptake. Furthermore, a separate meter can be installed for a residential consumer for charging EVs, which enables such consumers to get lower tariff due to slab-wise tariff structure. Similarly, seasonal tariffs are in place for household consumers, consuming electricity through three phase lines, to promote usage of EVs. From April 2021 to January 2022, the EVs imported in Nepal soared by 600% to 1200 in ten-month period (Nepallivetoday, 2022). The OEMs are installing EV charging stations across the country to keep up with the selling momentum.

Investment trends and outlook

Renewable energy: The Government of Nepal is continuing to invest in hydropower projects and projects of total capacity of around 8,859 MW are under study or exploration phase (updated as on 25 May 2022) (DOED, GON Ongoing Projects :: Under Study Projects, 2022). The graph below provides past trend of investments in clean energy sector of Nepal.

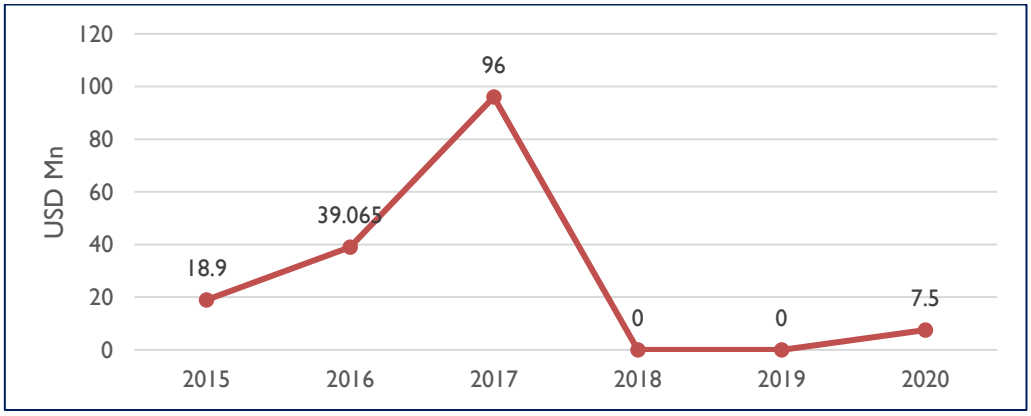


Figure 13: Trend of clean energy investments in Nepal
(Source: Climatescope by BloombergNEF, https://global-climatescope.org/tools/geography-comparison/)

Nepal has not been able to attract investments from private sector in non-hydro RE technologies due to predominant focus on hydropower development, relative lack of land for large scale solar projects and failure of the subsidy model. The Alternate Energy Promotion Center guided by Renewable Energy Subsidy Policy (2016) and Subsidy Delivery Mechanism Guidelines (2016) provides 65% subsidy to solar PV systems in public institutions in rural areas and 60% subsidy to solar PV systems for drinking water or irrigation pumping systems. However, the subsidy model has kept the prices low for long time which has resulted in non-operation of market forces effectively hindering private sector investments in other than hydropower RE. (Bhushal, 2019).

The list of financing commitments from various stakeholders for scaling up RE sector in Nepal is provided below.

Table 2417: Key financial commitments for achieving 2030 target of scaling up Nepal's RE

S. no.	Key financial commitments	Amount (in Mn USD)
1	UKAID fund to NREP Nepal	37.2
2	NIFRA energy bond	200
3	CREF (Central Renewable Energy Fund) for Nepal from various international financial institutions like KfW, DANIDA, DFID (UK), Norway, for the development of renewable energy systems	116.3
	Total	**353.5**

Advanced energy systems: There are around 300 electric cars, 2,000 electric two wheelers, and 1,200 battery operated tempos (safa tempos) plying on roads in Nepal as of 2020. In April 2021, NEA awarded contract for installation of 50 EV charging stations in seven provinces to a Chinese company. According to NEA, the charging stations will be installed along the highways and the city bus parks (Gupta A. , 2021). Several EV OEMs such as Kia, Mahindra, BYD etc. have plans to launch EV models in Nepal.

Business and operating models

Renewable energy: NEA owns and operates most of the large hydropower plants in Nepal. There are few private sector owners and operators of hydropower projects (such as Butwal Power Company, Sushmit Energy, etc.). Further, there are some other hydropower projects which are owned and operated or constructed on PPP basis (such as Upper Tamakoshi (456 MW), Rasuwagadi (110 MW), Middle Bhotekoshi (102 MW), Upper Trishuli (216 MW)) (Bhatta, 2019).

Advanced energy systems: The primary business model in EV is importing SKD or CKD and assembling them before selling to the customers. The business and operating models for EV charging station are primarily NEA owned and operated or OEM owned and operated. Any other innovative business and operating models in EV charging stations are not yet established.

Risks and uncertainties

Macro-economic and financing risks and uncertainties

Nepal is currently facing a challenging macroeconomic situation with depleting remittances, widening trade deficit due to unprecedented growth in imports, soaring imbalances in the balance of payments, and declining foreign exchange reserves. Prices of essential items have increased substantially and the local banks' capacity to finance domestic business has been severely constrained.

Further, the commercial structure in vogue exposes foreign investors to currency fluctuation risks. For example, payments from the NEA to RE developers under PPAs are denominated in Nepali Rupees, except for a few projects, which have dollar denominated PPA. Hedging options for the Nepali Rupee are prohibitively high due to a poorly developed hedging market. The cost of hedging the Nepali Rupee adds around 6% -7% to the borrowing costs and is a major deterrent to the inflow of foreign capital. In addition, interest rate volatility over the long gestation period of hydropower projects lead to uncertainty in term of project viability.

The volatile political environment (in the past 31 years there have been 28 Governments in Nepal), is another deterrent for foreign private capital in Nepal's clean energy sector.

Policy, techno-commercial and institutional risks, and uncertainties

Bureaucratic hurdles and perceived corruption are some of the reasons for many large-scale projects facing time and cost overruns. In 2016, Statkraft, a Norwegian hydropower developer interested in developing the 650 MW Tama Kosi III hydropower project with USD 1.5 Bn investment, backed out of the project after facing multiple bureaucratic hurdles in completing the required processes since 2007 (Shreshtha, 2016).

Further, lack of adequately skilled manpower, weak project management, and other techno-commercial risks (e.g., geological risks, earthquake, and climate change related disasters) often leads to time and cost overrun. A clear vision in the policy and regulatory framework with respect to RE and AES is also lacking and is evidenced by a lack of functioning power market in the country, required for enhanced RE uptake, even after several attempts at sector reform.

Political and macro-economic risks have been a key deterrent towards financing Nepal's clean energy transition. Even hydropower development in Nepal has been very slow despite the tremendous potential.

With a rapidly evolving regional power market in SAR, Nepal has the potential to be the clean energy battery for the region by exploiting its abundant hydropower resources and ensuring national level sustainability by leveraging advanced energy systems like EVs and hydrogen technology. The country's private sector stakeholders need to be a part of this transition and they will need enabling policies and innovative financing instruments to partner with foreign investors and DFIs to achieve country's sustainability objectives.

Sri Lanka

Broad landscape assessment

Renewable energy:

The Government of Sri Lanka has set an ambitious target of achieving 80% RE in the national grid by 2030 and 100% by 2050. (ADB, 100% Electricity Generation from Renewables An Asessment of Energy Sector in Sri Lanka, 2017) Solar, wind, biomass, and hydro are the commercially developed renewable energy sources in Sri Lanka. Apart from these, there are other sources such as wave energy, waste to energy etc. where Sri Lanka has made some progress in terms of conducting pilot projects. Sri Lanka has been exploring the idea of energy parks (solar and wind parks) and has plans for building such parks with donor support and through PPP mode.

Grid connected solar energy: A 100 MW solar PV park at Siyambalanduwa, Monaragala is being planned. Further, another 150 – 200 MW solar PV park is being explored at Poonaryn Peninsula (SLSEA, Energy Parks, 2022). Sri Lanka's Soorya Bala Sangramaya programme, introduced in 2016, envisions the deployment of 1 GW of rooftop solar capacity by 2025. RTS in Sri Lanka is driven by the net-metering scheme introduced in 2010. The Government of Sri Lanka has established a credit line of USD 50 Mn through loan from ADB to provide financing to rooftop solar projects on preferential terms under the programme Rooftop Solar Power Generation Project (Rooftop Solar Power Generation Project of the Government of Sri Lanka Funded by Asian Development Bank, 2022).

As on 31st December 2021, 70.92 MW of rooftop-based capacity was installed in Sri Lanka comprising 21.13 MW by commercial category consumers and 49.80 MW by residential category consumers (SLSEA, Soorya Bala Sangramaya (Battle for Solar Energy), 2022).

Grid connected wind energy: The 100 MW Thambapavani wind park (to the south of Mannar island), developed by Ceylon Electricity Board with financial assistance from ADB, was commissioned in March 2021 (Jaimes Kolantharaj, 2021). A feasibility study to undertake the second phase of the wind park (100 MW) on PPP basis is being explored. Another 240 MW of wind park is being explored at Poonaryn Peninsula (SLSEA, Energy Parks, 2022).

Hydropower energy: Hydropower is the main indigenous source of primary commercial energy in Sri Lanka. Estimated potential of hydro resource is about 2,000 MW, of which significant resource has already been harnessed. The geo-climatic condition in Sri Lanka is favourable for the mini hydro development, and several past studies have assessed the potential for the development of mini-hydro resources. A comprehensive study has been carried out as part of the dam safety and water resources planning project (DSWRP) of the Ministry of Irrigation and Water Resources, focusing on 13 river basins of the country, and the study has concluded that the total mini-hydro potential in the country as 873 MW. (CEB, 2021)

Other renewable sources of energy (biomass, waste to energy, etc.): Growing biomass as a fuel for the Dendro (wood mass) power generation gained attention in the recent past and at the end of 2020 total biomass-based capacity was 40 MW including both dendro and agricultural waste-based power generation. The growth of the biomass capacity in the past has not achieved the expected progress primarily due to the factors associated with biomass fuel supply mechanisms and only a moderate growth is expected in future.

As per IRENA, Sri Lanka has achieved over 54 MW of biomass generated power systems, (IRENA, Renewable Energy Capacity Statistics-Global Statistics (2021), 2021) combining both large scale biomass gasifiers and small sized biogas power generating units to small-scaled biomass gasification or combustion units. Sri Lanka's first waste to energy power plant of capacity 700 TPD, 10 MW was commissioned in Kerawalapitiya (CEB, 2021). The project was developed with private sector investment in association with the World Bank assistance.

Off-grid & decentralized energy generation: Total off-grid decentralized RE power systems in Sri Lanka now stands out at 13.96 MW (as of 2021), out of which pumped storage-based micro/ mini hydropower accounts for 6.16 MW, solar PV off-grid sources accounts for 7.8 MW capacity installed. (IRENA, Renewable Energy Capacity Statistics-Global Statistics (2021), 2021)

Advanced energy systems:

The updated estimates of number of electric two-wheelers, three-wheelers and four-wheelers plying in Sri Lanka are not available in the public domain. However, the import duties on the vehicles including EVs greatly impact the number of imported vehicles in Sri Lanka. No EV OEMs have a manufacturing facility for EVs in Sri Lanka. The EV OEMs are importing SKD or CKD and assembling them before selling to the customers.

Investment trends and outlook

The graph below provides past trend of investments in the clean energy sector of Sri Lanka.

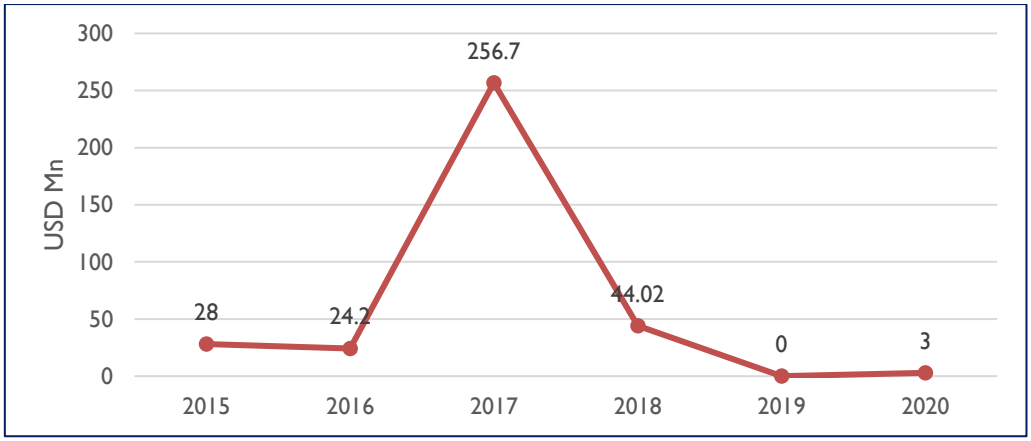


Figure 14: Trend of clean energy investments in Sri Lanka
(Source: Climatescope by BloombergNEF, https://global-climatescope.org/tools/geography-comparison/)

Sri Lanka is aiming to mobilize investments over USD 1 Bn from foreign direct investments (FDI) in transforming the power sector and renewable energy integration into their national grid.

These include proposals by Marubeni Corporation of Japan and India's Adani Group to set up renewable energy projects in the country. Marubeni Corporation has proposed an 800 MW solar and wind plant while the Adani Group has completed feasibility for a 500 MW solar and wind plant which is expected to be completed within two years.

During the first quarter of 2022, despite the ongoing economic crisis, Sri Lanka has attracted over USD 226 Mn in committed energy infrastructure projects, a 16% increase over the same period in 2021, as per the Board of Investment (BoI), under Government of Sri Lanka. Overall, the BoI is working on 49 project proposals worth USD1.46 Bn from countries including India, China, UK, US, and Japan in manufacturing, construction, and services sector.

Most of the investors are of the view that despite the economic turmoil Sri Lanka remains an attractive destination for infrastructure projects, especially in power and energy sector, hence they are confident that they can overcome this crisis shortly and development would be rightly back on track. (Economictimes, 2022)

The 103.5 MW wind energy project in Mannar islands which has been implemented with the financing help of ADB, is being planned for expanding the capacity to 200-250 MW in another phase, as per the technical feasibility studies conducted by ADB.

For solar, Sri Lanka has partnered with the Indian government for solar rooftop market development under the net-metering facility. A 100 Mn USD line of credit has been committed for the development of solar rooftop projects under this bilateral agreement by India, where residential buildings and institutions (such as schools, colleges, government buildings) would be covered.

Further, CEB has signed standardized power purchase agreement (SPPA) with Western Power Company Pvt Ltd, a unit of Sri Lanka's Aitken Spence group of companies, to develop a 2x10 MW municipal solid waste power plants at Muthurajawela and Karadiyana (CEB, 2021). These plants were constructed with an investment of 15 Bn Sri Lankan Rupees (USD 42 Mn) each. More investments are underway and preliminary studies are being undertaken for further assessment of using such technologies in future.

Business and operating models

Renewable energy: The utility scale RE projects (mostly hydropower) are mainly owned and operated by CEB. There are few privately owned and operated RE projects (such as Senok, Windforce). The trend of PPP financed RE projects is slowly catching up with setting up of wind parks and solar parks. In the rooftop solar sector, the business model is mainly the consumer owned rooftop solar system (CAPEX). A rooftop solar consumer or prosumer or both has the option to opt for the schemes namely (a) net metering, (b) net accounting, and (c) net plus. The details of these options are as follows:

Net metering: The consumer uses the electricity produced by rooftop solar PV system and exports the excess to the to the grid. If the energy produced by the consumer is more than his or her consumption, the extra units can be used anytime later, instead of when it is generated. There is no monetary transaction for the excess electricity exported to the grid.

Net accounting: Under this option, the consumer uses the electricity produced by rooftop solar PV system and exports the excess to the to the grid. The consumer gets paid by the distribution utility for the energy exported (excess generation) based on pre decided rate. On the contrary, the consumer will have to pay, at a pre-agreed rate, for the excess consumption over the generated electricity units.

Net plus: Under this option, the consumer pays for the total electricity consumed according to the existing tariff and he or she will be paid by the distribution utility for the entire quantum of electricity units generated and exported to the grid.

Advanced energy systems: Many OEMs from other Asian countries like India, China, Japan have shown keen interest in setting up assembling units/ manufacturing setup for EVs in Sri Lanka.

Risks and uncertainties

Macroeconomic and financing risks and uncertainties

Sri Lanka is currently undergoing a severe macro-economic crisis resulting from a balance of payment crisis, high debt to GDP ratio and other factors. This is likely to limit investments in clean energy projects in the short term. Due to the government and CEB's severe indebtedness, the RE project investors will perceive higher risk of delay or default by CEB as an off taker in the absence of credible sovereign guarantees under the standard PPAs. Further, CEB is expected to be financially constrained to develop adequate transmission network for evacuation of power from energy parks which will add to the risks and uncertainties.

Also, payments from the CEB to RE developers under the standardised PPAs are denominated in Sri Lankan Rupees. Hedging options for the Sri Lankan Rupee are prohibitively high due to a poorly developed hedging market. The cost of hedging the Sri Lankan Rupee adds around 6%-7% to the borrowing costs and is a major deterrent to the inflow of foreign capital. To add on, in the current situation with a rapidly depreciating local currency, availability of suitable hedging arrangements might be a huge challenge.

Furthermore, the present tax system in the country has become very complicated with frequent changes in coverage and rates, which leads to additional risks and uncertainties. For example, this is

a barrier for EV OEMs to invest in Sri Lanka's EV sector which currently does not have a local vehicle manufacturing industry.

Other techno-commercial risks and uncertainties

Sri Lanka faces high risks of RE curtailment which impacts project viability and investor returns. Wind project developers have been facing increased curtailment risks due to backing down instructions passed by load dispatch centres during seasons of high winds. Other issues include:

1. The standard PPAs for RE projects transfer the risks stemming from change in law to RE developers.

2. Limited availability of land is a key constraint for setting up utility scale RE projects/ energy parks in Sri Lanka.

3. There is lack of commercial plan for setting up EV charging station infrastructure.

The current economic crisis in Sri Lanka is likely to be a major deterrent to its plans for scaling up renewable energy and advanced energy systems. The current crisis will reduce investor confidence, the borrowing capacity of the country and interest of domestic players to explore new technologies with inherent risks in an untested market.

However, in the medium to long term, as the country tides over this crisis through international support and brings in appropriate and long-awaited reforms and policy changes, it is envisaged that private capital would be easier to mobilise to support the country's clean energy transition plans. Efforts towards achieving some of the 'quick wins' (i.e., plans and projects already in pipeline which are easier to finance) would continue in the meantime through innovative financing mechanisms.

Gap assessment

The gap assessment consists of quantitative financing gaps in scaling RE in the SAR countries and qualitative gaps discovered through the primary and secondary research during the study. The sections below provide the country gaps assessment.

Quantitative gap assessment

This section provides an estimation of the actual financing gaps that are required for each of the countries with respect to their actual or tentative commitments toward RE targets and financing commitments available in the public domain.

The table below summarizes country-wise estimate of quantitative gap:

Table 18 Summary of financing gap estimates of RE capacity requirements in SAR countries

Country	Estimated financing gap (in USD Bn.)		
	Equity	Debt	Total
Bangladesh (Target - 2041)	6.97	16.28	**23.25**
Bhutan (Target - 2025)	6.41	14.96	**21.37**
India * (Target - 2030)	132.29	308.68	**440.97**
India (EV)**	NA	NA	**180.00**
India (Hydrogen)***	NA	NA	**15.00**
Maldives (Target - 2030)	0.19	0.45	**0.64**
Nepal (Target - 2030)	9.02	21.06	**30.08**
Sri Lanka (Target - 2030)	1.74	4.06	**5.80**
TOTAL (in USD Bn)			**717.11**

* Estimated financing gap mentioned for India in USD Bn comprises of RE and BESS financing gaps combined as: RE financing gap of USD 228.6 Bn and BESS gap of USD 212.37 Bn by 2030.
** Estimate mentioned as available in public domain, comprising of the entire EV ecosystem to be built by 2030.
*** Based on estimate available in the public domain to set up 15 GW of green hydrogen electrolyser capacity by 2030 that would produce 3 million metric tons of green hydrogen

The total estimated financing gap for scaling clean energy investments in SAR countries is around **USD 717.11 Bn**.

There are certain assumptions that have been considered for the quantitative gap assessment for all the countries, besides some country-specific assumptions. The assumptions and limitations common to all SAR countries that underlie estimation of financing gaps are mentioned in detail below.

Assumptions & limitations:

- The targets for RE capacities have been mostly referred from the respective country-specific targets set by the governments of the respective SAR countries.

- For certain countries, the targets set by the respective governments are either overall RE target or solar energy targets. In such cases, the capacity targets for other renewable technologies have been derived assuming information available in the public domain and the overall target.

- In cases where the RE targets for the countries are available in percentage of the total power generation capacity by a future year, the RE technology specific target for the future year is arrived at considering the current installed power generation capacity and the projected installed capacity set for that future year (for e.g., Bangladesh 2041 and Bhutan 2025).

- The estimated financing commitments for each of the countries has been considered in this analysis as per the commitments made public by the respective governments or from the financing entities reports where such commitments are mentioned. There may be some government-to-government commitments or some domestic commitments which are not available in the public domain, such commitments have not been considered in this analysis.

- The commitments for most of the countries are allocated towards renewable or clean energy commitments. Technology-wise commitments are not available from those financing interventions. Hence, for the purpose of this analysis it is assumed technology-wise commitments to be allocated based on the target capacity allocated for that renewable technology for that respective country within a given year (details given in **Annexure-II**).

- A standard debt: equity ratio mix of 70:30 has been considered for estimating the financing gaps for each of the renewable energy-based technologies for finding out the financing estimates required to be achieved as per the individual commitments or targets been set by each of the SAR countries. This standardised debt: equity ratio has been considered for all SAR countries considered under this study.

- For estimating the financing requirement (in USD/ kW or USD/ MW) for various renewable technologies, reliance is placed on standard average capital costs of each technology prevailing worldwide in USD/kW or USD/MW. The actual debt equity mix for financing and the costs of capital may vary from country to country depending upon currency hedging and other associated risks. These hedging costs and other financial charges are not considered in this analysis.

Qualitative financing gaps and barriers assessment

This section follows from the previous chapter of market assessment where the current landscape, investment trends, business model, and risks and uncertainties in terms of clean energy transition were discussed. Below, for each of the SAR countries, we have focused in identifying the key gaps/ issues/ challenges which are acting as a deterrent towards commercial financing and mobilising private investments. This section also derives substantial insights from the primary interactions which were conducted as part of the study.

Bangladesh

Policy and institutional

a) Bangladesh's diesel/ HFO (heavy fuel oil) based rental power plants [which were allowed through the Quick Enhancement of Electricity and Energy Supply (Special Provisions) Act, 2010 to tide over the power supply crisis at that time] have high generation cost. To manage affordability and reduce the bulk tariff at while distribution utilities purchase power, the government provides substantial subsidies to reduce cost of fuel as well as for reduction of tariff. With current demand supply situation, there is surplus generation capacity in Bangladesh. However, the existing political economy nexus prevents withdrawal of the 2010 Act and closure of these rental plants. This distorts the power market and acts as a barrier for clean energy investments.

b) Currently, the RE sector suffers from lack of foresight, coherent policy, and systems to support the development of various RE technologies. In the Power Ministry, there is no separate and dedicated division for development of RE in Bangladesh. Thus, the conventional energy projects compete with RE projects for limited financial resources. Further, land availability and land title related legal issues is the biggest barrier for setting up utility scale solar projects in Bangladesh. There is no concerted effort from government/ associations/ authorities to resolve these gaps for enabling large scale investment mobilisation.

c) Other than infrastructure development company limited (IDCOL), there are no other institutions providing loan to finance RE projects at preferential/ lower rates of interest. Further, the process of obtaining loans from IDCOL is cumbersome and time consuming which acts as key barriers for project developers interested to finance RE projects in Bangladesh. Further, IDCOL does not list commercial utility-scale projects under its categories for eligible renewable energy projects.

Commercial and financing

a) Commercial lenders/ banks in Bangladesh generally tend to offer short tenure loans and loans with high rates of interest as they lack experience in understanding the risks involved in RE projects, risk mitigation measures and financing RE projects. This is a key impediment to scaling RE with commercial finance in Bangladesh.

b) Commercial lenders/ banks mostly have experience in financing conventional energy projects (based on fossil fuels) with PPAs that include capacity charge payments, and government utility acting as counterparty minimising the counter party default risk. RE projects mostly have single part tariff (with no capacity charge payments) and variable generation profile. Thus, RE projects lack the same comfort as that provided by conventional energy projects to the lenders. The commercial lenders/ banks are therefore wary in financing RE projects.

Bhutan

Policy and institutional

a) The private sector is almost non-existent (except for civil and electro-mechanical works for hydropower projects) in Bhutan for developing and financing power projects. The government plans and implements power sector projects in Bhutan. Entire financing, commercial or DFI assistance is routed through the government. This situation is expected to continue in the near future as the government considers hydropower sector as strategically important sector contributing to a large portion of Bhutan's GDP.

b) Compared to hydroelectric technology, the other clean energy technologies face many barriers which make them non-cost competitive with respect to hydropower. These include land terrain constraints for solar energy, narrow roads for transportation and high capital costs associated with wind energy, low availability of raw material and low energy generation at high altitudes for biomass energy. The renewable energy development fund (REDF) was provisioned for RE growth in Bhutan but till date there has not been any funds utilisation for RE projects. (IRENA, Renewable Readiness Assessment for Royal Kingdom of Bhutan, 2019). Further, for advanced energy systems such as BESS and EV there is no policy, strategy, targets, and plan for promotion and development of the sectors.

Commercial and financing

a) There are limited avenues for financing hydropower projects in Bhutan. There are very limited examples of private sector equity finance/ PPP (i.e., Dagachhu HEP), and in most cases, equity infusion is through grants or combination of debts and grants from DFIs or public sector financing or government funding. Instruments such as green bonds, PPP mode of financing are not yet tapped for financing hydropower projects in Bhutan.

b) The geological surprises contribute greatly to the hydropower project delays. The loan agreements (with DFIs) do not provide any flexibility in deferring loan repayments due to project delays, forcing the project to serve the loan even though the project is not commissioned.

c) The commercial banks in Bhutan do not provide any foreign exchange currency risk hedging instruments. Therefore, the hydropower projects financed using foreign currency debt need to approach banks in other countries like India for hedging currency risks. However, the same needs regulatory approvals from the central bank of that country which is often a cumbersome process. Hence, project viability gets impacted due to currency rate fluctuations.

India

The policy and institutional landscape in India are fairly matured as is evident in the analysis presented in the previous chapters. This is further corroborated by the large quantum of investments (both foreign and domestic) that have been seen in the country over the last decade in the clean energy sector. Hence, below, we have focused on few specific gaps, observed in financing clean energy projects in India, most of which are from a commercial perspective (while a few might also require indirect policy interventions).

a) **Economic, currency fluctuation, inflation:** In the current uncertain global economic environment, driven by the Covid-19 pandemic and increasing geo-political tension, global pullback from emerging markets and depreciation of the Indian Rupee with increased volatility has been adding to foreign investors' concerns over investments in RE sector in India.

   Furthermore, in this uncertain environment resulting in high inflation, project developers are often subjected to input costs variation after bidding which erodes the project returns.

b) **Off taker:** Poor financial and operational health of the state-owned distribution companies in India with total outstanding debt of the distribution companies as of May 2022 was USD 15.30 Bn. The average aggregate technical and commercial losses being 16.55% are one of the key reasons for non-bankability of grid connected RE projects (India P. T., 2022) (GOI, 2022).

c) **Taxation:** Ambiguity around the taxation of non-convertible debentures and masala bonds is perceived as key risk by foreign financiers. The ambiguity stems from the fact that if a Foreign Portfolio Investor (FPI) received less than 13.45% returns from the masala bonds, the fund is eligible for concessional tax slab of 5%, however, if the returns exceeded this threshold, the tax slab applicable to FPIs goes up to as much as 15-40% based on the country from which the FPI hails.

d) **Institutional capacity and business model:** In the institutional sector (comprising educational institutions and non-corporate institutions) there is lack of standardised procurement process and expertise which is the key reason for slow rate of adoption of rooftop solar by this segment. Further, for EV charging stations, a commercially feasible business and operating model is yet to emerge in India.

Maldives

The key gap/ barrier towards mobilising financing for clean energy transition in Maldives is the weak public sector financing capacity, which makes Maldives highly dependent on grants and soft loans from development cooperation to boost private sector investments. The limitation is also due to high public debt (owing to subsidies being provided by the government to reduce costs for the end users). Besides, currency inconvertibility risk exists for PPAs denominated in USD and payable in Maldives' Rufiyaa. In addition, the RE developers perceive high off-taker risk primarily due to utility's reliance on government subsidies as the retail electricity tariff is not cost reflective.

Nepal

Policy and institutional

a) The power generation sector is regulated through licensing in Nepal. This has created a market for trading of license where few players acquire licenses with the intention of either trading or selling them in the future instead of setting up RE projects. This creates uncertainty in the financial environment with respect to projects and the credibility of players.

b) Weak policy and regulatory mechanism in the power sector does not help in providing confidence to the developers who intend to invest. NEA, which is the single off-taker, has weak financials and poses off-taker risk. The electricity regulatory commission in Nepal is yet to be fully operationalised and exercise its powers pursuant to the Electricity Regulatory Commissions Act.

c) Frequent changes in government policy create an environment of uncertainty. For example, in 2016 the Government of Nepal reduced excise duty on EVs to 10% and waived the annual NPR 35,000 road tax on EVs. However, in the budget of 2020/21 the excise duty was increased to 30-80% depending on power capacity of the EV and increased customs duty to 80% (Kumar, 2020).

Financial and commercial

a) The domestic commercial banks have limited capital pool and the central bank has prescribed sectoral lending limits. This results in requiring a consortium of banks to finance even small scale 10 MW-30 MW RE projects.

b) The domestic commercial banks insist on guarantees and collaterals from the project promoters while financing the hydropower projects. The banks are not comfortable in project finance (non-recourse lending) in hydropower sector.

c) Commercial banks in Nepal have very minimum exposure to investments in infrastructure and energy sector. Despite 169 banks and financial institutions in operation, the total infrastructure exposure of the BFIs is USD 5.25 Bn, which is 17% of the total loans and advances (Bank, Nepal Energy Sector Assessment, Strategy and Roadmap, 2017).

d) Financing of large hydropower projects with foreign capital poses currency risks. There are no hedging instruments available to limit the foreign exchange volatility risks.

Sri Lanka

As discussed, Sri Lanka is currently undergoing an economic crisis and international efforts are underway to help the country recover from this current situation. It is envisaged that the country will undertake several much-awaited policies, regulatory and institutional reforms to overcome the current crisis. Such reform actions will span across the electricity sector, focused towards enhancing energy security and clean energy development, and reforms in the financial markets. Here, the focus is more on the financing gaps which emanates from commercial and regulatory issues, which can be addressed, in the short term, through innovative financing and a few quick-win non-financing interventions (as discussed in the next Chapter).

a) **Tariff and off-taker:** The end consumer tariff in Sri Lanka is non-cost reflective. Due to high indebtedness of CEB, investors associate high risks of delays or defaults in repayment with CEB as an off taker in the absence of sovereign guarantees for its contractual obligation. Furthermore, current standard PPAs transfer the risks stemming from change in law to developers (Dutt, 2020). Such an allocation of risks adversely affects the bankability of projects.

b) **Currency fluctuation:** The PPAs are denominated in Sri Lankan Rupee while the foreign developers' costs are in hard currency such as USD, Euro etc. exposing the foreign developer to currency risks. Due to fast deteriorating macroeconomic situation since January 2022 to April 2022, the Sri Lankan rupee depreciated by over 33% (Adaderana, 2022). Currency hedging options for the Sri Lankan Rupee are prohibitively high due to a poorly developed hedging market. Therefore, the cost of hedging the Sri Lankan Rupee adds 6–7% to borrowing costs and is a major deterrent to the inflow of foreign capital.

c) **Loan tenure:** The domestic banks have financed bulk of the small RE projects. However, they lack capacity and experience to finance large-scale RE projects. Further, they do not offer long tenure loans (>10 years). This requires the long term RE projects to explore additional avenues to refinance the balance loan.

d) **Banking regulations** in Sri Lanka, restrict a banks' exposure to single corporate borrowers (companies and related parties) to 40% of their capital base. This limits bank's ability to provide loans for large-scale capital projects. It is estimated that syndicate loan arrangements could be insufficient to mobilise finance at the scale needed to meet the 2030 RE ambitions (ADB, 100% Electricity Generation from Renewables An Asessment of Energy Sector in Sri Lanka, 2017).

e) **Scale:** Utility-scale RE projects tendered in Sri Lanka have been limited to size of 10 MW. Small projects are unattractive to international equity investors; they also raise transaction costs for the banks. This is one of the major reasons why decentralized off-grid systems are less developed in the market (Juerg Fuessler, Thomas Kansy, & and Randall Spalding-Fecher, 2019) .

Financing interventions

Specific financing instruments and opportunities for USAID and DFC in RE and advanced energy system sectors of SAR countries are identified in this chapter. A few innovative financing instruments that can address the gaps identified earlier are suggested along with opportunities for USAID and DFC to enable these innovative financing instruments. Lastly, a potential pipeline of short-term investment opportunities for DFC are identified based on the interactions as part of primary research.

Application of DFC's current suite of financing instruments

Currently, DFC's suite of products includes debt financing, equity investments, feasibility studies and technical assistance, investment funds and political risk insurance (USDFC, 2022). DFC has deployed these instruments across the world in the energy sector. A list of DFC's investments in the energy sector in Asia over the last few years is provided at **Annexure-III**.

The RE and advanced energy systems sectors of SAR countries are at different levels of maturity with India being the most mature market followed by Bangladesh, Nepal, Sri Lanka, Bhutan, and Maldives. Each of the SAR countries has some unique challenges and barriers as well as some common challenges and barriers in unlocking private sector capital. The following table recommends application of financing instruments from DFC's existing portfolio for addressing the gaps and barriers to unlocking private sector capital in SAR countries.

Table 19: Application of USAID/ USDFC's current portfolio of financing instruments for scale up of RE in SAR

Financing instrument	SAR country	Recommendation
Debt	Nepal	Debt in the form of line of credit to local/ domestic banks to lend to the RE sector projects.
	Bangladesh	
	Sri Lanka	USAID/ DFC can enter a consortium to extend finance as the domestic lenders lack sufficient experience to lend to utility scale RE projects.
	Maldives	Debt support to local utilities (FENAKA and STELCO) for small scale solar PV projects across the islands.
	Bhutan	DGPC/ RGoB has several large-scale hydropower projects in the pipeline. DGPC has expressed, need to avail debt and to diversify the lenders. In this context, DFC/ USAID may explore possibility of extending debt support to hydropower projects being developed in Bhutan.
	Nepal	NIFRA is raising finance through issue of USD 200 Mn bonds. The investments from NIFRA will primarily fund investments in

Financing instrument	SAR country	Recommendation
Investment funds		Nepal's large-scale hydropower and transmission infrastructure. DFC may subscribe to the issue of bonds from NIFRA.
	Bangladesh	BIFFL currently has no line of credit that it can extend to utility scale solar projects in Bangladesh. DFC/ USAID can explore the possibility of partnership with BIFFL in extending a line of credit that would discount the financing at the front end for large-scale solar PV project developers in Bangladesh.
	India	Ampyr Energy is an investment platform of AGP that invest in RE, BESS, sustainable infrastructure and communities, and green technologies across the agri-food sector. USAID/ DFC may evaluate potential investments in such investment platforms that provide access to diverse RE assets across India.
Equity	India	USAID/ DFC may invest in an equity stake in mid-size solar PV developers. In India mid-size solar PV developers (such as Oakridge Energy) are looking for equity investments, in the range of USD 5 Mn to USD 10 Mn, that can help them to scale up without losing ownership control.
Political risk insurance/ guarantees	Bangladesh	USAID/ DFC can provide political risk insurance or guarantees in these countries as foreign private sector developers avoid investing in these countries due to perceived high political risks.
	Nepal	
	Sri Lanka	
Feasibility studies and technical assistance	Bhutan	USAID/ DFC can conduct or finance feasibility studies and technical assistance in commercial-scale biogas plants, hydrogen fuel cell-based projects, waste-to-energy technologies, solar PV technologies, and BESS.
	Sri Lanka & Maldives	USAID/ DFC can conduct or finance feasibility studies and technical assistance in exploring geothermal power and ocean energy (wave energy, tidal energy, salinity gradient energy, ocean thermal energy conversion)
	Nepal	USAID/ DFC can conduct or fund feasibility studies and technical assistance in exploring potential sites for pumped storage hydropower projects in Nepal.

Innovative financing instruments

There is no internationally agreed definition of innovative financing. One of the World Bank report (WBG, 2015) defines innovative financing instrument as "any financing approach that generates additional development finance beyond conventional mechanisms by tapping new funding sources *or* enhances the efficiency of financial flows by reducing delivery time and/ or costs *or* being results-oriented by explicitly linking the funding flow to measurable performance on the ground." In some cases, the driving force behind the innovative financing instruments is two-fold, (1) to raise new resources and (2) to make the use of those resources more effective.

The key risks and barriers to enabling private sector participation in the SAR nations varies from country to country. To overcome some of the identified risks and barriers to unlocking private

sector capital for clean energy transition in the SAR countries, six innovative financing instruments are suggested in the study which are as follows:

1. Aggregation platforms and marketplace
2. Carbon crediting mechanism fund
3. Asset-backed securities
4. Infrastructure investment trusts or YieldCos
5. Currency risk hedging facility
6. First loss protection guarantee/ insurance

The concept of these innovative financing instruments and how they can help plug the identified gaps are discussed in the following sections.

Aggregation platforms and marketplace

The concept

The key features of aggregation platform cum marketplace are as follows:

- An online project sourcing/ aggregation platform can aggregate RE projects (such as solar rooftop projects) from multiple developers and package them together into larger deal sizes. For example, aggregating ≥ 100 MW generation can be used to access traditional debt financing from banks and other financing institutions.
- The platform would also help create standards for the collection of project documentation, making the projects more easily comparable and assessable as well as reducing the time needed for assessment.
- The standardised information can include off-taker information, project component, construction and performance documentation, and contracts (PPA, EPC contracts, etc.). The documentation should closely align with the due diligence requirements of the debt financing institutions.
- This would result in reducing portfolio risk by reducing financing cost for small-scale projects due to economies of scale in financing the projects and reducing single project specific risk by packaging multiple projects. This is likely to result in a significant reduction in transaction costs for the debt financiers.

- The platform would also help the overall market by sending a signal to the project developers about the standards they need to follow to get their projects accepted and eventually financed. As more projects get financed through the platform, it could set a market norm that will push developers to improve their standards.

In the adjoining representative figure, five small-scale rooftop solar PV projects with potential cost of debt (C_d) ranging from 10% to 14% are aggregated on the aggregation platform into a single project (portfolio) with lower cost of debt of around 10.5%.

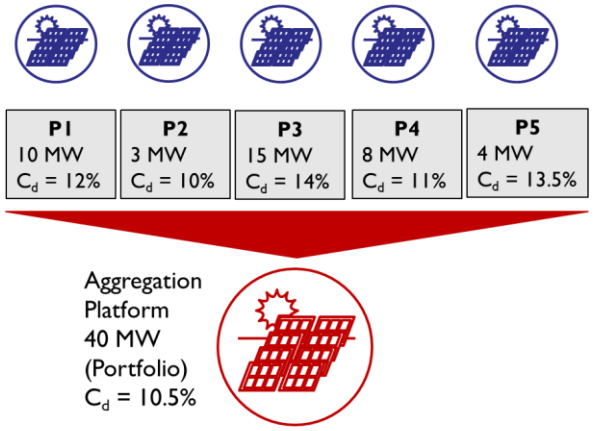


Figure 15: Illustration of Aggregation Platform

How it helps

The aggregation platform cum marketplace helps in addressing a few of the gaps identified in the previous chapter, for example:

- It would help in reducing the high cost of capital for RE projects (e.g., in Bangladesh), and even for a matured market like India for advanced energy systems like smaller scale projects on EV, BESS, etc. and off-grid projects.

- This instrument/ mechanism is also envisaged to support initial efforts for a country to get into different generation sources at a smaller scale (e.g., Bhutan, as it looks to diversify beyond hydropower through solar roof-tops and looks towards high-cost advanced energy systems like EV and BESS).

- Other policy and institutional challenges resulting in a financing gap (e.g., absence of a dedicated organization in Bangladesh, apart from IDCOL, offering concession finance for RE, and commercial banks preference towards tested conventional power projects) can also be addressed through this instrument.

Case study: Milk the sun

Milk the sun is a Germany based platform cum marketplace that offers a combination of the world's largest online marketplace for purchasing and selling photovoltaic systems, a professional online management tool combined with an access to the selected services for optimising solar investments. The platform connects the landowners, PV system installers, developers, investors, and other players in the ecosystem. The platform focuses on improving the flow of information between equity investors and projects, and provides value added services such as conducting initial due diligence of the project, standardization and transaction structuring receiving a fee in a transparent manner.

In India, the Energy Efficiency Services Limited (EESL), a state-owned enterprise, is implementing the world's largest energy efficiency portfolio across sectors such as lighting, buildings, electric mobility, smart metering, and agriculture solarisation. EESL focuses on solution-driven innovation with no subsidy or capital expenditure. It can do so using its pay-as-you-save (PAYS) model, which obviates the need for any upfront capital investment by the consumer. EESL aggregates demand from various sources (state utilities, public sector enterprises, etc.) and derives lower costs through economies of scale.

Opportunities for USAID/ USDFC to enable aggregation platform and marketplace model:

- Solar rooftop sectors in Bangladesh and Sri Lanka are likely to see a boost in the next few years. An aggregation platform can potentially help reduce the financing costs and bring standardisation. USAID/ USDFC may explore the possibility of creating or supporting such aggregation platform/ marketplace in Bangladesh and Sri Lanka to help scale up solar rooftop market.

- Bhutan, India, and Bangladesh are in the process to expand their EV market. A demand aggregation platform/ marketplace can help reduce the high upfront cost of the technology by leveraging economies of scale and competitive price discovery.

Carbon credit mechanism fund

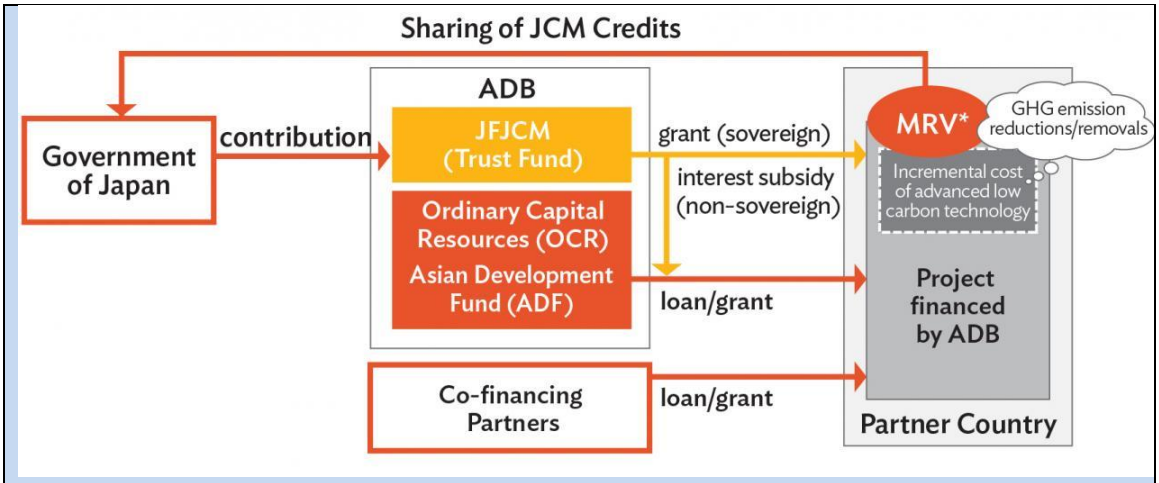
The concept

A carbon credit mechanism (through measurement, reporting and verification) may be established to unlock private sector capital from developed nations to finance clean energy transition. The returns for private sector are in the form of carbon credits that help them offset their GHG emissions and achieve the goal of Net Zero.

The following case study explains the instrument which has been currently used in Maldives.

Case Study: Japan fund for the joint crediting mechanism (JFJCM)

The JFJCM is a single-donor trust fund established in 2014 and managed by ADB. The fund aims to provide financial incentives for the adoption of advanced low-carbon technologies in ADB-financed and administered sovereign and non-sovereign projects. The fund provides grants and technical assistance to ADB projects utilising the Joint Crediting Mechanism or JCM. JFJCM provides a grant for the incremental cost of advanced low-carbon technologies. The maximum amount of support is 10% of the project cost (capped at USD 10 Mn) or USD 5 Mn if the project cost is less than USD 50 Mn. JFJCM provides an interest subsidy to ADB's loan.



(Image credits: ADB, Development Asia)

**MRV = Measurement, reporting, and verification of the greenhouse gas (GHG) emission reductions.*

The POISED project in Maldives is the first approved JFJCM project. JFJCM provided a USD 5 Mn grant to support the installation of a 0.5 MWh lithium-ion BESS with high-speed charge/ discharge features and advanced energy management system. The project is expected to contribute to increasing solar photovoltaic penetration capacity of the system with maximum demand from 33% to 54% and increase grid stability in Addu city. This investment ensures a significant reduction in the cost of electricity supply and enhances the security of supply while reducing GHG emissions.

The host country (i.e., United States or other partners contributing to the fund) can use the GHG emission reductions achieved in the form of carbon credits to meet the emission reduction targets of the host country and the partners.

How it helps

The carbon credit mechanism fund helps in addressing a few of the gaps identified in the previous chapter, for example:

- High cost of techno-commercially viable low carbon technologies, e.g., RE with BESS, is a key barrier towards financing and adoption in almost all the SAR countries. This is particularly true for the markets where these technologies are yet to be tested at a commercial scale, e.g., Bhutan, Nepal, Sri Lanka, and Maldives.

- Lack of a domestic financial market (as in Bhutan and Nepal) and weak public sector financing capacity (as in Maldives) makes these countries dependent on grants, soft loans from DFIs and bilateral sources.

The carbon credit mechanism fund has already helped Maldives and can also help the other SAR countries in addressing these gaps.

Opportunities for USAID/ DFC to enable carbon crediting mechanism:

- USAID/ DFC can be a co-financing partner with JFJCM to capitalise on JFJCM's momentum to facilitate diffusion of leading low-carbon technologies, products, systems, services, and infrastructure in SAR countries.

- Alternatively, USAID/ DFC can establish a carbon credit mechanism fund soliciting investments from private sector US corporations interested in ESG investing and earning carbon credits. The fund can facilitate diffusion of leading low-carbon technologies, products, systems and services, and infrastructure in SAR countries.

Asset backed securities

The concept

Securitisation is a process by which assets that have fixed, predictable cash flows are bundled together into a financial product called a security and sold to investors who then carry a portfolio risk instead of a single project risk. Below, the concept have been explained through examples and illustrations:

- The cash flows from the assets generate investor returns. For instance, the payment streams from the PPA, lease or loan agreement forms the cash flows underlying the security.

- For example, in the context of small hydropower assets in Bhutan and Nepal, utility-scale solar and wind assets in India, pooling of commercial and industrial rooftop systems or solar home systems for residential or energy access consumers in India, Bangladesh and Sri Lanka – each could be grouped into a security which is backed by the cashflow of underlying assets.

- Securitisation can help utility-scale project developers and rooftop solar and energy access companies refinance their existing portfolio at a lower capital cost by reducing the risk through a portfolio of diverse assets. Bundling utility scale with rooftop projects would mix public with private PPA risk, grid with off-grid risk, and large with small project execution risks.

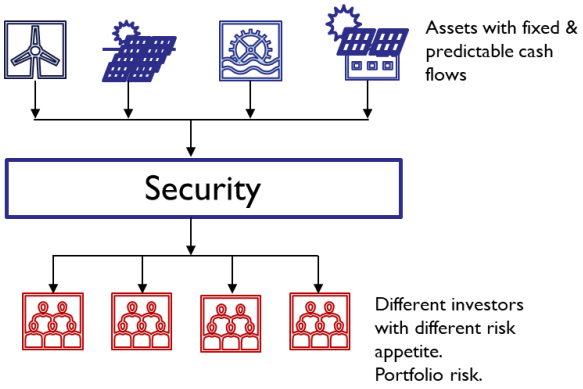


Figure 16: Asset backed security instrument

- Securitisation can allow project developers/ asset owners to reach a broader base of investors as securities are tradable at unit sizes much smaller than entire projects, thereby creating a more liquid market in RE asset ownership.

- Rating agencies are likely to rate the pooled assets according to the probability of payment default. Assets can then be categorized to match the risk/ return expectations of different types of investors. It is also possible to issue different tranches of securities for a single pool of assets. For example, senior and junior tranches could be issued, where the former has a right to payment before the latter and the lower risk offers a lower interest rate. This could make small hydropower, waste-to-energy, biomass, wind energy, and solar PV attractive for financiers with a lower risk or a high return appetite.

How it helps

While some of the specific benefits are explained above, asset backed securities can help countries like Bangladesh, which has no other institutions offering preferential or lower rate of interest for RE projects apart from IDCOL, to adopt a portfolio approach and get discounted finance/ re-finance.

Further, there are various small scale private sector developers exploring avenues to raise finances from non-traditional means such as crowdfunding platforms, social impact funds etc. which adopts a similar approach but are absent in the SAR. This instrument is envisaged to be an opportunity for such private sector players. Besides, this can also address the barrier related to unattractiveness of small projects to international and national equity investors and for banks, which has a high transaction cost for financing such small projects.

Opportunities for USAID/ DFC to enable Asset-backed Securities:

DFC can invest in risk assessment and securitisation platform for creating 'asset backed securities' for the RE assets in SAR countries. Such an instrument is likely to benefit RE developers in Bangladesh where the investment sources for RE projects are limited. Such an instrument (in the form of crowdfunding platform) can provide alternate avenues for small to mid-size project developers to raise finance in India also for small scale RE projects requiring access to finance in Sri Lanka.

Infrastructure investment trusts or YieldCos

The concept

Infrastructure investment trusts (InvIT) are much like YieldCos, which are legal entities into which developers bundle together and hold operational infrastructure assets. Key features are discussed below:

- Such entities are managed independently and may be publicly listed. Their shares are tradable either privately or publicly on the stock exchange. Company investors earn returns through the dividends from their shares in the InvITs. Dividends typically arise out of the cash flows from energy sales of the operational projects.

- Operational projects carry a lower risk than projects that are yet to be constructed. Therefore, by offering shares in the operational projects, a RE project developer can attract investors with expectation of lower rate of return and lower risk appetite.

- By reusing the capital freed from the sale of shares, the developer can pass on the benefit to the new RE projects. It is standard procedure for RE project developers to refinance the project debt after construction and a period of operation. However, with an InvIT, as in the case of securitisation, developers can easily bundle together a large and diverse pool of projects to reduce the risk at the portfolio level and further reduce the cost of capital.

- Easily tradable shares of InvITs offer liquidity and convenient sizing of investments to fixed assets such as large-scale hydropower assets, wind energy assets, solar PV assets, and transmission assets. InvITs facilitate access to a broader set of investors such as retail and institutional investors.

- The Securities and Exchange Board of India (SEBI) has had regulations in place for InvITs since 2014. Some of the mandatory SEBI InvITs regulations for infrastructure investment trusts in India are:

    - An InvIT must invest at least 80% of its total assets in completed infrastructure projects capable of generating income. The remainder of assets (up to a limit of 20%) held by the InvIT can be invested in under-construction infrastructure projects and various SEBI-approved equity, debt, and money market instruments.

    - InvITs must distribute at least 90% of their income to their unitholders as dividends on a bi-annual basis.

The typica/l structure of an InvIT is shown below:

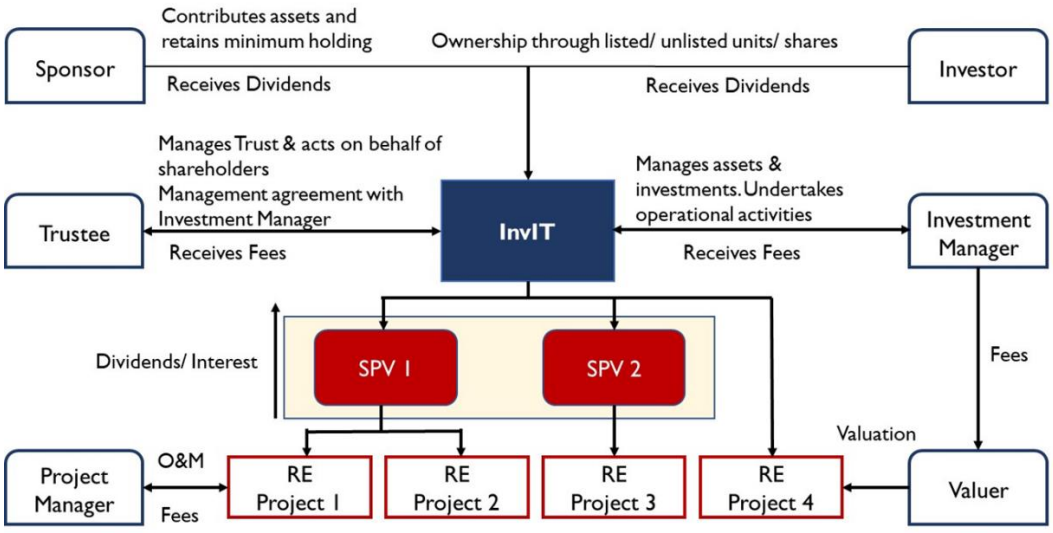


Figure 17: InvIT structure

How it helps

In India, private sector developers are keen to experiment with InvITs and there is a substantial scope to monetise operational assets through these for mobilising private investments. However, achieving 'AAA' status for all the operational assets to be pooled and listed through the InvIT is a challenge.

In countries like Nepal, Bhutan and Sri Lanka, no regulatory mechanism exists for InvITs and currently, the markets are not deep enough to support instrument such as InvIT. However, Nepal and Bhutan have operational hydropower assets (with scale) that can support monetisation through InvIT under appropriate regulatory mechanisms. The case for Sri Lanka is also similar.

Case Study: InvITs in India

- In India there are 19 registered InvITs with the Securities and Exchange Board of India (SEBI, 2022). The registered InvITs have roads, transmission networks, RE assets, and communication/ data fibre, water/ sanitation/ irrigation works, transport and logistics pooled assets.
- Anzen India Energy Yield Plus Trust is a privately held InvIT while Virescent Renewable Energy Trust is a publicly listed InvIT with both having RE backed operational assets. India Grid Trust and PowerGrid Infrastructure Investment Trust are publicly listed InvITs with transmission network backed operational assets.
- In 2021, the board of directors of NHPC approved formation of SPV/ subsidiary to monetise the operational hydropower assets of NHPC through an InvIT (TnDIndia, 2021).

]Opportunities for USAID/ USDFC to enable InvITs:

- In India where InvIT related framework is in place, USAID/ DFC can assist RE sector private sector developers in monetising their assets and recycling the capital through InvIT route. Achieving 'AAA' rating for an InvIT issue is a key barrier for RE developers intending to list InvIT. USAID/ DFC can participate as an anchor investor in RE InvIT issue (name lending) helping private sector RE developers achieve 'AAA' rating for the issue and help generate investor interest for successful listing of the InvIT issue.
- Because no supportive framework exists for InvITs in Nepal and Bhutan, USAID can explore monetisation of hydropower assets in Nepal and Bhutan by helping list them through InvIT route on the Indian stock markets.
- USAID can provide technical assistance in building capacity of securities market regulator in Sri Lanka for InvIT regulations/ framework.

Currency risk hedging facility

The concept

All SAR countries have experienced a devaluation of their currency against the USD in the past decade. Thus, currency risk is a key barrier faced by foreign financiers and investors keen to invest in RE sectors of SAR countries.

The rationale and concept of a currency risk hedging facility is explained below:

- The investments denominated in USD and Euro usually have low cost of capital (~ 1% to 3%). To be used locally, however, the currency devaluation risk needs to be hedged. The commercial instruments provided by commercial banks for hedging the currency risks costs an average of 6% to 8%, which renders the international financing uncompetitive vis-a-vis the domestic financing. An instrument that would lower these hedging costs would allow the RE developers to tap into a vast pool of debt and equity available in international markets. Increased competition from international flow of financing may nudge domestic banks in SAR countries to offer lower interest rates.

- For the RE sector, the opening of additional sources of finance is also a good hedge against any possible contraction in domestic lending due to power sector lending limits or a rise in lending to other infrastructure sectors. Many internationally active banks have high due diligence standards, which they would likely apply to SAR countries thus, raising the standards of project due diligence and execution.

- A potential solution may be lowering the hedging cost by USDFC to provide a direct subsidy to cover it entirely. This may be possible for some of the small countries such as Maldives. However, this may not be feasible for bigger markets such as India and Bangladesh because of the size of the financing required and the unpredictability of the overall cost as it is nearly impossible to plan a fixed-size fund that covers the currency risk. An alternate solution is to have a partial subsidy that covers only the most predictable parts of the currency hedging costs.

- Hedging costs can be broken down into different tranches, which include (a) the cost of the actual currency risk and (b) additional costs for counterparty credit risk, liquidity risk, and transaction/ deal facilitation. The currency risk is the most unpredictable part of the cost as it is based on balance of payment and other international factors. The remaining costs are more predictable. These can be used to design subsidy-based currency hedging facility for lowering the currency hedging costs.

- A currency hedging facility can provide benefits compared to a commercial cross currency swap. These include:

- The transaction structure and the upfront availability of the guarantee fee can eliminate the credit risk. Thus, the credit risk premium, which otherwise gets charged in a currency swap, gets eliminated.

- The currency hedging facility is more efficient use of public grants or subsidy, as it covers or targets only a certain tranche of the currency risk.

- If the currency depreciation is lower than expected, then the upside benefit remains with the currency hedging facility. This benefit can then be transferred to the donors or users later. This is a more optimal use of donor capital as compared to what would have been required in a commercial currency swap.

- A currency hedging facility can be structured for both debt and equity investments. The figure below provides an illustration of how a currency hedging facility can be structured.

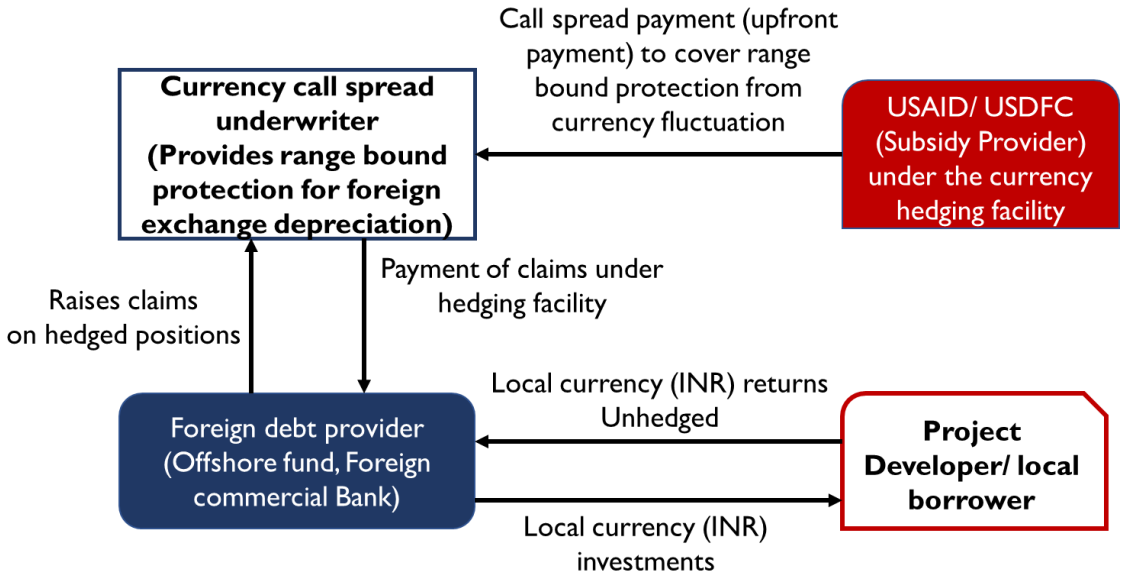


Figure 18: Structure of typical currency hedging facility for local currency PPA

- The currency hedging facility would determine the threshold of currency depreciation (e.g., up to 5%), which the foreign debt provider will have to bear. Beyond this threshold of currency depreciation and up to a user-specified upper limit (e.g., up to 10%), the coverage will be provided by the currency call spread underwriter[1]. The subsidy provider (usually a DFI) will have to make an upfront call spread payment [2]to cover the range bound

[1] An underwriter is any party that evaluates and assumes another party's risk for a fee in the form of a commission, premium, spread, or interest.
[2] A call spread payment is payment of fee to be made to the underwriter, in exchange for the services provided by the underwriter.

protection (>5% up to 10% of the currency depreciation). When currency depreciation is lower than expected (e.g., 6%), the benefit will remain with the hedging facility and can be returned either to the currency hedging facility provider or the foreign debt provider after the tenor (the length of time remaining before a financial contract expires) of the transaction.

- The transaction requires two separate tripartite contract agreements with project developer/ local borrower and the foreign debt provider. The first is an agreement with the currency hedging facility to cover currency risk up until the customizable annual currency depreciation rate (up to 5%). The second is an agreement with a currency risk underwriter to cover currency risk beyond that rate till an upper limit (> 5% up to 10%).

- However, it should be noted that such a currency hedging facility has its own limitations in providing currency hedging and may not be considered a permanent solution for foreign exchange rate variation risk. The currency risk hedging facility can be introduced selectively for high impact projects that face foreign risk variation as an insurmountable problem to unlock private sector capital in RE sector.

How it helps

A currency risk hedging facility helps to address one of the most common gap/ barriers impacting almost all the SAR countries – increasing currency volatility and non-availability of commercial instruments to hedge currency devaluation risk.

Opportunities for USAID/ USDFC to enable currency risk hedging facility:

The Climate Policy Initiative through its lab in India has developed conceptual solution for foreign exchange rate variation risk hedging facility. USAID/ DFC may further explore the concept to work out such a facility for SAR countries (more specifically Bhutan, Maldives, Nepal, and Sri Lanka).

First loss protection guarantee/ insurance

The concept

The rationale and concept of first loss protection guarantee/ insurance is explained below:

- The financial instrument protects or provides insurance for a certain percentage of capital against a financial loss due to default on an outstanding financial obligation (e.g., distribution utility to generator or C&I consumer to developer).

- The instrument can either be in the form of insurance that can be purchased by the financier or the asset owner; or it can be in the form of a guarantee fund sponsored by a third party (e.g., government or a DFI) to cover the potential losses that financiers can access at no cost.

- The financing instrument directly takes over a portion of the potential loss to the financier from a default, providing protection to the financiers up to a predetermined amount of financial losses, thereby enhancing the credit worthiness of projects. Such an instrument can help insulate the financiers or banks from the distribution utility payment default risk faced by RE developers.

- In cases where banks provide finance to RE projects on a non-recourse basis, the risk coverage offered by the guarantee or insurance will help in reducing the interest rate on loans. In cases where recourse loans are offered to the project developers, the guarantee/ insurance could help reduce the amount of collateral required from developers.

- Such an instrument is recommended for RE projects where the coverage is limited, specified and available under very specific conditions. Otherwise, the instrument can induce moral hazard (lack of incentive to guard against risk where one is protected from its consequences, e.g., by insurance) among beneficiaries. The financiers and developers may also be incentivised to develop riskier projects as the downside is protected by the guarantee/ insurance.

- In cases where the instrument is in the form of the guarantee, the government/ DFI deploying the instrument will be required to bear the costs. In cases where the instrument is in the form of insurance, the project developer would typically bear the costs.

How it helps

This instrument is envisaged to address some of the key financing gaps identified in the previous chapter, as discussed below:

- For India, this can be a mitigant to the high perception of default risk due to poor financial health of distribution utilities.

- Also, in case of solar rooftop developers in C&I segment for India, the developers are finding it difficult to find creditworthy C&I consumers as the market has saturated. While financing projects for not so creditworthy tier-2 and tier-3 C&I consumers, the rooftop developers are increasingly finding it difficult to finance it with low-cost finance due to perceived default risk by these tier-2 and tier-3 C&I consumers due to their lower creditworthiness.

- In Maldives, the RE developers perceive high off-taker risk primarily due to utility's (FENAKA, STELCO) reliance on government subsidies as the retail electricity tariff is not cost reflective. Similarly, for Sri Lanka, due to high indebtedness of CEB, investors associate high risks of delays or defaults in repayment with CEB as an off taker in the absence of sovereign guarantees for its contractual obligation.

Case Study: ADB's provision of USD 150 Mn credit guarantee to scale up India's solar power sector

In 2011, ADB sanctioned USD 15 Mn credit guarantee for loss protection. The guarantees were available to local and foreign commercial banks that financed private sector solar power plants in India. The guarantees covered 50% of the payment default risk on bank loans made to project developers.

The guarantee had limited success as it charged a fee to the participating banks which the banks felt was expensive. The facility could have worked better if the fee was charged to the developers instead. The developers would have found the fee reasonable as it would help them to improve the credit rating of their project and enable access to loans at lower rates.

Opportunities for USAID/ DFC to enable first loss guarantee/ insurance:

- USAID/ DFC may introduce first loss protection guarantee or insurance in Maldives and Sri Lanka where the foreign investors investing in RE projects may find such a facility useful to reduce the perceived risk of default by the state-owned utilities. The same might apply for Nepal and Bangladesh in case a sovereign guarantee is not applicable.

- In India, such an instrument can help private sector rooftop developers access finance at low rates for not so creditworthy tier-2 and tier-3 C&I consumers. The instrument would effectively improve the risk profile of such tier-2 and tier-3 C&I consumers. USAID/ USDFC may explore introducing the instrument for deepening the C&I consumer market for rooftop developers in India.

Potential investment pipeline of opportunities for USDFC in the short term

Based on the primary research conducted during the study, a list of potential investment short-term opportunities for USDFC is provided:

Table 20: Potential investment pipeline of opportunities for USDFC in the short term

S. no.	Entity	Country	Size of investment	Details
1	Ampyr Energy Platform of AGP Sustainable Real Assets	India	Few million USD	Ampyr Energy is currently in the process of raising USD 500 Mn for the Ampyr India platform focusing on RE and new technologies.

S. no.	Entity	Country	Size of investment	Details
2	Nepal Infrastructure Bank Limited	Nepal	Few million USD	NIFRA is in the process of issuing green bonds (~USD 30 Mn) and domestic bonds (~ USD 200 Mn) for investments in the energy sector (mostly hydropower).
3	Bangladesh Infrastructure Finance Fund Limited (BIFFL)	Bangladesh	Few million Dollars	Interested to explore co-financing opportunities with USDFC. The current Euro 50 Mn credit line from Agence Francaise de Development limits financing to 10 MW solar PV capacity. BIFFL is interested to have a credit line in place for larger utility scale projects.
4	Druk Green Power Corporation/ Druk Holding Investments (DHI)	Bhutan	Few million Dollars	DGPC is developing three small hydropower projects at three separate locations with cumulative capacity of 100 MW. DHI needs USD 118.48 Mn and is in talks with EIB and ADB currently. Also, DHI has two large hydropower projects namely Dorjilung HPP 1125 MW (in Mongar District) and Nyera Amari HPP 404 MW (in Samdrupjongkhar District), that are lined up with DPR under preparation. They are keen to explore DFC financing specially if it is concessional financing or equity-based financing.
5	Oakridge Energy	India	~ USD 7 Mn – 8 Mn	Oakridge Energy has been raising finances from social impact funds and crowdfunding platforms (mostly debt). Oakridge Energy is interested to get equity funding (minority interest).
6	Orion Group	Banglades	Undisclosed	A private sector developer with utility-scale solar power plant has raised FDI from Cargill Corporation and ADB in the past. They are interested in financing utility-scale solar projects with USDFC assistance and want to understand more details about USDFC products before sharing further details.
7	Sushmit Energy	Nepal	Undisclosed	Private sector developer with small-l scale hydropower projects in Nepal. Currently, have a pipeline of projects and can also bring to table potential investment opportunities in other IPPs in

S. no.	Entity	Country	Size of investment	Details
				Nepal (through IPPAN – the industry association). Wants to understand more details about DFC products before sharing further details.
8	Solartie	Bangladesh	Undisclosed	A women-led organization which focuses on solar PV project development, EPC and O&M, in Bangladesh which is keen to avail USDFC financing. Solartie has shared Information Memorandum for 5 MW solar PV project with government as counterparty and 1 MW solar PV industrial rooftop project in Bangladesh.
9	Department of Renewable Energy	Bhutan	Feasibility studies and technical assistance	DRE is interested to conduct feasibility studies along with USDFC for commercial scale biogas plants and hydrogen fuel cell-based projects, technical assistance in waste to energy technologies, solar PV technologies with storage systems.

Non-financing interventions

Non-financing interventions can address financing gaps emanating from policy, institutional, and commercial barriers and attract greater private sector participation. USAID can leverage its resources through varied non-financing interventions that include working with governments in SAR countries for:

- reforms in policy, institutions, PPP, and procurement,
- capacity building, and
- other interventions (e.g., transaction advisory, knowledge management, etc.)

A. Reforms (policy, institutional, PPP, and procurement)

a. Bangladesh

USAID can assist the ministry of power, energy, and mineral resources/ Power cell/ PPP office in preparing standard bid documents, codes & standards, and processes for RE procurement along with PPP contracts for increasing private sector participation in Bangladesh's utility scale RE sector.

b. Nepal

The key reform areas needed in Nepal which can facilitate investment mobilisation for clean energy are (a) unbundling of NEA, (b) greater integration of Nepal's power grid with India's power grid, (c) moving towards a competitive power market from a single buyer model, (d) regulatory strengthening, and (e) distribution sector reforms for operational efficiency. Also, Nepal needs to enable private sector participation in the transmission sector to bring efficiencies, drive down the costs and unlock private sector capital. While various DFIs are working with the government on a few of these areas, coordination between the donor community can help in identifying specific areas where USAID can focus on.

B. Capacity building

Non-financing interventions towards capacity building of state-owned utilities in Nepal, Bhutan, Maldives, and Sri Lanka in the areas of project finance, clean energy financing, various financial instruments and PPP will be beneficial as it will facilitate an enabling environment for private sector to interact with the public counterparts.

Such capacity building programmes will also be beneficial for domestic financial institutions in these countries. For example, commercial banks in Bangladesh lack technical skills in conducting due diligence of RE projects. USAID may conduct capacity building to train key staff in Bangladesh's commercial banks to acquire the technical skills for assessing various RE technologies.

C. Other interventions (e.g., transaction advisory, knowledge management, etc.)

a. India

   i. During the primary interactions, CESL expressed interest in technical assistance from USAID for (a) suggesting key changes to the PM KUSUM scheme to improve the business model and (b) exploring workable business models in the EV ecosystem.

   ii. USAID can provide technical assistance to MNRE/ Indian government agencies in exploring issuance of green government securities (G-secs) as an alternate mode of raising finance by attracting private sector capital for RE sector. USAID could assist the Government of India to raise finances for climate adaptation and climate mitigation activities by increasing private sector foreign investors showing preference to ESG products such a financial instrument. The UK issued its first Green Gilt issue worth GBP 10 Bn on the London Stock Exchange in September 2021 and the second Green Gilt worth GBP 6 Bn in October 2021.

b. Bhutan: The Department of Renewable Energy, RGoB has expressed its interest in technical assistance from USAID for development of a more robust platform integrated with advanced in-situ weather monitoring stations and real-time generation forecasts, and in enhancing the grid resilience through technological intervention to the threats from climate change such as landslides and other disasters.

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Annexures

Annexure-I

Brief profile of key stakeholders interacted during the study:

BANGLADESH

1.	**Name of primary stakeholder: Orion Power (A unit of Orion Group of Companies)**	**Country: Bangladesh**
	Brief profile: Orion group is one of the leading industrial conglomerates in Bangladesh over the years. With the support of a highly skilled management structure and 18,000 dedicated professionals, ORION has achieved a degree of success that is unparalleled in the country's business history. Orion has assumed the leadership role with its operations in the pharmaceuticals, cosmetics & toiletries, infrastructure development, real estate & construction, power, high-tech agro products, hospitality, textiles & garments, aviation management sectors. some of the units are successfully listed in the stock exchange. Besides these, Orion has extensively focused on infrastructure development and power generation businesses through major investment undertakings and significantly contributed to the country's national economy's stability through the right business to business strategy. The group's main objective follows the principle to reduce rural poverty and foster sustainable economic development of the country. Recently, Orion group executed a 134.3 MWp Solar power plant at Mongla area in Bangladesh, making it as one of the largest solar power projects in the country developed by a private sector organization in the Bangladesh power and energy segment.	
2.	**Name of primary stakeholder: Eastern Bank Limited (EBL)**	**Country: Bangladesh**
	Brief profile: Eastern Bank Limited, better known for its acronym EBL, has emerged as one of the most valuable financial institutions in Bangladesh, having its on-core strengths in IT, corporate governance, and servicing excellence in their respective businesses for many years. The guiding principle of EBL is to meet new challenges of contemporary marketplace and at the same time is focused on the power of personal touch and relationship banking. EBL started their venture in 1992 and carried forward with a confident stride and a pledge for impacting lives positively. Today EBL stands for service excellence, product innovation and world class banking experience. The most awarded bank in the country, EBL is also the first bank to be rated by the world's top rating agency Moody's and was awarded Ba3. The rating has been reaffirmed for the past three consecutive years. EBL's current rating is B1. Touching lives and impacting economy is the bracing motto of EBL. In power and energy, EBL supported projects have the capacity of generating over 2,100 MWs of electricity. EBL handles USD 5 billion worth trade volume of Bangladesh. In aviation financing EBL is an undisputed leader. EBL has so far financed USD 192 million in 12 aircraft including the national flag carrier Bangladesh Biman. EBL has acted as an intercreditor agent for a solar power plant project of 35 MW (AC) capacity, named as the Spectra solar power park, for a deal of USD 38.45 million. They had to structure their financing in such a way that the rate of interest was competitive with the local DFI offered Financing (@ 4-5% Taka currency), hence their role as an intercreditor agent was highly crucial in closing this deal.	
3.	**Name of primary stakeholder: Xolaren Ltd, Bangladesh**	**Country: Bangladesh**
	Brief profile: Xolaren Bangladesh was founded by an ambitious, dynamic, enthusiastic, and seasoned electrical engineer from varied industrial sectors in late 2018 with a strong vision to be recognized as a real engineering (mainly electrical) business locally and internationally.	

	Xolaren's objective is to provide a cutting edge, cost-effective, innovative products, solutions, and services, to cater ever emerging needs of our clients in the domain of engineering, renewable energies, energy efficiency/saving, and industrial services. Its clientele includes architects, contractors (both general and sub), owners, different industries, and government agencies. Xolaren's vision is to become Asia's leading climate change resilient engineering business providing their clients with the most advanced, accessible, and sustainable solutions in the areas of engineering, energy, environment (EEE) while upholding the highest standards of quality, efficiency, safety, and social responsibilities. In Xolaren, they perceive their mission to provide consulting, design, and engineering services in the areas of engineering, energy, industry, infrastructure, public sector, and environmental protection. They believe in delivering high-quality, cost-effective projects on schedule and to commit their client's satisfaction through continuous improvement of business practices in terms of safety, quality, and service delivery as well as sound environmental awareness policies.	
4.	**Name of primary stakeholder: Solar Tie Limited**	**Country: Bangladesh**
	Brief profile: Solar Tie Limited, a woman led solar start-up company, working to promote solar energy as a best suited renewable energy source across the country since 2017. Searching for a more viable and environment friendly alternative to business Solar Tie Limited decided to expand its operation with the solar project development, EPC, industrial roof top solar solution, RESCO model, solar Irrigation, independent solar power producer, design and consultancy, trading of solar product and energy efficient product in Bangladesh. This allowed Solar Tie Limited to provide a complete solar solution for its B2B and B2C. Solar Tie's mission is to serve the clients with commitments, ensuring safety and value-added products, having "working with sustainability" by upholding and maintaining reputation for quality, integrity, and honesty, to the full satisfaction of our valued clients. Solar Tie believes in the vision of developing solutions of all type of solar services for converting empty-unused rooftops into power sources by installing solar systems and making it into a reliable hub among clients, service holder and technical savvy individuals who are interested to explore this new energy segment.	
5.	**Name of primary stakeholder: Power Utility Bangladesh Limited (Bengal Solar)**	**Country: Bangladesh**
	Brief profile: Power Utility Bangladesh Limited inaugurated its journey in the early 1998 by generating power of more than 3 MW to manage the energy demand of the Bengal Group of Industries. The company then focused on minimizing the existing energy crisis in the country and spread its business in the renewable energy sector. To facilitate the unprivileged people of the remote areas with electricity and in fulfilling industrial demands, the company is contributing remarkable effort to achieve its goal. With its revolutionary growth, it has proved itself an established entity in the solar energy sector and leading the country for going toward green energy. Since inception, Power Utility Bangladesh Limited having the brand name "Bengal Solar" is solely promoting the use of solar energy and creating an awareness to reduce the environmental pollution by electricity generation. From 2000, "green energy made here" has become our slogan, emphasizing our belief in maintaining a sustainable environment for the future generation. Power Utility Bangladesh Limited pays attention to commercial, residential, and public sector off grid or grid–connected solar electric systems. With over 14 years of experience and a portfolio of numerous large, medium, and small solar photo voltaic projects, we are well–established and reliable. Power Utility Bangladesh Limited has affiliation with the topmost manufacturers of PV module and power conditioning devices of the world. We have a strong distribution network in distant parts of the country along with 56 branch offices and counting. We have a strong marketing team working passionately to reach the root level of Bangladesh and we are supported by a skilled technical team to set up and maintain renewable energy plants anywhere, anytime within the country.	

6.	**Name of primary stakeholder: Bangladesh Infrastructure Finance Fund Limited (BIFFL)**	**Country: Bangladesh**
	Brief profile: Bangladesh Infrastructure Finance Fund Limited (BIFFL) is a Bangladesh government owned non-bank financial institution with the purpose of encouraging investment in the infrastructure in Bangladesh. BIFFL and Infrastructure Development Company Limited are the only two government owned financial institutions responsible for financing infrastructure development in Bangladesh. BIFFL was established in 2011 with the Ministry of Finance being a shareholder. It was created with the aim to invest in large infrastructure projects like power plants, roads, ports, etc. On 11 March 2011, the company was incorporated with a paid-up capital of 16 billion Taka and obtained its license on 16 October from Bangladesh Bank. Its first loan for an energy company was to Sinha People's Energy Limited. Its first financing of an economic zone was a loan to Srihatta Economic Zone (Sylhet Economic Zone). It loaned 3.65 billion Taka (USD 42.2 Million) to Bangladesh Economic Zones Authority for the development of Srihatta Economic Zone in Sylhet. BIFFL provides funding for Public-private partnerships in Bangladesh. It had provided 21 billion Taka (USD 243 Million) financing to 26 Public-private partnership projects (PPP) by 2017 and has continued till date in many infrastructure projects till date.	
7.	**Name of primary stakeholder: Bangladesh Solar and Renewable Energy Association (BSREA)**	**Country: Bangladesh**
	Brief profile: Bangladesh Solar and Renewable Energy Association (BSREA) is the largest association of business houses and NGOs working for promoting the clean energy industry in Bangladesh. It is a non-profit organization established in 2011. Currently, it has 42 active members and 15 executive members. BSREA's main partner is Ministry of Power, Energy and Mineral Resources. BSREA also collaborates with other ministries such as Ministry of Finance, Ministry of Commerce. Among various institutions in renewable energy sector, BSREA is actively involved with Bangladesh Bank (Central bank of Bangladesh), Sustainable & Renewable Energy Development Authority (SREDA), Power cell and Infrastructure Development Company Limited (IDCOL). BSREA also actively collaborates with various development partners supporting the energy and power sector. The objective of BSREA is to promote the renewable energy sector through the facilitation of sustainable market uptake with partners and helping the country to achieve the sustainable development goals (SDGs) for the better future of Bangladesh.	

BHUTAN:

1.	**Name of primary stakeholder: Druk Green Power Corporation (DGPC)**	**Country: Bhutan**
	Brief profile: Druk Green Power Corporation Limited (DGPC) is an electricity utility company that operates and maintains hydropower assets of Bhutan. It was established in January 2008 through the merger of the three hydropower corporations of Basochhu, Chhukha and Kurichhu. Tala was merged later with DGPC in 2009, which has the largest hydropower capacity plant in Bhutan of 1,020 MW. With an installed capacity of 1,606 MW, the company's mission is to efficiently manage existing hydropower plants and accelerate hydropower development in Bhutan by developing new hydropower projects. As more projects were planned and developed and the electricity grid expanded to cover every nook and corner of the country, Bhutan embarked on restructuring the sector at the start of the 21st century through the adoption of a few new policies and legislative interventions. DGPC is at the helm of such developments in Bhutan's power sector. DGPC works in the vision to promote, develop, and manage renewable energy projects, particularly hydropower projects, in an efficient, responsible, and sustainable manner, to maximize revenues to the nation.	

2.	**Name of primary stakeholder: Department of Hydropower systems (DHS), RGoB**	**Country: Bhutan**
	Brief profile: The Department of Hydropower and Power systems (DHS) is a dynamic and efficient government agency committed to promoting sustainable hydropower for socio-economic development in pursuit of gross national happiness. The vision of DHS is to govern and facilitate integrated, regionally balanced, and optimal use of water resources for development of hydropower with minimal environment impacts. The primary objectives of DHS are as follows: • To ensure that hydropower exports generate maximum revenue for the nation. • To ensure secure, reliable, and affordable energy for the domestic consumers. • To provide enabling environment for participation of public and private sectors in development of hydropower resources. • Implement institutional reforms for efficient planning and management of the sector. • Develop and enhance professionals in hydropower development and management.	
3.	**Name of primary stakeholder: Department of Renewable Energy (DRE), RGoB**	**Country: Bhutan**
	Brief profile: The Department of Renewable Energy (DRE) has been established in December 2011 with the mandate to serve as the central coordination agency and the focal point of RGoB on all matters related to renewable energy development. Keeping in view the rising demand for electricity, concerns of global warming and Bhutan's increasing reliance on hydropower generation, the department aims to broaden the energy supply mix by exploring other forms of clean and renewable energy sources that will supplement hydropower generation shortage faced during the lean season. Given that fossil fuels are non-renewable, fast depleting and prices are highly volatile, the department also aims to pursue development of non-conventional renewable energy sources to reduce import of fossil fuels and enhance the energy security of the country. The department further wishes to keep abreast, explore, promote the emerging renewable energy technologies, and conduct research and development with an objective to make the technologies appropriate, affordable, and cost competitive in future. The department has three divisions with total staff strength of 36 regular staff, which are as follows: **1. Alternate energy division** **2. Planning & coordination division** **3. Research & development division** The vision of DRE is to ensure energy security and sustainable development of the country through promotion of renewable energy technologies, energy efficiency and conservation measures.	

INDIA

1.	**Name of primary stakeholder: AGP Sustainable Real Assets Holdings Pte Ltd (A subsidiary of AGP Group)**	**Country: India**
	Brief profile: AGP Sustainable Real Assets Holdings is an organization committed to investments in sustainable infrastructure and power projects. AGP's mandate is to stimulate, develop, invest, manage, and operate sustainable real assets that generate positive impact for people and the environment. We do this by focusing entirely on the financing, development, and operation of 'sustainable real assets'; transformative infrastructure assets that make positive contributions to satisfying the SDGs (Sustainable Development Goals). AGP group is working on its SDGs and is committed to deliver on 6 identified SDGs such as: clean water & sanitation, affordable clean energy, industry innovation & infrastructure, sustainable cities and	

	communities, responsible consumption & production, and climate action. AGP is committed to research, innovations, and collaborative working in sustainable development.	
2.	**Name of primary stakeholder: Oakridge Energy**	**Country: India**
	Brief profile: Oakridge Energy commenced their business of solar rooftop installations (residential, institutional, and commercial) in 2017 and has over 500 satisfied clients across India. A market leader across six north Indian states, Oakridge brings a blend of experience, technical expertise, and reliability in the rooftop solutions to delivering the best quality installations. Solar power can reduce your electricity bill by up to 60%. However, the process is laden with a lot of government approvals, design issues and technical questions. Oakridge helps the clients in addressing the above issues at their convenience and provides an in with an end-to-end solar installation with the best components at a cost that results in savings from day one.	
3.	**Name of primary stakeholder: Convergence Energy Services Limited (CESL)**	**Country: India**
	Brief profile: Convergence Energy Services Limited (CESL) is a green energy focused venture of The EESL Group owned by central public sector undertakings under the Ministry of Power, Ministry of New and Renewable Energy (MNRE). It offers interventions that solve multiple gap areas in the energy ecosystem by amalgamating seemingly independent sectors such as electricity, transport, home appliances and introducing models for adaptation at scale through government partnerships and innovative financing such as carbon markets. CESL focuses on energy solutions that lie at the confluence of renewable energy, electric mobility, and climate change. It builds upon the decentralized solar development experience in under-served rural communities in India, and over time, using battery energy storage, will deliver renewable energy solutions to power agricultural pumps, street lighting, domestic lighting, and cooking appliances in villages. CESL will also work to enable battery powered electric mobility and its infrastructure and design business models to increase the uptake of electric vehicles in India. CESL business models essentially operate closer to consumption thereby improving efficiencies in distribution of energy to last mile users. Demand-side energy efficiency schemes of national and state governments have been identified and partnerships created for distribution generation at scale. The Chief Minister Solar Agriculture Feeder Scheme of Maharashtra and the Solar-water pump-based PM-KUSUM program (Pradhan Mantri Kisan Energy Security and Upliftment Maha Abhiyan) are key policies being implemented by CESL.	
4.	**Name of primary stakeholder: Vikram Solar Ltd (VSL)**	**Country: India**
	Brief profile: Vikram Solar Limited (formerly known as Vikram Solar Private Limited) is one of India's largest module manufacturers, in terms of operational capacity, producing solar photo-voltaic (PV) modules (as on December 31, 2021), and is also an integrated solar energy solutions provider offering engineering, procurement and construction (EPC) services, and operations and maintenance (O&M) services. Vikram Solar is among the top five EPC players as per installed EPC base in India and have more than a decade of experience in executing EPC projects for solar plants and have more than 300 projects (As of December 2021). VSL is one of India's largest module manufacturers, in terms of operational capacity, with 2.5 GW of installed manufacturing capacity for solar PV modules, producing mono PERC, bifacial & monofacial and smart and polycrystalline PV modules across our factories located at Falta SEZ, Kolkata, West Bengal and at Oragadam in Chennai, Tamil Nadu. Both factories are strategically located with access to ports, rail and roads helping facilitate both our domestic as well as international operations VSL has a proven track record of more than 1.42 GW solar capacity in India (As of December 2021) VSL has a presence in almost 32 countries across ground mounted & rooftop projects and modules shipped globally. The vision of Vikram Solar has been to become one of the most valuable solar company delivering benchmark sustainable energy solutions worldwide.	

	The company's objective is to deliver reliable solar solutions through world class technology and innovation.

MALDIVES

1.	**Name of primary stakeholder: State Electricity Company Limited (STELCO)**	**Country: Maldives**
	Brief profile: The company emerged from modest beginnings in 1949 with an installed capacity of only 14 kW and providing electricity to just the residences in Male. Over the past five decades, the company operated as a government department under different names such as "Department of Electricity" and "Maldives Electricity Board". In 1997, "State Electric Company" STELCO, was formed. Initially, the number of customers were around 50 houses in Male'. Today the total number of customers have increased to 37,660 in Male' and 14,462 customers in different islands. Working with the customers in Maldives to correct any problems and taking actions to ensure that the problems do not recur, has been the major positives for the company. At all instances, striving to be honest, friendly, and courteous, and valuing all customers equally has been the guiding principles of STELCO. Making certain that failures in our services are rectified as soon as they are brought to our attention and giving utmost importance to treating personal information with the strictest confidentiality is one of the major objectives of STELCO. Under ADB assistance and under STELCO own budget, there are numerous Solar PV + Battery Energy Storage System (BESS) projects that are being installed in the Greater Male, and in the Outer Island region of Maldives and they are looking forward to expanding the Solar PV installations under the POISED program.	

NEPAL

1.	**Name of primary stakeholder: Nepal Infrastructure Bank Limited (NIFRA)**	**Country: Nepal**
	Brief profile: With an aim to meet the need of a dedicated infrastructure development bank in the country, Government of Nepal (GoN) and Nepal Rastra Bank paved the way for the establishment of infrastructure development bank through the annual budget for the fiscal year 2015-16 and the subsequent monetary policy of the same year. Accordingly, Nepal Infrastructure Bank Limited was registered under the Ministry of Industry and Commerce, Company Registrar's Office on 8th June 2018 as the first national level infrastructure development bank of the nation, promoted by Government of Nepal together with Banks and Financial Institutions (BFIs), life and non-life insurance companies, other private sector leading entities and a team of entrepreneurs. **Vision of NIFRA**- To be the nodal financial institution of the nation for infrastructure development. **Mission of NIFRA**- To accelerate investment in infrastructure. To bridge the financial gap for unlocking development potential. This marked as a significant milestone in the infrastructure sphere of the nation. The Bank obtained the operating license from Nepal Rastra Bank, the central bank of the country, on 11th February 2019 and formally started its operations on 6th March 2019. Being the first infrastructure development bank of the nation, NIFRA aims to bridge the infrastructure financing gap by raising resources from domestic and international market in the form of equity, debt, structured funds, and bonds and applying such resources into economically viable infrastructure projects by adopting proven models of infrastructure financing. NIFRA also aims to work as a nodal financial institution of the nation to accelerate the investment in infrastructure sector by developing the required ecosystem, to bridge the gap in financial resources required for country's infrastructure development, to promote the culture of private sector participation in infra-	

	projects and work closely with the Government of Nepal in planning and developing national policies for infrastructure development.	
2.	**Name of the Stakeholder-Renewable Energy Confederation of Nepal (RECON)**	**Country: Nepal**
	Brief profile: Renewable Energy Confederation of Nepal (RECON) is a common forum of associations of private sector involved in supply and delivery of alternative energy systems and services and NGOs involved in promotion of alternative energy in Nepal. It works as an umbrella organization of associations of private sector who are committed to lobby and advocacy and are highly dedicated in enabling environment to safeguard the rights and wellbeing of professionals and practitioners involved in renewable energy value chain. Eight institutions, such as, Nepal Biogas Promotion Association (NBPA), Nepal Micro Hydropower Development Association (NMHDA), Rural Technology Promotion Association Nepal (RuTPAN), Solar Electric Manufacturers Association Nepal (SEMAN), Solar Thermal Association Nepal (STAN), Water and Energy Consultants Association Nepal (WECAN), Biogas Sector Partnership Nepal (BSP-Nepal) and Resource Management and Rural Empowerment Centre (REMREC) had joined the confederation. The confederation plans for wider partnerships in the sector to extend more and help all stakeholders to well grow, so as more such institutions are expected to join RECON. Biomass Energy Entrepreneurs Associations Nepal (BEEAN) and Group of wind energy experts and entrepreneurs are also with RECON. Likewise, many academia, government, non-government and private sector-based experts, professionals, practitioners, and entrepreneurs are supporting RECON activities. RECON has been putting efforts in forging synergy with the institutions engaged in studies, research, development, implement, capacity building and finance for growth of RETs in the country. As such, with view to extend and exchange cooperation, the confederation had signed MoUs with Municipal Association of Nepal (MuAN), National Association of Rural Municipalities in Nepal (NARMIN), Federation of Nepalese Cottage and Small Industries Nepal (FNCSI) and Alternative Energy Promotion Centre (AEPC). Likewise, an MoU with Xihua University (Chendu, People's Republic of China) also has been signed for wider cooperation in study, research and knowledge exchange between Nepalese and Chinese academia and experts for promotion of renewable energy technology's (RETs).	
3.	**Name of the Stakeholder-Sushmit Hydropower Energy (Sushmit Group)**	**Country- Nepal**
	Brief profile: Sushmit Energy Pvt. Ltd is a leading hydropower project development company established with the aim of expanding hydro energy investment in Nepalese market. We specialize in the development and management of hydro projects with the aim of cost-effective investment and high level of profit to the investors and the nation as well. We are continuously working for leading the hydro energy sectors and qualified us in investment engineering. We value the time, money and energy of our partners and guarantee the highest return possible. Sushmit Energy is currently working on four hydropower projects aimed at generating at least 93 MW of electricity upon its completion. Backed by energy, financial and hydro experts we can many any size of project and accomplish the desired results. **Overall Objective:** The overall objectives of Sushmit International is to be the hydropower production and investment experts which will ultimately provide its stakeholders a high value of shares and dignity to be associated with.	

ENTIRE SOUTH ASIA REGION

1.	**Name of primary stakeholder: Asian Development Bank (ADB)**	**Country: South Asia**
	Brief profile: The Asian Development Bank (ADB) is committed to achieving a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty.	

	Established in 1966, it is owned by 68 members—49 from the region. The ADB envisions a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty in the region. Despite the region's many successes, it remains home to a large share of the world's poor: 263 million living on less than USD 1.90 a day and 1.1 billion on less than USD 3.20 a day. ADB assists its members, and partners, by providing loans, technical assistance, grants, and equity investments to promote social and economic development. ADB maximizes the development impact of its assistance by facilitating policy dialogues, providing advisory services, and mobilizing financial resources through co-financing operations that tap official, commercial, and export credit sources. ADB is assisting Sri Lanka for preparing the renewable energy roadmap for 2030 and is conducting a clear assessment of the various feasibility studies that are required for Sri Lanka to achieve this feat by 2030. ADB has implemented the Mannar Wind Park in Sri Lanka of 103.5 MW capacity, as a direct project financing to Ceylon Electricity Board (CEB) with assistance from the Government of Sri Lanka. For Maldives, ADB had prepared the Maldives Renewable Energy roadmap in 2020. Currently, ADB is implementing the POISED project in the Outer Island region in Maldives. Through this program ADB has funded around USD 38 Mn as grants for the development of solar PV Battery Energy Storage System (BESS) projects. With this the ADB has achieved to install solar PV plants in around 160 islands and the idea was to penetrate 10-30% of the energy demand from these solar PV installations. In the second phase, ADB intends to invest more in increasing the penetration of BESS and for upgrading the existing grid network.

Entire South Asia

1.	**Name of primary stakeholder: World Bank (WB)**	**Country: South Asia**
	Brief profile: The World Bank Group works in every major area of development. We provide a wide array of financial products and technical assistance, and we help countries share and apply innovative knowledge and solutions to the challenges they face. Since 1947, the WB has funded over 12,000 development projects, via traditional loans, interest-free credits, zero-low interest loans and grants. Three priorities guide the principles of work for WB with developing countries to end poverty and boost prosperity for the poorest people- people, peace, and prosperity. Helping create sustainable economic growth, investing in people and building resilience to shocks and threats that can roll back decades of progress. The WB through its various programs offer support to developing countries through policy advice, research and analysis, and technical assistance. The analytical work which WB provides often underpins their financing and helps inform developing countries' own investments. The WB has provided discounted financing for solar-rooftop development in India through a state-owned bank State Bank of India (SBI) to tackle high financing costs and within a year, most of the other domestic financiers lowered the rates charged by them comparable to the rates set by WB with SBI. The WB has been working with NITI Aayog (in India) for 2 years in developing market for battery storage, hydrogen energy and bringing the cost curve downwards while the government worked on the supply side. The WB has committed a package of USD 1 Billion across various operations to expand the market for battery storage systems across India.	

Annexure-II

Financing gap estimation under quantitative analysis for each SAR country:

Bangladesh

Renewable energy:

Under the draft National Solar Energy Roadmap and Power Sector Master Plan, Bangladesh has set a target to achieve 40% of the electricity consumption from RE sources by 2041 as its commitment towards achieving net zero ambition.

Assumptions and limitations:

1) The draft National Solar Energy Roadmap aims to achieve up to 40 GW of RE by 2041, with 40% solar rooftop-based systems contributing around 40% of the total target, that is, 16 GW from solar power capacity. (pv-magazine, 2021)

2) Targets for scaling wind energy and hydro energy in Bangladesh are not available in the public domain including in National Energy Sector Master Plan. Therefore, for this analysis RE projects which have been already planned and are ready for implementation, as per SREDA and Bangladesh power development board (BPDB) sources are considered as targets for wind energy and hydro energy development till 2041. SREDA has identified some of the potential sites for wind energy projects some of it has been already planned and some of it are in implementation stage. There are around 457 MW of wind energy projects that have been planned in Bangladesh, with some of the implementations have already been started (SREDA, SREDA | National Database of Renewable Energy, 2022).

3) For hydro energy, Bangladesh water development board (BWDB) and BPDB had identified some of the potential sites for hydropower generation which are mainly of small and mini hydro type capacity. The hydropower sites which have been identified and are in planning stage are mostly situated in the north-eastern part of the country under the flood action plan (FAP). Combining all the micro/ mini/ small hydro potential of the country the total capacity has been assessed to be around 351 MW (Wazed, 2008). A capacity of 2.80 GW (2,801 MW) of off-grid decentralized energy generation has been targeted (which comprises of solar home systems (SHS), irrigation pumping systems and solar mini-grids) respectively, out of the 40 GW estimated for RE by 2041 (SREDA, Renewable Energy Installed Capacity, 2022). No such target for biogas, biomass energy or WtE has been determined so far in the master plan framework yet.

4) The Government of Bangladesh has established two flagship green energy funds, namely the Bangladesh climate change trust fund (BCCTF) and the Bangladesh climate change resilience fund (BCCRF), which, as of now, are the main sources of green finance in Bangladesh:

a. The Climate Change Trust Act of 2010 established the BCCTF with the country's own budget. With an initial allocation of USD 100 Mn, in 2010, the accumulated resources of the fund stood at approximately USD 400 Mn in 2017, with a declining trend of yearly allocations.
b. The BCCRF is a donor-aided fund established in May 2010 that received donations of USD 188.2 Mn from various donors, which includes: United Kingdom (USD 96.9 Mn), the United States (USD 13.0 Mn), Switzerland (USD 12.5 Mn), Sweden (USD 19.3 Mn), Australia (USD 7.1 Mn), Denmark (USD 1.8 Mn), and the EU (USD 37.6 Mn), between 2010 and 2015 (Hossain, 2022). Bangladesh also has received commitment from global environment facility (GEF) funding of around 143.59 Mn USD. (Hussain, 2018)
c. Bangladesh has received financing commitments from the World Bank under its scaling up of renewables for low-income countries program (SREP) under World Bank, for an amount of 110 Mn USD. This was later extended for (scaling up for RE (SURE) program for renewable investments which has commitment of around 89.17 Mn USD by the WB for Utility scale Solar PV projects.
d. The climate investment fund – scaling up renewable energy program (CIF-SREP) (Hartwig Schafer & Seong, 2019) for Bangladesh approved USD 75 Mn in funding for Bangladesh as well for other renewable project financing such as waste to energy, biomass, off-grid decentralized systems.
e. Besides the RE financing facility (REFF) from World Bank has committed to lending of USD 108.23 Mn for a solar park project (at Feni-Chittagong, 100 MW Solar PV Plant) and USD 3.64 Mn for providing technical assistance (TA) for various solar utility scale projects, totalling USD 111.87 Mn. (Hartwig Schafer & Seong, 2019)
f. IFC has demarcated USD 15 Mn for supporting utility-scale solar and wind, and rooftop solar, and the ADB has demarcated USD 29.95 Mn for supporting off-grid solar (mini-grid and irrigation) in Bangladesh.

Total financing commitments which have been considered under various schemes and under various funding programs of various DFIs are mentioned below:

Table 21: Total financing commitments for scaling RE in Bangladesh

S. no.	Name of the financial institution (FIs) / funding schemes	Amount (Mn USD)
1.	Bangladesh climate change trust fund (BCCTF)	400
2.	Bangladesh climate change resilience fund (BCCRF)	188.2
3.	Global Environment Facility (GEF)	143.59
4.	Scaling up of Renewable Energy Program in Low Income Countries (SREP), under the World Bank (WB)	110
5.	Climate Infrastructure Mainstreaming Through Bangladesh Funds	40
6.	Scaling up Renewable Energy Program (SURE) in Bangladesh from World Bank (WB)	89.17
7.	Renewable Energy Financing Facility (REFF) from World Bank (WB) (108.23 + 3.64)	111.87

S. no.	Name of the financial institution (FIs) / funding schemes	Amount (Mn USD)
8.	CIF-SREP Investment Plan (Scaling up Renewable Energy Plan) for Bangladesh approved in 2015, was approved USD 75 Mn funding for the following renewable energy implementation, in cooperation with World Bank, the International Finance Corporation (IFC), and the Asian Development Bank (ADB) as: 4. USD 29.25 Mn for utility scale grid connected renewable projects and a Waste-to-Energy pilot project approved by World Bank 5. IFC Commitment for Utility scale grid connected solar and wind projects and rooftop solar projects for USD 15 Mn 6. An amount of USD 29.95 Mn approved by the Asian Development Bank (ADB) for funding of off-grid decentralized projects, solar irrigation, and mini-grid projects	75
	Total financial commitments	**1,157.83**

5) A debt-equity mix of 70:30 is assumed for financing the RE sector projects in Bangladesh.

6) Currency conversion factor considered: 1 Bangladesh Taka (BDT) = 0.012 USD or 1 USD = 86.44 BDT

Estimate of financing gap:

The summary of estimated financing gap for scaling RE to achieve the target by 2041 is as follows:

Table 1622: Summary of estimated financing gap for scaling Bangladesh's RE considering 2041 target

S. no.	RE technology	Target capacity by 2041 (MW)	Capacity installed (as of March 2022) (MW)	Estimated gap in capacity (MW)	Financing gap (in Mn USD)		
					Total (100%)	Equity (30%)	Debt (70%)
1	Grid connected solar energy	16,000	554	15,797	18,057.07	5,417.12	12,639.95
2	Hydroelectric energy	351.20	230	121.2	339.36	101.81	237.55
3	Wind energy	457	2.9	454.1	671.53	201.46	470.07
4	Off-grid & decentralized energy *	2,801	351	2,450	4,188.75	1,256.63	2,932.13
	Total	**19,609.2**	**786.9**	**18,822.3**	**23,256.71**	**6,977.01**	**16,279.70**

* For off-grid & decentralized energy sources, only solar based off-grid and decentralized applications have been considered, as laid down in the solar roadmap in their power sector master plan of Bangladesh like irrigation systems, home lighting systems (SHS), min-grids, etc. Other non-solar based sources have not been considered as they are not mentioned in any of the targets in their mast er plan yet.

Advanced energy systems:

Electric vehicle (EV): The ecosystem for EVs is in primitive stage in Bangladesh. The government/ SREDA has not specified any targets for scaling EVs in Bangladesh. Further, no information on financing commitment for scaling EV sector in Bangladesh are available in the public domain.

Battery energy storage system (BESS): The Government of Bangladesh has expressed its desire to incorporate BESS technology into the existing power system. However, no specific commitments and estimation of target capacity have been proposed in the power sector master plan.

Considering the above limitations, the financing gap cannot be determined for advanced energy systems in Bangladesh.

Detail calculations for financial gap estimation for each of the renewable technology is given below in detail:

Grid connected solar energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target (2041) in MW	A	16000	MW	The Bangladesh government/ SREDA in the draft National Solar Energy Roadmap has set a target of achieving 16 GW of Solar power in their electricity mix (National Solar Energy Roadmap) from SREDA. (Tachev, pv-magazine.com , 2020)
2.	Capacity already commissioned/ in pipeline for development in MW	B	554	MW	Status of installed capacity as accessed on 9 May 2022 on SREDA website. (SREDA, Renewable Energy Installed Capacity, 2022)
3.	Gap in meeting the 2030 target in MW	C = A-B	15446	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	1200000	USD/MW	USD 1.2/W considered approximate rate of solar grid connected power plants, taking average of both utility Scale ground

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
					mounted and rooftop power plants (USD 1.4/ W for Utility scale and USD 1/ W for Solar rooftop) (IDA, 2019)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	18535.2	USD Mn	
6.	Already committed financing from multilaterals/ governments/ private sector/ funds etc. in Mn USD	F	478.13	USD Mn	As Solar Energy have been assumed to be around 40% of the Total target of 40 GW (i.e., 16 GW) Renewable Energy Capacity by 2041, hence total financial commitments have been assumed to be 40% of the total financial commitments allocated for renewable projects in Bangladesh, i.e. 463.32 Mn USD in addition to USD 15 Mn from IFC for supporting utility scale solar rooftop project, hence a total of USD 478.132 Mn has been assumed to allocated for Solar project development. (Hussain, 2018)
7.	Financing Gap in Mn USD	G = E-F	18057.07	USD Mn	
8.	Debt component used for financing the projects (%)	H	0.7	%	Debt Equity ratio of 70:30 assumed for all solar and RE projects in Bangladesh in line with standard project financing terms, as ratio differs from project to project and on the investor's

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
					credentials and client credibility (IDA, 2019)
9.	Equity component used for financing the projects (%)	I = 1-H	0.3	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	12639.95	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	5417.12	USD Mn	

Hydropower projects:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target for Hydropower in MW	A	351.20	MW	The potential identified sites for Hydropower development have been studied by BPDB and it has been determined to develop- 1.201 MW (1201 kW-micro hydro flood action plan) + 35 MW (Meghalaya river basin) + 75 MW (Matumuhari Hydroelectric project) + 140 MW (Sangu project) + 100 MW (Karnafuli Hydro extension planning project) = 351.2 MW are some of the targeted Hydro projects set by BPDB. (Prof. Dr. Md Abdul Wazed, 2008)

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
2.	Capacity already commissioned/ in pipeline for development in MW	B	230	MW	Status of installed capacity as accessed on 9 May 2022 on SREDA website. (SREDA, SREDA | National Database of Renewable Energy, 2022)
3.	Gap in meeting the 2030 target in MW	C = A-B	121.20	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	2800000	USD/MW	Standard capital cost for Hydropower projects is considered as 2.8 million USD/ MW (Ansari Atif, 2014)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	339.36	USD Mn	-
6.	Already committed financing from Multilaterals/ governments/ private sector/ funds etc. in Mn USD	F	0	USD Mn	At present only one hydropower plant exists. It is expected that in future, other projects developed beyond the borders of Bangladesh can be utilized to make up the target. Domestically, this will not be possible. Hence, out of the potential identified sites for future hydropower development, the financing commitments haven't been successfully estimated yet.
7.	Financing Gap in Mn USD	G = E-F	339.36	USD Mn	
8.	Debt component used for financing the projects (%)	H	0.7	%	
9.	Equity component used for	I = 1-H	0.3	%	

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
	financing the projects (%)				
10.	Estimate of gap in debt financing in Mn USD	J = G*H	237.55	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	101.81	USD Mn	-

Wind energy projects:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target for capacity by 2041 in MW	A	457	MW	SREDA has set target of developing 457 MW of wind power projects in Bangladesh including the projects which have been planned and projects under implementation. (SREDA) (The latest addition is of 100 MW wind farm at Matarbari Coal complex) (SREDA, SREDA | National Database of Renewable Energy, 2022)
2.	Capacity already commissioned/ in pipeline for development in MW	B	2.9	MW	Status of installed capacity as accessed on 9 May 2022 on SREDA website. (SREDA, Renewable Energy Installed Capacity, 2022)
3.	Gap in meeting the 2041 target in MW	C = A-B	454.1	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	1677000	USD/MW	The capital cost estimate for an onshore wind Energy project is around 1,677/kW. (Lundy, 2020)

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	761.53	USD Mn	
6.	Already committed financing from Multilaterals/ governments/ private sector/ funds etc. in Mn USD	F	90	USD Mn	For Utility Scale Wind Energy projects, a grant of USD 75 Mn and a financing of USD 15 Mn has been sanctioned from CIF-SREP funding scheme from WB and ADB. (IDA, 2019)
7.	Financing Gap in Mn USD	G = E-F	671.53	USD Mn	
8.	Debt component used for financing the projects (%)	H	0.7	%	
9.	Equity component used for financing the projects (%)	I = 1-H	0.3	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	470.07	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	201.46	USD Mn	

Off-grid and decentralized energy generation projects:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target (2041) Solar Off-grid/decentralized systems in MW	A	2801	MW	Based on National Solar Energy Roadmap (SREDA) and National Power Sector Roadmap, 2,500 MW Irrigation systems, 285 MW

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
					Home Lighting systems and 16 MW mini-grid systems have been considered (2,801 MW) (pv-magazine, 2021)
2.	Capacity already commissioned/ in pipeline for development in nos.	B	351	MW	Status of installed capacity as accessed on 9 May 2022 on SREDA website. (SREDA, Renewable Energy Installed Capacity, 2022)
3.	Gap in meeting the 2030 target in nos.	C = A-B	2450	MW	
4.	Estimated cost per System for development of capacity (USD/MW)	D	1755000	USD/MW	Capital cost for standard Off-grid solar projects with battery-based backup systems has been considered at 1,755 USD/ kW, including mini-grids. No Solar Street Lighting Systems (SSL) or Solar Lanterns (SLS) has been considered here. Solar power packs, Solar Home lighting Systems (HLS) and Off-grid systems and Solar based Irrigation pumping systems has been considered only as per the target. (Lundy, 2020)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	4299.75	USD Mn	
6.	Already committed financing from Multilaterals/ governments/ private sector/ Funds etc. in Mn USD	F	110.99	USD Mn	As Decentralized off-grid systems constitutes around 7% of the total target of 40 GW RE capacity by 2041, hence total financial commitments have been assumed to be 7% of the total financial commitments allocated for renewable

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
					projects in Bangladesh plus additional USD 29.95 Mn from CIF-SREP funds from World Bank allocated for decentralized off-grid projects. (IDA, 2019) (Hossain, 2022)
7.	Financing Gap in Mn USD	G = E-F	4188.75	USD Mn	
8.	Debt component used for financing the projects (%)	H	0.7	%	
9.	Equity component used for financing the projects (%)	I = 1-H	0.3	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	2932.13	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	1256.63	USD Mn	

Bhutan

Renewable energy:

The RGoB in its alternative renewable energy policy-2013 (AREP-2013) has set target for scaling RE (excluding hydropower) in Bhutan by 2025.

Assumptions and limitations:

For hydroelectric energy, the target of 10,000 MW was initially set to be achieved by 2020, which was later extended to 2025. No information regarding revised target is available in the public domain. This target was set under bilateral financing arrangement with the Government of India for hydropower surplus export to India in monsoon season. (Bank, Green Power in Bhutan-Clean Energy crosses borders to reach poor households, 2018)

AREP-2013, sets target of achieving 20 MW of other renewable sources (5 MW: solar energy, 5 MW: wind energy, 5 MW: biomass and 5 MW: others which is not specified but assumed to be from off-grid decentralized sources or from solar water heating sources or small hydro sources) by 2025 (IRENA, Renewable Readiness Assessment for Royal Kingdom of Bhutan, 2019).

The financial commitment towards development of clean/ RE projects in Bhutan (Bank, Sector Assessment Roadmap (Energy)-Royal Government of Bhutan , 2018) is as follows:

Table 1723: Financial commitments for RE scale up of Bhutan

S. no.	Financial commitments by various DFIs or multilaterals/ government sources	Amount (Mn USD)
1	Green power development project II	120.0
2	Acceleration of hydropower trading development	1.0
3	Promoting clean energy development	5.6
4	Green power development project for off-grid and on-grid rural electrifications and solar electrifications, small hydropower systems	106.3
5	Rural renewable energy development project for off-grid and on-grid rural electrification, solar electrification, wind power projects and biogas plants	21.6
	Total	**254.5**

1. A debt-equity mix of 70:30 is assumed for financing the RE sector projects in Bhutan.
2. Currency conversion factor considered: 1 Bhutanese Ngultrum (Nb) = 0.013 USD or 1 USD = 77.50 Nb.

Estimate of financing gap:

The summary of estimated financing gap for scaling RE to achieve the target by 2025 is as follows:

Table 18:24 Summary of estimated financing gap for scaling Bhutan's RE considering 2025 target

S. no.	RE technology	Target capacity by 2025 (MW)	Capacity installed in (MW) (as of 2021)	Gap in installed capacity (MW)	Financing gap (in Mn USD)		
					Total (100%)	Equity (30%)	Debt (70%)
1	Hydroelectric energy	10,000	2,326	7,674	21,334.5	6,400.35	14,934.15
2	Solar PV	5	0.3	4.7	5.64	1.69	3.95
3	Wind	5	1	4	6.71	2.01	4.69
4	Other RE sources*	10	4.3	5.7	23.35	7.01	16.35
5	**Total**	**10,020**	**2,331.6**	**7,688.4**	**21,370.20**	**6,411.06**	**14,959.14**

* Other RE sources include Biomass energy, off-grid, and decentralized sources (DRE), solar water heating systems, micro/mini hydro systems, and off-grid rural electrification systems.

Advanced energy systems:

EV: The government of Bhutan, under the Bhutan sustainable low-emission urban transport systems project, is rolling out a program to electrify the taxi fleet of the capital, Thimphu. The plan was launched in early 2018 with 26 electric taxis. The city has 535 taxis, 500 of which are

envisioned to become electric based over the course of three years from now. (IRENA, Renewable Readiness Assessment for Royal Kingdom of Bhutan, 2019)

However, no specific commitments or targets have been specified for EVs or BESS or any of the emerging new technologies, hence Bhutan does not have a target for capacity building for these technologies yet. Considering the above limitations, the financing gap cannot be determined for advanced energy systems in Bhutan.

Detail calculations for financial gap estimation for each of the renewable technology is given below in detail:

Grid connected solar energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target solar capacity in Bhutan by 2025 in MW	A	5	MW	Alternative Renewable Energy Program (AREP), Bhutan has targeted 20 MW of RE from other sources such as- Solar 5 MW, Wind- 5 MW, Biomass- 5 MW and Other RE- 5 MW. (IRENA, Renewable Readiness Assessment for Royal Kingdom of Bhutan, 2019)
2.	Capacity already commissioned/ in pipeline for development in MW	B	0.3	MW	(IRENA, Renewable Energy Capacity Statistics-Global Statistics (2021), 2021)
3.	Gap in meeting the target capacity in MW	C = A-B	4.7	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	1200000	USD/MW	Estimated Cost for Solar PV projects considered as standard USD 1.2 Mn/kW (or USD 1.2/W). (IRENA, Renewable Power Generation Costs in 2020, 2020)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	5.64	USD Mn	

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	0	USD Mn	Most of the fund dedicated for clean energy projects has been for Hydropower development. The fund for AREP program hasn't been placed yet (REDF). (IRENA, Renewable Readiness Assessment for Royal Kingdom of Bhutan, 2019)
7.	Financing Gap in Mn USD	G = E-F	5.64	USD Mn	
8.	Debt component used for financing the projects (%)	H	70%	%	-
9.	Equity component used for financing the projects (%)	I = 1-H	30%	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	3.948	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	1.692	USD Mn	

Wind energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target of wind capacity in Bhutan by 2025 in MW	A	5	MW	Alternative Renewable Energy Program (AREP), Bhutan has targeted 20 MW of renewables from other sources such as- Solar 5 MW, Wind- 5 MW, Biomass- 5 MW and Other RE- 5 MW. (IRENA, Renewable Readiness Assessment for Royal Kingdom of Bhutan, 2019)

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
2.	Capacity already commissioned/ in pipeline for development in MW	B	1	MW	(IRENA, Renewable Energy Capacity Statistics-Global Statistics (2021), 2021)
3.	Gap in meeting the target capacity in MW	C = A-B	4	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	1677000	USD/MW	A capital Cost of USD 1,677 /kW has been considered a standard capital cost of wind energy plant (< 50 MW) (Lundy, 2020)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	6.71	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	0	USD Mn	_
7.	Financing Gap in Mn USD	G = E-F	6.71	USD Mn	
8.	Debt component used for financing the projects (%)	H	70%	%	_
9.	Equity component used for financing the projects (%)	I = 1-H	30%	%	
10.	Estimate of gap in debt	J = G*H	4.70	USD Mn	

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
	financing in Mn USD				
11.	Estimate of gap in equity financing in Mn USD	K = G*I	2.01	USD Mn	

Hydropower energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target Hydropower capacity in Bhutan by 2025 in MW	A	10000	MW	RGoB has set a target of 10,000 MW of Hydropower generation as part of the India-Bhutan bilateral cooperation. (Bank, Green Power in Bhutan-Clean Energy crosses borders to reach poor households, 2018)
2.	Capacity already commissioned/ in pipeline for development in MW	B	2326	MW	As of 2021, around 2,444 MW of hydropower capacity has been installed in Bhutan, thus making it as the primary source of Energy/Power generation in Bhutan. (IRENA, Renewable Energy Capacity Statistics-Global Statistics (2021), 2021)
3.	Gap in meeting the target capacity in MW	C = A-B	7674	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	2800000	USD/MW	USD 2,800/ kW of standard capital cost has been considered for Hydropower projects, including both Large & Small (1-25 MW and 25 MW and above) (Ansari Atif, 2014)

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	21487.2	USD Mn	
6.	Already committed financing from Multilaterals/ Governments/ Private Sector/ Funds etc. in Mn USD	F	152.7	USD Mn	ADB has commited USD 254.5 Mn towards clean energy projects, rural electirifcaiton proejcts in Bhutan. Out of this USD 152.7 Mn is allocated for large Hydro projects. (Bank, Sector Assessment Roadmap (Energy)-Royal Government of Bhutan , 2018)
7.	Financing Gap in Mn USD	G = E-F	21334.5	USD Mn	
8.	Debt component used for financing the projects (%)	H	70%	%	
9.	Equity component used for financing the projects (%)	I = 1-H	30%	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	14934.15	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	6400.35	USD Mn	

Biomass + other RE sources of energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target Biomass capacity in	A	10	MW	Biomass (5 MW) + Other RE sources (like Waste-Energy, Decentralized systems, off-grid

	Bhutan by 2025 in MW				SHS, etc.) (5 MW) = 10 MW (IRENA, Renewable Readiness Assessment for Royal Kingdom of Bhutan, 2019)
2.	Capacity already commissioned/ in pipeline for development in MW	B	4.3	MW	(IRENA, Renewable Energy Capacity Statistics-Global Statistics (2021), 2021)
3.	Gap in meeting the target capacity in MW	C = A-B	5.7	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	4097000	USD/MW	USD 4097/kW has been considered as an estimated standardized biomass energy generation plant using waste resources. (Lundy, 2020)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	23.3529	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	0	USD Mn	-
7.	Financing Gap in Mn USD	G = E-F	23.35	USD Mn	
8.	Debt component used for financing the projects (%)	H	70%	%	-
9.	Equity component used for financing the projects (%)	I = 1-H	30%	%	
10.	Estimate of gap in debt	J = G*H	16.35	USD Mn	

	financing in Mn USD				
11.	Estimate of gap in equity financing in Mn USD	K = G*I	7.01	USD Mn	

India

Renewable energy:

The non-fossil fuel-based energy target set by MNRE after the latest Glasgow COP 26 summit has been 500 GW by 2030.

Assumptions & Limitations:

1. The technology wise target for achieving 500 GW by 2030 comprises of solar: 300 GW, wind: 100 GW
1. Hydropower: 70 GW, off-grid & decentralized generation: 16 GW and other RE sources: 14 GW (livemint.com e. b., 2021).
2. For BESS target is achieving around 38 GW of 4-hour duration (or 152 GWh units) of generation capacity by 2030. (Mercomindia, 2021)
2. The financial commitments for achieving the 2030 target from various institutions (MNRE, Action Plan for the achievement of 175 GW of Renewable Energy Target -Seventeenth Lok Sabha Report , 2021) is as follows:

Table 19:25 Financial commitments for achieving India's RE scale up target of 2030

S. no.	Financial institution (FIs) / funding schemes	Financial commitment (in Mn USD)
1	Indian renewable energy development agency (IREDA)	435.42
2	Power finance corporation (PFC)	299.55
3	Rural electrification corporation (REC)	304.64
4	World Bank-SBI credit line for solar rooftop development	660
5	Asian development bank (ADB) loan commitment to PNB for rooftop solar projects	500
6	New development bank (NDB) loan financing to Canara Bank for renewable energy projects	200
7	KfW (Kreditanstalt für Wiederaufbau) Germany, credit line for solar rooftop project construction	1,193
8	Battery production development central financial assistance for ACC based Battery production (INR 19,500 Cr from Ministry of Finance)	2,565.78
9	FAME commitment for EV manufacturing enhancement from Ministry of Finance	1.54

S. no.	Financial institution (FIs) / funding schemes	Financial commitment (in Mn USD)
10	Central financial assistance (CFA) commitments for PM Kusum Scheme applications (INR 344.22 Bn)	4,529.21
	Total financial commitments	**10,689.14**

3. The capital costs considered for estimation of financing requirement is average standard capital costs in Mn USD/MW (MNRE, Action Plan for the achievement of 175 GW of Renewable Energy Target -Seventeenth Lok Sabha Report , 2021)
4. Currency conversion factor considered: 1 Indian Rupee (INR) = 0.013 USD or 1 USD = 76.21 INR.

Estimate of financing gap:

The summary of estimated financing gap for scaling RE to achieve the target by 2030 is as follows:

Table 20:26 Estimation of financing gaps for renewable energy technologies in India by 2030

S. no.	RE technology	Target capacity by 2030 (MW)	Capacity installed (MW) (As of March 2022)	Gap in capacity installation (MW)	Financing gap (in Mn USD)		
					Total (100%)	Equity (30%)	Debt (70%)
1	Grid Connected Solar Energy	300,000	54,000	246,000	140,437.22	42,131.17	98,306.05
2	Wind Energy	100,000	40,500	59,500	52,723.40	15,817.02	36,906.37
3	Hydropower Technology	70,000	47,930	22,070	27,584.00	8,275.20	19,308.80
4	Biomass Energy*	10,000	10,682	-	-	-	-
5	Off-Grid & Decentralized Generation**	15,868	3219	12,649	7,851.96	2,355.59	5,496.37
	Total#	**495,868**	**156,331**	**340,219**	**228,596.58**	**68,578.98**	**160,017.61**

* For biomass energy, the already set target is for 2022 which has been achieved. No information about revised target for biomass energy is available in the public domain.

** Total off-grid and decentralized energy targets have been considered as: 118 MWp of off-grid decentralized application consisting of solar streetlights (0.3 Mn), solar study lamps (2.5 Mn), off-grid power packs (100 MWp) + PM KUSUM scheme program of 25,750 MW consisting of component-A (10,000 MW), component-B (1.75 Mn standalone pumps or 8,250 MW solar capacity) & component-C (1 Mn solarized agriculture pumps or 7,500 MW capacity). (MNRE, mnre.gov.in, 2019)

Total target capacity has been rounded off to 500,000 MW (or 500 GW) as set by MNRE by 2030, as other RE sources capacity of balance approx. 4,000 MW (4 GW) hasn't been framed yet by the ministry, hence it is not considered in gap estimate analysis.

Advanced energy systems:

BESS:

The summary of estimated financing gap for BESS in India by 2030 is as follows:

Table 21:27 Estimation of financing gaps for BESS in India by 2030:

S. no.	RE technology	Target capacity by 2030 (MWh)	Capacity installed (MWh) (As of March 2022)	Gap in capacity installation (MWh)	Financing gap (in Mn USD)		
					Total (100%)	Equity (30%)	Debt (70%)
1	BESS	152,000	6,800	145,200	212,368.42	63,710.53	148,657.89

Electric Vehicles (EV):

NITI Aayog has estimated cumulative investment of over USD 180 Bn in EV production and setting up EV charging infrastructure to achieve the ambitious target of 2030 (PTI, Rs 12.5 tn investment needed to realise India's 2030 EV targets: Study, 2020).

Hydrogen Technology:

India hydrogen alliance has estimated requirement of USD 15 Bn to set up 15 GW of green hydrogen electrolyser capacity by 2030 that would produce 3 million metric tons of green hydrogen (Koundal, 2021).

Detail calculations for financial gap estimation for each of the renewable technology is given below in detail:

Grid connected Solar energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target for Solar capacity by 2030 in MW	A	300000	MW	The Renewable energy target set by MNRE after the latest Glasgow COP 26 summit has been 500 GW by 2030. Out of this solar capacity of 300 GW combining both utility scale and rooftop projects has been targeted by 2030. .p (Vibhuti Garg , 2022).
2.	Capacity already commissioned/ in pipeline for development in MW	B	54000	MW	As of March 2022, around 53,994 MW has been installed from Solar sources, combining both on-grid and off-grid sources. Capacity for this calculation rounded

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
					off to 54,000 MW. (MNRE, mnre.gov, 2022)
3.	Gap in meeting the 2030 target in MW	C = A-B	246000	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	592105.26	USD/MW	An estimated cost of INR 45 Mn/ MW has been standardized for Solar power projects, as per MNRE estimate standards. (MNRE, Action Plan for the achievement of 175 GW of Renewable Energy Target - Seventeenth Lok Sabha Report , 2021)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	145657.89	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	8790.71	USD Mn	A financial commitment of USD 0.5 Bn from ADB to Punjab National Bank for rooftop solar projects, USD 0.2 Bn from New Development Bank to Canara Bank for solar utility scale projects and USD 1,193 Mn credit from KfW for solar rooftop development and USD 660 Mn USD credit line from World Bank to State Bank of India for solar rooftop projects: USD 2,553 Mn. Another USD 6,237.71 Mn minimum amount allocated from IREDA PFC and REC, out of total USD of 10,396 Mn for total RE commitments. (MNRE, Financial Constraints in the Renewable Energy Sector- Twenty First Report from

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
					Lok Sabha Standing Committee, 2021) (Arjun Dutt, 2019)
7.	Financing Gap in Mn USD	G = E-F	136867.19	USD Mn	
8.	Financing Gap for Component A scheme under KUSUM for 10,000 MW in Mn USD	G1	3570.03	USD Mn	The estimated cost for Component A has been considered as per MNRE standard estimate of A standard cost of Rs 45 Mn/ MW under Component-A for Grid connected Solar power plant. Detail calculation shown below in the table next for Component-A.
9.	Total Financing Gap for Grid connected Solar	G2=G+G1	140437.22	USD Mn	
10.	Debt component used for financing the projects (%)	H	0.7	%	Standard debt: equity ratio of 70:30 is considered for the financing gap estimation. (MNRE, Action Plan for the achievement of 175 GW of Renewable Energy Target - Seventeenth Lok Sabha Report , 2021)
11.	Equity component used for financing the projects (%)	I = 1-H	0.3	%	
12.	Estimate of gap in debt financing in Mn USD	J = G*H	98306.05	USD Mn	
13.	Estimate of gap in equity financing in Mn USD	K = G*I	42131.17	USD Mn	

Component-A under KUSUM Scheme:

The Component- A under KUSUM Scheme is the installation of decentralized ground/stilt mounted grid connected solar power plant systems of capacity ranging from 500 kW to 2 MW capacity, will be setup by individual farmers individual farmers/ group of farmers/ cooperatives/ panchayats/ Farmer Producer Organizations (FPO)/Water User associations (WUA) hereinafter called Renewable Power Generator (RPG). However, States/DISCOMs may allow setting-up of solar or other renewable energy-based power plants of capacity less than 500 kW in specific cases. The REPP will be preferably installed within five km radius of the sub-stations to avoid high cost of sub-transmission lines and to reduce transmission losses.

Component- A KUSUM scheme financing gap estimate:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target for Solar power plant systems under Component A by 2030 in MW	A	10000	MW	KUSUM Scheme Component-A target of 10,000 MW of grid connected Solar power plants (MNRE, mnre.gov.in, 2019)
2.	Capacity already commissioned/ in pipeline for development in MW/Numbers	B	1000	MW	(MNRE, Action Plan for the achievement of 175 GW of Renewable Energy Target - Seventeenth Lok Sabha Report , 2021)
3.	Gap in meeting the 2030 target in MW/Number	C = A-B	9000	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW) of all 3 components of A, B&C	D	592105.26	USD/MW	The estimated cost for Component A has been considered as per MNRE standard estimate of A standard cost of Rs 45 Mn/ MW under Component-A Grid connected Solar power plant. (MNRE, Action Plan for the achievement of 175 GW of Renewable Energy Target - Seventeenth Lok Sabha Report , 2021)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	5328.95	USD Mn	
6.	Already committed	F	1758.92	USD Mn	Out of CFA of total USD 4,219 Mn, a proportion of 38% of this

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
	financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD				CFA has been assumed for Component-A and balance 62% being considered @ 31% each for B & C.
7.	Financing Gap in Mn USD	G = E-F	3570.03	USD Mn	

Wind energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target for Wind Energy in 2030 in MW	A	100000	MW	100 GW of wind power by 2030 out of the 500 GW renewable energy target. (Vibhuti Garg , 2022)
2.	Capacity already commissioned/ in pipeline for development in MW	B	40500	MW	As per MNRE wind energy capacity of 40.5 GW has been installed as of early 2022 data. (MNRE, mnre.gov, 2022)
3.	Gap in meeting the 2030 target in MW	C = A-B	59500	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	921052.63	USD/MW	A standard estimated cost of Rs. 70 Mn/ MW of wind energy has been considered as per MNRE estimation (MNRE, Action Plan for the achievement of 175 GW of Renewable Energy Target - Seventeenth Lok Sabha Report , 2021)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	54802.63	USD Mn	
6.	Already committed financing from multilaterals/	F	2079.24	USD Mn	Out of the total financial commitments for RE, around 20% has been assumed to be allocated

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
	governments/ Private Sector/ Funds etc. in Mn USD				for wind in line with wind constituting 20% of total RE capacity (100 GW out of 500 GW). (MNRE, Financial Constraints in the Renewable Energy Sector- Twenty First Report from Lok Sabha Standing Committee, 2021)
7.	Financing Gap in Mn USD	G = E-F	52723.40	USD Mn	
8.	Debt component used for financing the projects (%)	H	70%	%	Standard debt: equity ratio of 70:30 is considered for the financing gap estimation_(MNRE, Action Plan for the achievement of 175 GW of Renewable Energy Target - Seventeenth Lok Sabha Report , 2021)
9.	Equity component used for financing the projects (%)	I = 1-H	30%	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	36906.38	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	15817.02	USD Mn	

Hydropower energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target (2030) for Hydropower (both Large & Small) in MW	A	70000	MW	60 GW of Large hydro and 10 GW of Small hydro (micro, mini) has been targeted by 2030 as part of target commitments of 500 GW of RE by 2030. (energy.economictimes, 2022)

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
2.	Capacity already commissioned/ in pipeline for development in MW	B	47930	MW	A total of 47,930 MW of Hydropower capacity has been installed in India, where around 4,830 MW of Small Hydro and 43,100 MW of Large Hydro power projects have been installed in India. (NHPC, nhpcindia, 2021)
3.	Gap in meeting the 2030 target in MW	C = A-B	22070	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	1315789.47	USD/MW	An estimated capital cost of around Rs 100 Mn/ MW have been assumed as per MNRE estimates._____(MNRE, Action Plan for the achievement of 175 GW of Renewable Energy Target - Seventeenth Lok Sabha Report , 2021)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	29039.47	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	1455.46	USD Mn	Out of the total financial commitments towards RE around 14% has been assumed to be allocated for Hydropower in line with hydropower constituting 14% of total RE capacity (70 GW out of 500 GW). (MNRE, Financial Constraints in the Renewable Energy Sector- Twenty First Report from Lok Sabha Standing Committee, 2021)

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
7.	Financing Gap in Mn USD	G = E-F	27584.01	USD Mn	
8.	Debt component used for financing the projects (%)	H	70%	%	Standard debt equity ratio of 70:30 for hydropower financing in India is considered. The debt equity ratio depends on the investor profile, currency involved and project ownership. (Dr Arun Kumar, 2012)
9.	Equity component used for financing the projects (%)	I = 1-H	30%	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	19308.81	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	8275.20	USD Mn	

Off-grid & decentralized energy generation system:

For the sake of analysis, it is assumed that off-grid systems in India comprises off-grid systems/ appliances + decentralized systems under PM KUSUM scheme.

Estimate for off-grid systems/ appliances:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target (2030) in MW	A	118	MW	A target of around 118 MWp has been considered under the MNRE off-grid and decentralized application program consisting of 0.3 Mn solar streetlights, 2.5 Mn solar lamps and 100 MWp of solar off-grid power packs. (MNRE, Action Plan for the achievement of 175 GW of Renewable Energy Target -Seventeenth Lok Sabha Report , 2021)

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
2.	Capacity already commissioned/ in pipeline for development in MW	B	2.486	MW	The capacity installed has been around 12,167 SSL, 60,662 Solar lamps and 1,422 kW of Solar power packs, which is equivalent of around 2.486 MW installation.
3.	Gap in meeting the 2030 target in MW	C = A-B	115.513	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	1192.04	USD/MW	Estimated cost based on cost of each system of solar streetlights, solar lamps, and solar off-grid power packs. (MNRE, mnre.gov, 2021)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D /10^6	0.14	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	0.04	USD Mn	A Central Financial Assistance of 30% in General category states and 90% for NE states has been committed. Based on that an estimate of financial commitments has been found out here for the purpose of this study. (MNRE, Action Plan for the achievement of 175 GW of Renewable Energy Target -Seventeenth Lok Sabha Report , 2021)
7.	Financing Gap in Mn USD	G = E-F	0.10	USD Mn	
8.	Debt component used for financing the projects (%)	H	70%	%	
9.	Equity component used for financing the projects (%)	I = 1-H	30%	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	0.07	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	0.03	USD Mn	

Estimate for PM KUSUM Scheme:

In the PM KUSUM scheme Component B of scheme is installation of standalone solar powered agriculture pumps of capacity up to 7.5 HP. This component is considered as off-grid solarization of pumps.

Component C of the scheme consists of solarization of grid connected agriculture pumps of capacity up to 7.5 HP. This component is considered as decentralized generation which is an energy efficiency measure not pumping energy into the grid but reducing the demand at the consumption point. Therefore, this component is considered as decentralized application.

Sr. no.	Particulars	Legend	Amount (Component B)	Amount (Component C)	Unit of measurement (UoM)	Source
1.	Target (2030) in MW of each Components A, B & C	A	8250	7500	MW	MNRE PM KUSUM Scheme Notification, Feb 2019, Ministry of New and Renewable Energy (MNRE) (MNRE, mnre.gov.in, 2019)
2.	Capacity already commissioned/ in pipeline for development in MW/Numbers	B	1849.273	1367.31	MW	A 1,000 MW under Component-A has been installed as of 2021, followed by **392,270 nos**. of standalone pumps (Component-B) and **182,308 nos.** (Component-C) of solarized agriculture pumps have been sanctioned so far. The Capacity in MW have been determined based on MNRE estimation that out of 1.75 Mn pumps equivalent to 8.25 GW capacity would be added and out of 1 Mn solarized pumps an equivalent of 7.5 GW capacity would be added. (MNRE, Action Plan for the achievement of 175 GW of Renewable

Sr. no.	Particulars	Legend	Amount (Component B)	Amount (Component C)	Unit of measurement (UoM)	Source
						Energy Target - Seventeenth Lok Sabha Report , 2021)
3.	Gap in meeting the 2030 target in MW/Number	C = A-B	6400.723	6132.69	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW) or USD/HP for pumps for B)	D	903110.048	789473.68	USD/MW	A standard cost of INR 45 Mn/ MW under Component-A, INR 68.6 Mn/ MW under Component-B and Rs 60 Mn/ MW under Component-C have been considered. (MNRE, Action Plan for the achievement of 175 GW of Renewable Energy Target - Seventeenth Lok Sabha Report , 2021)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	5780.56	4841.60	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	1385.15	1385.15	USD Mn	A Central Financial Assistance (CFA) of INR 34,422 Cr (USD 4,529 Mn) has been committed from MNRE for the PM KUSUM scheme. Out of CFA of total INR 34,422 Cr (or USD 4,219 Mn), a proportion of 38% of this CFA has been assumed for Component-A and balance 62% being considered @ 31% each for B & C.

Sr. no.	Particulars	Legend	Amount (Component B)	Amount (Component C)	Unit of measurement (UoM)	Source
						(MNRE, mnre.gov.in, 2019)
7.	Financing Gap in Mn USD	G = E-F	4395.41	3456.45	USD Mn	
8.	Debt component used for financing the projects (%)	H	70%	70%	%	
9.	Equity component used for financing the projects (%)	I = 1-H	30%	30%	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	3076.79	2419.51	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	1318.62	1036.93	USD Mn	

Total estimate of financing requirement for off-grid and decentralized energy generation capacity against commitments by 2030 = USD 0.096 Mn (off-grid decentralized applications like SSL, SLS and off-grid power packs) + USD 7,851.86 Mn (PM KUSUM Scheme, Component-B & C only) = **USD 7,851.96 Mn**.

Total Installation of off-grid & Decentralized (DRE) energy system till date (Mar 2022) - 3216.58 MW (KUSUM scheme-B & C) + 2.48 MW (Off-Grid decentralized application Programme) = **3,219.07 MW or 3,219 MW.**

Biomass energy:

India has achieved over 10,682 MW of Biomass energy capacity, (MNRE, mnre.gov, 2022)which has surpassed the estimated target of 10,000 MW set previously by 2022. Till yet, there has been no revised target for Biomass energy that has been considered by 2030, hence, we have not considered the estimation of this financing gap of Biomass energy in this study as the target, which was previously set, has already been achieved.

Battery energy storage systems (BESS):

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target (2030) in MWh	A	152000	MWh	India has set an ambitious target of 152,000 MWh (38,000 MW of 4 hrs.) or 152

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
					GWh of BESS installation by 2030. (India M. , 2021)
2.	Capacity already commissioned/ in pipeline for development in MWh	B	6800	MWH	India has installed around 6,800 MWh of utility scale BESS capacity by 2021. (India M. , 2021)
3.	Gap in meeting the 2030 target in MWh	C = A-B	145200	MWh	
4.	Estimated per MWh cost for development of capacity (USD/ MWh)	D	1480263.16	USD/MWh	A unit cost of INR 11.25 Cr/ MWh (USD 1.48 Mn/ MWh) is considered in Indian market for BESS system. (MNRE, Financial Constraints in the Renewable Energy Sector- Twenty First Report from Lok Sabha Standing Committee, 2021)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D /10^6	214934.21	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	2565.79	USD Mn	A financial commitment from the Ministry of Finance, Government of India, for an amount of USD 2,565.8 Mn has been committed for the manufacturing and production of BESS capacity development. (NEERAJ KULDEEP, 2016)
7.	Financing Gap in Mn USD	G = E-F	212368.42	USD Mn	
8.	Debt component used for financing the projects (%)	H	70%	%	A standard debt-equity ratio of 70:30 has been considered for BESS project. Any variation in the above ratio mainly depends upon the project characteristics. (NEERAJ KULDEEP, 2016)
9.	Equity component used for financing the projects (%)	I = 1-H	30%	%	
10.	Estimate of gap in debt	J = G*H	148657.89	USD Mn	

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
	financing in Mn USD				
11.	Estimate of gap in equity financing in Mn USD	K = G*I	63710.53	USD Mn	

Maldives

Renewable energy:

Solar and wind energy are considered to play key role in RE scale up in Maldives by 2030.

Assumptions & limitations:

1. The paradigm shift scenario by 2030 for Maldives estimates solar PV technology playing key role in scale up of RE in Maldives. The roadmap considers solar PV + BESS POISED project (24 MWp) + rooftop solar PV (4.5 MWp) + upgradation of POISED hybrid plants with storage (83 MWp) + floating PV solar with storage (15 MWp) + floating solar PV + rooftop solar installations in resorts, industrial, agricultural islands (~ 200 MWp) + Solar PV Hybrid plants (7.5 MWp) = 334 MWp. (ADB, A Brighter Future for Maldives powered by Renewables , 2020)

2. Wind energy systems has been considered at 17 MW, consisting of 15 MW of micro-wind turbine-based rooftop systems followed, 2 MW of onshore wind energy, which has been earmarked at Thilafushi or Ghulifalhu islands.

3. The total solar installed capacity has been considered as 19 MW + solar PV & BESS under POISED (36 MW) = 55 MW. (AIIB A. I., 2021)

4. The financial commitments for achieving the 2030 target from various institutions (ADB, Proposed Loan and Grant for Additional Financing Republic of Maldives-Preparing Outer Islands for Sustainable Development Project, 2020) is as follows:

Table 2228: Financial commitments for achieving Maldives' RE scale up target of 2030

S. no.	Financial commitments	Amount (in Mn USD)
1.	Accelerating sustainable private investments in renewable energy – CIF & WB	18.0
2.	POISED- ADB, JFJCM, EIB & CIF	105.0
3.	Greater Malé waste-to-energy project- ADB & AIIB	151.0
4.	Small-scale waste-to-energy- ADFD & IRENA	12.5
5.	Waste-energy Addu City- ADFD & IRENA	14.0
6.	Accelerating renewable energy integration for sustainable energy (ARISE)- WB, CTF, Canada Facility, and AIIB	86.0

S. no.	Financial commitments	Amount (in Mn USD)
	Total	**386.5**

ADB- Asian development bank, AIIB- Asian infrastructure investment bank, CIF- Climate investment fund, JFJCM- Japan fund for joint crediting mechanism, EIB- European investment bank, CTF- Climate technology fund, ADFD-Abu Dhabi fund for development, IRENA- international renewable energy agency, WB-World bank.

5. A debt-equity mix of 70:30 is assumed for financing the RE sector projects in Maldives.

6. Currency conversion factor considered: 1 Maldivian Rufiyaa (MVR) = 0.065 USD or 1 USD = 15.38 MVR.

Estimate of financing gap:

The summary of estimated financing gap for scaling RE to achieve the target by 2030 is as follows:

Table 23:29 Estimation of financing gaps for renewable technologies in Maldives

S. no.	RE technology	Target capacity by 2030 (MW)	Capacity installed in (MW) (As of 2021)	Gap in installed capacity (MW)	Financing gap (in Mn USD)		
					Total (100%)	Equity (30%)	Debt (70%)
1	Solar PV + BESS	334	55	279	622.42	186.73	435.69
2	Wind	17	1	16	7.51	2.25	5.25
3	Other RE sources	2	0	0.5	6.26	1.88	4.38
	Total	**353**	**57.5**	**295.5**	**636.19**	**190.86**	**445.33**

Detail calculations for financial gap estimation for each of the renewable technology is given below in detail:

Grid connected solar energy including solar PV systems (rooftop & ground-mounted), solar + BESS, hybrid solar & floating solar PV:

Sr. No.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target RE Capacity in Maldives by 2023 in MW	A	334	MW	Solar PV + BESS POISED project- 24 MWp + Rooftop Solar PV: 4.5 MWp + Upgradation of POISED hybrid plants with storage: 83 MWp + Floating PV solar with storage: 15 MWp + Floating solar PV + Rooftop solar installations in resorts, industrial, agricultural islands: 200 MWp + solar PV hybrid plants: 7.5 MWp = 334

Sr. No.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
					MWp target by 2030. The Target for 334 MWp is under the paradigm shift scenario which states that Maldives would cover around 70% of total power consumption from renewables. consisting of 200 MWp_(Bank, Roadmap for the Energy Sector 2020-2030- A Brighter future for Maldives powered by Renewables, 2020)
2.	Capacity already commissioned/ in pipeline for development in MW	B	55	MW	The 55 MW of Solar projects installed include 19 MW of solar PV + BESS under POISED program and another 36 MW under implementation from AIIB. (ADB, Proposed Loan and Grant for Additional Financing Republic of Maldives- Preparing Outer Islands for Sustainable Development Project, 2020)
3.	Gap in meeting the target capacity in MW	C = A-B	279	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	2980000	USD/MW	The estimated project cost as per project proposal under POISED program is USD 2.98/ MWh. (AIIB A. I., 2021)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	831.42	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/	F	209	USD Mn	A financial commitment of total USD 209 Mn out of USD 386 Mn has been committed from ADB, AIIB and Global Climate Fund dedicated for the POISED project (18+105+86).

Sr. No.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
	Funds etc. in Mn USD				More funding requirements has been proposed for future expansion by ADB. (ADB, Proposed Loan and Grant for Additional Financing Republic of Maldives-Preparing Outer Islands for Sustainable Development Project, 2020)
7.	Financing Gap in Mn USD	G = E-F	622.42	USD Mn	
8.	Debt component used for financing the projects (%)	H	70%	%	
9.	Equity component used for financing the projects (%)	I = 1-H	30%	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	435.69	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	186.73	USD Mn	

Wind energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target RE Capacity in Maldives by 2023 in MW	A	17	MW	15 MW Wind energy-based rooftop micro turbine systems and a 2 MW Wind energy onshore based project has been targeted. More such projects are in the process of identification. (Bank, Roadmap for the Energy

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
					Sector 2020-2030- A Brighter future for Maldives powered by Renewables, 2020)
2.	Capacity already commissioned/ in pipeline for development in MW	B	1	MW	(IRENA, Renewable Energy Capacity Statistics- Global Statistics (2021), 2021)
3.	Gap in meeting the target capacity in MW	C = A-B	16	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	1677000	USD/MW	A standard cost of USD 1677/kW has been considered, accepted globally. Other internal costs, specific to the country has been not considered. (Lundy, 2020)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	26.83	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	19.32	USD Mn	A dedicated portion of USD 19.325 Mn considered for Wind energy system out of total 386 Mn financial commitments from various multilaterals and DFIs (5% of Total financial commitment). (Bank, Additional Financing of Preparing Outer Islands for Sustainable Energy Development Project (RRP MLD 46122-005), 2021)
7.	Financing Gap in Mn USD	G = E-F	7.51	USD Mn	
8.	Debt component used for financing the projects (%)	H	0.7	%	

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
9.	Equity component used for financing the projects (%)	I = 1-H	0.3	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	5.25	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	2.25	USD Mn	

Other RE sources (like waste-energy, decentralized energy generation):

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target for WtE capacity in Maldives by 2030 in MW	A	2	MW	A 2 MW Waste-Energy plant has been identified in Male which to be installed and marked for the paradigm shift scenario. No specific targets for Biomass and other potential WtE plants have been mentioned yet. (Bank, Roadmap for the Energy Sector 2020-2030- A Brighter future for Maldives powered by Renewables, 2020)
2.	Capacity already commissioned/ in pipeline for development in MW	B	0	MW	* To be implemented, not installed currently.
3.	Gap in meeting the target capacity in MW	C = A-B	2	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	4097000	USD/MW	A standard cost of USD 4097/kW of Waste to Energy plant have been estimated considering municipal solid wastes. (Lundy, 2020)

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	8.19	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	1.93	USD Mn	An amount of 0.5% of the total financial commitment have been considered for Other RE sources like, Waste to Energy, decentralized systems, off-grid power packs or biogas, has been considered under the paradigm shift scenario for renewable expansion. (ADB, Proposed Loan and Grant for Additional Financing Republic of Maldives-Preparing Outer Islands for Sustainable Development Project, 2020)
7.	Financing Gap in Mn USD	G = E-F	6.26	USD Mn	
8.	Debt component used for financing the projects (%)	H	0.7	%	
9.	Equity component used for financing the projects (%)	I = 1-H	0.3	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	4.38	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	1.88	USD Mn	

Nepal

Renewable energy:

Nepal has set a target of achieving 12,000 MW of hydropower and 2100 MW of solar PV by 2030 (Laws, 2022).

Assumptions & limitations:

The financial commitments for achieving the 2030 target from various institutions (NREP, 2022) is as follows:

Table 2430: Financial commitments for achieving 2030 target of scaling up Nepal's RE

S. no.	Financial commitments	Amount (in Mn USD)
1	UKAID fund to NREP Nepal	37.2
2	NIFRA energy bond *	200
3	CREF (Central Renewable Energy Fund) for Nepal from various international financial institutions like KfW, DANIDA, DFID (UK), Norway, for the development of renewable energy systems	116.3
	Total	**353.5**

* From NIFRA interaction, it has been found that NIFRA would release Energy bonds of USD 200 Mn in 4 equal tranches of USD 50 Mn each towards clean energy investments in Nepal.

1. A debt-equity mix of 70:30 is assumed for financing the RE sector projects in Nepal.
2. Currency conversion factor considered: 1 Nepalese Rupee (NPR) = 0.080 USD or 1 USD = 124.5 NPR.

Estimate of financing gap:

The summary of estimated financing gap for scaling RE to achieve the target by 2030 is as follows:

Table 25:31 Estimation of financing gap for renewable technologies in Nepal

S.no.	RE technology	Target capacity by 2030 (MW)	Capacity installed in (MW) (as of 2021)	Gap in installed capacity (MW)	Financing gap (in Mn USD)		
					Total (100%)	Equity (30%)	Debt (70%)
1.	Hydropower systems	12,000	2,004	9,996	27,688.33	8,306.50	19,381.83
2.	Solar PV	2,100	60	2,040	2,394.97	718.49	1,676.48
	Total	**14,100**	**2,064**	**12,036**	**30,083.3**	**9,024.99**	**21,058.31**

Detailed calculations for financial gap estimation for each of the renewable technology are given below in detail:

Grid connected solar energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target of Solar power in Nepal in MW by 2030	A	2100	MW	Under the recent National Determined Contributions (NDC), Nepal has committed to around 2100 MW of Solar power capacity by 2030. (Laws, 2022)
2.	Capacity already commissioned/ in pipeline for development in MW	B	60	MW	The capacity installed consists of utility scale and off-grid systems. More number of off-grid and decentralized systems from solar have been installed in Nepal. (IRENA, Renewable Energy Capacity Statistics-Global Statistics (2021), 2021)
3.	Gap in meeting the estimated potential in MW	C = A-B	2040	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	1200000	USD/MW	An USD 1.2/W has been considered for Solar rooftop and utility scale projects on an average in South Asia. (Hartwig Schafer & Seong, 2019)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	2448	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	53.03	USD Mn	A total financial commitment of USD 353.5 Mn has been committed which consists of around 15% allocation towards Solar power development as Nepal intends to have around 15% of the total target in Solar (2,100 MW out of 14,100 MW) (NREP, 2022) (IRENA, Renewable Readiness Assessment for Royal Kingdom of Bhutan, 2019)
7.	Financing Gap in Mn USD	G = E-F	2394.97	USD Mn	

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
8.	Debt component used for financing the projects (%)	H	0.7	%	
9.	Equity component used for financing the projects (%)	I = 1-H	0.3	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	1676.48	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	718.49	USD Mn	

Hydropower (large & small) systems:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target of Hydropower in Nepal in MW by 2030	A	12000	MW	Nepal under its Energy Sector Assessment and roadmap has targeted for 12,000 MW of hydropower capacity by 2030, which has been extended from 2022, out of total economic potential of 42,000 MW. (Bank, Nepal Energy Sector Assessment, Strategy and Roadmap, 2017)
2.	Capacity already commissioned/ in pipeline for development in MW	B	2004	MW	As of 2021, around 1302 MW of Hydropower capacity have bene installed in Nepal. (Punam Karki, 2019)
3.	Gap in meeting the estimated	C = A-B	9996	MW	

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
	potential in MW				
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	2800000	USD/MW	An estimated cost of USD 2800/kW has been considered for standard hydropower systems (above small category) (Ansari Atif, 2014)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	27988.8	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	300.48	USD Mn	A financial commitment of USD 353.5 Mn has been committed for clean energy projects, especially in Hydropower projects to New and Renewable Department Nepal (NREP): 37.2 Mn UKAID + 200 Mn NIFRA + 116.3 CREF fund = 353.5 Mn USD. Out of which 85% of funds allocated towards Hydropower development has been assumed. (NREP, 2022)
7.	Financing Gap in Mn USD	G = E-F	27688.33	USD Mn	
8.	Debt component used for financing the projects (%)	H	0.7	%	
9.	Equity component used for financing the projects (%)	I = 1-H	0.3	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	19381.83	USD Mn	

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
11.	Estimate of gap in equity financing in Mn USD	K = G*I	8306.50	USD Mn	

Sri Lanka

Renewable energy:

Assumptions & limitations:

The 2030 Sri Lanka energy sector Roadmap for achieving 80% RE considers achieving 6817 MW of installed RE capacity comprising following technology wise capacity Solar PV (2684 MW), wind (1013 MW), hydropower (3000 MW), Biomass (120 MW) (CEB C. E., 2021).

The financial commitments for RE scale up in Sri Lanka consist of (a) USD 0.35 Mn from the carbon partnership with the World Bank and (b) USD 100 Mn credit line (Dutt, 2020) from Government of India under bilateral cooperation towards development of Solar rooftop and utility scale solar.

1. A debt-equity mix of 70:30 is assumed for financing the RE sector projects in Sri Lanka.
2. Currency conversion factor considered: 1 Lankan Rupee (LKR) = 0.0028 USD or 1 USD = 357.14LKR.

Estimate of financing gap:

The summary of estimated financing gap for scaling RE to achieve the target by 2030 is as follows:

Table 26:32 Estimation of financing gaps for renewable technologies in Sri Lanka

S. no.	RE technology	Target capacity by 2030 (MW)	Capacity installed in (MW) (as of 2021)	Gap in installed capacity (MW)	Financing gap (in Mn USD)		
					Total (100%)	Equity (30%)	Debt (70%)
1.	Solar	2,684	425	2,259	2,633.18	789.95	1,843.23
2.	Wind	1,013	179	834	1,248.36	374.51	873.85
3.	Hydro	3,000	1,815	1,185	1,768.02	530.41	1,237.61
4.	Biomass*	120	50	70	147.35	44.21	103.14
	Total	**6,817**	**2,469**	**4,348**	**5,796.91**	**1,739.08**	**4,057.83**

* Biomass and other RE sources like waste to energy, waste heat energy sources.

Advanced energy systems:

There is no information regarding targets and financial commitment for scaling advanced energy systems such as BESS, EV, and hydrogen technology in Sri Lanka.

Detail calculations for financial gap estimation for each of the renewable technology is given below in detail:

Grid connected Solar Energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target Solar Capacity in Sri Lanka by 2030 in MW	A	2684	MW	Sri Lanka has committed towards 80% of Renewable energy capacity in the electricity consumption by 2030 as part of the UNFCCC commitments. Based on that the target for RE capacity has been determined considering long-term generation expansion plans from 2022-2030 and from 2030-2040. Here we would consider expansion target up to 2030. (CEB C. E., 2021)
2.	Capacity already commissioned/ in pipeline for development in MW	B	425	MW	The capacity of 425 MW Solar power consisting of both rooftop and ground mounted utility scale systems as of Jan 2022. (CEB C. E., 2021)
3.	Gap in meeting the target capacity in MW	C = A-B	2259	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	1210000	USD/MW	An estimated Unit cost of USD 1210/kW has been considered for Solar PV projects in Sri Lanka. (Dutt, 2020)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	2733.39	USD Mn	
6.	Already committed	F	100.21	USD Mn	An estimated financial commitment towards clean

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
	financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD				energy growth in Sri Lanka has been committed under the schemes- USD 350,000 (or USD 0.35 Mn) under Carbon partnership facility under World Bank and USD 100 Mn USD under India- Sri Lanka bilateral agreement from IREDA, for solar rooftop development. (Dutt, 2020). Total financial commitments considered for Solar- 100 Mn + 60% of 0.35 Mn USD = 100.21 Mn USD, has been considered based on the capacity targets for individual solar and wind, out of total USD 100.35 Mn.
7.	Financing Gap in Mn USD	G = E-F	2633.18	USD Mn	
8.	Debt component used for financing the projects (%)	H	0.7	%	As of now a standard 70:30 Debt-Equity ratio has been considered for renewable projects in Sri Lanka (Dutt, 2020)
9.	Equity component used for financing the projects (%)	I = 1-H	0.3	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	1843.23	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	789.95	USD Mn	

Wind energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target Wind Energy Capacity in Sri Lanka by 2030 in MW	A	1013	MW	The target has been estimated based on the potential identified sites that has been planned by the CEB by 2030. (CEB C. E., 2021)
2.	Capacity already commissioned/ in pipeline for development in MW	B	179	MW	(CEB C. E., 2021)
3.	Gap in meeting the target capacity in MW	C = A-B	834	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	1497000	USD/MW	An estimated unit cost of USD 1497/kW for Wind energy projects has bene considered in the Sri Lankan energy sector. (Dutt, 2020)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	1248.50	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	0.14	USD Mn	Under Carbon partnership facility, an amount of USD 0.35 Mn (USD 350,000) has been received in Sri Lanka for clean energy commitments, which has been proportioned between Solar and Wind projects considering 60 % & 40% respectively, depending upon their capacity targets. (ADB, 100% Electricity Generation from Renewables An Asessment of Energy Sector in Sri Lanka, 2017)
7.	Financing Gap in Mn USD	G = E-F	1248.36	USD Mn	
8.	Debt component	H	0.7	%	

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
	used for financing the projects (%)				
9.	Equity component used for financing the projects (%)	I = 1-H	0.3	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	873.85	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	374.51	USD Mn	

Hydropower (large & small) energy:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target Hydropower Capacity both (Large & Small) Capacity in Sri Lanka by 2030 in MW	A	3000	MW	The Hydropower target has been mentioned considering only the planned sites that have been identified, certain unplanned sites that has potential for future expansion hasn't been considered here as there is no such future targets for hydropower yet. (CEB C. E., 2021)
2.	Capacity already commissioned/ in pipeline for development in MW	B	1815	MW	(CEB C. E., 2021)
3.	Gap in meeting the target capacity in MW	C = A-B	1185	MW	
4.	Estimated per MW cost for development	D	1492000	USD/MW	An estimated standard unit cost of USD 1,492/kw has been

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
	of capacity (USD/ MW)				considered for Hydro projects in Sri Lanka. (Dutt, 2020)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	1768.02	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	0	USD Mn	-
7.	Financing Gap in Mn USD	G = E-F	1768.02	USD Mn	
8.	Debt component used for financing the projects (%)	H	0.7	%	
9.	Equity component used for financing the projects (%)	I = 1-H	0.3	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	1237.61	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	530.41	USD Mn	

Biomass energy + other RE sources:

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
1.	Target Biomass + Other RE Energy Capacity in Sri Lanka by 2030 in MW	A	120	MW	The Biomass capacity of 120MW is comprised of Biogas plants, Cogeneration systems and Biomass based Heat generating plants which has lot of potential in Sri Lanka. Recently a 10MW Waste-Energy plant has also been installed in Kerawalapitiya area, in collaboration with CEB and SLSEA, which has been considered in this category. (CEB C. E., 2021)
2.	Capacity already commissioned/ in pipeline for development in MW	B	50	MW	As of 2021, capacity installed consists of Waste-Energy units and other forms of Biomass energy generation systems. (CEB C. E., 2021)
3.	Gap in meeting the target capacity in MW	C = A-B	70	MW	
4.	Estimated per MW cost for development of capacity (USD/ MW)	D	2105000	USD/MW	An estimated standard cost of USD 2,105/kW has been considered for Biomass projects in Sri Lanka. (Dutt, 2020)
5.	Estimate of Financing required for meeting the gap (in Mn. USD)	E = C*D/10^6	147.35	USD Mn	
6.	Already committed financing from multilaterals/ governments/ Private Sector/ Funds etc. in Mn USD	F	0	USD Mn	No specific commitments could be determined for Biomass and other RE sources compared to Solar and Wind energy systems. (Dutt, 2020)
7.	Financing Gap in Mn USD	G = E-F	147.35	USD Mn	
8.	Debt component	H	0.7	%	

Sr. no.	Particulars	Legend	Amount	Unit of measurement (UoM)	Source
	used for financing the projects (%)				
9.	Equity component used for financing the projects (%)	I = 1-H	0.3	%	
10.	Estimate of gap in debt financing in Mn USD	J = G*H	103.15	USD Mn	
11.	Estimate of gap in equity financing in Mn USD	K = G*I	44.20	USD Mn	

Annexure-III

USAID/ USDFC's deployment of financing instruments across energy sector projects in Asia (Source: https://www.dfc.gov/our-impact/all-active-projects) (data as of 31st December 2021)

Country	Name of the company	Investment instrument	Amount committed/ invested	Brief about the area of investment
India	Punjab Renewable Energy Systems Private Limited Pres Oorja Private Limited	Guarantee	USD 10,000,000	Guaranty of a loan to Punjab Renewable Energy Systems Limited and a loan to its wholly owned subsidiary, Pres Oorja Private Limited, a biomass supply chain management company in India, to construct seven biomass briquetting plants and finance working capital needs of the companies (the "Project").
Sub-Saharan Africa and Asia	Energy Access Relief Fund, B.V.	Investment Fund	The DFC will purchase USD 10 million of notes with a 4- year term.	The Fund will make unsecured loans to energy access companies that require liquidity due to impact of the COVID-19 pandemic. The Fund also supports UN Sustainable Development Goal 7 (SDG7) to ensure access to affordable, reliable, sustainable, and modern energy for all.
India	National Investment and Infrastructure Fund (the "Fund)	Investment Fund	Up to USD54.91 million Indian National Rupees ("INR") equivalent of equity in the Fund. Up to USD 1.28 million INR equivalent equity investment in the Fund Manager	National Investment and Infrastructure Fund focused on developing core infrastructure development in India for its long-term sustainable growth. Sub-sectors of interest to the Fund will include energy, transportation, and urban infrastructure
India	Electronica Finance Limited cKers Finance Private Limited	Guarantee	USD 12,500,000	Multiparty loan portfolio guaranty intended to strengthen each guaranteed party's ability to provide loans to micro, small and medium enterprises, residential consumers, or low-income community-based organizations in India that are investing in or providing distributed renewable energy generation solutions, such as rooftop solar solutions, with the goal of reducing carbon emissions,

Country	Name of the company	Investment instrument	Amount committed/ invested	Brief about the area of investment
				thereby creating a positive impact on the environment.
India	ReNew Solar Power Private Limited	Debt	USD 75,000,000	The proceeds of the loan will provide liquidity to mitigate the potential for a near-term decline in cash flows due to delayed payments received from State Discoms and the unavailability of additional funding due to the declining credit profiles of Indian banks.
India	ReNew Sun Waves Private Limited	Debt	USD 140,000,000	Development, construction, and operation of a 300-megawatt solar photovoltaic power plant in Rajasthan, India.
India	ReNew Sun Bright Private Limited	Debt	USD 142,000,000	Development, construction, and operation of a 300-megawatt solar photovoltaic power plant in Rajasthan, India
India	ReNew Sun Energy Private Limited	Debt	USD 53,500,000	Development, construction, and operations of a 105-megawatt solar photovoltaic power plant located in the Patan district of the state of Gujarat, India.
India	Paryapt Solar Energy Private Limited	Debt	USD 27,300,000	The Paryapt Solar Project (the "Project") will fund the development and construction of a 50-megawatt solar power project in Gujarat, India.
India	Sitara Solar Energy Private Limited	Debt	Up to USD 50,000,000	The Sitara Solar Project (the "Project") will fund the development and construction of a 100-megawatt solar power project in Rajasthan, India.
India	South Asia Growth Fund II, L.P., a limited partnership organized under the laws of the Province of Ontario, Canada	Fund Investment	Up to USD 20 million	The Fund will generate long-term capital appreciation through equity and equity-linked investments in companies that seek growth and expansion opportunities supporting energy, environmental products, and services, and water efficiency value chains in India.
India	HCT Sun LLC	Equity	USD 10,000,000	Installation, maintenance, and sales of power to commercial clients from rooftop solar panels operated by the Foreign Enterprise
India	Greater Pacific Capital Partners II, L.P.	Fund Investment	USD 700 million	Greater Pacific Capital Partners II, L.P intends to provide growth capital to medium-sized companies in India that operate primarily in one of the following sectors: (i)

Country	Name of the company	Investment instrument	Amount committed/ invested	Brief about the area of investment
				healthcare (ii) technology, and (iii) services.
India	Iron Pillar Fund I Ltd.	Fund Investment	OPIC direct loan of up to USD 25 million.	The Fund will invest in late-stage (series B, C, D) rounds of Indian technology companies focusing on consumer and enterprise markets in a range of sectors.
India	Orb Energy Private Limited	Debt	A 9.5-year direct loan not to exceed USD 10,000,000	The origination, financing, and installation of solar photovoltaic ("PV") systems in India by the Borrower's subsidiary, Orb Energy Private Limited (India) (the "Project Company") and the refinancing of existing senior debt (the "Project")
India	ReNew Wind Energy (TN 2) Private Limited – Telangana	Debt	Up to USD 74,020,695	The Project is under the ReNew Master Financing Facility, a USD 250 million financing facility for the development, construction, and operation of solar PV projects awarded under the Government of India's Jawaharlal Nehru National Solar Mission. The Project will result in the construction of a 100 MW capacity solar PV located in the state of Telangana. The Project will diversify the country's power generation mix with a clean source of renewable power. The Project also contributes to the U.S. government's commitment to assist India with its transition to a low carbon economy and to help India achieve the goals of the NSM, which is targeting an addition of 100 GW of solar power by 2022.
India	ReNew Wind Energy (TN 2) Private Limited – Telangana	Debt	Up to USD 74,020,695	The Project is under the ReNew Master Financing Facility, a USD 250 million financing facility for the development, construction, and operation of solar PV projects awarded under the Government of India's Jawaharlal Nehru National Solar Mission. The Project will result in the construction of a 100 MW capacity solar PV located in the state of Telangana. The Project will diversify the country's power generation mix with a clean source of renewable power. The Project also contributes to the U.S. government's commitment to

Country	Name of the company	Investment instrument	Amount committed/ invested	Brief about the area of investment
				assist India with its transition to a low carbon economy and to help India achieve the goals of the NSM, which is targeting an addition of 100 GW of solar power by 2022.
South Asia and Southeast Asia	ISQ Asia Aggregator Ltd.	Debt	OPIC loan guaranty of up to USD 200 million in principle plus accrued and accreted interest thereon.	The Fund will target value-added middle market infrastructure investments throughout South and Southeast Asia (India, Indonesia, Philippines, Sri Lanka, Thailand, and Vietnam) and anticipates making investments across the region in transportation, renewable energy, waste management, water resources, and distributed combined heat and power projects
Global (44 counties, including Mexico, Honduras, Guatemala, Kenya, Nigeria, Tanzania, India)	Envirofit International, Inc.	Debt	USD 4,000,000, < 7 years	Envirofit International, Inc. was created to design, manufacture and distribute clean cookstoves that reduce pollution and energy dependence while yielding health, environmental, and economic improvements. Over the past 8 years, the company has become one of the leading clean cookstove businesses, producing high performing biomass cookstoves that are efficient, durable, and affordable for households and institutions in developing nations. It has created a line of cookstoves that offer economic, health and environmental benefits.
India and Southeast Asia	Asia Catalyst Fund, LP, a	Fund Investment	OPIC loan guaranty of up to USD 150 million in principle plus accrued and accreted interest thereon.	The Fund invests in the Asian middle market with an experienced, stable, and cohesive senior executive team that has an 18-year track record of investing in companies in the financial services, agribusiness, and environmental sectors
India	Azure Sunlight Pvt. Ltd.	Debt	A Loan Facility in an amount not to exceed USD 20,000,000.	The project comprises the development, financing, construction and operation and maintenance of an approximately 19 MW portfolio of rooftop solar generation systems (each, an "Individual Project" or combined, the "Individual Projects") located in various cities throughout India (the "Project"). Azure Sunlight will be the equity owner of this portfolio

Country	Name of the company	Investment instrument	Amount committed/ invested	Brief about the area of investment
				of rooftop solar systems and will utilize a USD 20 million loan facility ("Loan Facility") from OPIC to provide the debt portion of financing for each Individual Project. OPIC's Loan Facility will be repaid from the aggregate cash flows from Individual Projects. The Loan Facility will be secured by all assets, contracts, and reserves of the Individual Projects. Azure Power India Private Limited ("Azure Power"), the parent company of Azure Sunlight, will act as turnkey construction contractor as well as operations and maintenance provider.
India	Simpa Energy India Private Limited	Debt	USD 3,000,000 (with a tenor of 6.75 years)	Simpa has developed a mobile-based payment technology for retail solar systems that enables collection from rural, underserved communities thereby expanding the penetration of home solar units and access to home lighting for thousands of Indian families. Simpa will use the loan to finance approximately 50,000 new retail solar systems.
India	Southern Energy Partners, LLC	Reinsurance	Tamil Nadu II: USD 495,000	The projects included in this action memo are all wind energy production projects.
India	Azure Power Gujarat Private Limited	Debt	USD 14.7 million	The development, construction, and operation of a 5 MW photovoltaic solar power generation facility located in Surendra Nager District of Gujarat, India.
India	ESP Urja Private Limited	Debt	Located in Surendra Nager District of Gujarat, India. Proposed OPIC Loan: USD	The development, construction, and operation of a 5 MW photovoltaic solar power generation facility located in Surendra Nager District of Gujarat, India.
India	Applied Solar Technologies (India) Private Limited ("AST")	Debt	A senior, secured corporate loan of up to USD 150,000,000 with a 13-year term, consisting of a three-year availability period and a 10-year	AST will use the proceeds of the Loan (defined below) for the expansion of its business of providing solar-based hybrid power solutions for large telecommunication tower operators in India pursuant to long-term master service agreements (the "Project").

Country	Name of the company	Investment instrument	Amount committed/ invested	Brief about the area of investment
			repayment period (the "Loan").	
India	Husk Power Systems Inc	Debt	USD 750,000	Development, installation, and operation of 36 independent mini energy generation facilities powered by rice husk waste for providing electric services to rural villages in India (the "Project").

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